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Constraint-Based Syntax-Semantics Processing

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Tese orientada por Professora Doutora Palmira Marrafa
Professor Doutor Ivan Andrew Sag

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ABSTRACT

This dissertation examines the structure and the meaning of coordination structures. In the realm of syntax, it is often assumed that coordination structures come in different flavors and that they are the locus of various kinds of structural asymmetries and irregularities. This dissertation argues that many of these views are not well motivated empirically, and offers novel empirical observations that suggest a more systematic view. With regard to semantics, it is standardly assumed that there are many different kinds of conjunction meanings – some of which are arbitrarily ambiguous – and that they have different syntactic distributions. Standard accounts usually resort to complex covert machinery in order to account for various special cases of semantic interpretation which are observed. A more uniform semantic account is proposed in this dissertation. New evidence is provided to show that the standard distinction between Boolean and Non-Boolean conjunction is most problematic, and that cross-categorial conjunction can be viewed as a unique kind of conjunction, without exceptions for the nominal domain. It is argued that pluralic NPs (including plural NPs and conjoined NP structures) are not ambiguous in any way, and that distributive, collective and cumulative readings are best modeled via the lexical semantics of predicates that subcategorize for these arguments.

A unique coordination construction and a unique semantic composition process are argued to account for a wide range of coordination phenomena, including conjunction and disjunction, without higher-order operations nor appeal to massive semantic ambiguity. Various recalcitrant phenomena that occur in the presence of coordination are predicted by the theory, via independently motivated ellipsis phenomena and via processing constraints. The result is a leaner theory of the syntax-semantics interface for coordination in which coordinate structures interact in a uniform way with other constructions.

Key words: syntax, semantics, interface, coordination.

RESUMO

Esta dissertação examina a sintaxe e a semântica das estruturas de coordenação. Os fenómenos que ocorrem nestas estruturas revelam um variado leque de interacções que se estabelecem entre a estrutura sintáctica, a estrutura semântica, a prosódia, e a pragmática. Como tal, dificilmente se pode considerar apenas uma destas vertentes sem levar em conta o papel das demais. Isto não só porque nem sempre é claro que fenómenos pertencem a que domínio da gramática, especialmente no caso da sintaxe e da semântica, mas como um estudo integrado permite obter uma visão mais equilibrada dos fenómenos. Contudo, praticamente sem excepção, a investigação feita no passado dedica-se isoladamente ou à sintaxe ou à semântica, e não a ambos os níveis com igual objectividade. Para além de não existir uma abordagem integrada dos dois níveis de representação no que diz respeito a fenómenos de coordenação, as abordagens existentes não oferecem uma perspectiva uniforme dos dados. Por exemplo, na sintaxe é comummente assumido que existem vários tipos de assimetria no que diz respeito à estrutura, processo de formação, categoria, e natureza dos constituintes coordenados. É tipicamente argumentado que existe uma distinção sintáctica entre coordenação simétrica e coordenação assimétrica (esta última tida como sendo de alguma forma processada como uma estrutura subordinada), que em línguas como o Inglês e o Português dois tipos diferentes de estratégias de concordância existem para estruturas coordenadas, e que os elementos coordenados não têm um estatuto idêntico. Nesta dissertação argumenta-se que estas posições assentam ou numa recolha de dados inadequada ou em pressupostos mais teóricos do que empíricos. Dois exemplos particularmente importantes dizem respeito à ideia de que o operador de coordenação é o núcleo da estrutura coordenada e à perspectiva em que as comparativas são tidas como estruturas coordenadas. Nesta dissertação são enumerados os argumentos que são usualmente referidos na literatura e é mostrado que todos estes são muito problemáticos. Por outro lado, são dados vários argumentos puramente empíricos que indicam que estas estruturas não têm núcleo sintáctico e que são muito diferentes das estruturas comparativas. Qualquer que seja a abordagem ou quadro teórico adoptado, estes dados devem ser levados em consideração, pois eles não só permitem evitar várias estipulações teóricas como levam a várias predições correctas.

No que diz respeito à semântica, o estado da arte é igualmente complexo. É quase

sem excepção assumido que existe um grande número diferente de interpretações para a conjunção. Estas interpretações ou resultam de uma enumeração exaustiva de items lexicais para a conjunção, ou de um conjunto de operações invisíveis que manipulam estrutura de forma a obter as interpretações pretendidas. Um outro exemplo é distinção pilar a todas as abordagens de semântica formal, onde é feita uma distinção entre conjunção Booleana e conjunção não Booleana. É distinção basicamente assume que há um tipo de conjunção especial para certos domínios nominais e um outro tipo de conjunção para domínios não-nominais (e certos e determinados domínios nominais). Nesta dissertação argumenta-se que esta distinção é empiricamente problemática, e que os dados apontam para um único tipo de conjunção, que pode abarcar todas as categorias coordenáveis.

No que diz respeito à interpretação das pluralidades obtidas por meio da conjunção, é tipicamente assumido que estas possibilitam um leque de interpretações muito vasto. Em casos extremos é proposto que a interpretação da conjunção requer estruturas infinitas, de tamanho superior ao conjunto dos números naturais. Esta posição não só é problemática do pronto de vista cognitivo, como é duvidosa do ponto de vista linguístico. Nesta dissertação defende-se que a interpretação da pluralidade não implica qualquer forma de ambiguidade e que as várias interpretações que podem surgir na presença de SNs que denotam uma pluralidade resultam do conteúdo lexical dos predicados que os seleccionam.

Este estudo sugere assim que é necessária uma perspectiva mais uniforme e integrada da sintaxe e da semântica das estruturas de coordenação em geral, e que esta pode beneficiar de uma abordagem equilibrada dos dois níveis de descrição linguística. Os dados empíricos clássicos da coordenação são retomados e complementados com novos dados. Estes permitem obter uma visão mais uniforme de vários fenómenos em discussão. O resultado continua a ser uma rede de interacções complexa, mas inúmeros casos excepcionais são agora explicáveis sem apelo a estipulações. Foram identificados dois aspectos que são fundamentais para que varias idiossincrasias se tornem apenas casos particulares resultantes de uma mesma generalização. Estes dizem respeito a fenómenos de elipse e a fenómenos de processamento cognitivo. Uma vez que a existência dos respectivos fenómenos é estabelecida independentemente, vários casos que são normalmente vistos como excepções são obtidos como predições. Consequentemente, é aberto caminho para uma teoria mais parcimoniosa e com uma cobertura empírica superior à de abordagens anteriores.

Neste trabalho defende-se que as estruturas de coordenação em discussão correspondem a essencialmente o mesmo tipo de estrutura. Por exemplo, é argumentado que a distinção entre coordenação simétrica e coordenação assimétrica tem uma natureza semântico-pragmática, e não uma natureza puramente estrutural. Defende-se para além disso que o mesmo tipo de construção coordenativa pode dar conta de disjunções assim como de vários tipos de conjunção. No que diz respeito à composição de estrutura semântica é proposto que todos estes tipos de coordenação podem ser entendidos como resultando do mesmo processo de composição semântica, o mesmo activo em estruturas não coordenadas. Defende-se aqui que fazem parte da semântica lexical os mecanismos que possibilitam o leque de fenómenos semânticos que ocorre na presença de pluralidades. Estes mecanismos lidam com pluralidades simples ou complexas de uma forma relativamente uniforme e sem casos especiais. Vários fenómenos de interpretação são abordados de uma perspectiva lexicalista, incluindo leituras distributivas, colectivas, e cumulativas.

Em diversas instâncias os dados sugerem que vários níveis distintos, nomeadamente os níveis sintáctico, semântico, pragmático, e morfo-fonológico, interagem a nível local. Tal é mais evidente no que diz respeito aos fenómenos de elipse abordados nesta dissertação. Estes impõem condições a todos estes níveis localmente, à estrutura à qual se aplicam. Como tal, os dados sugerem que estes fenómenos de elipse não são processos de interface mas sim fenómenos locais que dependem de vários tipos de propriedades linguísticas em simultâneo. De facto, esta é uma das razões pelas quais foi adoptada uma teoria linguística onde todos estes níveis estão localmente e simultaneamente acessíveis, a Gramática de Estruturas Sintagmáticas determinadas pelos Núcleos (*Head-driven Phrase Structure Grammar*). Outras evidências são fornecidas em suporte de teorias declarativas, monoestratais e baseadas em restrições. Em particular, a possibilidade de generalizar a análise da sintaxe da semântica das estruturas de coordenação a um único padrão de interface advém do facto de a gramática consistir num conjunto de restrições, e de estas poderem ser subespecificadas. Este tipo de abordagem baseada em restrições também se estende à representação de estruturas semânticas. As estruturas de coordenação exibem vários tipos de ambiguidades de escopo (ou âmbito) quantificacional e como tal nesta dissertação as representações semânticas descrevem conjuntos de interpretações usando um formalismo baseado em restrições. Tal permite que a desambiguação semântica não seja um processo generativo mas sim um processo puramente iterativo e monotónico, sem que seja obtida uma explosão combinatória de representações.

Como formalismo de representação semântica foi adoptada a lógica de predicados com quantificadores generalizados, com uma interpretação dinâmica. A adopção de uma lógica dinâmica prende-se não só com as reconhecidas limitações que a linguagem da lógica clássica tem no que diz respeito à representação de vários fenómenos linguísticos, mas também com a análise que é proposta para a semântica da conjunção. Neste trabalho defende-se que a conjunção nas línguas naturais é essencialmente um mecanismo dinâmico e ontologicamente neutro. Mais precisamente, que embora a conjunção permita formar entidades relativamente complexas, não há razão empírica para que estas façam parte da estrutura de interpretação, nem da denotação dos predicados. Por exemplo, nenhum predicado denota estruturas plurais arbitrariamente complexas. É assim proposto que as entidades plurais formadas por conjunção são externamente dinâmicas e não são directamente representadas no modelo. Isto não só permite manter uma estrutura de interpretação de primeira-ordem, sem recorrer a modelos generalizados, como permite analisar a conjunção sem sobregeração massiva, ao contrário das abordagens anteriores.

PALAVRAS-CHAVE: sintaxe, semântica, interface, coordenação.

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Contents

Chapter 1

Introduction

In this dissertation I explore the syntax and the semantics of coordination structures, and consider not only how these two levels interact with each other, but also how they interact with the overall grammar. Although I focus mostly on English and on European Portuguese, the obtained results have a much broader implication because most of the phenomena discussed here also occur in many other languages.

A great deal of research has been dedicated to the topic of coordination structures in the last 50 years, spanning a multitude of different approaches in many different theoretical frameworks. However, most research is directed either at syntax or at semantics, and very little attention is given to how exactly the two levels interact. I believe that dedicating equal attention to both levels is crucial for obtaining a solid and well-grounded theoretical foothold. With regard to the linguistic problems, research questions abound. In the realm of syntax there is much debate concerning the role of coordination lexemes, the existence of null coordinators, the syntactic relationship between conjuncts, the peculiar extraction phenomena that certain coordination structures exhibit, the necessary properties that allow two different structures to be coordinated, the relation between coordination structures and comparative and subordination structures, peculiar ellipsis phenomena than can optionally occur, the various patterns of agreement that obtain in nominal coordination structures, the distribution and syntactic realization of the lexemes *either* and *or*, etc.. In the realm of semantics, the issues are no less complex, and the debate no less lively. There are many questions pertaining to how exactly the meaning of coordination structures is construed. For example, in the case of conjunction one is typically confronted with a large array of different possibilities and ambiguities that have led to the view that pluralities formed by conjunction are many-ways ambiguous, and that there are a number of covert formal mechanisms that apply whenever necessary to allow for these interpretations. It also is widely assumed that there are various kinds of conjunctions *and*, with different distributions, and that yield a host of different readings. Others argue that the range of usages is much simpler. Finally, there is still a major ongoing debate as to how distributive, collective, reciprocal, and cumulative readings are best accounted for, and what kind of logical framework and model theory is the more adequate to model these meanings. This matter is rather complex because it extends beyond coordination, and concerns the grammar of plurality in general.

One problem with some of these previous accounts is of methodological nature. It is some times the case that theory-dependent assumptions have lead accounts into empirically inadequate analyses. Also, some of the data assessment is lead astray by taking extra-grammatical interferences or semantic effects for syntactic principles. The fact that a given sentence sounds strange does not necessarily mean that a grammatical principle has been violated. Sometimes sentence processing goes awry for cognitive reasons. Take a classical example like *The horse raced past the barn fell.* This sentence is hard to process and is typically deemed ungrammatical by native speakers. Yet the garden-path effect disappears with a different choice of words that makes the grammatical parse more likely to be prominent, like *The thief arrested by the police turned out to be our nephew.* In fact, Pearlmutter and MacDonald (1979) show that the latter sentence is processed as easily as the overt relative counterpart: *The thief that was arrested by the police turned out to be our nephew.* The explanation for this difference lies in nonlinguistic plausibility information. The NP *the thief* is not a good subject phrase for the verb *arrested* purely for reasons of world knowledge. More recently, MacDonald et al. (1994) also show that frequency plays an important role. The reason why the first sentence has such a garden path effect is that *raced* occurs more frequently as a finite verb form than as the participle form. In this dissertation I bear in mind that processing difficulty should not be confounded with grammatical constraints, for it allows one to make sense of apparent paradoxes in the data without resorting to theoretical stipulations.

1.1 Main Contributions

This dissertation offers novel empirical observations and develops innovative accounts for phenomena pertaining to the syntax and semantics of coordination structures. The main contributions of this dissertation are the following:

- This dissertation argues that all kinds of coordination structures boil down to the same syntactic construction, and that the semantic composition process is also exactly the same. Thus, the proposed account consists in a unique coordination construction rule, and in the lexical entries for the coordination lexemes *and*, *or*, and *but*.

- An independently motivated theory of extraction is provided. This account interacts with coordination and captures challenging phenomena, including the Across-The-Board exceptions, the extraction patterns observed in asymmetric coordination, and adjunct extraction phenomena.

- Various evidence is provided showing that the widely assumed distinction between Boolean and Non-Boolean conjunction is problematic. It is argued that virtually all kinds of conjoinable categories yield a plurality, and that the Boolean/Non-Boolean readings can be obtained with one and the same meaning for conjunction, without covert semantic operations. Various puzzling semantic composition cases and non-standard agreement patterns are argued to be a consequence of independently motivated ellipsis phenomena coupled with frequency-based processing biases.

- Instead of being many-ways ambiguous, coordination lexemes are argued to have one meaning only. In particular, it is proposed that plurality-forming conjunction is inherently dynamic and amounts to a mechanism that assembles pluralities on-the-fly. Thus, pluralities can be arbitrarily complex but remain ontologically neutral. This avoids having to assume that humans somehow deal with a massive combinatorial explosion of meanings for conjunction.

- With respect to the grammar of plurality, various kinds of ambiguities and interpretations are considered, and it is argued that the source of ambiguity is located in the semantics of predicates that select pluralic arguments. The result is a uniform lexicalist approach to the so-called distributive, collective, and cumulative readings which can deal in a fully uniform way with scope ambiguities and any kind of NP argument, including singular, plural, and arbitrarily complex NP conjunctions.

- Finally, two accounts are provided for two different kinds of peripheral ellipsis phenomena, which operate at different levels. Left-Periphery Ellipsis is argued to operate on linearized constituents and to impose sense identity conditions, and Right-Periphery Ellipsis is argued to be sensitive to prosodic constituency and to impose morphophonological identity. A major aspect of this account is that it captures the fact that these ellipsis phenomena apply both to sub-lexical and phrasal structures.

1.2 Outline

Chapter 2 provides an empirical assessment of some of the main syntactic aspects of coordination. In it I discuss the grammatical role and status of both the coordination lexeme and of the conjuncts. It is argued that there are no empirical grounds for the assumption that coordination constructions are headed, contrary to what has been claimed elsewhere. Furthermore, comparative constructions are argued to be fundamentally different from coordinate constructions on both syntactic and semantic grounds.

Chapter 3 addresses in some detail the meaning of coordination and the meaning of coordination lexemes. One of the central aspects of this chapter is the reevaluation of the empirical basis of the widely assumed Boolean vs. Non-Boolean distinction. Both denotational and structural arguments are provided to show that this distinction is problematic. The alternative view that emerges is simpler and encounters less recalcitrant cases, as it opens way for a truly uniform view of conjunction and of the grammar of plurality. A final contribution of this chapter concerns semantic scope. Not only it is shown that can conjuncts interact scopally, but also that coordination does not impose scope islands.

Chapter 4 discusses in more detail the range of interpretation phenomena that can arise in the presence of nominal pluralities. Both plural and conjoined noun phrases are considered, and a general account is sketched in which distributive, collective and cumulative readings are obtained in a uniform way. A Dynamic Predicate Logic fragment is formalized for this purpose, and it is shown how the same lexical entry can directly predicate singular, plural, and arbitrarily complex noun phrases, using the same lexical constraints.

It is also argued that conjunction is best viewed as a dynamic mechanism that obtains ontologically neutral pluralities. Not only this allows to keep the model simple and free from higher order entities, but it also makes sense from a linguistic perspective because no predicate can contain arbitrarily complex pluralities in its denotation.

Chapter 5 formalizes the account in Head-Driven Phrase Structure Grammar, and proposes to capture the structure and meaning of coordination with one general coordination rule and one uniform semantic composition process. The proliferation of lexical entries for coordination lexemes is avoided and both cross-categorial conjunction and disjunction structures are uniformly obtained via the same general rules. It is shown how coordinate and non-coordinate structures interact in a uniform fashion with other structures in the grammar.

Chapter 6 extends the coverage of the HPSG theory and considers various kinds of headed constructions. These can be coordinated in the same way as other structures in the grammar, and interact with other coordinated structures in a uniform fashion. Constituents are combined without need for the grammar to distinguish between coordinate or non-coordinate constituents, both for the purposes of syntactic distribution and for the purpose of semantic composition. Thus, the very same lexical entry can combine with an argument of arbitrary complexity. The result is a lexicalist and constraint-based syntax-semantics account of the grammar of plurality that avoids the combinatorial explosion of interpretations by representing plural and scope ambiguities in a semantic underspecification framework.

Chapter 7 shows how the grammar can be extended to also account for extraction phenomena, correlative markers, and agreement phenomena in coordination. The account predicts the Coordinate Structure Constraint and Across-The-Board exceptions from the interaction between a non-headed analysis of coordination and an independently motivated theory of extraction. These results are based on previous work from non-transformational grammar, but the current account deals with a number of special cases that are usually not addressed, including the extraction phenomena observed in asymmetric coordination. With regard to agreement, it is also argued that apparent cases of closest-conjunct agreement in

English and in Portuguese and certain other puzzling cases can be explained by ellipsis and cognitive processing preferences.

Chapter 8 discusses a number of ellipsis phenomena that are central to the account proposed in this dissertation.[1] These phenomena go well beyond coordination but allow to explain a number of complex cases that have led astray previous accounts. It is argued that extraction, movement, and multidominance accounts of ellipsis are problematic, and that a deletion account can capture the data in a straightforward manner.

Chapter 9 overviews the technology necessary to implement the HPSG formalization. It discusses various challenges that this enterprize faces and what kind of technology can overcome them. Here, we find various computational and linguistic issues that interact in complex ways.

1.3 Head-Driven Phrase Structure Grammar

Head-Driven Phrase Structure Grammar (HPSG) is a well-developed and formal theory of grammar which is based on the notion of constraint satisfaction. Linguistic objects are viewed as feature structures organized via a system of types. For some major publications see for instance Pollard and Sag (1994) and Ginzburg and Sag (2000).

The fact that this theory can be cast in precise mathematical terms has led to large-scale grammar implementations and to the development of efficient computational systems for processing natural languages. But that is not to say that HPSG is a theory directed to grammar implementation. Quite the contrary, HPSG is a linguistic theory on its own right, offering elaborate accounts of a host of natural language phenomena. It is only because explicit and well-defined HPSG theories are available that it becomes possible to construct computational implementations. There are a number of linguistic reasons for adopting this brand of constraint-based grammar, rather than modern derivational/transformational frameworks. Below I briefly review some of the major points in favor of this move.

[1] I adopt the general term *Peripheral Ellipsis* rather than *Conjunction Reduction* and *Right-node Raising*. The former incorrectly implies that it only occurs in coordination structures, and the latter presumes a movement analysis, which is well-known to be problematic.

Precision

Scientific theorizing is an incremental and experimental process. Typically, such theories are highly idealized mathematical formulations that capture a fragment of the observable phenomena. But the formulation of a well-defined and coherent scientific theory does not imply a complete and final account of the phenomena: good scientific practice mandates a clear and objective formulation of hypotheses and analyses, so that it is possible to objectively evaluate the empirical coverage and predictive power of the theory. That is not to say that the only valid theories are ones cast in absolute mathematical rigor. Rather, the theoretical assumptions should be defined in an explicit way, so that they may be applied mechanically and without appeal to subjective interference.

One of the major problems of modern transformational work is that proposals are often too vague and ill-defined for a quantitative evaluation. Generally, accounts often boil down to an informal description of how a certain derivation goes, with little regard for making clear what is the exact nature of the mechanisms and operations that step-by-step have lead to that particular result. Most aspects of the theory are not explicitly defined, unlike earlier transformational work. The research program proposed in Chomsky (1995) and much subsequent work, referred to as *The Minimalist Program*, fails the above criteria and has been much criticized for it (Johnson and Lappin 1997; Lappin et al. 2001; Postal 2004; Seuren 2004).

Other frameworks, such as HPSG, resort to a logical formalism in which the theoretical formulations can be cast in a precise way. For a characterization of the mathematical foundations of this framework see Carpenter (1992) and Richter (2004).

Parsimony

The fact that most research in Minimalism is discussed in an informal manner can also give the illusion that it is a simple framework. This is because one never actually sees the full representation of linguistic structures, or the theory itself (in the form of an explicit formulation of the basic operations, the full range of features that are postulated, etc.). Moreover, Postal (2004) and Van Valin (2002) argue that many of the basic assumptions behind Minimalism have dubious empirical support. See also Johnson and Lappin (1997), Lappin et al. (2000b), and Lappin et al. (2000a) for controversies with regard to cognitive implausibility, redundancy, vagueness, and circularity.

A framework such as HPSG offers a simpler approach to grammar than the one provided by Minimalism. For example, there is no postulation of traces or functional nodes lacking overt lexical items (e.g. SPEC, IP, AgrP, AUX, vP, AGR, CP, NumbP, GendP, or T). Rather, the only nodes that are assumed are in correspondence with parts-of-speech that are observable on a distributional basis. In HPSG, linguistic descriptions are information-rich entities that contain fine-grained information about phonology, syntax and semantics. All these levels of information are crucial for any theory of language, however a particular theory opts to encode them. In HPSG these are represented as feature structures. For example, the feature PHON encodes information about phonology, SYN encodes various kinds of syntactic information including part-of-speech and subcategorization patterns, and SEM encodes semantic representations. These three kinds of information are locally and simultaneously present as illustrated in the (simplified) feature structure given in (1) below for the sentence *Kim laughed*:

(1)
$$\begin{bmatrix} \textsc{phon} & \text{kɪm læft} \\ \textsc{syn} & \begin{bmatrix} \textsc{head} & \textit{verb} \\ \textsc{subj} & \langle\,\rangle \\ \textsc{comps} & \langle\,\rangle \\ \textsc{gap} & \langle\,\rangle \end{bmatrix} \\ \textsc{sem} & \mathsf{laugh(kim)} \end{bmatrix}$$

The kind of information posited in these structures has been found to play a role in human language processing. In MacDonald, Pearlmutter, and Seidenberg (1994) it is argued that grammatical category, valence, thematic role assignments, as well agreement information are the kind of information associated to lexical entries. This is essentially the case of theories such as HPSG. Compare with the (simplified) lexical entry for the verb *laughed*, where ϕ is the semantics of the NP.

(2)
$$\begin{bmatrix} \textsc{phon} & \text{læft} \\ \textsc{syn} & \begin{bmatrix} \textsc{head} & \textit{verb} \\ \textsc{subj} & \langle\ \mathrm{NP}{:}\phi\ \rangle \\ \textsc{comps} & \langle\,\rangle \\ \textsc{gap} & \langle\,\rangle \end{bmatrix} \\ \textsc{sem} & \mathsf{laugh}(\phi) \end{bmatrix}$$

Since HPSG does not assume the existence of interface stages nor multiple levels of derivation (like the distinction between overt and covert parts of the derivation), it can also offer a leaner view: there is only one level of representation, and semantic, morphologic, phonologic, and syntactic information are simultaneously and incrementally available. This also means that the theory offers an ideal setting for coping with various phenomena that result from interactions between these levels of linguistic description. For example, Inkelas and Zec (1990b) and many others have argued that prosodic structure is sensitive to syntactic boundaries, category membership, headship, (directionality of) branching, and grammatical relations.[2] This offers independent motivation for assuming that words and phrases are information-rich entities, since this kind of information is relevant at a local level, rather than involving post-processing at interface stages. Further motivation for this kind of locality comes from recent psycholinguistic results suggesting that constructing an interpretation for a sentence is a word-by-word integration of a variety of different information sources, including lexical constraints, plausibility constraints, and discourse context constraints.[3]

In HPSG there is a unique core operation, called *structure-sharing*. This central notion amounts to stating that two features have the same value. This is the kind of constraint involved in ensuring agreement, subcategorization satisfaction, variable binding, representation of tree structure, and basically all that goes on in the grammar. This even includes extraction phenomena. The presence of an unbounded dependency is recorded locally, rather than resulting from the displacement of syntactic structure. It amounts to a property that both the mother node and one or more of the daughters have. This offers a uniform view of how linguistic constraints propagate in a syntactic tree. By and large, it all boils down to conditions that require that features have a certain value.

There is not only no need for movement operations, but the empirical consequences are also striking. Take for example the Coordinate Structure Constraint and the 'Across-The-Board' exceptions long noted in Ross (1967). These are discussed in detail in Chapter 2. One of the major results in non-transformational grammar is that both these effects can be obtained as predictions of independently motivated structure-sharing constraints. For example, in Pollard and Sag (1994) the existence of an unbounded dependency is registered in a SYN feature. In the representation given in (1) this corresponds to the feature GAP. The mother and the daughters of a coordination

[2] In this regard, Lexical-Functional Grammar resorts to a similar albeit less uniform formalism. The various levels of description are distributed over independent structures and special mapping operations are required to establish connections between them. Also, LFG feature values are not typed, which is one of the main sources of linguistic generalization that HPSG offers.

[3] See for instance Gibson (1998).

structure are assumed to have the same SYN values, for independent reasons. Consequently, all conjuncts are required to have exactly the same value for GAP. This entails that either conjuncts have the same gapped elements, or that they are both ungapped.

Conversely there has never been a satisfactory account of the CSC and ATB exceptions in transformational grammar because it is no trivial matter to get the facts right without having to stipulate special mechanisms (and crucially, without creating inconsistencies with other kinds of movement phenomena). One classic example of this is the special ATB-movement mechanism of Williams (1978). This special movement targets identical constituents in many positions, one inside each conjunct, but outputs a single instance of that constituent outside the conjuncts. This kind of exceptional and complex operation should be eliminated in favor of a simpler and more general mechanism. HPSG offers just this with structure-sharing, the very same property that is ubiquitous in the grammar model. More recent accounts in transformational attempt to obtain the phenomena via other kinds of machinery, but as we shall see, fall short on achieving this goal. The inability of transformational grammar to account for these phenomena suggests that important generalizations are being missed.

Performance

HPSG assumes that the processing of a linguistic structure does not involve any kind of structure-altering operations. Rather, sentence processing consists solely of *adding* linguistic information. Once introduced, the very same piece of linguistic information cannot be altered or displaced. This property follows the view that linguistic processing is done incrementally by integration of various kinds of linguistic and non-linguistic information. Put more explicitly, it is assumed that the construction of linguistic structure amounts to adding nodes to a tree, rather than from non-trivial tree-manipulations.

In constraint-based grammar however, the grammar is seen as a model of linguistic knowledge, not a model of processing. The fact that HPSG is neutral with regard to processing allows the same grammar to be used in language production or in language understanding. The grammar consists of nothing but a set of well-formedness statements that all linguistic objects must satisfy, thus defining the set of possible linguistic structures, without actually building any structure. The latter is left to the language processing module, usually referred to as the parser. In this view, linguistic processing is not the result of an assembly line of intermediate stages of computation in which linguistic structures undergo a number of covert operations, but rather an incremental and information-rich process based on the satisfaction of constraints. In many implementations of HPSG one resorts to standard parsing technology that has been made available for computational systems, but more recent research is concerned with cognitively motivated models of parsing. Given the neutrality of HPSG, these can in principle be integrated into a unified performance-based grammar model. Note also that the 'assembly line' style of derivations in Minimalism makes little sense: derivations start with collections of words (numerations), a number of operations retrieve these elements and combine them in various ways until obtaining a pair of sound-meaning elements (π, λ) that are interpretable in PF and in LF respectively. However, in a model of language production it makes more sense to start with a LF representation and output a PF representation, and in a model for language understanding it makes more sense to start with a PF representation and output a LF representation. Intuitively speaking, LF representations are of no use to the speaker *after* the utterance has been computed. The architecture underlying Minimalism makes little sense from the stand point of human language processing, in spite of claims about biolinguistic motivations alluded to in Chomsky (2005).[4]

1.4 Semantic Preliminaries

In this section I will briefly discuss some basic matters concerning the kind of semantic representation framework adopted in this dissertation. One of the core endeavors of linguistic theory is to capture how strings of words map into meaningful units. The matter is of course far from trivial, and one usually adopts highly idealized logical languages in order to capture core semantic aspects of linguistic structures. The current work does not hinge on any particular logical approach to natural language semantics, and thus I will opt for a fairly vanilla formal backbone, Dynamic Predicate Logic (Groenendijk and Stokhof 1991). This is essentially standard predicate logic with a dynamic semantics. Chapter 4 lays down in more detail the logical language, satisfaction conditions, and model theory that I am assuming. For now, it suffices to assume that the logical representations adopt here are essentially first-order logic.

However, in this work I will be particularly interested in quantifier scope phenomena. As is well known, the presence of certain quantifiers can trigger various different kinds of readings. For example, the well-worn sentence *Every arrow hit a target* has two readings, one in which different targets were hit by arrows ($\forall > \exists$) and a second reading

[4]For other objections and discussion see for instance Labelle (2007) and Sag and Wasow (2007).

where there is a single target and all arrows hit it (∃>∀). Similar examples are *Every student speaks two languages.* It is widely recognized that scope tends to be closer to the dependencies observed in syntactic structure, as leftmost elements tend to get higher scope than subsequent elements. Thus, the first reading reported above is usually more readily obtained that the latter. It is also known that context and world knowledge can interfere and reverse the preferential scoping resolutions. Take for instance two essentially isomorphic sentences with different preferential readings: *Every hunter killed a duck* (∀>∃), *Every priest knelt before a colossal stone statue of Chtulhu* (∃>∀).

Because subjects and both direct and indirect objects can scopally interact (as well as quantifiers embedded in certain structures such as *A sample from every brew was analyzed*) the number of scopings grows exponentially on the number of quantifiers in a sentence. For example, *Two boys wrote an email to every girl in school* has a total of 6 possible scopings, even though not all are equally prominent. Humans do not perceive this massive ambiguity because the aforementioned processing preferences come into play, and constrain the possible combinations in various ways. Recently, semantic underspecification frameworks have been devised so that one can state scoping constraints in a uniform fashion. Some examples are Alshawi and Crouch (1992), Reyle (1993), Copestake et al. (1995), Bos (1996), Egg et al. (2001) and Richter and Sailer (2001). In these accounts, a given parse for a sentence does not yield a combinatorial explosion of semantic representations, but rather a unique meta-representation that *describes* the set of readings. The scopal elements in this meta-representation can combine in various ways as long as the subordination constraints are not violated. Thus, the set of readings can be restricted simply by adding more subordination constraints, which can originate from various linguistic and contextual sources. Consider the example below, and the respective semantic representations:

(3) a. Every arrow hit a target.

b. $\forall x(arrow(x) \rightarrow \exists y(target(y) \wedge hit(x, y)))$

c. $\exists y(target(y) \wedge \forall x(arrow(x) \rightarrow hit(x, y)))$

Both readings can be described by the following underspecified representation:

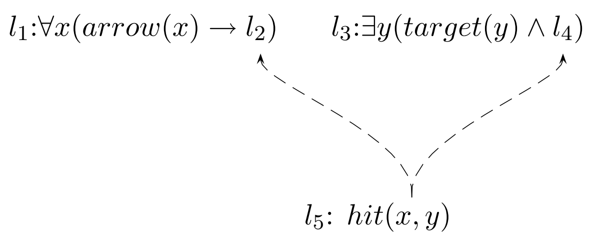

Figure 1.1: Underspecified representation of (3)

The labels l_n are used to identify semantic components and to indicate argument slots that can take other semantic components. The arrows seen in Figure 1.1 are subordination constraints. These state that no matter how scope is resolved, the predicate l_5 must be located (directly or indirectly) in the argument slots l_2 and l_4. For example, the reading in (3b) is obtained if $l_2 = l_3$ and (3c) obtains if $l_4 = l_1$.

The subordination constraints associated with the meta-representation above are: $l_5 \leq l_2, l_5 \leq l_4$. The relation '$l \leq l'$' states that l can be either equated or subordinated to l'. The constraint can thus be resolved in one of two ways: either as identity ($l = l'$) or as strict subordination ($l < l'$). An underspecified representation is therefore a tuple $\langle U, S \rangle$ where U is a set of labeled predications and S is a set of subordination conditions. These subordination relations thus form a system of constraints that restrict the possible disambiguations. The matter of deciding whether a given disambiguation is legitimate is intuitively simple: the underspecified representation forms a joint-lattice, and a legal disambiguation is one in which each label is assigned to another label in such a way as to the obtained representation corresponds to a tree.[5] For example, the $l_1 = l_2$ is not a legal resolution because tree structures are of course acyclic.

The particular underspecification framework that I adopt is Minimal Recursion Semantics (MRS), following closely from Copestake et al. (2006). Therein the reader can find the relevant formal MRS definitions and conditions on scope resolution.[6] The frameworks proposed in Reyle (1993) and in Bos (1996) are very similar to MRS, and

[5]The joint-lattice of course has a unique top element. This is identified as $l_\top$ and is usually omitted as a simplification. See for example Reyle (1993) and Copestake et al. (2006) for more details.

[6]See also Fuchss et al. (2004) for efficient state-of-the-art methods for disambiguating MRS representations obtained from parsing real corpora. In fact, MRS adopts a special '*qeq*' relation instead if the standard '$\leq$', but as Copestake et al. (2006, 299,ft.11) note (and Fuchss et al. (2004) show in practice), all the relevant constraints can be encoded via '$\leq$'.

differ mostly in minor technicalities. The former is however cast in Discourse Representation Theory (Kamp and Reyle 1993), and since I intend to remain as theory-neutral as possible, I will adopt MRS. One particular property that Reyle (1993) and Copestake et al. (2006) share is that when two labels identifying two predications are equated this means that they are implicitly conjoined. Thus, the resolution $l = l'$ for $l{:}dog(x)$ and $l'{:}big(x)$ means that $l{:}dog(x) \wedge big(x)$. In the example in Figure 1.1 this is not legal because it makes it impossible to obtain a tree, but in other cases this kind of resolution is most useful. In MRS terms this is referred to as *intersective combination*.

A cognitively and linguistically well-motivated theory of scope processing can be built on top of the grammar, but for now no such theory exists. Thus we are left with more traditional computational tools for producing the representations that a given MRS structure describes. This will suffice for our purposes. In sum, I will therefore assume that the grammar is nothing but a set of constraints that describe grammatical expressions, and that scope resolution is a separate process, akin to parsing. Ultimately, these three components should be integrated a uniform way under a general theory of grammar and of linguistic performance.

Chapter 2

On the Nature of Coordination

This chapter identifies the basic empirical aspects of coordination structures. One of the main observations is that there are two main kinds of constructions. In headed constructions there is a grammatically dominant daughter which establishes the category and distribution of the whole, whereas in non-headed constructions no daughter can be said to be dominant. The non-headed analysis makes a number of correct predictions for coordination which are missed by other analises. In particular, the arguments usually provided in favor of coordination structures being headed by the coordinator lexeme are shown to be flawed.

The data also indicate that coordination and comparative constructions are different instances of non-headed constructions. A number of proposals in the literature assume that at least some kinds of comparatives are coordinates, but the evidence provided in this chapter shows how problematic these claims are. It is also argued that non-headed constructions in general require that daughters have the same categorial status. Some well-known apparent counterexamples are shown to be a consequence of independently motivated phenomena, and not actual counterexamples.

Another major aspect of coordination concerns the interaction with extraction and ellipsis phenomena that have long been observed in the literature. The empirical evidence discussed here indicates that the widespread assumption that asymmetric coordination structures are in fact subordinates is unfounded and that all kinds of coordinate structures (symmetric or asymmetric) have the same syntactic structure. There are however semantic and pragmatic differences which lead to different extraction and ellipsis patterns.

2.1 General Characterization

Consider the concepts of *head* and of *dependent*, in pre-theoretical terms. The head of a construction is the main unit involved in determining both the syntactic distribution and the meaning of the whole. A prototypical example is a complementation structure, consisting in one head and one or more dependents. Thus the constituents in (1) have the same distribution by virtue of the verbal head, not the dependent.

(1) a. [*smiled*]

b. [*saw* [*John*]]

c. [*said* [*that he saw John*]]

Is also often the case that a dependent can be omitted, fronted, or extraposed while the head cannot. In this sense, a *headed construction* is a construction in which the distribution of the whole is determined by the head, and in which one daughter is understood as being dependent on the other.

Another instance of a headed construction is adjunction, as illustrated in (2). These examples are composed by a dependent clause that attaches to the preceding clause:

(2) a. Tom went to his room [before Jane arrived].

b. Tom went to his room [because Jane arrived].

c. Tom went to his room [although Jane arrived].

The bracketed structures are semantically dependent (subordinate) to the head clause they attach to. This is made clear by the fact that if one reverses the clause order a completely different sentence meaning is obtained:

(3) Jane arrived before Tom went to his room.

The bracketed constituents are typically seen as adjunction structures because of their adverbial-like distribution. These constituents can be fronted or interleaved with the head clause in various ways:

(4) a. [Before Jane arrived], Tom went to his room.

b. Tom, [although Jane arrived], went to his room.

In coordination constructions something very different occurs. First, neither daughter can be said to be a dependent. For example, observe that reversing the order of conjuncts yields no major shift in meaning:[1]

(5) a. Tom likes to sing and Jane likes to dance. ↔

b. Jane likes to dance and Tom likes to sing.

Thus, neither daughter can be said to be the head because no subordination dependency is established between conjuncts. This fact also explains why coordinate structures do not have the mobility that is observed in subordinates. A conjunct cannot be fronted in any way, as seen below:

(6) a. *And Jane likes to dance, Tom likes to sing.

b. *Jane likes to dance, Tom likes to sing and.

Adversative coordination is no exception with regard to the reversibility criterion. The sentences in (7) are truth-conditionally equivalent despite the fact that each one cancels a different pragmatic expectation. Often this cancelation is further emphasized with expressions like *regardless*, *even so*, *all the same*.

(7) a. It's raining outside, but I'm going for a walk.
[$\not\to$ I'm staying indoors]

b. I'm going for a walk, but it's raining outside.
[$\not\to$ the weather is not bad]

Bloomfield (1933) thus distinguishes between two basic kinds of grammatical constructions, *headed* and *non-headed*:[2]

> Endocentric constructions are of two kinds, *co-ordinate* (or *serial*) and *subordinate* (or *attributive*). In the former type the resultant phrase belongs to the same form-class as two or more of the constituents. (...) In subordinative endocentric constructions, the resultant phrase belongs to the same form-class as one of the constituents, which we call the *head*.
>
> (Bloomfield 1933, 195)

[1]As will be discussed later, there are certain coordination structures that yield meaning shifts, but the contrast that obtains is much more subtle than the one observed in subordination structures.

[2]This usage of the term *endocentric* is distinct from the modern generative grammar usage.

In this view both non-headed and headed (or subordinate) constructions are endocentric in the sense that their grammatical function is determined by their daughters: all of the daughters in the case of coordination and exactly one of the daughters (the head) in the case of subordination.

In fact, the syntactic and semantic nature of non-headed constructions differs so much from subordination that there are several ellipsis patterns which occur in the former. This fact is perhaps due to daughters being equally prominent and in some way interpreted as parallel structures, rather than as heads and dependents. One such example is medial Gapping:[3]

(8) a. Fred ordered books on Monday and Alice on Tuesday.
  b. Fred can bring that book on Monday or Mia on Tuesday.
  c. Fred works on Monday but Mary on Tuesday.

(9) *Fred ordered books on Monday although/because Alice on Tuesday.

A second case in point is Left-Periphery Ellipsis, often also referred to as *Conjunction Reduction*, or *Argument Cluster Coordination* (see Sag (1976) and Kuno (1976)):

(10) a. Fred sent a gift card to Bill, and a book to George.
  b. Fred sent a gift card to Bill, or a book to George.
  c. Fred gave a great book to Bill, but nothing fancy to George.

(11) *Fred sent a book to Bill although/because/before gift cards to George.

Ross (1967), Berry-Rogghe (1970), Napoli (1983), van Oirsouw (1987), and Hendriks (1995) also assume that Right-Periphery Ellipsis – often referred to as *Right-Node Raising* (Postal 1974) – only applies to coordinate constructions. However, this position is problematic because this phenomenon is known to also occur many other kinds of constructions. This matter is discussed in more detail in Chapter 8, where it is argued that these are instances of deletion.

[3]Jackendoff (1971) first pointed out that Gapping does not apply to subordinates. Sag (1976), Neijt (1979, 59) and Sag et al. (1985, 157) note that Gapping also occurs in adversative coordination, with examples like *Some people go by car, but others by bike.*

2.1.1 Categorial Identity

Another major reason for assuming that coordination structures are non-headed resides in the fact that the coordinate structure has the same grammatical function and category as the conjuncts: given a number of conjuncts of category X, the distribution of the coordinate constituent that is obtained is again the same as of a X constituent. In other words, the category of the whole is identical to the categories of the conjuncts, even though the entire coordination structure is syntactically, phonologically and semantically a richer constituent than the conjuncts taken individually. Some sub-clausal examples of this are given below for perspicuity, even though they do not exhaust all the combinations of the possible conjoinable categories.

(12) a. I gave him [a book and a hat]$_{NP}$

b. [The car and the bike]$_{NP}$ collided.

(13) a. A [tall and blond]$_{AP}$ man is here.

b. You're [happy and healthy]$_{AP}$.

(14) a. These are a few comments [from myself and from other people]$_{PP}$.

b. Most employees have a great deal of faith [in people and in legal processes]$_{PP}$.

McCawley (1982, 216) and others also noted that certain coordination structures can be embedded under a modal verb, which suggests that these are basically ordinary VP coordinations:

(15) a. Fred both [must have been singing songs] and [probably was drinking beer].

b. Fred must both [have been singing songs] and [have been drinking beer].

c. Fred must have both [been singing songs] and [been drinking beer].

d. Fred must have been both [singing songs] and [drinking beer].

In early transformational grammar there was some resistance against the idea that sub-clausal coordination existed. All coordination was viewed as clausal coordination, via the application of a deletion operation called *Conjunction Reduction* from Chomsky (1957). But soon it became clear all kinds of categories can coordinate. Consider for example the following verbal coordination structures. None can be re-analyzed in terms of clausal coordination, either because the clausal counterpart is ungrammatical or because it is truth-conditionally different:[4]

(16) a. She both [loved her subjects and was loved by them]$_{VP}$.

b. He spent the day [alternatively [criticizing Sue and being criticized by her]]$_{VP}$.

(17) a. He should [leave his job and move to NY]$_{VP}$.

b. You can't [drive a car and talk on the phone]$_{VP}$.

c. Some/None of the boys [gathered outside and sat down quietly]$_{VP}$.

There is also strong typological evidence for the existence of phrasal coordination. It is well-known that the majority of languages in the world uses one coordination lexeme in nominal conjunction and another in clausal conjunction. Some of these – Maori, Chamorro, Yapese, and Supyire – are closer to European languages in that a unique coordinator marker is used for disjunction (see for instance Haspelmath et al. (2005) and Haspelmath (2007)).

The fact that coordination can take a number of conjuncts of a given category and obtain a new constituent of the same category also means that it can apply recursively:

(18) a. [[Tom and Mary] or [Mia and Sue]] got married.

b. I can either [sing and dance] or [sing and play the guitar].

On the other hand, constituents with different parts-of-speech cannot be coordinated:

(19) a. *[Tim smiled]$_{\mathrm{S}}$ and [the book]$_{\mathrm{NP}}$.

b. *[Yesterday]$_{\mathrm{AdvP}}$ and [Fred overslept today]$_{\mathrm{S}}$.

c. *Fred hates [his voice]$_{\mathrm{NP}}$ and [to sing]$_{\mathrm{VP}}$.

d. *I made Mary both [laugh]$_{\mathrm{VP}}$ and [happy]$_{\mathrm{AP}}$.

Gazdar et al. (1985) and others have noted counterexamples to the latter observation. This is the case of (20), in which an adjectival phrase appears to be conjoined with a predicative NP. Many authors have since suggested that it is some semantic aspect that is involved in determining what constituents can be conjoined (see for example Munn (1993) and Johannessen (1998), among many others).

[4] The direct generation of passive VPs and 'post-raising' was originally argued for in Freidin (1975), Brame (1976), Bresnan (1977), Dowty (1978), and others.

(20) Tom is wealthy and a Republican.

Recently, Beavers and Sag (2004) point out that if [*wealthy and a Republican*] were an actual constituent then it should be extractable. As it turns out, this is not the case. Confront the pair of examples that I offer in (21):

(21) a. ?*It was [unjust and a Republican] that he appeared to be _ .

b. It was $\left\{\begin{array}{l}\text{[unjust and dishonorable]}\\ \text{[a Republican and a liar]}\end{array}\right\}$ that he appeared to be _ .

If these structures do not actually form constituents then how should they be analyzed? As it turns out, the grammar may already provide a solution. Crysmann (2003) and Beavers and Sag (2004) and others note, the moment one allows for Left Peripheral Ellipsis to operate in the grammar to account for data like (10), then the cases of coordination of unlike categories become unremarkable and are obtained as a prediction, as in (22d). In all of these cases exactly the same operation is occurring: an item which is left-peripheral in the coordination structure is omitted.[5]

(22) a. Tom [gave a book to Sue yesterday] and [~~gave~~ a rose to Mary today].

b. I [gave Mary a coloring book] and [~~gave~~ new roller skates to her sister].

c. You [sent the letter to Mia on Monday] or [~~sent a postcard~~ to Kim on Friday]?

d. Tom [is wealthy] and [~~is~~ a Republican].

Note that the ellipsis analysis also has the benefit of explaining why these sentences are interpreted like the non-elided counterparts, in the sense that they describe two events, not just one. Ellipsis also correctly predicts that sentences like (23a) are ambiguous between a PP coordination reading (one postcard for two people) or a VP coordination reading (two mailings of a different postcard for each person). The latter is predicted by a VP coordination analysis with left-periphery ellipsis of the verbal head.

(23) a. I sent a postcard to your brother and to your sister.

b. I found a penny in the kitchen and in the yard.

[5]Beavers and Sag (2004, 55–57) also show that cases similar to (21) which are more acceptable can easily receive an ellipsis analysis.

Other examples are cases where one would have to assume that entire clauses can be conjoined with an NP, as seen in (24). An ellipsis analysis readily captures this cases in terms of standard clausal coordination:

(24) Either [Fred said that Kim wanted a book] or [a magazine].

Crucially, note that this sentence does not mean *Fred said that Kim wanted either a book or a magazine* but rather *Either Fred said that Kim wanted a book or Fred said that Kim wanted a magazine*. Finally, challenging puzzles such as the one noted in Jacobson (1987) also come out as predictions without the need for further assumptions about coordination.

(25) *Pat grew and remained wealthy and a Republican.

This example is ungrammatical because the underlying non-elided counterpart also is. Namely, the VP **grew a Republican*. The ellipsis account thus offers a unifying view of all of these data, dispensing special-purpose mechanisms that do not offer any real explanation as to why certain unlike coordinations are possible and others are not.[6]

In conclusion, there is no evidence for the coordination of different categories, as the counterexamples come out as a consequence of an independently motivated phenomenon. Consequently, this analysis allows for a simpler and more uniform theory of coordination. Chapter 8 is dedicated to ellipsis, and discusses in more detail what conditions govern this kind of ellipsis phenomenon.

Other apparent exceptions like *Tom, and probably Fred, is going home early tonight* are best analyzed as parenthetical insertions, as they are prosodically marked and the conjuncts do not form a semantic unit: **Tom, and probably Fred, are friends*.

In sum, one of the trademarks of coordination is that the category of the mother node is identical to the categories of the daughters. This is consistent with the notion that coordination is a non-headed construction. The latter position goes back at least as Bloomfield (1933, 195), and is embraced in various accounts, ranging from Transformational Grammar as in Ross (1967) and Pesetsky (1982), to Categorial Grammar (Gazdar 1980), Head-Driven Phrase Structure Grammar (Pollard and Sag 1994), and Huddleston et al. (2002, 1275), among many others. However there are some proposals that take a different stance, which I discuss next.

[6]For example, Daniels (2002), Levy and Pollard (2002), Sag (2002), and Yatabe (2004) stipulate what are the legal 'unlike' part-of-speech combinations in a more or less exhaustive enumeration.

2.1.2 A Critique of Headed Accounts

A number of authors have proposed that coordination structures are headed by the coordination lexeme, such as Rothstein (1991), Munn (1993), Kayne (1994), and Johannessen (1998). This position is empirically hard to motivate because the category of the coordination lexeme is definitely not the same as the coordination structure. For example, the distribution of the word *and* does not match anything else other than the distribution of other coordinator lexemes. The assumption that the coordinator is the head requires further theoretical assumptions about how the category of coordinate structures is determined.

Assuming that the coordination lexeme is a head also goes against the fact that no expression in any language subcategorizes for an expression headed by a coordinator. This contrasts with headed structures in general, and in particular with *before* and *because* subordinates which are well-known to be selected as complements in clefts:

(26) a. It was before Jane arrived that Tom left.

b. It was because Jane arrived that Tom left.

(27) *It was and Jane arrived that Tom left.

Of course nothing prevents a theory from working around these problems by introducing extra theoretical assumptions, but the point is that the non-headed analysis avoids such theory-dependent stipulations. At the end of the day, what really matters is the empirical coverage of the theory and the empirical basis of the assumptions.

There is to my knowledge no clear empirical evidence offered in support of the hypothesis that the coordination lexeme is the head of a coordinate structure. For example, Munn (1993, 12) assumes that coordination structures are headed by the coordinator particle without discussion, and resolves the issue with purely theory-internal argumentation: non-headedness and multiple headeness are hypotheses to be discarded because they violate most versions of X-bar theory. This kind of theory-dependent argumentation should be avoided at all cost for obvious reasons.

Kayne (1994) suggests that the position of the coordination lexeme is correlated with the position of the verbal head, by claiming that in verb final languages coordination markers *tend* to be pospositional while in verb initial languages the coordination lexemes *tend* to be prepositional. Apart from the fact that Kayne offers no data or source for this claim, there are various flaws in this argument. First, if the distribution of the coordinator were indeed correlated with the distribution of the verb then one would expect that in freer word order languages the position of the conjunct would be relatively free also. But this never occurs. For example, in Russian the coordinator *i* is required to immediately precede the last conjunct, whereas the verb can be realized in many different positions. Second, Kayne's claim is not supported by the data. Zwart (2005) presents a survey of 136 languages where half are verb-final and half are verb-initial languages, and compares these according to their initial conjunctions [*conj* NP] and final conjunction [NP *conj*] strategies. The conclusion is that verb-final languages overwhelmingly employ initial conjunction strategies. For example, 119 of these languages have exclusively initial conjunctions, 12 languages exhibit both initial and final conjunctions, and only 4 have exclusively final conjunctions. Given these two problems it is clear that there is no correlation between verb position and coordinator position.

Johannessen (1998) discusses ten criteria that she presumes to correlate with headedness. Half of these criteria are inconclusive, as they either don't apply to coordinators, or yield no definite answer. The criteria that are deemed to be conclusive however, are controversial at best. One of them is the same as Kayne's. A second one is based on the assumption from Svenonius (1992) that uniqueness is a characteristic of heads, as illustrated by examples in which non-heads are iterated like *slowly, mysteriously evaporated*. Johannessen (1998, 91) somehow concludes that conjunctions cannot iterate by offering examples like **a girl and a boy and*, which are actually grammatical coordination patterns in some languages.[7] Another problem for Johanessen's claim is that uniqueness has nothing to do with headedness, for there are constructions in which non-heads cannot iterate, e.g. **She nobody smiles.*

Another criterion is based on the idea that the conjunction particle is a distributional equivalent for the whole, and that conjuncts are not. The argument is flawed in various levels and goes in the following way. First, Johannessen (1998, 81) correctly notes that the conjunction can never take the place of a conjunct as in (28a). Next, it is claimed that conjuncts do not have the same distribution as the coordinate structure either, as shown in (28b).

(28) a. $\left\{ \begin{array}{l} \text{Ruth and Ursula} \\ \text{*And} \end{array} \right\}$ embraced.

[7] It is also unclear why the above string was chosen to claim that coordinators do not iterate rather than a grammatical polysyndetic coordination like *and a girl and a boy*.

b. *Ruth/Ursula embraced.

This is the first flaw in the argument. The reason why (28b) is ungrammatical is not because of the category of the NP, but because this kind of verb requires a NP denoting a plurality: *They/The women embraced.* In argument positions where no such requirement is made the conjuncts can have the same distribution as the mother, as in *I saw them/the women/Ruth/Ursula/Ruth and Ursula.* What should be at stake here is the category of the mother versus the categories of the daughters, not the semantics of each conjunct and the mother. Obviously, a phrasal node is usually much richer than either of its daughters.

Johannessen (1998, 81) then concludes that conjuncts are definitely *not* distributional equivalents of the coordinate structure. As noted above, this argument is fallacious because it confuses syntactic category with semantic content. Equally problematic is the second part of the conclusion advanced in Johannessen (1998, 82). In spite of the fact that the conjunction lexeme is *never* a distributional equivalent of the whole, it is concluded that the conjunction lexeme *might* very well be the head after all. The oddness of **And embraced* is seen as irrelevant because functional categories 'are known to be unable to occur on their own'.[8] The argumentation in Johannessen (1998) is misleading, based on dubious hypotheticals, and presents conclusions that simply do not follow from any premises. Other criteria that are offered concern the adverb *respectively* and Norwegian pronouns. However, the data provide no actual support in favor of or against a headed analysis of coordination.

In conclusion, there is no known empirical evidence in favor of coordinators being heads. Making such an assumption entails a series of theoretical stipulations that can be avoided if coordinators are not seen as heads: coordination is an iterative construction in which expressions of the same category are joined to yield a larger expression of the same category, with a richer semantic content. As we shall see in the course of this work a number of correct predictions follow from this simple and intuitive view.

2.1.3 Extraction and Symmetry

A peculiar aspect of coordination is that it is in general very restrictive with regard to extraction phenomena, as first noted in Ross (1967). Ross pointed out that while

[8]It is unclear what the latter claim actually consists of, given that there are contexts in which it could be argued that functional categories 'occur on their own', as in prepositional stranding.

subordinate constructions allow extraction of one or more daughters, coordinate constructions do not tolerate this pattern. Confront the data in (29) and (30):

(29) a. Who did you mistake [_] for [Eric Idle]?

b. Who did you mistake [Eric Idle] [for _]?

(30) a. *Who did you see [_ and Tim]?

b. *Who did you see [Tim and _]?

c. *Who did you see both [_ and _]?

d. *Which of her books did you find both [[a review of _] and [_]]?

Another aspect is that an embedded element can be extracted from one of the daughters in a subordinate structure, but not from one of the conjuncts as illustrated in (31) and (32) respectively:

(31) a. Who did you talk to _ before/because Tom had arrived?

b. The gifts that Sam bought _ before/because Fred was born got lost.

(32) a. *Who did you [talk to Fred and read about _]?

b. *Who did you [talk to _ and read about Fred]?

Ross thus formulated a condition called the Coordinate Structure Constraint (CSC), which is in essence a stipulation of how movement can operate in coordination. Following Grosu (1973) I refer to (a) as the *Conjunct Constraint* and refer to (b) as the *Element Constraint.*

Coordinate Structure Constraint

In a coordinate structure,
(a) no conjunct may be moved,
(b) nor may any element contained in a conjunct be moved out of that conjunct.

However, Ross also noted that the Element Constraint can be violated if each conjunct is equally affected by extraction. Compare (32) with the following:

(33) a. Who did you both [talk to _ and read about _]?

b. Who did [you talk to _ and Tom argue with _]?

c. The gifts that [Sam bought _ and Fred mailed _] got lost.

d. This is the person that I [met _ and joked about _] earlier today.

The CSC and ATB phenomena strengthen the claim no single conjunct is the head of a coordinate structure because each conjunct is on equal syntactic and semantic grounds: if one conjunct contains missing elements, then so all others must contain the same missing elements. This is the core insight of lexicalist and non-transformational accounts of extraction such as Gazdar (1980), Gazdar et al. (1985), and Pollard and Sag (1994). These approaches are well-known to *predict* both the CSC and the ATB phenomena, without appeal to coordination-specific stipulations.

To my knowledge no such account exists in transformational grammar. The phenomena raise a fundamental problem for movement because even though there are various gaps, there is only one filler. This is not the usual way that movement is taken to operate, and thus transformational attempts to model the ATB phenomena are forced to make extra assumptions about what kinds of operations are in effect. Given this state of affairs, various alternatives have been proposed in the transformational literature, in an attempt to obtain the CSC and ATB facts via some other machinery. All of these come short at obtaining the intended set of predictions.

For example, Pesetsky (1982, 309) proposes a special principle named *Path Containment Condition* (PCC), which hinges on the notion of *path*. This account constitutes an attempt to give a generalized theory of constraints on crossing nested dependencies and of the CSC. However, the account fails to rise up to either goal. A path is defined as the set of nodes in a tree structure that connect the head of a chain to the foot of the chain. The PCC states that if two paths overlap, one must contain the other, which in turn is intended to yield the CSC and ATB effects. However, the PCC condition is known to be too strong for several reasons, and further machinery has been introduced in an attempt to emend the problem. Moreover, if the PCC is supposed to account for the CSC and ATB phenomena, then this account incorrectly predicts that multiple extractions are impossible. For an illustration, consider the well-known example in (34):

(34) [A violin this well crafted]$_i$, even [the most difficult sonata]$_j$ [will be easy to play $\__j$ on $\__i$].

On the topic of crossing nested dependencies, more recent and experimental research such as Fanselow and Frisch (2004) and Sag et al. (2007) has shown that the acceptability of different orderings of crossing dependencies is very sensitive to non-syntactic factors. This suggests that no grammar conditions restrict the possible crossing dependencies, and the reduced acceptability of some of the data is due to cognitive processing effects rather than to some principle of the grammar.

Other attempts to obtain the CSC and ATB facts are equally flawed. For example, in the multidimensional account in Goodall (1987) coordinate structures are treated in terms of the union of reduced phrase markers, and the ATB effect is predicted as a result. But as Goodall (1987, 74) notes, this approach cannot account for the deviance of examples like those in (30). Other accounts like Munn (1993) and Johannessen (1998) suffer from the same problem.[9] Moreover, Johannessen (1998, 228–235) also assumes that sub-clausal coordination is obtained from clausal coordination, and so the account fails to cope with (35a) because the clausal counterpart (35b) is impossible:[10]

(35) a. What kind of herbs can I both eat _ and make tea from _ ?
b.*What kind of herbs can I both eat _ and can I make tea from _ ?

More recently, Colaço (2005, Ch.4) proposes that the ATB effect is due to ellipsis of the left periphery, rather than extraction out of the coordination structure. This is argued to be best captured in terms of a non-standard kind of movement operation, but these details can be neglected here for simplification. In this account, *Who do you think that Mary likes and Bill hates* would have to somehow be analyzed as *Who do you think that Mary likes and ~~Who do you think that~~ Bill hates.*

The argument supporting this account is roughly as follows: this particular kind of ellipsis phenomenon and the CSC/ATB effects are restricted to coordination and comparative structures, thus, it is possible that the ATB effects are not due to extraction out of a coordinate structure, but due to an ellipsis phenomenon that targets non-initial daughters. However, this argument is based on the faulty assumption that comparatives obey the CSC. As I will show in §2.1.4, comparatives do not obey the CSC. The latter fact removes the possibility explaining ATB effects with this particular kind of ellipsis. There is also a second problem for Colaço (2005), which consists in the widespread assumption that asymmetric coordination structures are subordinate rather than coordinate. I now turn to this matter.

Ross (1967) noted that there are various counterexamples to the Element Constraint. Consider for instance the data in (36), taken from Ross (1967) and Schmerling (1972):

[9]For example, Johannessen (1998, 234) suggests that the Element Constraint results from semantic conditions, but no actual account is provided.

[10]For more discussion and controversies see Borsley (1994, 2005) and Johannessen (1998, 167–169).

(36) a. Here's the whiskey which I went to the store and bought _ .

b. Who did Lizzie Borden take an axe and whack _ to death?

These examples are interpreted in a different way than canonical coordinate structures. The event that the first conjunct describes is interpreted as preceding the second, and certain presuppositions are also produced: the whiskey was purchased at the store, and the axe is the murder weapon. Let us first consider cases without extraction phenomena.

Levin and Prince (1986) make a distinction between *symmetric* and *asymmetric* coordinate structures. In symmetric coordination conjuncts are understood as being mutually independent and thus reversing their order does not yield semantic contrast. On the other hand, the order of the conjuncts in asymmetric coordination cannot be reversed without some contrast. Usually, any given coordination structure is ambiguous between a symmetric and an asymmetric reading. World knowledge, tense, and context often making one interpretation more prominent than the other. The two readings are seen in (37) and in (38), respectively.

(37) a. Fred likes London and Mia likes Prague.

b. Tom fixed the door and Mary painted the window frame.

c. Tom was fiddling with the guitar and Trent was playing the drums.

(38) a. I dialed 911 and an ambulance arrived.

b. The lights went out and I couldn't see anything.

c. He jumped on his horse and rode off into the sunset.

d. I was in Scotland the other day and someone wanted to buy a castle.

The latter readings can be paraphrased with *and then*, *and so*, and *and there*, respectively. Other known cases of asymmetrical readings constitute threats:

(39) a. Open the car door again and I'll slap you.

b. You will leave the room or I will call the police.

Various other types of asymmetric constructions and violations to the Element Constraint are discussed in Goldsmith (1985) and Lakoff (1986). For instance, in (40) the conjunction is interpreted roughly as '*while*':

(40) a. How much can you drink _ and still stay sober?

b. How many lakes can we destroy _ and not arouse public antipathy?

Levin and Prince (1986) note that other trademark properties of coordination are lost in asymmetrical constructions, namely the possibility of Gapping. For instance, the sentence in (41a) is ambiguous between a symmetric and an asymmetric reading, while (41b) only has the symmetric reading.

(41) a. Sue became upset and Dan became downright angry.

b. Sue became upset and Dan downright angry.

In fact, there is stronger evidence for Gapping not applying to asymmetrical constructions to be found in the grammatical contrast between the minimal pairs in (42) and (43). The former are asymmetrical structures and the latter are symmetrical.

(42) a. The robbers were caught, and they *(were) arrested.

b. Tom got some cornflakes, and he *(got) breakfast.

(43) a. We were caught, and they (were) released.

b. Tom got some cornflakes, and she (got) some bread and butter.

Correlative expressions like *both* introduce a pragmatic import that establishes that the conjuncts are on equal grounds, and thus are only felicitous in symmetric coordination as Schmerling (1972) notes. For example, the data in (44a) do not have an asymmetrical interpretation and (44b) is odd:

(44) a. I both woke up and had breakfast.

b.*Would you both be an angel and make me some coffee?

Ross (1967), Schmerling (1975), Goldsmith (1985), and many others since then hold that asymmetric coordination is in fact a subordination structure. For example, Ross proposes that *and* is reanalyzed as syntactic subordinator, but this account is shown to be unattainable by Schmerling (1972). The subordinate counterpart is often not synonymous with the asymmetric coordination realization.

Postal (1998) proposes a purely syntactic account of the phenomena, by positing the existence of phonetically unrealized resumptive pronouns. He proposes the existence of two types of extraction: A-extraction, which leaves behind a trace, and B-extraction, which leaves an invisible resumptive pronoun. The claim is that the counterexamples to the CSC are either instances of B-extraction, and thus not true counterexamples, or that they do not involve true conjunction. Levine (2001) offers a detailed assessment of Postal (1998) and provides a number of counterexamples to the data on which Postal's account is based, as well as arguments against the non-coordinate status of asymmetric constructions (see also Hukari and Levine (1995, 279–284)).

As far as the present discussion is concerned, the crux of the matter is that there is no independent evidence for asymmetric constructions being subordinate rather than coordinate. Lakoff (1986) points out that asymmetric constructions behave very much like coordination in the sense that they can be iterated:

(45) a. How many kinds of tequila has he [snuck off to Mexico, sampled _ , and come back the same day without telling anyone]?

b. Concerts that short, you can leave work early, hear the entirety of _ , and still be back at the job before anyone notices you are gone.

Lakoff offers examples with multiple gaps too:

(46) a. What did he go to the store, buy _ , load _ in his car, and unload _ ?

b. How many courses can you take _ for credit, still remain sane, and still get all A's in _ ?

c. This is the kind of brandy that you can sip _ after dinner, watch TV for a while, sip some more of _ , read an article, finish off _ , go to bed, and still feel fine in the morning.

Another fact that undermines the idea that asymmetric constructions are subordinates is that these structures lack the mobility that is standardly observed in subordinate constructions (Levine 2001, Kehler 2002):

(47) a. We can expect our graduate students to teach one course, and still finish a dissertation on time.

b.*And still finish a dissertation on time, we can expect our graduate students to teach one course.

I provide further evidence against asymmetric coordination being analyzed as subordination with the distribution of the correlative marker *either*. This expression, unlike *both*, is compatible with both symmetric and asymmetric coordination. Consider some examples of the latter:

(48) a. Either I'm leaving before the end of the movie or I'll miss the bus.

b. Either you will leave the room or I'll call the police.

(49) a. *Either if I forget to leave before the end of the movie then I'll miss the bus.

b. *Either if you leave the room then I will not call the police.

Thus, there is ample evidence in favor of Lakoff (1986). Asymmetric structures are most likely to be coordinate structures, and the Coordinate Structure Constraint does not exist. Rather, extraction patterns are dependent on semantic properties of the conjuncts and of the relationship that holds between them. Kehler (2002) follows Lakoff's reasoning and argues that the unacceptable cases should result from violations occurring at the pragmatic level. A *Discourse Coherence* account is thus developed with the goal of explaining the extraction possibilities in coordination structures as a result of discourse relations. The hypothesis put forth by Kehler is basically that there is a parallelism relation that holds between the conjuncts in symmetric coordination, and that this parallelism must hold even when the parallel elements are extracted.

Let us consider this proposal in more detail. Given a coordination like [S_1 and S_2], Kehler (2002, 15) proposes that speakers identify a relation p_1 from S_1 that applies to a set of entities $a_1, \ldots, a_n$, and a second relation p_2 from S_2 which applies to a second set of entities $b_1, \ldots, b_n$. Crucially, the corresponding arguments a_i and b_i are *parallel arguments*. Discursive coherence is obtained if it is possible to infer a common (or contrasting) relation p from p_1 and p_2. For an illustration of the account consider (50).

(50) John bought the book and Bill read the book.

The relations obtained from the conjuncts in (50) are $p(a_1, a_2)$ and $p(b_1, b_2)$, respectively. The inference process for parallel structures establishes that p_1 is *buy*, p_2 is *read*, p is *do something*, the arguments a_1 and b_1 are *John* and *Bill* respectively, and a_2 and b_2 are both *the book*. Kehler (2002, 121–126) argues that extraction *must* be ATB because of the assumption that the parallelism between arguments must be preserved. The parallel arguments a_2 and b_2 are extractable to a position that establishes them as topic, as in (51), and as such either both are extracted or both remain *in situ*. Otherwise the parallelism between a_2 and b_2 would not be preserved.

(51) What book did John buy and Bill read?

Conversely, extraction in asymmetric coordination structures need not be ATB because the underlying inferential pragmatic relation does not establish parallelism.

But there is a number of problems with this proposal. First, Kehler (2002) does not make clear exactly how the parallel relations and arguments in p are to be determined. There is no discussion about how these relations are read off from semantic or syntactic structure. This is specially problematic in the face of symmetric coordination structures like (52), in which conjuncts have very different structures:

(52) a. Which famous rock star did [Mia photograph _] and [Fred tell you that Kim actually interviewed _]?

b. Which topic is [Mary writing a thesis on _] and [Fred thinking about giving me a book about _]?

c. This is the book [that I wanted to buy _] and [that Rebecca thinks you should read _ too].

Moreover, the notion of parallelism as discussed in Kehler (2002, 15–17) breaks down in cases like (53). Here the extracted elements are not intuitively parallel in any way, since they are subjects and complements:

(53) a. I know someone [who Bill has met _] and [who I think _ might like Mary].

b. This is the person [who Fred said _ called us yesterday] and [who you forgot to take a picture of _].

c. Which person did you say that [Fred met _ at the party] and [Mia thought _ was some TV celebrity]?

The possibility of having subject and object extraction was first noted in Goodall (1987), with examples like (54a). Levine and Hukari (2006) also note data like (54b).[11]

(54) a. We went to see a movie which [the critics praised _] but [_ was too violent for my taste.]

[11] See also Levine et al. (2001) for similar cases with subordinate constructions and parasitic gaps.

b. Robin is the only person who [_ likes me] and [I like back _].

Another shortcoming of Kehler (2002, 93) is that Gapping is predicted to be infelicitous in comparatives, which is known to be possible since Huang (1977), as discussed in §2.1.4. See also Frasier and Clifton (2006) for other problems with Kehler (2002) pertaining to experimental evidence.

Still, Lakoff's view that pragmatic and semantic factors are responsible for extraction patterns is well supported. There are no good reasons for assuming that asymmetrical structures are subordinates rather than coordinates. They have no mobility at all and can be iterated. The fact that Gapping and Left-Periphery Ellipsis do not apply to these structures is not particularly important given that these ellipsis phenomena also occur in certain comparative constructions. Comparatives are shown to not be coordinate structures in §2.1.4 below. It is therefore more likely that such ellipsis phenomena are regulated both by pragmatic and semantic factors rather than by coordination. This is also consistent with the fact that the judgments on many of these examples are subtle and non consensual.

One important fact that is observed in the literature is that the non-ATB extraction in asymmetric coordination need not be sensitive to the order of the conjuncts. Rather, extraction seems to be optional for the less prominent and backgrounded conjuncts (these express either discourse-old information or information which is not directly relevant to the communicative role of the sentence). For example, if the topical element in (55a) is *store* then (55b) is more plausible, but if the topical element is *whiskey* then (55c) becomes more plausible.

(55) a. I went to the store and bought a bottle of whiskey for $15.

b. This is the store that I went to _ and bought a bottle of whiskey for $15.

c. This is the bottle of whiskey that I went to the store and bought _ for $15.

Note that in both cases the situation described in the first conjunct is taken to precede the situation described in the second. This shows that the asymmetric reading that is established between the conjuncts is not directly correlated with the extraction pattern. In §7.1.3 I propose that the possibility of non-ATB extraction phenomena results from a coercion process that applies to verbal conjuncts. This process has the effect of backgrounding the meaning of the conjunct and of making the conjunct compatible with the presence of gapped elements. In this view the asymmetric coordination structure itself has the same syntactic structure as symmetric coordination, but in the former case some of the conjuncts have undergone a backgrounding process.

On the other hand, asymmetric readings can be seen as resulting from extra pragmatic import that can optionally be added to coordination structures in general. In the examples given above, a condition $e_1 \leqslant e_2$ is added to the semantics of the coordinate structure, stating that the occurrent of the event e_1 associated with the first conjunct precedes the occurrence of the event e_2 associated with the second conjunct.

Ross (1967) also argued that the Element Constraint violations only target non-negative and non-stative VPs, but I believe that this ought to have a simple explanation. It may be the case that S conjuncts are harder to background for pragmatic reasons. After all, they convey entire propositions. In this view a VP can more easily be backgrounded and give rise to asymmetric readings because in VP coordination it is more natural that conjuncts describe a logical sequence of situations, all applying to one and the same subject, rather than describing an independent set of situations. If S backgrounding can be made more prominent for contextual reasons, then the purportedly impossible CSC violations are more acceptable. Judgments may be gradient, but Ross (1967) would predict that (56) is fully impossible.

(56) ? This is another animal that we opened the trap like I mentioned before and Mia managed to rescue _ .

2.1.4 Comparative Structures

Comparatives and coordinates exhibit certain similarities which have led many authors to propose that (at least some) comparative structures are coordinate. This is the case of McCawley (1964), Hankamer (1973, 66), Napoli (1983), and Moltmann (1992) among others. Below I shall address this topic and conclude that these claims are too strong.

In simple comparatives the *than*-marked constituent is a measure phrase that denotes the second term of comparison. In this kind of comparative the *than*-phrase must be right-adjacent to the comparative form, and is restricted to nominal constituents:

(57) a. More than three consultants work at HP.

b. More than three gallons of beer spilled on the floor.

This motivates an analysis in which the comparative form is quantificational in nature, and subcategorizes for a *than*-marked measure phrase complement.

In a second kind of comparative – usually referred to as 'subdeletion' – the term of comparison is not right-adjacent to the marked phrase and the latter is associated with a missing degree specifier (signaled by Δ below).

(58) a. More consultants work at HP than Δ engineers work at PARC.
 b. This Spring, HP hired more consultants than PARC hired Δ engineers.

Each daughter contains an embedded degree value occupying a specifier position, which then is somehow compared across the two structures.

It is often assumed that the *than*-marked constituent is adjoined to the following constituent, but there is evidence against this. Unlike what occurs in subordinate structures, the second daughter cannot be fronted:

(59) a. *Than engineers work at PARC, more consultants work at HP.
 b. *Than PARC hired engineers, HP hired more consultants.
 c. *As engineers work at PARC, as many consultants work at HP.

This is one similarity with coordination structures, but there are many reasons why comparatives cannot be coordinate structures. First, it is known since Hankamer (1973) that these comparatives exhibit some form of parallelism with regard to the compared terms. If the first term of comparison is a subject, then the second term of comparison cannot be a complement, and *vice versa*:

(60) a. HP hired more consultants than PARC hired engineers. [C Δ]
 b. More consultants work at HP than engineers work at PARC. [S Δ]
 c.*More consultants work at HP than PARC hired engineers. [S & C Δ]
 d.*HP hired more consultants than engineers work at PARC. [C & S Δ]

(61) a. HP hired as many consultants as PARC hired engineers. [C Δ]
 b. As many consultants work at PARC as engineers work at HP. [S Δ]
 c.*As many consultants work at HP as PARC hired engineers. [S & C Δ]
 d.*HP hired as many consultants as engineers work at PARC. [C & S Δ]

This contrasts with coordination in the sense that subjects and complements can be extracted. Recall the data in (54b), repeated below for perspicuity:

(62) Robin is the only person who [_ likes me] and [I like back _].

Further negative evidence is that non-ATB extraction is possible in the first daughter:

(63) a. This is the company that (Fred said) _ hired more consultants than PARC hired programmers.

b. Which company (did you say) _ hired more consultants than PARC hired programmers?

It should be stressed that these examples do not exhibit any change to the prototypical interpretation of the comparative, unlike what occurs with non-ATB extraction and asymmetric coordination.

The opposite claim is made in Corver (1990) and Hendriks (1995) about extraction in comparatives. These authors conclude from (64) that a Wh-element cannot be extracted from one of the two clauses of a clausal comparative (their judgements):

(64) *Which actor do as many men admire _ as women detest Sylvester Stallone?

In my view, attributing the oddness of (64) to hard syntactical facts about extraction in comparatives is irreconcilable with grammatical examples such as the ones given above, as well as with variants of (64) like (65a):[12]

(65) a. Which actor do as many men admire _ as there are women who detest Sylvester Stallone?

b. What kind of TV shows do men watch _ as often as women watch soap operas?

Hendriks (1995) thus analyzes (64) as a coordinate and the sentences in (65) as subordinates. This approach is undesirable as it draws a distinction between virtually identical structures without solid empirical reasons. A simpler explanation of the facts is that (64) is odd because the compared terms are for pragmatic reasons not as easily processed in the correct way as in (65a). This may be because *as*-marked constituents can also be parsed as adverbial comparatives, as in *Men love Angelina as Women love Brad*, a parse that is more straightforwardly ruled out for (65a).

[12] Attributed to Joan Bresnan (p.c.) in Hendriks (1995, 63).

The same facts about extraction are true for other languages such as Portuguese, in spite of claims to the contrary in Matos (2002, 746).[13] For an illustration, consider the data in (66).

(66) a. De quem é que o Tó gosta tanto _ quanto a Ana gosta de mim?
of who is that the Tó likes much _ as the Ana likes of me

b. A quem é que nós ganhámos mais vezes _ do que o PSV nos ganhou?
to whom is that we won more times _ than that the PSV us won

c. Que carro é que tu achas que _ custa mais do que um BMW custa?
which car is that you think that _ costs more that what a BMW costs

There is also a striking difference between the interpretation of embedded comparatives and coordinates. In (67a) the object of the speaker's thoughts is a composite state-of-affairs which consists in two different propositions, while in (67b) the object is a single proposition that compares two degrees.

(67) a. I think that [PARC hired consultants and HP hired programmers].

b. I think that [PARC hired more consultants than HP hired programmers].

This indicates that conjuncts are free to denote but the daughters of comparatives do not have this ability. The interpretation of the latter is inextricably tied.

Another difference resides in the coordination and comparative lexemes. The former are compatible with the presence of all kinds of markers while the comparative expressions are not, as illustrated in (68).

(68) a. I think that PARC hired consultants and that HP hired programmers.

b.*I think that PARC hired more consultants than that HP hired programmers.

A final difference between comparatives and coordination that I will draw attention to, is the fact that only the latter can occur recursively. A coordination structure can function as a conjunct in a larger coordination as in (69) but comparatives are fundamentally different as shown in (70).

[13]The author claims that Portuguese comparatives require ATB extraction based on the example *O que é que o Luís é mais _ do que o João é trabalhador?* ('what is Luís more than João is hard-working?') which is claimed to be ungrammatical. Colaço (2005) subscribes to these judgments. All of the informants that I consulted accept this sentence as grammatical, if only pragmatically odd given the nature of the compared terms. The data in (66) are deemed fully grammatical.

(69) a. [Tom and Mary] and [Fred and Sue] love going to the movies.

b. Kim was [drunk or high] and [signed in for the marines].

c. [Sue is in London] and [Tom used to live in Trento but now he's in Nijmegen].

(70) a.*PARC hired more consultants than [HP fired more engineers than IBM fired].

b.*More consultants work at HP than [as many engineers work at PARC as programmers work in IBM].

All this evidence makes it most unlikely that comparatives and coordinates are syntactically identical structures. There are, however, some similarities that suggest that comparative structures are non-headed. First, various ellipsis phenomena that prototypically occur in coordination structures such as Gapping and Left-Periphery Ellipsis also occur in these comparatives:

(71) a. Fred ordered more books on Monday than Alice on Tuesday.

b. More men buy books on Monday than women on Tuesday.

c. Fred spends as much money on drugs as Alice on books.

(72) a. More people sent gift cards to Bill than books to George.

b. Fred sent more gift cards to Bill than books to George.

c. Fred sent as many gift cards to Bill as books to George.

Moreover, various different parts-of-speech are suitable daughters for the comparative structure: The comparatives in (73) are usually claimed to have a metalinguistic comparison interpretation (*he's more dead than alive* or *his problems are more financial than legal*) which can be paraphrased with '*rather*'. I believe they are ambiguous between the latter and a standard scalar comparison.

(73) a. Some people brought [more books than magazines]$_{NP}$ to the library counter.

b. On some campuses, students already pay [more in fees than in tuition]$_{PP}$.

c. If the frame is [more wide than long]$_{AP}$, it will be automatically resized.

d. I was still standing straight up when I [more saw than heard]$_{V}$ you talk.

As in coordination constructions, the categorial status of the bracketed constituent seems not to be determined by the comparative markers, but by the daughters. If a comparative has two NP daughters then the mother node is an NP. This entails that one can even coordinate an NP with a comparative:

(74) People brought either [too much food]$_{NP}$ or [more books than magazines]$_{NP}$.

The evidence thus suggests that these comparatives are non-headed constructions. The daughters are parallel in the sense that neither is more prominent than the other, and in that parallel effects are observed in the compared terms. The overall picture of the foregoing discussion can be summarized in the following typology:

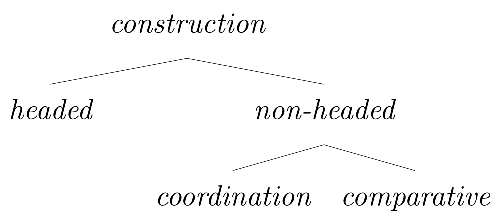

Figure 2.1: Typology of constructions

This work will not address comparative structures but for completeness, it is noted that English has various other kinds of comparatives, including correlatives [*the more* S] [*the more* S], and a kind of subordinate construction often referred to as *comparative ellipsis* comparatives.[14] Neither kind of comparative requires ATB extraction either:

(75) Which tea was it that the more you drank _ the smarter you got?

(76) a. Who is John more dependent on _ than Mary?

b. Who is John as tall as _ ?

c. Who did John come earlier than _ ?

d. Which people can Robin run nearly as fast as _ ?

Comparative ellipsis cases often require the omission of the compared term, as in *Fred is taller than Sue* *(*is tall*). These are best seen as subordinate structures given that

[14]For more discussion see for instance Culicover and Jackendoff (1999).

the embedded phrase can be extracted, as noted by Ross (1967, 53), Hankamer (1974), and Corver (1990, 210), among others. The subordinate analysis is further motivated the fact that it is possible to front this constituent as in Huddleston et al. (2002, 1105). A similar behavior can be seen in other languages such as Portuguese, given the possibility of topicalizing the subordinate daughter:

(77) a. Do que ele, ninguém é mais louco _ .
of than him nobody is more crazy
'than him, nobody is crazier'

b. Como tu, não há quem me conheça tão bem _ .
like you, not is who me know as well
'there isn't anyone who knows me as well as you do'

2.2 On Syntactic Structure

I now turn to aspects pertaining to the structure of coordination. There are some well-known reasons for assuming that the coordinator particle forms a constituent with one of the conjuncts. In the case of English, the rightward conjunct. As noted by Ross (1967), the natural intonation break occurs before the coordination lexeme rather than between the coordinator and the conjunct. The coordinator particle and the conjunct form a prosodic constituent.[15] Another piece of evidence that is consistent with Ross's view is that there are languages in which coordinators are in fact not independent words, but are suffixed and written as a single word together with the conjunct they attach to. One example of this is the Latin element *-que*, which forms with the preceding conjunct a single domain for stress assignment. Given these observations, a possible structure for coordination is a binary branching structure, rather than a flat one. This kind of analysis is illustrated in Figure 2.2, and goes back at least to Yngve (1960).

[15]This evidence is not as clear-cut as one would expect because it is known at least since Chomsky (1965) that prosodic units can sometimes be at odds with syntactic units.

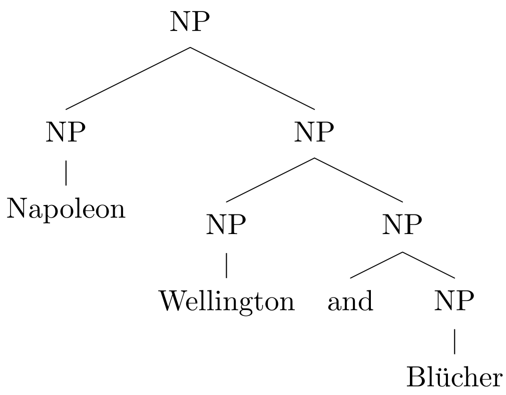

Figure 2.2: Coordinate structure [NP [NP and-NP]]

This fairly traditional and familiar kind of representation can be captured by two rules. One that allows a coordination marker (*and*, *or*, or *but*) to attach to an unmarked constituent X and yield a coordination-marked X in the process, and a second rule that allows recursive iteration of conjuncts:

(78) a. $X_{crd+} \rightarrow$ *coord* X_{crd-}

b. $X \rightarrow X_{crd-} \quad X_{crd+}$

The feature CRD$\pm$ indicates if the phrase is taken to be coordinate or not and is used to control the way that the rules can apply.[16] This is not the actual account that will be put forth, but for the present discussion it will suffice. There may also be processing reasons for adopting this analysis. It is hard to see how a rule of the form [$X \rightarrow X_1 \ldots X_n$ and X] can be stored in the brain, given that the number of elements in the right-hand side is unbounded. The recursive rule in (78b) avoids this problem.

Munn (1993, 15) claims that further evidence for *and* forming a constituent with the conjunct on the right is that it can be 'extraposed', as in (79). But this conclusion is unwarranted. Cases like (79a) are better viewed as instances of Left-Periphery Ellipsis: *John* [*bought a magazine yesterday, and ~~bought~~ a newspaper today*]. For one, cases that unambiguously require a NP coordination structure (as opposed to also lending themselves to an ellipsis analysis) do not allow for the so-called extraposition counterpart as shown in (80).

(79) a. John bought a book yesterday, and a newspaper.

[16] This kind of feature has been used in various places for this effect, such as Kamp and Reyle (1993, 207) and Beavers and Sag (2004) for example.

b.*John bought a newspaper yesterday a book and.

(80) a. John parked between a car and a truck yesterday.

b.*John parked between a car yesterday, and a truck.

The conjunct extraposition analysis would thus have to make some extra stipulations to get the above facts right, while the ellipsis analysis provides a straightforward account of the data, without further assumptions. Another problem for the extraposition story is that if extraposition is supposed to hinge on the fact that [*and a newspaper*] forms a constituent, then this predicts that other constituents can be extraposed too, which turns out to be false:

(81) *John bought and a newspaper yesterday, a book.

Munn (1993, 16) also claims that a binary branching analysis correctly predicts that *He$_i$ and John$_i$'s dog went for a walk* is ungrammatical because the anaphoric linkage is not c-commanded. First, it is not clear that this example is ungrammatical at all. Some of the speakers I consulted accept such examples as grammatical. Any deviance must be due to non-grammatical factors given that there are a number of counterexamples to Munns's claim:

(82) a. I don't think that [the man I saw in his$_i$ house] and [Fred$_i$] know each other.

b. [His$_i$ car made a strange noise] and [John$_i$ pulled over by the road side].

c. I wish to inform [him$_i$] and [all of Dr. Phill$_i$'s viewers] that real counseling sessions take place behind closed doors, not in TV.

d. [I didn't think he$_i$ was crazy] but [there was a man$_i$ on the corner that looked at me in a very funny way].

Gazdar et al. (1982) also provide many grammatical cases in which the non-initial conjunct is a pronoun coindexing with an R-expression in a preceding conjunct:

(83) a. We invited [[Betsy's$_i$ mother] and [her$_i$]] to the ceremony.

b. A disagreement arose between [[Clinton's$_i$ bodyguard] and [him$_i$]] over White House security.

c. A disagreement arose between [[each candidate's$_i$ campaign manager] and [him$_i$]] over the protocols for the debate.

In sum, Munn's proposal that c-command determines the possible anaphoric linkages in coordination structures is unwarranted. This claim is also endorsed by Matos (1994, 310) and Colaço (2005, 76–80) for Portuguese coordinate structures. The example in (84) is labeled as ungrammatical (Matos's judgement):

(84) *Ela$_i$ viu esse livro na livraria mas a Maria$_i$ decidiu não o comprar.
she saw that book in-the library but the Maria decided not it buy

The informants that I consulted report that although this binding is not preferential, it well within the realm of possibility if properly contextualized. This may be because the realization of a proper noun implies the introduction of a discourse-new individual, and because cataphoric bindings are harder to process that anaphoric ones. Still, one can find sentences that more readily elicit the allegedly impossible binding (although these also have prominent third-party readings):

(85) a. Ela$_i$ prometeu que chegava a horas e eu acredito sempre nas
she promised that arrive on time and I believe always in-the

promessas da Ana$_i$.
promisses of-the Ana

b. Ninguém a$_i$ convidou para a festa mas a Ana$_i$ decidiu ir à mesma.
nobody her invited to the party but the Ana decided go to anyway

c. Eu sei que ela$_i$ gosta de mim e a Ana$_i$ sabe bem que eu gosto dela$_i$.
I know that she likes of me and the Ana knows well that I like her

In other accounts of binding theory, such as Pollard and Sag (1994), the binding principles are non-configurational since they are stated on the argument structure of the lexical head. Given that coordination lexemes are not heads, the binding conditions do not apply and patterns like the one above are allowed.

But let us return to the syntax of coordination. Kayne (1994) and Johannessen (1998) make extra assumptions in claiming that cases like *Napoleon, Wellington and Blücher* contain a phonetically unrealized coordination particle between the first two conjuncts. Thus, a *monosyndetic* coordination structure like *Napoleon, Wellington and Blücher* is claimed to be structurally identical to a *polysyndetic* coordination *Napoleon and Wellington and Blücher*. One major problem for this claim is that polysyndetic coordination structures allow for a wider range of readings than monosyndetic coordinate structures as Borsley (2005) and others have noted. Consider the well-worn sentence given in (86):[17]

(86) Napoleon and Wellington and Blücher fought against each other.

If there is a prosodic break after the second conjunct then the preferential parse is [[NP *and*-NP] *and*-NP]. This reading is easier to obtain if the last conjunct is phonologically heavier, e.g. *Gebhard von Blücher*. As a result of this parse the first two conjuncts are interpreted as an independent group. Let us call this group g, and take b to be the individual introduced by *Blücher*. The entire subject NP thus denotes a group $g' = \{g, b\}$, and the reciprocation in the verb phrase in (86) can obtain a reading in which Napoleon and Wellington fought with Blücher, by predicating the two members of g'.

If null coordinators existed, then the monosyndetic variant of (86) – *Napoleon, Wellington and Blücher fought against each other* – would have this kind of reading also. But as Borsley (2005) points out, it doesn't. Even with a pause after the noun *Wellington*, one does seem to get the reading where Napoleon and Wellington fought with Blücher.

A second interpretation is obtained if the prosodic break is placed after the first coordinate marker, yielding the parse [NP *and*-[NP *and*-NP]]. This structure allows for the historically correct reading in which Napoleon fought against Wellington and Blücher in the battle of Waterloo. Again, this kind of reading is not available with the monosyndetic variant.[18] The existence of null coordinators in monosyndetic coordination is therefore problematic because polysyndetic coordination can obtain readings which are lacking in monosyndetic coordination. In conclusion, I reject the existence of null coordinators in monosyndetic coordination.

2.2.1 Correlative Markers

Expressions like *both*, *either*, and *neither* are traditionally referred to as correlative markers, given that they typically co-occur with coordinate structures. See for instance Sledd (1959, 205), Strang (1962, 174), and more recently in Huddleston et al. (2002,

[17]This kind of example has received much attention because these readings can be used to argue against the idea that Non-Boolean conjunction is associative (Hoeksema 1983; Krifka 1991).

[18]For completeness it should be pointed out that the coordinate NP can also be interpreted as conveying that everyone fought each other. For now I will ignore these kinds of readings as they do not alter Borseley's point. All that this shows that there isn't a one-to-one mapping between the structure of coordination and semantic interpretation.

1308) and in Quirk et al. (1985) among many others. There are various correlative markers in English, but I shall concentrate on *both* and *either*.

The modern use of the English correlative *both* is always left-adjacent to the first conjunct of a non-clausal binary coordination. See the data in (87) and in (88):

(87) Kim $\left\{\begin{array}{l}\text{saw both Mary and Sue.}\\ \text{is both strong and agile.}\\ \text{can both drink and smoke.}\\ \text{works both quickly and efficiently.}\\ \text{is both on the board and on the committee.}\end{array}\right\}$

(88) a.*Both I was surprised and Tom was delighted.

b.*I was both startled, surprised and delighted.

Dougherty (1973) and Munn (1993, 23) claim that *both* is a quantifier that attaches to plural NPs, and not necessarily to coordinate structures. This in not an uncontroversial position given that *both* can attach to many other kinds of categories other than NPs, and no evidence is provided in favor of quantifiers being able to attach to non-nominal categories. There is however a second usage of *both* which is quantificational in nature and that can attach to non-coordinate nominal structures:

(89) a. Both men play soccer.

b. Both the girls like rugby.

Note that the quantificational usage can float to the right (similarly to expressions like *all* and *each*), but not the correlative *both*. Compare the example in (90) with the data in (91):

(90) (Both) the kids in my team (both) scored a lot.

(91) a. I can (both) drink and sing (*both).

b. The (both) omnipresent and omnipotent (*both) god (*both) was pleased.

It is therefore likely that there are at least two usages of *both*: one is quantificational in nature and targets certain pluralic NPs, and the other is a correlative marker that attaches to conjoined constituents. Languages such as Portuguese lack the latter usage, for instance. The expression *ambos* ('both$_{masc.pl}$') only attaches to plural NPs, may float to the right, and agrees in number and gender with the nominal.

In general terms correlative markers stress that the conjuncts are semantically parallel in some sense. In the case of *either*, it stresses that only one of the disjuncts is true in a given state of affairs, while in the case of *both* each conjunct is perceived as pertaining to an independent state of affairs. For example, in cases of NP coordination that can be interpreted distributively or collectively, the insertion of *both* forces the latter reading. This is illustrated in (92) which can only mean that both individuals have spouses.

(92) Both Fred and Mia are married.

Thus, predications that are necessarily collective become infelicitous, as noted in Ladusaw (1982), Roberts (1987, 199) and others. In (93) the presence of *both* makes the collective reading impossible:

(93) a. (#Both) Fred and Mia are a happy couple.

b. One of $\left\{\begin{array}{l}\text{the two books}\\ \text{\#both books}\end{array}\right\}$ is damaged.

c. Jonathan found a poem stuck between $\left\{\begin{array}{l}\text{\#both}\\ \text{two}\end{array}\right\}$ pages.

Syntactically, the correlative marker *either* is similar to *both* in several aspects. It can attach to constituents of virtually any category and also has a second usage as a determiner, in examples like *I love either painting* or *I'll do it either way.* In the correlative marker usage, *either* attaches to a disjoined coordinate structure and strengthens the exclusive implicature of the disjunction. For example, (94) means that there is a copy in one of two locations, but not a copy in each location:

(94) Tom left a copy either on the desk or on the drawer.

This exclusive 'or' implicature can be canceled in certain contexts, as is the trademark of implicatures. One such case is under the scope of negation. In the counterpart given in (95) the exclusive 'or' interpretation is gone because the sentence means that there is no copy anywhere. If the exclusive 'or' reading were the one being negated, then the sentence would also be true if both locations contained a copy.

(95) There isn't a copy either on the desk or on the drawer.

The correlative *either* is also less restricted than *both* in a number of ways. First, it does not require a binary coordination as the data below illustrate, although some speakers have a preference for a binary structures.

(96) a. You can cite the comments made either to me, to members of the RGA Committee, or to the committee's consultants.

b. The survey can be given to either me, you, or Peggy until Friday.

c. He was being followed by either the FBI, the Mafia, or his own wife.

Second, correlative *either* is well-known for its adverbial-like distribution. In the data in (97) the position of the correlative marker can vary even though the coordination is always clausal (the possible surface realizations of the correlative are noted between brackets):[19]

(97) <Either> Fred <either> will <either> write <either> a mystery or he'll write a romance.

Recently, den Dikken (2006) proposes that the distribution of *either* correlates with interpretive focus (not the focally pitch accented constituent) as illustrated by the examples in (98). The interpretive focus is underlined and the pitch accent focus is in uppercase:

(98) a. <Either> John <either> will <either> read <either> <u>CHAPTER 3</u> or he'll read CHAPTER 4.

b. <Either> John <either> will <either> <u>read <*either> CHAPTER 3</u> or he'll <u>prepare DINNER</u>.

c. <Either> <u>John <either> will <either> read <*either> CHAPTER 3</u> or <u>Jones will FLUNK him</u>.

Here, the phonological focus in the first disjunct is systematically on the direct object (CHAPTER 3) but the interpretive scope of contrastive focus is different in the three examples (as marked by the underlining). The sensitivity to contrastive interpretive focus provides further evidence for the correlative being an emphatic operator rather than a semantic operator like the disjunction or a conjunction lexeme.

There are also cases in which the correlative appears to float leftwards in (99):

[19]Note also that the order is fixed in the determiner usage: *I *<either> love <either> painting.*

(99) a. Either Fred will write a mystery or a romance.

b. Either John will read chapter 3 or read chapter 4.

Following Schwarz (1999), Beavers and Sag (2004) and Hofmeister (2005), I will assume that these cases are instances of Left Periphery Ellipsis at the clausal level (e.g. *Either* [*Fred will write a mystery*] *or* [~~*Fred will write*~~ *a romance*]). Independent evidence for this comes from semantics. Even thought the disjunction seems to be sub-clausal rather than clausal, these examples are interpreted as the non-elided counterparts. Again, once a mechanism for LPE is put forth, such data are obtained as a prediction.

Hendriks (1995) and many others argue that the distribution of *either* indicates that this is an adverbial form. There is in fact a pure adverbial usage of *either*:

(100) Mary didn't do anything, and John didn't either.
(Culicover 1999, 54)

The distribution of *both* is much more restricted and there is no evidence for it having adverbial properties. Consider the following data:

(101) a.*Fred will both write a mystery and he'll write a romance.

b.*Fred will write both a mystery and he'll write a romance.

(102) Mary did it, and John did it too/*both.

There are also other evidence for the distribution of *either* being adverbial in nature. For example, in Romance languages *either* ... *or* structures are realized with the same marker 'or ... or', and there is no evidence that the disjunction lexeme has any adverbial properties. Consider data from Portuguese:

(103) a. Ou a Ana vai escrever um romance ou ela vai escrever um policial.
or the Ana will write a romance or she will write a crime novel

b. A Ana ou vai escrever um romance ou ela vai escrever um policial.

c.*A Ana vai ou escrever um romance ou ela vai escrever um policial.

d.*A Ana vai escrever ou um romance ou ela vai escrever um policial.

The adverbial-like properties of *either*, and the fact that *either* and *both* correlatives also occur as other parts-of-speech suggests that these expressions attach to the entire coordination structure, e.g. [*either* [*XP or-XP*]] rather than the left-most conjunct. In Romance languages however, it is more plausible that each conjunct is individually marked. For example, French has a correlative disjunction pattern [*soit*... *soit*...] in which the presence of the first marker is obligatory. This indicates that the two daughters are inter-dependent and that the outer *soit* is not merely an intensifier as is the case of English correlatives.

A common property to all correlative markers is that the iteration of conjuncts outside the marked structure is prohibited. The only way to add another conjunct is to embed the correlative coordination in a new coordination structure:[20]

(104) a. You can talk to either Fred or Jeff.
b.*You can talk to Kim, either Fred or Jeff.
c. You can talk to Kim, and/or either Fred or Jeff.

(105) a. You can talk to both Sue and Jeff.
b.*You can talk to Sue, both Sue and Jeff.
c. You can talk to Sue, and/or both Sue and Jeff.

The reason for this may very well be connected with the fact that the correlative marker functions as an intensifier: *both* stresses that each conjunct is equally prominent in the respective predication, and *either* stresses that each disjunct is an equally plausible in the respective predication. The introduction of an extra conjunct beyond the correlative expressions would therefore defeat the purpose of the intensifier.

2.2.2 The Uniformity of Conjuncts

The simplest assumption one can make about the syntax of coordination structures is that conjunct iteration is a process by which a conjunct is added to yields a larger coordinate structure. However, Borsley (2005) questions this view. Here it is claimed that the second and third conjuncts in structures like *Hobbs, Rhodes and Barnes* do not form a coordinate structure. Four pieces of evidence are given in support of his claim. The first one concerns the marker *both*, and consists in the claim that the contrast in (106) results from the second and third conjuncts not forming a coordination structure:

[20] In Sag et al. (1985) this is captured via linear precedence rules.

(106) a.*Hobbs, both Rhodes and Barnes.

b. Hobbs and both Rhodes and Barnes.

But the same facts follow if one assumes that the marker *both* closes off the possibility of iterating the embedded coordination, as discussed above. This has the benefit that the syntactic structure of coordination can be kept uniform and simple. In that view there is nothing wrong with (106b) because it contains two independent coordination structures, one embedded in the other. The two structures are illustrated in the parse trees in Figure 2.3. The relevant generalization here is that the rightmost conjunct must contain a coordinator marker (e.g. bear a feature specification *crd+*), and that the presence of the marker *both* resets this marking value:

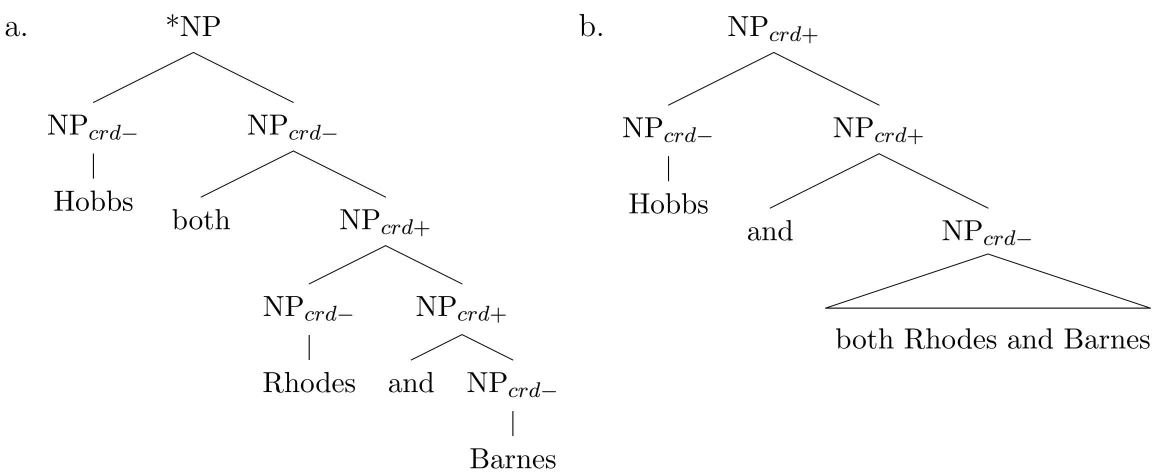

Figure 2.3: Parse trees for (106a) and (106b)

Thus (106a) is ruled out because the rightmost daughter of the mother node is not suitable for being a conjunct according to the coordination rule: X $\rightarrow$ X_{crd-} X_{crd+}.

A second argument given in Borsley (2005) concerns *respectively* readings. The claim is based on the fact that, while (107b) is infelicitous, the sentence in (107a) means either i) that Hobbs and Rhodes saw one of the girls while Barnes saw the other, or ii) that Hobbs saw one of the girls while Rhodes and Barnes saw the other.

(107) a. The two girls were seen by Hobbs and Rhodes and Barnes, respectively.

b. #The two girls were seen by Hobbs, Rhodes and Barnes, respectively.

But this can be seen as a consequence of the fact that *Hobbs and Rhodes and Barnes* can have several different parses, and thus yield complex structured pluralities, while *Hobbs, Rhodes and Barnes* only contains one plurality. In one parse, say [*Hobbs and-*[*Rhodes and-Barnes*]] there are semantically two individuals: one atomic individual h (for the NP *Hobbs*) and a plurality $g = \{r, b\}$. The entire structure thus yields a complex plurality $\{h, g\}$, which the adverb *respectively* can take and obtain the i) reading discussed above. Similarly, the second reading is obtained if the coordination embedding is [[NP and-NP] and-NP] instead. The above contrasts follow without the need to assume that the final two conjuncts do not form a coordination structure.

Another piece of evidence offered in Borsley (2005), but which can be explained away in very much the same way, is that the examples in (108) are not equivalent.

(108) a. Hobbs and Rhodes and Barnes lifted the rock.

b. Hobbs, Rhodes and Barnes lifted the rock.

The claim is that (108b) lacks two of the readings that (108a) can have, namely the reading in which Hobbs and Rhodes lifted the rock together and Barnes lifted it on his own, and the reading in which Hobbs lifted the rock on his own and Rhodes and Barnes lifted it together. These differences in interpretation come out as a consequence of the fact that (108a) can be parsed in (at least) two ways that (108b) cannot: as [*NP and-*[*NP and-NP*], and as [[*NP and-NP*] *and-NP*]. As in the previous examples with *respectively* readings, these parses yield pluralities with different structures, which in turn allow for the extra readings in question.

Borsley (2005) discusses a final argument based on Gapping, attributed to Paul Postal (p.c.), which hinges on the contrast illustrated in (109). The point is that if the two rightmost conjuncts formed a coordination structure then Gapping could apply to them without applying to other leftmost conjuncts:

(109) a. Tom ate a hamburger, and Alice drank a martini, and Jane a beer.

b.*Tom ate a hamburger, Alice drank a martini, and Jane a beer.

As before, the acceptability of (109a) can be seen as a consequence of the fact that the sentence can be parsed as containing two independent coordinations, in which Gapping occurs in the nested conjunction only. The oddness in (109b) can thus be explained as a violation of the parallelism relation typical of symmetric coordination: all conjuncts are equally prominent and to have Gapping target only two conjuncts goes against the parallelism and symmetry expectations.

There is however a potential problem for this explanation. In (110) Gapping appears to apply to only the first two conjuncts:

(110) Alice drank a martini, Jane a beer, and Tom had nothing at all.

But this case can be explained again as two independent coordination structures. The first two conjuncts can form an asyndetic coordination which is conjoined with the third clause. Supporting evidence for this position is given in (111) below, in which one can observe simultaneous asyndetic conjunction and monosyndetic disjunction.

(111) a. The castle lies to the North, the river too, or else we're completely lost again.
b. Don't fuss about it, calm down, or we'll be stuck here all night long.
c. Go out there, preform, inspire people, or one day you'll wake up to discover that you've been wasting your life with lame excuses.

If this assessment is correct then the example in (110) is unexceptional. The first two conjuncts form an asyndetic coordination structure, targeted by gapping. All in all, the case made in Borsley (2005) regarding the non-coordinate status of the two rightmost conjuncts is very problematic. All of the contrasts observed follow from a standard analysis of coordination, and from an analysis in which extra-correlative conjunct iteration is blocked.

2.3 Summary

§2.1 The empirical evidence observed indicates that coordination constructions are best seen as non-headed rather than headed structures. It is shown that the few arguments given in the literature for the coordinator lexeme being the head are most problematic.

Coordination structures differ fundamentally from comparative constructions with regard to various factors, including distributional patterns, subcategorization properties, ellipsis, and semantics. Many of these differences are argued to fall out as a consequence of non-headedness. It was also argued that independent phenomena such as Left-Periphery Ellipsis predicts so-called *coordination of unlikes* as a special case, and allows for a simpler and more uniform theory of coordination.

So-called symmetric and asymmetric coordination structures are argued to consist in basically the same kind of syntactic structure, even though these differ with regard to semantic and pragmatic import. The latter import is claimed to be responsible for the various peculiar extraction patterns observed in asymmetric coordination. It is argued that there is no convincing empirical evidence that asymmetric coordination structures are in fact subordinate structures, and thus a more general and unifying view of the phenomena is in order.

Finally, it is also shown that comparative structures are best seen as a non-coordinate and non-headed construction. Both comparative and coordinate structures share a number of properties that set them apart from subordination, but they also differ in fundamental ways. Contrary to claims in the literature, comparatives need not adhere to the CSC. Other difference concern the distribution of the comparative marker and the impossibility of recursion. A non-headed analysis explains in a natural way why comparatives exhibit a small number of similarities with coordination.

§2.2 The syntactic evidence indicates that coordination structures can be understood as a unique general binary branching construction. While the syntactic structure and semantic interpretation do interact in a closely related way, it is also noted that these are not necessarily isomorphic.

Correlative markers are argued to not be associated with distinct kinds of syntactic coordination structure. Rather, they are seen as emphatic expressions that add pragmatic conditions which bias the interpretation of coordination structures.

Chapter 3

On the Semantics of Coordination

This chapter focuses on the semantic characterization of the main coordination types that are introduced by the lexemes *and*, *or*, and *but*. Their basic semantic properties are discussed, and various research avenues that have been proposed in the literature are put in perspective.

As it turns out, there are several problems with the widespread view of the semantics of coordination. These problems are both structural and denotational. Structurally, it is shown that not only are there scope interactions between conjuncts, but that coordination is not a scope island. Denotationally, the idea that the standard dichotomy between so-called *Boolean* and *Non-Boolean* conjunction is empirically flawed. For the last 30 years has been assumed almost without exception that there is a Boolean *and* and a Non-Boolean *and*. However, the evidence provided in this chapter shows that this distinction does not exist as such in natural language, and that both kinds of readings can be obtained from exactly the same meaning for conjunction, without assuming complex covert machinery. A number of challenging phenomena are also shown to follow from the existence of independently motivated peripheral ellipsis phenomena. This is of great importance since it dispenses with complex machinery that is usually postulated specifically to deal with these cases.

This chapter suggests that there is a unique semantic composition process for all of these realizations and that cross-categorial coordination can be accounted for in a uniform fashion. This approach is formalized in detail in the subsequent chapters. In particular, Chapter 4 is dedicated to the many intricacies of the interpretation of NP conjunction.

3.1 A Critical Overview

The case of conjunction is a particularly complex one, and has proven to be a very challenging problem for formal semantics. However, I believe that this problem is made more complex than it really is for historical reasons. In what follows I will briefly put in perspective the major views of the field, before moving on to a more empirical in-depth characterization of the phenomena.

Ever since the mid-fifties, formal semantics had no way to deal with sub-clausal coordination. Gazdar (1980), Partee and Rooth (1983) and Keenan and Faltz (1985) show how the logic of the connectives *and* and *or* can be generalized to nonsentential categories by resorting to boolean algebras of properties, in a Montague-style semantics. As a result, the two connectors can be given a generalized interpretation ranging over any conjoinable category:

(1) a. $[\![\phi \textit{ and } \psi]\!] = [\![\phi]\!] \cap [\![\psi]\!]$
    b. $[\![\phi \textit{ or } \psi]\!] \ \ = [\![\phi]\!] \cup [\![\psi]\!]$

This meaning of conjunction is usually referred to as *Boolean*, precisely because it is essentially the one of the classical propositional connective. There is however a problem with this approach, as it cannot account for the conjunction of NPs as in *John and Mary smiled*. These are a recalcitrant exception because they simply do not behave like intersection: the NP denotes two individuals, not one.

At this stage one reaches a choice point: either the original assessment of conjunction as intersection is wrong, or NP coordination is a different kind of animal. By and large the field of semantics has tried to accommodate for the recalcitrant cases by making additional stipulations with the goal of obtaining a boolean interpretation for NP coordination. For example, some authors propose to analyze the semantics of *John and Mary smiled* as equivalent to clausal coordination: *John smiled and Mary smiled*. One example of this is Partee and Rooth (1983) who propose that NP conjuncts are type-lifted from $\alpha \wedge \alpha$ to $\lambda u.[\alpha(u) \wedge \alpha(u)]$. This allows the verb *smiled* to be copied into each conjunct, so that the intersective meaning of conjunction in (1a) can apply as usual.

Partee and Rooth (1983) already note that such a 'copy-out' analysis is empirically problematic, as it fails to account for collective readings as in *John and Mary are friends*. But the problem is actually more severe. It fails even with distributive verbs in examples like *John and Mary smiled at each other*, and the 'copy-out' proposal is known to be problematic since at least Vergnaud (1974):

(2) $$\text{[The boy and the girl] who} \left\{ \begin{array}{l} \text{are friends} \\ \text{met outside} \end{array} \right\} \text{smiled.}$$

The verbal predicate cannot be distributed over each conjunct in neither of these cases (cf. **The boy who are friends and the girl who are friends smiled*). Clearly, a more parsimonious analysis is to assume that NPs can actually coordinate and that the result of NP conjunction is an NP that denotes the collection of individuals denoted by each conjunct. This view explains why plural NPs can occur essentially in the same environments:

(3) $$\text{The kids who} \left\{ \begin{array}{l} \text{are friends} \\ \text{met outside} \end{array} \right\} \text{smiled.}$$

In my view, the above data should have been sufficient for abandoning the 'copy-out' analysis proposed in Partee and Rooth (1983). It simply doesn't work. But in spite of these shortcomings this kind of analysis is still widely endorsed in current research.[1]

A step in the right direction is given in Barwise and Cooper (1981). Here, NPs are seen as generalized quantifiers, which has the benefit of allowing NP conjunction to be interpreted as set intersection. Conjunction can be interpreted as the intersection of the principal filters generated by the denotations of the conjuncts. For example, take a principal filter F for a domain element x to be defined as $\mathrm{F}_x := \{X \mid x \in X\}$. For $[\![John]\!]=j$ and $[\![Mary]\!]=m$ we now have:

(4) $[\![John\ and\ Mary]\!] = \mathrm{F}_j \cap \mathrm{F}_j$

Sentences like *John and Mary are nice* can now be analyzed in a standard way: the denotation of the NP *John and Mary* is intersected with the denotation of the VP.

The problem with this analysis is that it again ignores the fact that the readings that a plural NP can obtain are also available for NP coordination. In this case, the problem arises from collective readings as illustrated below:

(5) $$\left\{ \begin{array}{l} \text{The boys} \\ \text{John and Mary} \end{array} \right\} \text{met in London.}$$

[1]E.g. Blackburn and Bos (2003), Babko-Malaya (2004) and Gawron and Kehler (2004).

The problem for boolean conjunction is that $\mathrm{F}_j \cap \mathrm{F}_j$ is certainly not a member of the extension of the collective predicate. Distributive predicates denote a set of atoms, but collective predicates denote sets of collections of atoms. Once again there is a recalcitrant case, which indicates that a linguistic generalization is being missed. Moreover, this generalization hinges on the parallel behavior observed between conjoined NPs and plural NPs. Any account should incorporate this crucial fact.

Again, the recalcitrant case was handled as an exception in the literature. Link (1983) and others propose a new kind of conjunction, apart from Boolean conjunction, just to handle collective readings: the *i*-sum *and*. In the interpretation of the latter the filter is generated not by the two individuals, but by the join of j and m in a lattice structure:

(6) $[\![John \oplus Mary]\!] = \{X | j \vee_i m \in X\} =: \mathrm{F}_{j \vee_i m}$

The literature therefore dubs the cases of NP coordination involving collective readings as Non-Boolean conjunction (see Hoeksema (1988), Krifka (1990), Link (1984) and many others) while all other cases are seen as plain old Boolean conjunction. This is quite misleading because it glosses over the well-known fact that NP coordination, just like a plural NP, can have collective and distributive readings simultaneously:

(7) [[The boy and the girl] who (both) smiled and gathered outside] are siblings.

In other words, the fact that a coordinate NP gets a distributive or collective reading should have nothing to do with conjunction. Distributive and collective readings also arise with plural NPs, and thus the generalization is simply that these (and various other readings) arise in the presence of NPs that denote collections:

(8) $\left\{ \begin{array}{l} \text{The boys} \\ \text{John and Mary} \end{array} \right\} \left\{ \begin{array}{l} \text{are asleep.} \\ \text{met.} \\ \text{weigh 90kg.} \end{array} \right\}$

In Winter (2001) all conjunction is seen as Boolean, and collective readings arise from a covert operator that is postulated for this very purpose. Again, the effect of the various operators that are stipulated is that a conjunction like *John and Mary* is at least three-ways ambiguous, which lacks empirical motivation. On the contrary, a conjunction like *John and Mary* should ideally have one kind of meaning only, and that meaning should be closely related to the meaning of a plural NP.

Matters are typically worse with regard to the Non-Boolean meaning. As is discussed in more detail in Chapter 4, when conjuncts are pluralic as in *Kim and the girls*, then certain ambiguities arise that are typically modeled by allowing conjunction to be many-ways ambiguous. For example, in Carpenter (1997, 323) Non-Boolean conjunction is four-ways ambiguous, in Link (1984) any NP conjunction is many-ways ambiguous depending on how a group formation function applies, and in Landman (1989) any entity is *infinitely* ambiguous because group formation can apply indefinitely and the domain of the model in transfinite. Finally, in Gillon (1987) and Schwarzschild (1991) there is an enormous combinatorial explosion of readings, the vast majority of which is never observed and are presumed to be blocked by unknown pragmatic factors (these problems are discussed in more detail in §4.1.1). All in all, the complex machinery and explosion of meanings can very well lead one to conclude that linguistic generalizations are being missed when it comes to the semantics of conjunction.

Krifka (1990) attempts to reconcile Boolean and Non-Boolean conjunction. Krifka argues for a more uniform semantic account, and quite correctly in my view: not only because this is desired in terms of parsimony, but also because no language seems to make the Boolean/Non-Boolean distinction with different conjunction lexemes. Krifka thus proposes to collapse the two meanings under a generalized conjunction operation '$\sqcup$'. However, the uniformity that is achieved falls very short of the stated goal because generalized conjunction '$\sqcup$' is still defined by stipulating the two different kinds of conjunction as separate cases (Krifka 1990, 171):

(9) If α and α' are of type e, then $\alpha \sqcup \alpha' = \alpha \oplus \alpha'$;
If α and α' are of type t, then $\alpha \sqcup \alpha' = \alpha \wedge \alpha'$.

In what follows I will propose that, by and large, most of conjunction in natural language is plurality-forming and that this kind of conjunction has only one meaning. Moreover, the data presented below shows that there are two major empirical problems with the traditional Boolean / Non-Boolean dichotomy. There is considerable linguistic evidence suggesting that virtually all kinds of categories yield a plurality of some sort and that these can enter collective predications of their own. This in turn means that the original assessment made in the literature about conjunction being Boolean is misguided. In this dissertation I will show how a fairly large spectrum of data can emerge as a byproduct of aspects that are in fact independent of conjunction. The end result is a simpler and far more parsimonious theory of conjunction: one that does not need to resort to generalized operations on higher-order types, complex meaning composition operations, or empirically unmotivated covert operations commonly adopted in the formal semantics literature.

The second problem with the standard view on the meaning of coordination structures is more structural in nature, and concerns the fact that there can be scope ambiguities *between* conjuncts. In other words, the binary structure $\phi \wedge \psi$ and $\phi \vee \psi$ that is taken for granted in the vast majority of the above proposals is problematic. I will show that this fact is actually responsible for predicting certain non-trivial ambiguities that conjunction can produce in certain cases.

In what follows I will discuss the conjunction types of coordination and sketch an analysis. The actual syntax-semantics interface is formalized in the subsequent chapters, and puts forth one general rule that generalizes over all types of coordination.

3.2 Non-intersective Conjunction

The term *non-intersective* is henceforth used to refer to a type of conjunction in which the denotation of the whole is larger than the denotation of the conjuncts, abstracting away from distributive or collective interpretations. Both conjunction and plural nominal expressions denote non-atomic elements of the domain, and thus both kinds of structures should naturally allow for such interpretations.

What is special about the semantics of non-intersective coordination is that it yields a non-atomic element which can enter predications that the conjuncts in isolation cannot. A few examples are visible in (10). Here, the complex subject NP obtained by conjunction has the same agreement and distribution as a plural NP:[2]

$$\text{(10) a.} \left\{ \begin{array}{l} \text{Some students} \\ \text{A boy and a girl} \\ \text{*A boy} \end{array} \right\} \text{met in the park.}$$

$$\text{b.} \left\{ \begin{array}{l} \text{Several students} \\ \text{The boy and the girl} \\ \text{*The boy} \end{array} \right\} \text{were smiling.}$$

[2] Some of these examples also allow for singular collective nouns, which is addressed in §6.2.2.

c. $\left\{\begin{array}{l}\text{Many students}\\ \text{The boy and the girls}\\ \text{*The boy}\end{array}\right\}$ who were compared $\left\{\begin{array}{l}\text{were European.}\\ \text{became best friends.}\end{array}\right\}$

Wierzbicka (1967), Lakoff and Peters (1969), Smith (1969), Vergnaud (1974), Massey (1976) and many others have noted that NP coordination structures cannot in general be reduced to sentential coordination. These data show that NPs can be directly coordinated and that they yield a plurality.[3] The semantic interpretation of these entities is a topic of much debate and interest given the wealth of possible interpretations that can arise from the interplay of collective predications, distributive predications, and scope. This is essentially the topic of Chapter 4.

There is nothing peculiar about the subject position with regard to non-intersective conjunction. In fact, predicates like *disperse*, *stack*, *interconnect*, and *between* actually require that their complement arguments be pluralities:

(11) a. Fred stacked $\left\{\begin{array}{l}\text{the dishes}\\ \text{the plate, the cup and the pan}\\ \text{*the mug}\end{array}\right\}$ by size.

b. My car is parked between $\left\{\begin{array}{l}\text{two other vehicles}\\ \text{a bus and a truck}\\ \text{*a bus}\end{array}\right\}$

An important aspect of this type of coordination is that it does not target N' constituents. These do not yield pluralities, and *both* cannot attach to such conjuncts:

(12) a. *These man and woman were married.

b. *Two man and woman were neighbors.

(13) a. *I saw the both boy and girl.

b. *I met a both boy and girl.

[3]Schein (1993) has recently revived the intuition underlying Conjunction Reduction, using event semantics. For various problems and criticism of this account see Lasersohn (1995, 46), Link (1998a, 321–326), and Winter (2001, 43).

But note that the oddness in (12) poses a paradox. How can it be that N' conjunction does not yield a plurality, when it is well-known that such readings can arise in cases of N' coordination like the ones below:

(14) a. The boy and girl were flirting.

b. The boy's uncle and aunt were kissing.

c. Your father and brother are more likely to understand this than you.

d. This ship and crew are ill-suited for that purpose.

The standard view is that some complex agreement operations and covert semantic copying operations are going on, as in Dowty (1986) or more recently in King and Dalrymple (2004). For instance, Link (1984) introduces a boolean meet conjunction just for this kind of example: $\phi \odot \psi = \lambda x[\phi(x) \wedge \psi(x)]$.

But Quirk et al. (1985, 960) – and others more recently such as Beavers and Sag (2004) – offer a much simpler analysis. These authors note the data can be seen as standard NP coordination analysis via an ellipsis operation. In this view, there is no reason to assume that Left Periphery Ellipsis is restricted to verbal domains, and thus it can also target nominal coordination. The same phenomenon involved in accounting for [*I gave a book to Kim and ~~gave~~ a record to Sue*] is also responsible for [*The boy and ~~the~~ girl*] *were flirting.* I subscribe to this position because it presents a host of empirical and conceptual advantages which I note and list below. First, it readily predicts that the examples in (12) are ungrammatical (cf. **These man and ~~these~~ woman*, and **Two man and ~~two~~ woman*). Another virtue of the ellipsis analysis is that it explains why *both* can precede the determiner in examples like (15):

(15) a. Both the soloist and recitalist were late.

b. You may apply for both a stipend and expense reimbursement.

These are difficult to capture in a base-coordination account because *both* would in that case have to scope directly over a non-coordinate structure [*both* [Det N']] with the extra requirement that the embedded N' be coordinate. If this is correct, a prediction is made about verbal constituents: it is expected that a similar pattern with *both* also occurs in verbal coordination. This is borne out in examples like (16), where the correlative requires the presence of a NP coordination:

(16) a. She both opened the door and the window.

b.*She both opened the door.

Not only does ellipsis provide a simple account of the phenomena and explains why certain (apparent) N' conjunctions are ungrammatical and others are not, but it also allows for a simpler and more uniform semantic analysis. Ellipsis makes unnecessary extra machinery to obtain the same meaning as in the NP coordination counterpart. These cases are handled straightforwardly, as a standard cases of NP conjunction.

Further evidence for ellipsis involves numeral expressions like (17), which can be interpreted as referring to a total of twenty people or to a total of forty people.

(17) Twenty men and women protested.

The latter reading is readily obtained by ellipsis [*twenty men and ~~twenty~~ women*] *protested*. The former reading can be obtained if the numeral expression is allowed to attach to a coordination of bare NPs: [*Twenty* [*men and women*]]. The complex NP denotes a collection of at least two men and two women and the numeral imposes a cardinality condition of a total of 20 individuals.

A similar behavior is observable with certain adjectives such as *similar*. Cases like [*Similar* [*men and women*]] can also have the reading in which men are similar to women and vice-versa. For now I will not discuss the exact account of the distribution of numerals, but I will assume that these and certain adjectival expressions can attach to bare NPs. This topic is addressed in more detail in §6.6. For now I will note that Vergnaud (1974) and von Stechow (1980) offer independent evidence for the possibility of adjunction to NP, with data like *Everyone who I met was nice* or *The boy and the girl who kissed each other are friends of mine*, and *The man and the woman in the same picture are cousins.*

The point of this kind of example is that the ellipsis analysis again makes several predictions which turn out to be correct. Consider the following data:

(18) a. Two men and women protested.

b.*Two boy and girl protested.

The sentence (18a) is only felicitous with a total of four individuals. This can be obtained via peripheral ellipsis in the NP coordination level: [[*Two men*] and [~~*two*~~ *women*] *protested*]. The non-elliptical parse consists in a structure where the numeral attaches directly to the bare NP *men and women*. This yields a semantic anomaly:

the numeral requires exactly two individuals while the NP *men and women* denotes at least four individuals (*men* denotes at least two individuals and *women* denotes at least two individuals).

Similarly (18b) is odd because neither analysis is possible. The ellipsis analysis is impossible because *two boy* and *two girl* is ill-formed, while the N' coordination is ruled out because N' coordination *boy and girl* cannot form a plurality.

3.2.1 Quantificational Conjuncts

Link (1987) argues that the coordination of singular universally quantified NPs does not yield pluralities. In that view, there is a different *and* for cases like *Every man and every woman*. Others like van Eijck (1983, 102), Hoeksema (1988, 77), and Winter (2001, 31) disagree with this assessment by offering examples like the following:

(19) a. Every man and every woman could be happy together.
b. Pedro and every other farmer beat donkeys.
c. Every soldier and every officer met.
d. Every American and every Russian spoke with each other.

These sentences seem to require a context in which the speaker intends to stress that each and every entity is involved in the collective state-of-affairs. Quantificational NP conjuncts thus behave essentially in the same way as other NP conjuncts. These can yield both distributive and collective readings. Distributive readings are easy to produce, e.g. *every man and every woman were smiling*, but collective readings are less common. I supplement the above data with more natural examples, validated by native speakers.

(20) a. Every foreign country and every colony were in communication with each other.
b. Ultimately, every being on the planet and every device will be interconnected.
c. But if every Gemini and every Scorpio were the same it would be a pretty dull place, don't you think?

(21) a. This might also be a heavy overhead, if there are a lot of objects and we need to test for a collision between every object and every other object.

b. There is no one set of terms and conditions that will suit every transaction between every buyer and every seller.

(22) [The reverend and every member of the congregation]$_i$ crossed themselves$_i$ as the soldiers filed past.

This shows that non-intersective conjunction is uniform. It applies to various kinds of NPs and allow for both distributive and collective readings. In (23) for instance, the relative clause requires a collective reading that applies to the set of foreign countries and colonies and the main verb *inspect* triggers a distributive reading:[4]

(23) [[[Every foreign country] and [every colony]] that were in communication with each other] were inspected.

On the other hand, in the current analysis, cases like (24) are unremarkable and unproblematic. These can be treated as elliptical, exactly as discussed above, via standard NP coordination with Left Periphery Ellipsis of the quantifier.

(24) a. Every mother and father came to the party.

b. Every linguist, logician, and philosopher agreed with each other.

Again, this allows for a much simpler and uniform analysis of the phenomena, without the need to resort to a different meaning for conjunction or to special-purpose covert operations as in Heycock and Zamparelli (1999) and in several other previous proposals.

One peculiar aspect of the coordination of universally quantified NPs is the fact that it can yield ambiguities that are not present in existentially quantified conjuncts. For example, world knowledge leads us to presume that (25a) is interpreted as meaning that pairs of boys and girls kissed, not that everyone kissed each other. However, in cases where no such background bias exists this ambiguity surfaces. Thus (25b) can mean (among other things) that only pairs of boys and girls shook hands or that everyone shook hands.

(25) a. Every boy and every girl kissed.

b. Every boy and every girl shook hands.

[4]Still, the above authors do not pursue a uniform meaning for conjunction. For example, in Hoeksema (1988) conjunction has various different meanings. Van Benthem (1991, 124) also notes that the modified Lambek Calculus that Hoeksema proposes both over- and undergenerates.

This suggests that non-intersective conjunction is not simply plurality formation, and that the semantics of the conjuncts can interact in several ways.

I believe this phenomenon is closely tied with the fact, first noted in Carpenter (1997, 325), that the presence of quantificational conjuncts can trigger scope ambiguities *between* conjuncts. Consider the example in (26) below. If the pronouns are bound to the nominal in the first conjunct then this means that the universal quantifier is interpreted as taking wide scope. In that particular reading, the second conjunct gets a non-specific interpretation in which several different supervisors were involved.

(26) Every student and his or her supervisor met.

Let us consider some more examples of this phenomenon. In example (27a) it is more likely that there is a unique team of physicians, not one per patient. Given that world knowledge makes it preferable to identify *her* with Dr. Jane Forrester, then the second conjunct is not under the scope of the universal quantifier introduced by the first conjunct.

(27) a. Dr. Jane Forrester usually encourages a collaborative decision process between each patient and her team of physician specialists.

b. The same is true of any form of association which would prejudice the direct and immediate relationship between every bishop and his counselor.

In (27b) the reverse scope occurs. It is more likely that the pronoun *his* is identified with the first conjunct. This results in a narrow scope interpretation where there could be different counselors for each bishop.

Crucially, note that scope interactions in coordination are in no way limited to pronominal conjuncts. Given the proper contextual elicitation, the narrow scope of a given conjunct becomes more or less likely. The speakers I have consulted find the two examples below ambiguous with regard to the scope of the conjuncts:[5]

(28) a. Your task will be to document the social interaction between each female and an adult male. [$\forall>\exists$ / $\exists>\forall$]

b. Let us suppose that the goal is to promote a closer relationship between every customer and a new product. [$\forall>\exists$ / $\exists>\forall$]

[5] I am thankful to David Beaver (p.c.) for suggesting (28c) to me.

c. In order to blackmail the entire linguistics department, a model and each professor were photographed together at the party. [∀>∃ / ∃>∀]

The scopal interactions are more visible with collective predications of course, given that these have an effect on the kind of plurality that the verb applies to. But the same phenomena also occurs with distributive verbs, which again shows that the semantic structure of NP coordination is the same, regardless of the kind of interpretation that the verbal predicates trigger.

(29) Every student and a parent were standing on stage. [∀>∃ / ∃>∀]

These data show that the standard view of the semantic structure of conjunction $[\![\phi \wedge \psi]\!]$ is problematic. Virtually all accounts of coordination are silent about these kinds of readings, including Lasersohn (1995), Landman (1995), Schwarzschild (1996), Lønning (1997), Link (1998b), and Mckay (2006).[6]

In addition Barwise (1979) and Lønning (1989) have argued that conjuncts must also be allowed to remain scopally independent. For instance, it is not necessarily the case that there is a dependency between logicians and linguists in a sentence like *Every linguist and every logician agree.* This kind of example has been used to motivate branching quantification analysis:

(30) Few of these girls and at most four of those boys all dated each other.

The relevant generalizations seem to be as follows. Conjunction forms a plurality and conjuncts are allowed to interact scopally or to remain independent. The scopal aspect is rather simple to capture in a semantic underspecification framework. It requires no extra conditions: conjuncts are free to be combined, as long as they contribute to the plurality formation in a proper way. To illustrate how this can be achieved in MRS, consider the following example:

(31) [[Every inmate and a guard]$_{NP}$ met].

I will begin with some basic assumptions. The NP *every inmate* is to be represented in MRS terms as $l_4 : \forall x_1(inmate(x_1) \rightarrow l_6)$. Apart from the underspecification labels, this representation is fairly standard. For convenience, I write NP^{x_1} to abbreviate the

[6]This is also problematic for accounts that hinge on the assumption that the Coordinate Structure Constraint is also active on semantic structure, such as Winter (2001). See §3.6 for more on this topic.

semantic representation while singling out the nominal quantified variable. Similarly, the NP^{x_2} *a guard* is represented as $l_7 : \exists x_2(guard(x_2) \wedge l_9)$, and the verb predicate is represented as $l_{12} : meet(x)$.[7]

With regard to conjunction, I propose that the lexeme *and* introduces the semantic representation $l_1 : \exists x(l_2 \wedge l_3)$ and that for each conjunct NP$^{x'}$ a condition $x' \in x$ is introduced. This requires that the conjunction obtains a non-atomic entity x that contains the referents of the conjuncts. In terms of semantic composition in coordination, all that is required is that these membership conditions are subordinate both to the scope of the conjuncts and to the restrictor argument of the existential quantifier introduced by coordination. As usual, the verb predicate is required to be subordinate to the scope argument of the NP that it subcategorizes for. The result is illustrated in the MRS structure below, for the sentence in (31):

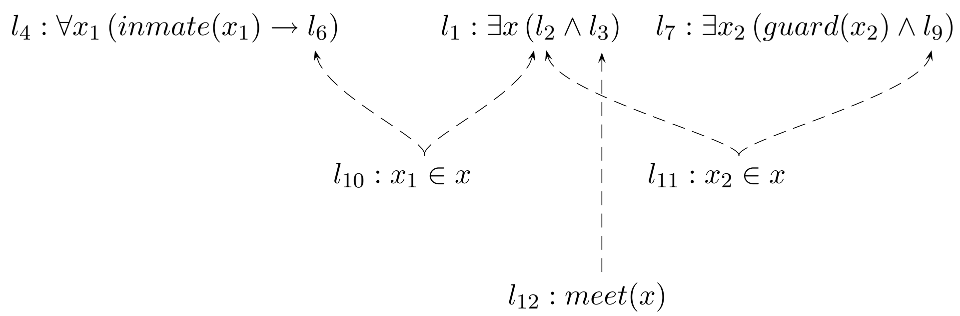

Figure 3.1: Depiction of underspecified NP coordination

This underspecified representation describes various different interpretations. For example, if the conjuncts are both plugged in the restrictor of the plurality ($l_4 = l_2$ and $l_7 = l_2$) then the membership relations can be plugged into the scope of the NPs ($l_{10} = l_6$ and $l_{11} = l_9$). This will obtain the reading seen in (32), which is basically an interpretation where the conjuncts do not interact scopally and where x is a plurality that contains all of the inmates and one guard:

(32) $\exists x(\,(\forall x_1(inmate(x_1) \rightarrow x_1 \in x) \wedge \exists x_2(guard(x_2) \wedge x_2 \in x)\,) \wedge meet(x))$

[7]For now I will ignore the sub-entailments that a covert reciprocal predicate like *meet* contains. Thus, with regard to semantic composition, the account is essentially the same for non-reciprocal predicates like *gather* or *disperse*. The semantics of a distributive verb like *swim* can for the time being be represented as $l_{12} : \forall k(k \in x \rightarrow swim(k))$. For more discussion see Chapter 4.

In this scope resolution, if any of the NPs were to contain a pronoun as in *a guard that he chose*, then it would be impossible to find an antecedent in the remaining conjunct. If on the other hand, one conjunct is plugged into the scope of the other, such as $l_6 = l_7$, then the non-specific reading of the second conjunct in (33) obtains.

(33) $\exists x(\,(\forall x_1(inmate(x_1) \rightarrow \exists x_2(guard(x_2) \wedge x_1 \in x \wedge x_2 \in x))\,) \wedge meet(x))$

This representation differs from (31b) not only truth-conditionally, but also in the fact that it allows pronouns embedded in the narrow scope NP to be bound to the wide scope NP.

Finally, in (34) one can see the reverse case, the one in which the indefinite NP gets a wide scope reading over the universally quantified conjunct. Again, this representation allows for any embedded pronoun to be bound to the conjunct that takes wide scope.

(34) $\exists x(\,(\exists x_2(guard(x_2) \wedge \forall x_1(inmate(x_1) \rightarrow x_1 \in x \wedge x_2 \in x)\,)) \wedge meet(x))$

Of course, if the conjuncts are quantified with the same force, as in (35), then all the scope disambiguations are truth-conditionally equivalent:

(35) An inmate and a guard met.

$\exists x(\,(\exists x_1(inmate(x_1) \wedge x_1 \in x) \wedge \exists x_2(guard(x_2) \wedge x_2 \in x)\,) \wedge meet(x))$

This is not a problem pertaining to this particular account given that the phenomenon of equivalent quantifier scopings is an intrinsic and all-pervasive property of scope processing, including quantifier raising (May 1977), quantifier storage (Cooper 1983; Keller 1988), and scope underspecification formalisms in general. For example, both *Some student gave a book to a professor* and *Every student gave a book to a professor* have a total of six scopings. In the former case, all six are equivalent while in the latter two of the scopings are equivalent.[8]

Note also that nothing requires that the conjuncts must be embedded in the restrictor argument of the existentially quantified plurality $\exists x$. In the case of conjuncts which are also existentially quantified this is not important, because no meaning contrast is obtained. It is as circumstantial as the two scopings of *A guard saw an inmate.* But the case is totally different in the case of quantificational conjuncts as it provides an account of the ambiguity observed in (36), without the need for type-raising or the stipulation of additional semantic composition operations:

[8]For computational methods for detecting and/or efficiently eliminating redundant quantifier scopings see Vestre (1991), Gabsdil and Striegnitz (2000), Chaves (2003) and Koller and Thater (2006).

(36) a. Every soldier and every officer met.

b. $\exists x((\forall x_1(soldier(x_1) \rightarrow x_1 \in x) \wedge \forall x_2(officer(x_2) \wedge x_2 \in x)) \wedge met(x))$

c. $\forall x_1(soldier(x_1) \rightarrow \forall x_2(officer(x_2) \rightarrow \exists x((x_1 \in x \wedge x_2 \in x) \wedge met(x))))$

In (36b) the plurality x contains all the soldiers and all the officers. The collective predicate *meet* applies to x and yields a reading in which these individuals met. In (36c) on the other hand, the plurality x is formed with pairs of a soldier and an officer, which in turn obtains the reading in which these pairs met. In other words, the underspecified representation in Figure 3.1 can handle all the readings and scopal interactions that have been considered so far with exactly the same underlying constraints. This provides a rather uniform account of the phenomena via an independently motivated mechanism: scope. The various readings are a consequence of scope rather than of invisible semantic operators specifically stipulated for this purpose.

3.2.2 Non-Nominal Conjuncts

Starting with Reichenbach (1947) and Davidson (1976), the idea that verbs contain an event variable has been fruitful in accounting for various kinds of phenomena, such as Kamp (1979), Partee (1984), Higginbotham (1985), Bach (1986), Link (1987), Krifka (1989), Parsons (1990), and Pustejovsky (1991) among many others.[9] In the well-known examples given below, eventualities can be bound anaphorically or even distributed over:

(37) a. Fred stabbed Jones. It happened at midnight.

b. John called every Monday. (= for all past Mondays John called)

Following Zwarts (1992), I use the term *referential argument* to talk about the unsubcategorized semantic argument that a given expression introduces. For example, a noun *man* introduces an individual referential argument x given the semantic representation $man(x)$ (and thus x is the referential argument of $[the\ man]_{NP^x}$), and the referential argument that a verb like *stab* introduces is an eventuality e, given a lexical representation like $\exists e\, stab(e, x, y)$.

So far I have considered nominal pluralities, but Bach (1986, 9) and Link (1998a, 240) and others have considered the possibility of *event pluralities*. The idea is fairly

[9]Katz (2000) argues against the view that all verbs contain eventuality variables, but the arguments are in my view rather inconclusive. I offer various evidence in favor of such variables below.

simple. While a nominal plurality is a collection of individuals, a plural eventuality is a collection of events. One case where this assumption is of particular importance concerns conjunction. Below I provide empirical evidence that supports the claim that non-intersective conjunction is not limited to noun phrases, and that it forms pluralities out of events also.[10] Let us first consider verbal conjunctions. The preferential interpretation of (38a) is one in which the PP collectively predicates the totality of events associated with the VPs: twenty seconds is the total of time spent doing both activities.

(38) a. Sue read the instructions and dried her hair, in exactly twenty seconds.

b. Often, Kim goes to the beach and Sue goes to the city.

c. The dog barked and the lights went out. This happened simultaneously.

d. He alternately gestures with his hands and holds them very still.

Sentence (38b), due to Oehrle (1987), describes the frequency of two joint event-types, not of independent frequencies of occurrence. In (38c) the pronoun is collectively linked to both events introduced in the preceding sentence. These readings also arise in subclausal coordination, namely in VP and in V coordination.

What the above data show is that the standard Boolean view of verbal conjunction is flawed. The fact there are adverbial expressions that predicate over pluralic events really calls for a non-intersective analysis of verbal conjunction also. This offers the possibility of a truly uniform analysis of conjunction, in which the very same semantic composition process is in place: conjunction builds pluralities with the referential arguments of the conjuncts (as long as these are properly quantified, recall that N' conjunction does not yield a plurality).

Link (1998a, 240) argues that there is no reason to assume that verbal pluralities have an intrinsic logical structure. This is because pluralities, nominal or otherwise, need not correspond to a coherent part of the world. Consider the example below, due to Borik (2002, 168):

(39) A frog hopped into the pond, and a satellite was launched.

---

[10]These cases are usually not discussed in the literature, and when they are, their existence is often dismissed. For example, Camacho (2003, 30) claims that plural events are 'systematically absent cross-linguistically'.

Link (1998a, 240) holds that plural eventualities are like nominal pluralities in that they can be composed of unrelated elements. The above sentence is best viewed as an existential statement about a collection of different (and mutually independent) events, the same way that nominal pluralities are existential statements about a collection of independent individuals.

Let us consider how the account of conjunction sketched so far would scale to verbal coordination. The constraints are essentially the same: conjunction introduces an existentially quantified plurality that contains the referential arguments of each conjunct. The membership relations are as before required to be subordinate to both the plurality quantifier and the quantifiers that bind the events from each conjunct. Consider for example a sentential conjunction with an adverb predicating the plural eventuality e:

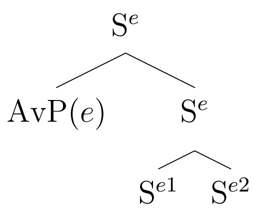

Figure 3.2: Non-intersective conjunction in clausal coordination

The end result is illustrated in the example below:[11]

(40) Often, Kim goes to the beach and Sue goes to the city.

$$\exists x\,(Kim(x) \wedge \exists y\,(beach(y) \wedge \exists k\,(Sue(k) \wedge \exists w\,(city(w) \wedge$$
$$\exists e\,(often(e) \wedge (\exists e_1\, go(e_1, x, y) \wedge e_1 \in e) \wedge (\exists e_2\, go(e_2, k, w) \wedge e_2 \in e))\ ))))$$

Since conjunction can coordinate other parts-of-speech other than nominal and verbal, it would be expected that the same kind of plurality formation occurs elsewhere. Indeed, the coordination of adjectival structures and prepositional structures can also be said to yield pluralities. Lasersohn (1995) notes that the adverb *alternate* attaches to coordinate adjectival phrases. Below I note that it can attach to basically any kind of predicative phrase:

[11]For reasons of uniformity, I follow Kamp and Reyle (1993) in representing proper nouns as existentially quantified expressions. These are interpreted as saying that x stands for the individual denoted by the predicate $Kim(x)$, which depends on the context and on the speaker's intention.

(41) a.*He became alternately fearful.

b.*Kim's grades are alternately negative.

(42) a. He became alternately fearful and angry.

b. Kim's grades are alternately positive and negative.

c. The hands are alternately clenched and opened.

(43) a. Buchanan's residence was alternately in Berlin and in Italy.

b. As a Republican, Champollion was alternately in favor and out of favor.

These sentences cannot be seen as elliptical VP coordinations for two reasons. First, cases like *Kim is probably both fearful and angry* do not have grammatical non-elided counterparts: **Kim is probably both fearful and (Kim) is probably angry.* Second, the adverbial predicate is interpreted semantically as predicating two events. This is evidence in favor of so-called Neo-Davidsonian variables, as it suggests that prepositions and adjectives contain an eventuality referent. For example, an adjective like *tall* can be seen as introducing a stative referential argument: $\exists e_1\, tall(e_1, x)$. Coordination then assembles a plural eventuality in the same way as discussed for verbal coordination.

Further independent motivation for this event variable comes from degree expressions. These can be seen as predicating over the eventuality:

(44) a. Fred is *so* in love.

b. Mary is *so* tall.

c. John is *such* a fool. (cf. **Such* a fool walked in.)

In terms of the syntax-semantics interface, a key point of the present analysis lies in the fact that conjuncts are required to have the same subcategorization requirements. Recall that this follows from the fact that coordination structures are non-headed, as discussed in the previous chapter. Thus, in a verb phrase coordination [VP^{e1} & VP^{e2}], if one conjunct selects for a singular NP^{x} then the remaining conjunct must also select for the very same NP^{x} subject:

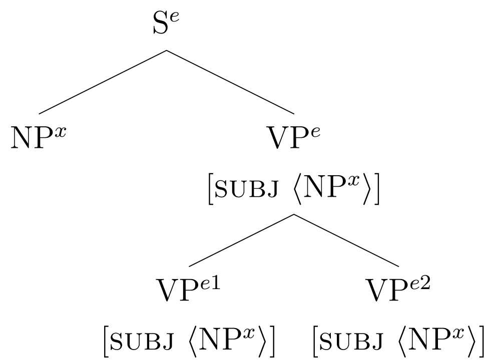

Figure 3.3: Non-intersective conjunction in VP coordination

Thus, even though the conjuncts apply intersectively to one and the same argument x, they also yield a plurality that can be predicated by certain adverbials:

(45) Kim often smiled and danced.

$$\exists x\,(Kim(x) \wedge \exists e\,(often(e) \wedge (\exists e_1\, smile(e_1, x) \wedge e_1 \in e) \wedge (\exists e_2\, dance(e_2, x) \wedge e_2 \in e))\ )$$

The conjunction of adjectives behaves essentially the same way. The referential arguments e_1 and e_2 of the conjuncts are used to assemble a pluralitity e, while at the same time the external arguments of the adjectives are required to be the same: x. Thus when two adjectival phrases like [*tall and skinny*] are conjoined the one and the same NP is modified by the resulting AP. The plurality e which is formed can be predicated by certain adverbs such as *equally* (requiring that each eventuality in e has an equal degree):

(46) Kim is equally tall and skinny.

$$\exists x\, Kim(x) \wedge \exists e\,(equally(e) \wedge (\exists e_1\, tall(e_1, x) \wedge e_1 \in e) \wedge (\exists e_2\, skinny(e_2, x) \wedge e_2 \in e))$$

In the case of prepositions like *inside* the account is exactly the same. These are represented as $\exists e\, inside(e, x, y)$, where x is the referential argument of the modified nominal and y is the referential argument of the complement.

This gives the illusion that there are several kinds of conjunctions: when the coordinate phrase takes an argument, something that looks like Boolean conjunction arises, but when the coordinate phrase is taken as an argument by a collective predicate, then what looks like a Non-Boolean conjunction arises. Crucially, these readings can occur simultaneously. The point is that these cases are orthogonal and reducible to one and the same kind of conjunction. In that sense, there is absolutely no difference between cross-categorial conjunctions, and the only thing that is special about NP conjunction is that it triggers plural agreement.

Consider now the ambiguous sentence in (47). In one reading the NP denotes a set of individuals who are both interesting and brilliant. This is just coordination of APs as described above. But there is also an apparent non-intersective reading, where the NP denotes a set of individuals, some of which are interesting and some of which are brilliant.

(47) I met interesting and brilliant people.

The case of the non-intersective interpretation it is often seen as recalcitrant, and requiring complex covert operations. But this is unnecessary given that this reading can be captured by standard NP coordination, as a prediction of Right Periphery Ellipsis: [[*interesting ~~people~~*] *and* [*brilliant people*]]$_{NP}$. The possibility of Right Periphery Ellipsis in NP coordination is clearer in cases in which the overt conjuncts do not even form constituents:[12]

(48) a. The difference between an interesting and a tedious teacher is this.

b. This is both the only and the last journal ever published by the university.

c. She has to choose between a two- and a four-wheel drive model.

Cases like (49) are also ambiguous. The difference is that the elliptical NP coordination parse is the only parse that is pragmatically felicitous, since the AP coordination parse entails that cats can be simultaneously large and small.

(49) That year we had an equal number of large and small cats.

An ellipsis operation also correctly predicts that provided by the fact that the above examples have the same interpretations as the full, non-elliptical NP coordination counterparts. This allows us to avoid postulating coordination-specific machinery to somehow enable AP coordination to somehow yield non-intersective NP readings. Right-Periphery Ellipsis is an independently motivated operation and the data above follow as predictions.

Let us consider the case of predicative nominals. Take for instance (50a), where the NP *a singer and a composer* refers to one and the same individual rather than two.

[12]Right Periphery Ellipsis may even apply to names, even though these are usually regarded as syntactically flat strings, as in *Barbara and Jenna Bush were born in 1981.*

(50) a. Lisa is a singer and a composer.

b. He's my friend and my lover.

c. A wife and a wonderful friend, Mia meant the world to me.

d. He was the owner of a bookstore and one of the editors of the *Daily Post*.

The account of these data can be basically the same as the one for adjectives. Following Partee (1987) in general terms, I will assume that predicative nouns are semantically very similar to adjectives and prepositions. A predicative NP like *a singer* is represented as $\exists e_1\, singer(e_1, x)$. This allows for a uniform account: in the conjunction of predictive NPs, a plural eventuality e is formed and the external argument x is shared between conjuncts:

(51) $\exists x\, Lisa(x) \wedge \exists e\, ((\exists e_1\, singer(e_1, x) \wedge e_1 \in e) \wedge (\exists e_2\, composer(e_2, x) \wedge e_2 \in e))$

Note that the fact that N' categories are quantificationally defective and cannot be conjoined also bears the correct results for the coordination of predicative nominals:

(52) a. *She is a both [wife and mother]$_N$.

b. *She is the either [wife or mother]$_N$.

Let us take stock of the observations made so far. In the present view conjunction always yields a plurality. A 'Boolean' reading arises when the coordinate phrase is taken as a functor and a 'Non-Boolean' reading arises then it is taken as an argument. Both roles are simultaneously compatible because they are fully orthogonal. These results scale to the coordination of virtually any category, dispense the need to postulate a construction for each kind of coordination type, and avoid the need of formal stipulations about type-shifting, or invisible higher-order operators.

This theoretical perspective also allows the behavior of the correlative marker *both* to explained in a systematic way. This correlative attaches to any category and requires that the constituent denotes plurality with two members:

(53) Kim $\left\{\begin{array}{l}\text{is both (\#tall,) strong and agile.}\\ \text{saw both (\#Mary,) Sue and Kim.}\\ \text{both (\#composes,) sings and plays the drums.}\\ \text{works both (\#quickly,) efficiently and accurately.}\\ \text{is both (\#the director,) the editor and the owner.}\\ \text{is both (\#a conductor,) a composer and a performer.}\\ \text{is both (\#on the board) on the committee and on the fencing team.}\end{array}\right\}$

This semantic account is parsimonious and intuitive given that the meaning of *both* presupposes 'two'. This dispenses having to stipulate extra machinery so that the correlative can 'look down' and count granddaughter nodes. In fact, examples like (54) indicate that a purely syntactic (and non-elliptical) approach would have problems with the view that *both* attaches to strictly binary structures.

(54) I can take care of both [Tom and Mia], [Fred and Sue] or [Bob and Ann].

The present account is also consistent with cases in which the conjuncts are not existential singular NPs. Thus, *both the boys and the girls* is felicitous because the plurality contains two members, each of which is a plurality in itself.[13]

(55) a. Both the boys and the girls protested.

b. These are the areas where both most consumers and most employers are focusing their concern.

Similarly, *both* is free to co-occur with singular quantified conjuncts given that the scope interactions allow for a doubleton plurality to be obtained as discussed in §3.2.1.

(56) a. He did therefore have both every reason and every opportunity to be a close observer of Nazism.

b. I want you all to know I've listened to both every Chillis album and every one of John's solo albums thoroughly.

3.2.3 Other Views

Munn (1993, 169) proposes that conjunction is a group forming pro-form, occurring both in phrasal and in clausal conjunctions, cross-categorially. No evidence is provided to support this claim. The idea that a pro-form is semantically group-forming as put forth in Munn (1993) is unexpected because the meaning of a conjunction lexeme does not coincide with the meaning of any element in the sentence. Munn (1993) must therefore make further assumptions about an exotic new kind of polymorphic pro-form that bears meaning and is without an antecedent. It is unclear what further stipulations this entails.

[13] A similar case is the naturally occurring example noted by Lasersohn (1995, 151): *In contrast, both [Avery] and [Jones and Thomas] need extra statements in their grammars to make the distinction.*

Moreover, if *and* were a pro-form then it would naturally follow that it could be substituted by other expression of the same type. As it turns out, this prediction fails: *Both Tom$_i$ and Fred$_j$ are nice* vs. **Both Tom boys$_{i+j}$ Fred are nice.* The theory must therefore be extended with further assumptions in order to block this. There are also various aspects of Munn (1993) that are most unclear and prevent an evaluation of the proposal. For example, Munn (1993, 172) opts not to provide the semantic analysis of conjunction.

Lasersohn (1995, 272–277) also considers the hypothesis that conjunction yields a plurality cross-categorically, noting the distribution of *alternatively* as discussed above. Lasersohn's account does not cover the full range of phenomena considered so far but it already resorts to a rather complex number of constructs. This is mostly due to the fact that Lasersohn adopts Neo-Davidsonian representations. The account of conjunction consists in a rule that contains various kinds of conditions, sub-conditions and exceptions. Below I reproduce this rule (below, conjunction is '&'), to illustrate the complexity of this account.

(57) Where X_i, ..., X_n are sets, and f, f' are functions $(X_1 \rightarrow \ldots (X_n \rightarrow \{0{,}1\}))$:

$[f \ \& \ f']$ is that function $(X_1 \rightarrow \ldots (X_n \rightarrow \{0{,}1\}))$ such that $[f \ \& \ f'](x_1)\ldots(x_n)$ $= 1$ *iff* for some $a_1, \ldots, a_n$, $b_1, \ldots, b_n$, and for all i $(1 \leq i \leq n)$:

(i) if $X_i \in \{U, V\}$ then $x_i = \{a_i, b_i\}$;

(ii) if $X_i \notin \{U, V\}$ then $x_i = a_i = b_i$;

(iii) $f(a_1) \ldots f(a_n) = 1$; and

(iv) $f'(b_1) \ldots (b_n) = 1$;

and $[f \ \& \ f'](x_1)\ldots(x_n) = 0$ otherwise.

(Laserson, 278)

Here, U and V are higher-order domains of individuals and of events, respectively and event predicates denote functions from V to $\{0{,}1\}$. An equally complex set of conditions is proposed to analyze disjunction. Unfortunately, many of the details of the account are unknown: no discussion is devoted to scope or to quantificational conjuncts, and nothing is said about how a systematic syntax-semantics mapping is to be obtained.

There are also several linguistic problems with the above definition, which require it to become more complex. For example, it must be generalized so that it can deal with coordinations with more than two conjuncts (i.e., instead of f and f' one should allow for $f_1 \ldots f_k$). Winter (2001, 43) also points out that further conditions may be needed to prevent overgeneration, because the above definitions allow conjuncts to be mapped into the wrong arguments. The above definition also allows for N' conjunction to yield pluralities, which as we have seen above is problematic.

The theory proposed in this chapter achieves a greater coverage while being more parsimonious. It basically amounts to two assumptions. First, the conjunction lexeme introduces an existentially quantified plurality α (this plurality can be composed of individuals or of eventualities). Second, the coordination rules previously discussed are augmented so that a membership relation '$\delta \in \alpha$' is added for each conjunct X with a referential argument δ. The membership relations are required to be subordinated to the existential quantifier over α and the quantifier binding the conjunct δ. The net result of these constraints is a leaner and more uniform account of cross-categorial conjunction.

Stated in this fashion, my account also makes a prediction. If the referential argument of each conjunct is required to be bound by a quantifier, then this entails that N' conjuncts cannot be conjoined. This explains why cases like **These boy and girl* are ruled out. In Chapter 5 I will show how the same coordination rule and the same semantic composition process can be generalized over other kinds of coordination, including disjunction.

3.3 Intersective Conjunction

The foregoing discussion has shown that the meaning of natural language *and* cannot be captured in terms of a Boolean conjunction in the spirit of Gazdar (1980) and Keenan and Faltz (1985). I will therefore abstain from using the term Boolean, and instead employ the term *intersective* to refer to a very restricted kind of conjunction that truly behaves like set intersection. Some well-known examples of this are given in (58). Here, the coordination of two singular NPs does not trigger plural agreement and does not yield an NP that denotes two individuals:

(58) a. The owner and the editor (of the newspaper) is a member of the club.

b. His aged servant and the subsequent editor of his collected papers was with him at his death-bed.

c. Tom's father and Suzanne's uncle is waiting for you.

In these examples, the conjoined NP denotes a unique person. Some authors like Quirk et al. (1972) dub these cases as *appositional coordination*. There are various properties that are peculiar to this conjunction type. For example, it can occur in non-predicative positions and is not compatible with the presence of *both*. The latter contrasts with non-intersective coordination of predicative NPs as shown in (60).

(59) a. (*Both) the idea and the challenge is to extend access to everyone.

b. (*Both) the owner and the editor of *The Post* was a member of the club.

(60) Tom is (both) $\left\{\begin{array}{l}\text{the owner and the editor of \textit{The Post}.}\\ \text{on the board and on the committee.}\\ \text{quick and efficient.}\end{array}\right\}$

The asymmetry with regard to *both* and the lack of plural agreement shows that intersective and non-intersective conjunction differ in a fundamental way. But there are also similarities. For example, as in other cases of coordination, the determiner can be omitted by Left-Periphery Ellipsis:

(61) a. The owner and (the) editor is a member of the club.

b. The simplest process and (the) shortest solution is this one.

Intersective conjunction is not limited to definite determiners either. It is also observed with other kinds of NPs, including quantificational ones. Consider the example in (62a). The intersective reading yields an interpretation where only the individuals that are both husbands and fathers must do the test:

(62) a. Every husband and every father is required to do this test.

b. Every singer and every dancer knows this song.

Quantificational conjuncts that are intersectively conjoined can also be targeted by Left-Periphery Ellipsis as shown below:

(63) [Every wife and ~~every~~ mother] should read this book.

The intersective use of *and* is thus very different from the non-intersective use. Because no plurality is formed, the presence of *both* is not tolerated and no plural agreement is triggered (if conjuncts are singular, of course). Moreover, it seems that intersective conjunction only targets NP conjuncts. In that sense this conjunction *and* is similar to other conjunctions that are syntactically very restricted, such as arithmetical conjunction, numerical composition conjunction, and packaging conjunction:

(64) a. Let us suppose that two and two is five.

b. There were two hundred and twenty two sightings.

c. Two ham rolls and a glass of milk was more than Sue wanted.[14]

Note that not all nouns are suitable for intersective conjunction. Only conjuncts that are semantically compatible are felicitous. The reason for this probably stems from lexical semantics. For example, *cat* and *dog* are not compatible word meanings because the defining properties of being a dog are incompatible with the defining properties of being a cat. Thus, **A cat and a dog likes sugar* is ungrammatical. There are however a great deal of compatible nominal word meanings, such as *lawyer*, *poet*, *husband*, *father*, or *fireman*, which do allow for the intersective interpretation.

3.4 Adversative Conjunction

Adversative coordination is very similar to non-intersective conjunction in semantic terms. As (65) shows, this is also a plurality-forming conjunction. The adverb can predicate over the combined frequency of the two event-types:

(65) Often, Tom goes to the beach but I stay at home.

What is special about adversative coordination is that it cancels expectations likely to be abduced from the initial conjunct. This is often further highlighted with the presence of expressions like *regardless*, *even so*, *all the same*. Similarly to other coordination types, various categories can be conjoined as long as the initial conjunct carries enough semantic import to trigger presuppositions which can be canceled by the second conjunct.

(66) a. Fred is going to the movies tonight, but he's going alone.

b. Sue is rich, but she is happy.

(67) a. Tom was tall but very slim.

b. Hungry but alive, a cat was found after 3 weeks in a plane's cargo hold.

Sag et al. (1985, 138,ft.10) point out that *but* cannot coordinate NPs. This is illustrated in examples like (68). A structure like *Tom and Mary* forms a grammatical and meaningful constituent, but the adversative counterpart does not: **Tom but Mary.*

[14]Example taken from Sag et al. (1985, 154, ft. 22).

(68) *I like Tom but Mary.

But this observation is not quite right, since predicative NPs can be adversatively conjoined. This is illustrated in (69), and lends further support to my proposal that predicative nominals has an eventuality referent.

(69) a. Kim made him a good servant but a bad master.

b. A useful servant but a dangerous master, James could not be entrusted with this matter.

But this raises one important question concerning the difficulty in rescuing (68) via ellipsis: ?**I like Tom but ~~I like~~ Mary.* I believe that the latter is degraded because there is not enough contrastive force in these conjuncts. One would have to establish that liking Tom would probably mean that one would not like Mary. Other cases in which this contrast is more easy to obtain are grammatical:

(70) a. He has many acquaintances but very few friends.

b. Many acquaintances but very few friends came to the party.

c. Some but not all students came.

The example in (70a) is thus an instance of VP coordination with Left-Periphery Ellipsis while (70b,c) are instances of S coordination with Right-Periphery Ellipsis.

Another reason why (68) resists being parsed elliptically may be connected to the fact that the NP coordination of proper nouns is extremely frequent but the coordination of quantificational NPs is extremely rare. A search in the British National Corpus shows a very strong tendency for avoiding the conjunction quantificational NPs. The corpus has 100 million words from written and spoken language, and yet the pattern [*Many ... and few*] (with a window of up to 3 words between *Many* and the conjunction) has a total of 4 occurrences, and the pattern [*Many ... and many*] as 58 occurrences. On the other hand, the coordination of non-quantificational NPs is extremely frequent. For example, [*a ... and a*] has 4,682 occurrences, with the same window.[15]

In this view, after the NP parse for (68) fails for grammatical reasons, the elliptical alternative is not attempted by the parser for two reasons. First, the NP parse is so overwhelming preferential that it inhibits the (more complex) elliptical alternative,

[15]See §7.3 for a similar explanation for agreement asymmetries in coordination.

and second, the VP coordination alternative does not have enough pragmatic contrast: liking Tom does not usually mean that one cannot like Mary. Matters are different in the case of quantificational NP conjuncts like *Many acquaintances but very few friends*. The coordination of this kind of conjuncts is much more infrequent, and thus the NP coordination analysis does not obscure the elliptical parse. This explanation is compatible with experimental findings in language processing, in which both lexical probabilities and syntactic expectations are known to affect ambiguity resolution (for a recent discussion of competing theories and new results see for instance Gibson (2006)).

Huddleston et al. (2002, 1312) also discuss non-coordinate usages of *but*, including emphatic reaffirmation (*Nothing, but nothing will change my mind*) and exception prepositional uses (*everyone but Jill was told*, and *everyone was told but Jill*). There are also adverbial usages of *but* which trigger discourse anaphora interpretations, and sometimes also have the appearance of NP coordination:

(71) a. They had not invited Jill (to the party), but (rather) Fred.

b. They didn't throw Tom out of the party yesterday, but rather, Fred.

I will not discuss this kind of ellipsis in this work and thus will merely note that adversative coordination does not conjoin nominal constituents.

It also is traditionally assumed that adversative coordination is necessarily binary. This means that *but* yields a rather exotic kind of coordination, for it is the only coordination lexeme that does not allow iteration of conjuncts. A more satisfactory and uniform analysis would be that the requirement for a binary structure is only apparent. There is some evidence consistent with this view. Consider the examples (72a) taken from Huddleston et al. (2002, 1312). The fact that Kim is Irish and Pay is Welsh is what is contrasted with Jo being Scottish:

(72) a. Kim is Irish, Pat is Welsh but Jo is Scottish.

b. Alice drank a martini, Jane drank a beer but Tom had nothing at all.

c. I wanted to buy the house, she wanted to sell it but we couldn't come to an agreement.

Yet I see no reason why it cannot be held that there are three conjuncts in these examples but that the last conjunct is contrastively marked. This would mean that adversative conjunction allows iteration of conjuncts, but that the adversative lexeme adds pragmatic information to the conjunct that it attaches to. Further evidence for this position comes from the observation that the three conjuncts can be predicated simultaneously, just like in non-intersective conjunction:

(73) a. How often would [Alice order a pizza, Jane order a burger, but Tom order nothing at all]?

b. Often [I wanted to buy the house, she wanted to sell it, but we couldn't come to an agreement].

I thus propose that the main difference between *and* and *but* is that the latter does not attach to nominal constituents and introduces a pragmatic import that cancels an expectation that stems from the preceding conjuncts. In this view, no extra syntactic constraints are necessary for adversative conjunction as the apparent binary structure is biased by the pragmatic contrastive import.

3.5 Disjunction

Disjunctive coordination is obtained with the lexeme *or* and can coordinate both clausal and sub-clausal constituents. Thus, disjunction is similar to non-intersective conjunction with regard to syntax:

(74) a. Someone ate all the cookies or Mary forgot to bring a box today.

b. There is a burglar in the office or in the building next door.

c. He's someone who loves, pursues, or desires attention.

d. This problem can turn out to be either very difficult or very easy.

The main distinction that this construction type has with regard to conjunction is of course semantic. Disjunction is used to describe alternatives:

(75) a. [A dog or a wolf]$_x$ is in the barn. I heard it$_x$ howling last night.

b. Any decision made by [a man or a woman]$_x$ is [his or hers]$_x$ to make alone.

There are several parallels that can be drawn between non-intersective conjunction and disjunction. First, both coordination lexemes seem to introduce a novel referent which is available for continuations as seen in (75) above. This suggests that one can view the representation of disjunction as basically isomorphic to conjunction.

Note also that cases like (75a) are ambiguous between a reading where the speaker hypothesizes that the animal howling is a canine or a lupine animal and another where the speaker is committed to the existence of a dog and a wolf, one of which did the howling. If we make the same assumptions that were made for non-intersective conjunction, the latter reading is accounted for if the conjuncts have wide scope over the disjunction. A similar ambiguity is seen in the example in (76), taken from Rooth and Partee (1982). The reading forced by the continuation is the one in which the indefinites have narrow scope under the intensional verb predicate.

(76) Mary is looking for a maid or a cook (... but I don't know whether it's a maid or a cook that Mary is looking for).

Generally speaking, disjunction allow for the same kind of scope interactions between conjuncts that conjunction does. This strongly suggests that both kinds of coordination are in fact structurally very similar. For example, in (77) the definite NP can be interpreted with wide scope over the first conjunct (a unique associate of a third party) or with a narrow scope reading (possibly different associates of the director).

(77) a. Each director or an associate signed this document.

b. Each gangster or a lawyer must be present.

c. Every man or his wife must sign this document.

The standard use of disjunction can also be interpreted in two very special ways. In one case, the speaker assumes that either alternative can be true, but not both (exclusive disjunction). In the other case, the possibility of both alternatives being true is not excluded. These two readings have a relatively expressive effect on agreement in English. Given singular conjuncts, the inclusive reading is compatible with both plural and singular agreement, while exclusive reading requires singular agreement:

(78) a. Tom or Fred $\left\{\begin{array}{l}\text{is}\\ \text{are}\end{array}\right\}$ going to lose the match.

b. Tom or Fred $\left\{\begin{array}{l}\text{is}\\ \text{?are}\end{array}\right\}$ going to win the last boxing match of the evening.

c. Tom or Fred $\left\{\begin{array}{l}\text{is}\\ \text{*are}\end{array}\right\}$ going to be the chosen one.

Huddleston et al. (2002) provide various arguments in favor of the exclusive disjunction reading being an implicature, rather than ambiguity of *or*. For instance, as usual with implicatures, the exclusive reading can either be made explicit or canceled as in (79a), and it disappears in certain contexts, as under the scope of negation. This can be seen in (79b), which is lacking the exclusive *or* interpretation.

(79) a. He'll invite Kim or Pat, $\left\{\begin{array}{l}\text{but not both}\\ \text{perhaps both}\end{array}\right\}$.

b. There isn't a copy on the desk or on the drawer.

For some time it was held that Latin had two different markers for disjunction, *vel* for inclusive disjunction, and *aut* for exclusive disjunction. See Barrett and Stenner (1971) and Jennings (1994) for discussion and rebuttals of this claim.

Since peripheral ellipsis is known to target disjunctions of clauses and verbal constituents, it is expected that it also occurs in NP disjunction. These ellipsis operations provide a simple explanation for cases that are usually taken as recalcitrant:

(80) a. [Every man or ~~every~~ woman] knows this.

b. If you have found [a dog or ~~a~~ cat] you should call me.

c. [Some ~~students~~ or most students] were on time.

Independent evidence for an elliptical analysis is provided by the fact that *either* can attach to what on the surface seems to be an embedded N' disjunction as in (81). The ellipsis analysis readily explains this distribution.

(81) Either every man or woman will be left out of the contest.

As in the case of conjunction, there is no direct evidence for the existence of disjunction of N' categories. Consider the following data:

(82) *If you have found an either [dog or cat] you should call me.

3.6 Non-Existence of Scope Islands

Some research such as Winter (2001) assumes that the CSC also applies to semantic structure. According to this view, coordination structures prevent nested quantifiers from outscoping the conjunct in which they occur in. Winter (2001, 83) claims that this is why the object *every man* is unable to scope outside the coordination:

(83) Some woman [gave birth to every man] and [will eventually die].

This claim cannot be correct because other quantifiers such as existentials and definite descriptions can take wide scope, as in (84). Here, one complement NP must take wide scope over not only the coordination structure but also over the subject. The sentence means that there is one particular movie such that everyone loved it and praised it.

(84) a. Everyone [loved the movie$_i$] and [praised it$_i$].

b. Every guest met [the cook] and [each of his six assistants].

c. [Every kid I know saw a bright light] and [I think some teachers saw it too].

If the CSC were to also apply to semantic structure then this behavior should be impossible for *any* NP, not just quantificational NPs. This suffices to show that Winter's claim is wrong and that importing the CSC to the semantics is unwarranted. Moreover, as discussed in §2.1.3 there are independent reasons for rejecting the existence of the CSC altogether.[16]

The missing reading in the rather artificial example in (83) is most likely due to the lack of contextual elicitation rather than hard semantic constraints. In the examples listed below embedded universal quantifier can be more readily interpreted as outscoping the indefinite subject NP:[17]

(85) a. The White House is very careful about this. An official representative will personally read each document and reply to every letter.

b. We had to do this ourselves. By the end of the year, some student had proof-read every document and corrected each theorem.

Note also that (83) is preferentially interpreted with an asymmetrical reading, which would presumably make it easier to get an asymmetric scoping also. But that reading is missing because of the lack of contextualization. Below I provide a case of clausal coordination with an asymmetrical reading in which the universally quantified NP conjunct *every grocery store in town* can take wide scope over the indefinite conjunct *a muffin*. Imagine that Fred is a student conducting a market study about muffins in his small town.

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[16]See also Geurts (2000) for many problems with the use of choice functions in Winter (2001).

[17]I owe these examples to Ivan Sag (p.c.).

(86) a. And so what does he do? He goes into every grocery store in town and he buys a muffin.

b. Fred went to each grocery store in town and he bought a muffin.

I therefore conjecture that conjuncts are typically and preferentially perceived as scopally independent, unless anaphoric linkages or contextual information biases one conjunct to obtain wider scope. As discussed in §1.4, this is a general property of scope phenomena. Put in MRS terms, I thus propose that given two conjuncts $l_1 : \phi$ and $l_2 : \psi$ the preferential scope resolution is be $l_1 = l_2$ (which in practice is an intersective combination: $\phi \wedge \psi$). This position is synthesized in the following scope processing tendency, which may result from the fact that coordination structures are non-headed:

(87) Conjunct Scope Resolution

the preferential scope resolution in non-headed constructions is one in which the semantic representations remain scopally independent.

Copestake et al. (2006) also argue that each daughter is a scopal island, at least for some scope-bearing elements. To motivate this position Copestake et al. (2006) discuss the example in (88) for which the adverb *probably* can exhibit various scopings:

(88) a. Every dog probably chases a cat.

b. $probably(\forall x(dog(x), \exists y(cat(y) \wedge \exists e\ chases(x, y)))$

c. $\forall x(dog(x), \exists y(cat(y) \wedge probably(\exists e\ chases(x, y)))$

...

The claim that adverbs like *probably* cannot have scope beyond their local conjunct is supported by the non-equivalence of sentence pairs like the following:

(89) a. Sandy stayed and probably fell asleep. $\not\leftrightarrow$

b. Probably Sandy stayed and fell asleep.

In my view this non-equivalence is as expected because a rightward embedded scopal element located in the final conjunct usually has no reason to gain wide scope over the left conjunct. Unlike pronominal or relational NP conjuncts, adverbials do not introduce anaphoric dependencies that can force a wide scope reading. But if my position is correct, then it should even so be possible to find examples similar to (89) in which a ϕ-embedded adverbial outscopes ψ, although the judgments can be expected to be subtle. Below I offer some candidate sentences which I believe can receive this kind of interpretation:

(90) a. I usually open the window and the dog starts barking.
usually(I open the window & the dog starts barking)

b. I usually cry and he gets me a kleenex.
usually(I cry & he gets me a kleenex)

The dog barking is not a consequence of how often the speaker opens the window, but rather it is often the case that the dog barks when the window is opened. Here the adverb is realized in the left conjunct, which can more easily gain semantic scope over the entire coordination in an asymmetrical reading. In examples like (89) this is much harder to obtain because the adverb is located in the second conjunct and scope is known to preferentially mirror syntactic structure.

There are also cases of symmetric coordination in which this phenomenon is possible. Although the sentences below are ambiguous between a local adjunction of the adverb, the wide scope reading also appears to be possible:

(91) a. He probably was not a Roman citizen and he had never even been to Rome.
probably(He was not a Roman citizen & he had never even been to Rome)

b. Kim probably is playing Juliet and Fred is playing Romeo.
probably(Kim is playing Juliet and Fred is playing Romeo)

If one takes scope resolution as a processing, pragmatic and context-dependent process, then local scope-taking should be seen as a default case rather than a hard semantic constraint. The simplest and therefore preferential scope resolution is one in which conjuncts remain scopally independent, unless otherwise required by anaphora, context or pragmatic import.

3.7 Summary

§3.1 It is argued that associating collective readings to Non-Boolean conjunction and distributive readings to Boolean conjunction is missing major linguistic generalizations because the same conjunctive NP can be simultaneously interpreted distributively or collectively. The latter fact is well-known but often neglected or seen as recalcitrant because of the mainstream view on this matter.

The fact that plural NPs can also obtain distributive and collective readings indicates that a uniform account should be pursued. NP conjunction and plural NPs should systematically denote collections, without appeal to covert machinery or type-shifting operations.

§3.2 The Boolean/Non-Boolean dichotomy is empirically flawed given that the conjunction virtually any category can be observed to yield a plurality. This is a major advantage of the current account because it opens the way to a truly uniform view of the meaning conjunction in natural language. Conjunction is thus argued to systematically form a collection from the denotation of the conjuncts, independently of their category.

Various apparent exceptions and challenging cases are shown to be uniformly predicted as instances of peripheral ellipsis. Cases of true N' conjunction are argued to be impossible.

§3.3 A very restricted kind of conjunction, intersective (or appositional) conjunction is shown to apply only to non-predicative NP conjuncts and to not yield a plurality of any kind. This kind of conjunction also differs from the above in that it does not co-occur with the correlative *both*. This falls as a consequence of the fact that no plurality is formed. Intersective conjunction is therefore closer to other special conjunction types, such as arithmetical conjunction, numeral composition conjunction and packaging conjunction. Various challenging cases are shown to be predicted as instances of peripheral ellipsis.

§3.4 It is argued that adversative conjunction is basically the same as non-intersective conjunction *and* with the differences that NP conjuncts are not allowed, and that an added contrastive import is associated with the final conjunct. This view offers a more uniform account of these structures since it does not follow the mainstream assumption that adversative conjunction is necessarily binary. It is argued that determiner adversative coordination is not possible, and that it is a consequence of ellipsis.

§3.5 A brief overview of disjunction shows that this kind of coordination is very similar to conjunction with regard to syntax and scope interactions. This opens the possibility for a uniform syntax-semantics theory that is general enough to encompass both conjunction and disjunction. It is also argued that N' categories cannot be disjoined, and that certain apparent exceptions are elliptical NP disjunctions.

§3.6 In this section it is argued that coordination does not establish semantic scope islands, contrary to claims put forth in the literature. This is clearly true for existentially quantified expressions, but for other kinds of scope-bearing operators the matter is not so simple. As it turns out, the preferential scope resolution is canonically local, rather than outscoping the coordination structure. But many examples can be found in which context and pragmatics promote wide scope of quantificational NPs and scopal adverbs. The theory should therefore not prohibit scope interactions beyond the coordinate structure because these are possible, albeit requiring proper contextualization.

Chapter 4

On the Interpretation of Pluralities

This chapter takes a closer look at the interpretation of pluralities and focuses on how a uniform account can deal with both simple individuated pluralities (formed by nominal pluralization) and with complex pluralities (obtained via non-intersective conjunction). A brief overview of previous proposals is provided and various kinds of readings are identified, including distributive, collective, cumulative, reciprocal, and *respectively* readings.

The evidence indicates that pluralities in general are not ambiguous, and that the source of the various possible readings is located in the lexical semantics of predicates that select for pluralic arguments. Conjunction is argued to have one meaning only, instead of being many-ways ambiguous. More generally, pluralic NPs are not semantically ambiguous. The theory that is proposed can capture the various possible plural and scope ambiguities in an straightforward manner, via lexically specified semantic underspecification constraints. Thus, the same verbal lexical entry can deal with singular and pluralic arguments of any complexity, in a uniform fashion.

Another important aspect of this account is that the meaning of conjunction is argued to be dynamic and ontologically neutral. Conjunction is viewed as a mechanism that assembles a plurality on-the-fly, rather than picking an arbitrarily complex entity from the model. This is motivated by the fact that although there are various predicates that are sensitive to the structure of complex pluralities, no predicate can be said to denote these arbitrarily complex entities. As such, conjunctive pluralities should not be a part of the model.

4.1 General Aspects of Interpretation

This section is not intended to be an exhaustive exposition on all that has been said about pluralities. For overviews of the various contentions and controversies, I refer the reader to Schein (1993), Lasersohn (1995), Landman (1995), Schwarzschild (1996), Lønning (1997), Link (1998b), Landman (2000), and Mckay (2006).

The main challenge posed by the grammar of plurality is how to arrive at empirical generalizations that allow for a simple and uniform account of the data. Not only the Boolean/non-Boolean dichotomy has so far prevented to obtain a uniform account of plural nominal phrases and conjoined NPs, but also NP conjunction is standardly viewed as many-ways ambiguous (e.g. Hausser (1974), Link (1984), Gillon (1987), Hoeksema (1988), Landman (1989), van der Does (1992), Winter (2001), and many others). I will argue that this is undesirable, and that pluralities in general should be systematically associated with one and the same interpretation. Moreover, I claim that pluralities in general combine with other predicates in a thoroughly uniform fashion, regardless of the plurality being the result of a conjunction or not. Just the same way as a plural NP like *several books* has only one meaning (a collection of at least two books), so should an NP like *a book and several magazines* have only one meaning.

4.1.1 Plurals

It is standardly accepted that there are two main modes of predication for plural nominal phrases. One is *distributive* and the other is *collective*. A plural NP is interpreted distributively when taken as an argument of a predicate that semantically can only apply to atomic individuals. For example, in a sentence like *Five boys sneezed* there are five sneezes, and five sneezing events, not just one. Any theory of semantics must capture this subtle state of affairs. On the other hand, a plural NP is said to be interpreted collectively if taken as argument of a predicate that applies to collections of individuals. One such example is *The spaceship landed between two craters*, where the sentence describes a single landing event that involves a collection of two craters.

Distributive predicates thus apply to the members of the plural rather than to the whole plurality, associating each member to an independent state-of-affairs. Verbs pertaining to physiological events such as *smile*, *shout*, *sneeze*, *die*, *sit*, *jump*, *give birth* typically interpret their plural subjects distributively. Distributive predicates may also be found in other parts-of-speech, in adjectives like *green*, *tall*, *happy*, *Italian*, etc. Many English adjectives and finite past tense verbs are compatible with both singular and plural subjects, even though the predication is always distributive. For example, in (1a) each plant dies, possibly in different points in time, and in (1b) the predicates *give birth* and *Italian* are properties attributed to each individual and not to the collection of women:

(1) a. $\left\{\begin{array}{l}\text{Two plants}\\ \text{The plant}\end{array}\right\}$ died.

b. $\left\{\begin{array}{l}\text{Several Italian women}\\ \text{An Italian woman}\end{array}\right\}$ gave birth today.

Collective readings on the other hand, involve a state of affairs which cannot be brought about by each individual separately. A collective predicate therefore applies to the plurality as a whole and not to each separate individual, even though in some cases there are sub-entailments that extend to the members of the plurality. For example, predicates like *gather*, *surround*, *meet*, *flock*, *cluster*, *disperse*, *separate*, *scatter*, and *spread out* are collective in this sense given that no single individual separately brings about the situations described by these verbs. Other collective predications simply lack these sub-entailments, such as *outnumber*, *be the same*, and *in equal numbers*, the complement argument of *pile*, *stack*, *list*, *be among*, and *be between*. Consider for instance the example in (2a), where the main predication is only felicitous when the subject denotes a plurality:

(2) a. $\left\{\begin{array}{l}\text{Many people}\\ \text{\#One person}\end{array}\right\}$ dispersed from the main plaza.

b. The current scattered $\left\{\begin{array}{l}\text{various ships}\\ \text{\#the boat}\end{array}\right\}$.

c. A dog is among $\left\{\begin{array}{l}\text{the cows}\\ \text{\#the cow}\end{array}\right\}$.

The oddness that arises when collective verbs are realized with atomic arguments is semantic rather than syntactic. It ensues because of what collective predicates mean, given that their denotation only contains non-atomic elements of the domain. Note that this position leaves open the possibility that in certain contexts no infelicity arises, as in constructions where the proposition is necessarily false:

(3) a. It is impossible for a single person to disperse.

b. If a bird could flock alone, then there would be lots of flocking around.

Other collective predicates additionally carry a relational import. This is the case of the subject argument of intransitive *argue*, *disagree*, *marry*, *collaborate*, *compare*, *dance*, *be similar*, *be friends*, *be married*, and *be (inter)connected*, as well as the complement argument of verbs like *interconnect* and *mix*. In these cases the collective predicate establishes a reciprocal relationship between the members of the plurality, which is sometimes made explicit by the usage of a reciprocal expression like *each other*. For this reason these are usually known as 'covert reciprocals' (Langendoen 1978). Thus (4a) means that a given particle hit some other particles and vice-versa.

(4) a. $\left\{\begin{array}{l}\text{Three protons}\\ \text{\#A proton}\end{array}\right\}$ collided.

b. $\left\{\begin{array}{l}\text{The dogs}\\ \text{\#The cat}\end{array}\right\}$ can coexist peacefully.

c. The systems manager decided to interconnect $\left\{\begin{array}{l}\text{five computers}\\ \text{\#a computer}\end{array}\right\}$.

It often held that these readings result from a null complement ellipsis, in which case a reciprocal *with*-phrase is covert. But this analysis is problematic for various reasons. First, it fails to explain why the covert reciprocation only occurs with certain words. Compare the examples in (5) with the ones in (6). All of these examples are compatible with an overt reciprocal complement, but only (5) can have the covert reciprocal reading:

(5) a. The boys are friends / neighbors.

b. The men fought / argued.

(6) a. The boys are owners / supporters.

b. The men helped / observed.

One can of course make all sorts of stipulations about why this is so, but barring unmotivated assumptions, the null complement ellipsis makes the wrong prediction. Another problem for the ellipsis concerns symmetric adjectives like *similar*. The reciprocal reading arises both in predicative position and in adnominal position, but the latter is incompatible with any kind of complement:

(7) a. Five kids were very similar (to each other).

b. Five similar *(to each other) people were interviewed.

This removes all support for a null reciprocal complement analysis. A more parsimonious assessment is one in which the reciprocation is incorporated in the meaning of the intransitive predicate. As such, the predicate can be seen as a kind of collective predicate since this realization requires a pluralic subject.[1] I will not pursue the matter of reciprocation entailments any further here, and assume that the intransitive realization is interpreted roughly as in Krifka (1991):[2]

(8) $[\![P(x)]\!] = \forall k\,(k \in x \rightarrow \forall w\,(w \in x \wedge k \neq w \rightarrow P(k, w)))$

The distinction between collective and distributive interpretations is not universally accepted however. Various authors like Katz (1977), Langendoen (1978), and Higginbotham (1980) claim that the distinction between collective and distributive readings does not exist, and argue that both amount to indeterminacy in the interpretation. This position is refuted by the very existence of collective predicates, which impose different semantic constraints on their arguments as shown above. Another shortcoming of this view is that only distributive readings give rise to scope ambiguities. This is important because it suggests that distributivity is a matter of semantic structure rather than just of truth-conditions. For example, the sentence in (9a) does not have a reading where more than one building was surrounded and (9b) does not mean that there were different parties.

(9) a. Many soldiers surrounded a building.

b. The candidates met in an office party.

Now compare the above data with similar structures containing distributive predicates.

(10) a. Many soldiers fired at a building.

[1]This analysis can also scale up to NP coordination: *The car and the bus collided.* It is well-known that these cases cannot be reanalyzed in terms of a comitative structure. The latter has different truth-conditions, as it does not require the complement to be in motion: *The car collided with the bus.* Compare also *The car collided with the brick wall* with #*The car and the brick wall collided.*

[2]The universal quantification should be extended with a contextual parameter because not all kinds of reciprocation exhaust the members of the plurality. Alternatively, other weaker forms of reciprocity can be adopted. For an account of overt *each other* in HPSG see Chaves (2005b).

b. Two women gave birth in an office party.

Each of the examples in (10) has at least two readings. In (10a) there can either be a unique building or several and in (10b) there could be one unique party or several. As in standard scope ambiguities, the preferential choice of scope hinges not only on syntactic structure and lexical semantics, but also on the contextual setting. For instance, a specific reading ([∃>∀]) is the preferential interpretation for the indefinite NP in *The newspaper said that two women gave birth in an office party.* This is presumably because it is simply more likely that a newspaper would find two births at the same party a rarer event and that is more newsworthy. The tendency is reversed in contexts where this is not the case. For example, the same NP is preferentially interpreted non-specifically ([∀>∃]) in *The study shows that several women gave birth in an office party.* As in quantifier scope ambiguities, the wide scope of an embedded operator is harder to obtain than if it were in a higher syntactic position. Thus, although this is not the preferential reading, (11a) can be interpreted as conveying that different stories were told for different guests, and (11b) can mean that there is one different guard per exit:

(11) a. Grandpa made sure he told an embarrassing story about me to the guests.

b. A guard was stationed in front of the various exits of the stadium.

c. A misaligned direction was the cause of six car accidents this month.

In sum, there is little support for the idea that there are no such thing as collective and distributive readings, and there is evidence that suggests that distributivity is a structural operation that can interact scopally with other elements in the sentence.

Finally, there is also a third kind of reading, usually referred to as *serial* or *cumulative* in the sense of Kroch (1974) and Scha (1981). This reading arises in sentences containing more than one plural argument, and consists in a rather vague mapping between the members of the plural arguments.[3] Consider the example in (12).

(12) The soldiers hit the targets.

The sentence can be true in the cumulative reading under any pairing of soldiers and targets. For example, consider a case in which there are three soldiers and four targets. The sentence in (12) would be true, for example, if soldier s_1 hit only targets t_1, t_2 and t_3, and soldier s_2 hit only targets t_2 and t_3, and soldier t_3 hit only target t_4.

[3] See also Langendoen (1978) and Carlson (1980).

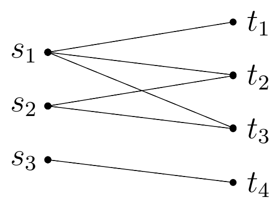

Figure 4.1: A mapping of soldiers and targets

Note that this is not some kind of distributive reading. The distributive paraphrase *Every soldier hit every target* would in fact be false in the described context. Cumulative readings are perhaps more obvious in examples involving numerals, as in (13).

(13) 600 Dutch companies use 5000 American computers.

There are a total of 600 companies and a total of 5000 computers, and any mapping between the two is possible. This contrasts with distributive readings in the sense that the total of individuals is uncertain. For example, in well-worn examples like *Each student speaks two languages* the narrow scope reading of the plural makes it impossible to tell how many languages in total are spoken.[4]

Some authors have taken the cumulative reading and proposed that it explains the full range of the date. In this view, the distinction between collective and distributive is oversimplified. The full spectrum of readings is vague in nature and collective and distributive interpretations are nothing but opposite extremes of this spectrum. This *indeterminacy* approach is put forth by Gillon (1987), Schwarzschild (1991), van der Does (1992), van der Does and Verkuyl (1996), and others. This line of analysis argues that plural NPs are intrinsically indeterminate and vague, and as such are always represented with the same logical form. For this purpose the denotation of a plural NP is usually construed in terms of a model-theoretic second-order operation involving some form of *partition* or *cover* of the domain (in some cases the denotation of the plural can overlap with 'pseudo-partitions'). For instance, in Gillon (1987) a plural

[4]Scha (1981) goes further in claiming that *the* does not yield distributive readings at all. This is hard to accept given data like *The boys love a girl from class* or *The men in this wing got a coronary bypass*, etc. (see also Peres (1998, 343, ft.1) for more counterexamples and discussion). Moreover, not only plural definites yield collective/distributive readings, but they can also have a preferential narrow scope in certain contexts such as *The dogs that won each race were hungry* (Allen 1995).

noun phrase can be many ways ambiguous, with one reading for each minimal cover of the set denoted by the noun phrase:

(14) a. A *cover* of a set A is a set C of non-empty subsets of A such that $\bigcup C = A$

b. A *minimal cover* of A is a set C' no proper subsets of which are also covers: $\forall X((X$ is a *cover* of A & $X \subseteq C') \rightarrow X = C')$

Thus, for $A = \{a, b\}$ we have only two minimal covers, $\{\{a, b\}\}$ and $\{\{a\}, \{b\}\}$, and for $A = \{a, b, c\}$ we have a total of eight minimal covers: $\{\{a, b, c\}\}$, $\{\{a\}, \{b, c\}\}$, $\{\{b\}, \{a, c\}\}$, $\{\{c\}, \{b, c\}\}$, $\{\{a, b\}, \{a, c\}\}$, $\{\{a, c\}, \{b, c\}\}$, $\{\{a, b\}, \{b, c\}\}$, and $\{\{a\}, \{b\}, \{c\}\}$. The intuition is that on one end of the spectrum one has a collective reading (over the set $\{a, b, c\}$) and on the other, a distributive reading (over the sets $\{a\}, \{b\}$, and $\{c\}$). Unfortunately, indeterminacy accounts raise more problems than they solve.

Landman (1995, 452) notes that these accounts must somehow require that NPs become scopeless, which may be problematic for the analysis of cases in which it can be argued that at least some plural NPs are involved in scope ambiguities (e.g. in the presence of negation, indirect discourse, and disjunction). One such example already discussed is *Each student speaks two languages*, in which the total of languages of a narrow scope reading is unknown while the wide scope reading fixes that there is a total of two languages.

A more serious problem for most of the indeterminacy accounts is that the multiple interpretations of a plural NP are often located in the NP. This view is problematic because the same NP can be simultaneously interpreted collectively and distributively in the same sentence.[5] This possibility was is noted in Hausser (1974), Hoeksema (1983), Massey (1976), Link (1984), and Dowty (1986). For an illustration, consider the data below:

(15) The horses grazed$_D$ aimlessly, dispersed$_C$ across the landscape.

(16) a. Several gangsters who surrounded$_C$ the building were shot$_D$.

b. All the transistors that were defective$_D$ were piled$_C$ in a corner.

c. The boys who sneezed$_D$ outnumbered$_C$ the boys who didn't sneeze.

[5]Of course, this is also a problem for accounts that accept the collective/distributive distinction in the logical form, but locate this ambiguity in the meaning of the plural NP, such as Lakoff (1972), Kroch (1974), and others. For criticism see Roberts (1987).

d. Most of the lawyers who died$_D$ yesterday were friends$_C$.

(17) a. Some boys gathered$_C$ outside and slept$_D$ under an oak tree.

b. Most protesters smiled$_D$ and dispersed$_C$ from the street.

c. The boys who got sick$_D$ and who were separated$_C$ after the doctor arrived were examined$_D$ and distributed$_C$ to different classes.

Recall that the above VP coordination data cannot be reanalyzed as S coordination via ellipsis, as noted in Lakoff and Peters (1969), Vergnaud (1974), Massey (1976), Link (1983), Hoeksema (1983) and many others. In general, the clausal counterparts have different truth-conditions as the examples below illustrate. For example, it may be that all the boys gathered outside but none of them sat down quietly, in which case the sentence in (18) with VP coordination is true, while the S coordination is false.[6]

(18) a. None of the boys gathered outside and sat down quietly. $\neq$

b. None of the boys gathered outside and none of the boys sat down quietly.

(19) a. Some students gathered outside and smiled uneasily. $\neq$

b. Some students gathered outside and some students smiled uneasily.

(20) a. Less than five kids gathered outside and sat down. $\neq$

b. Less than five kids gathered outside and less than five kids sat down.

In Schwarzschild (1991) the cover-based analysis is formulated without locating the ambiguity in the noun phrase. This is accomplished by postulating implicit adverbial operators on the verb phrase, to yield the distributivity effect on covers of the subject NP. But this is again a problematic analysis. When VPs are conjoined, the analysis does not allow one VP to yield a collective reading of the subject while the other yields a distributive reading. Schwarzschild (1996, 75) attempts to solve the problem by stipulating a special rule just for the interpretation of VPs. But as the data above suggest, this phenomenon is not restricted to VP coordination in any way. It occurs in relative clauses, absolute constructions, and also V coordination as in *I washed*$_D$

[6]Recall also that a clausal coordination analysis with a null pronominal subject is not tenable for the coordination data either, as discussed in §5.2. The recipe to show this is to place *both* before the first verb, yielding a ungrammatical clausal counterpart: *Some students both gathered outside and smiled uneasily* vs. **Some students both gathered outside and they smiled uneasily.*

and piled$_C$ the dishes all of which would require special rules just for the plural NPs. Schwarzschild (1996) is therefore missing a generalization by having to multiply out grammar rules in order to accommodate the cases that involve plurals.

The indeterminacy approach advocated in Gillon (1987), Schwarzschild (1991) and Verkuyl and van der Does (1991) has also been much criticized on the grounds that there is a very large number of ways to partition a plural denotation, yet the vast majority of which do not correspond to observable readings. For example, Lønning (1997) notes that Verkuyl and van der Does (1991) wrongly predicts that (21) has more interpretations other than the distributive and collective readings. For instance, the sentence cannot mean that two boys collectively bought one book and that a third boy bought another book.

(21) Three boys bought a book.

A similar point is raised in Carpenter (1997), who notes that this kind of analysis predicts that (22) has approximately 2^7-1 (= 127) different interpretations, depending on how the collection of 7 students is divided.

(22) Seven students took a class.

Yet the vast majority of these interpretations is never observed. Lasersohn (1989) criticizes Gillon (1987) on a similar basis, with data like (23). Suppose that each TA was paid $5.000 last year. In this situation each of the sentences seen in (23) comes out true.

(23) a. Three TAs earned exactly $15.000 last year.
b. Three TAs earned exactly $5.000 last year.

As Laserson notes, this can be obtained straightforwardly if the subject of the sentence (23a) is interpreted collectively and if (23b) is interpreted distributively. The problem for the indeterminacy approach is that it also incorrectly allows for other sentences to come out as true in the context described above, e.g. *Three TAs earned exactly $10.000 last year*. Similarly, Krifka (1991, 85) notes that sentences like (24c) can only mean that the animals were separated by race, while the partitions analysis predict that there is a wide range of other readings, e.g. separation by age, by size, and so on.

(24) The cows and the pigs were separated.

To this criticism Gillon (1990) and Schwarzschild (1996, 63–68) reply that the missing readings are blocked by some kind of context sensitivity and/or pragmatic effect. But until this theory of pragmatic distributivity is fleshed out, the covers/partitions proposal is impossible to evaluate objectively and therefore is lacking as a plausible theory of plurality.

The collective/distributive ambiguity analysis – if located in the head that selects the plural argument – is the more parsimonious and sound theoretical hypothesis. It offers the possibility of having a uniform denotation for plural NPs, has no problem with co-predication, and does not yield a combinatorial explosion spurious readings which arguably hinge on stipulated pragmatic effects. Thus I follow Lønning (1991), Lasersohn (1995, 132–141) and Link (1998b, 176–181) in observing that existing cover/partion analysis is linguistically too problematic as it stands.

Following Link (1983) and many others in general terms, distributivity can be seen as a universally quantified condition '$\forall y\,(y \in x \rightarrow \ldots)$' that ranges over all the members y of a plurality x and outscopes the verb predicate:

(25) a. The students read a paper.

b. $\exists x(students(x) \wedge \forall y\,(y \in x \rightarrow \exists z(paper(z) \wedge \exists e\, read(e, y, z))))$

c. $\exists z(paper(z) \wedge \exists x(students(x) \wedge \forall y\,(y \in x \rightarrow \exists e\, read(e, y, z))))$

In order to obtain the two formulas above all that one must ensure is that on the one hand the plural always outscopes the respective distribution, and on the other, that all the arguments of the verb and all the respective distributions outscope the verb. These constraints can of course be succinctly captured as standard subordination '$\leq$' constraints. The two readings given above can be succinctly captured in MRS as illustrated in Figure 4.2.

The reading in (25b) is obtained if the subordination constraints are resolved as $l_5 = l_2$, $l_6 = l_3$, $l_7 = l_4$, while the reading in (25c) is obtained with the resolution $l_4 = l_1$, $l_5 = l_2$, $l_7 = l_6$. Scope disambiguation is best viewed as a dynamic and monotonic process rather than an enumerative one, and therefore it is natural to extend an underspecification account of quantifier scope ambiguities to also deal with scope ambiguities triggered by the presence of distributivity. Again, various sources of information – including lexical semantics, contextual prominence, and pragmatics – can be used to bias a certain sub-formula to have wider or narrower scope. Semantic

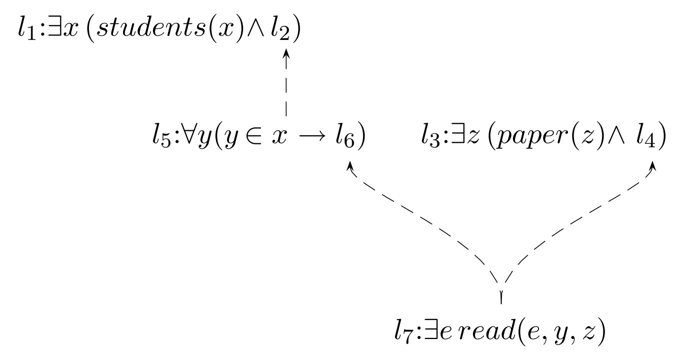

Figure 4.2: Underspecified representation of (25)

underspecification formalisms allow this to be stated in a straightforward fashion, by simply adding a subordination '$\leq$' constraint.[7]

More complex cases like *Several students saw two teachers* can also be accounted for. Transitive distributive verbs like *saw* can introduce one distribution condition per argument. Each of this distribution can interact with the co-argument NP and correctly predict three distinct readings as seen in (26). One in which both NPs outscope both distributions (each student saw the same two teachers), a second in which the complement NP has narrow scope (each student saw two possibly different teachers), and a third in which the subject NP has narrow scope (the total number of teachers that were seen is two, but each student may have seen only one teacher).[8]

(26) Several students saw two teachers.

a. $\exists x(students(x) \wedge \exists z(teachers(z) \wedge \forall y(y \in x \rightarrow \forall k(k \in z \rightarrow \exists e\, saw(e, y, k)))))$

b. $\exists x(students(x) \wedge \forall y(y \in x \rightarrow \exists z(teachers(z) \wedge \forall k(k \in z \rightarrow \exists e\, saw(e, y, k)))))$

c. $\exists z(teachers(z) \wedge \forall k(k \in z \rightarrow \exists x(students(x) \wedge \forall y(y \in x \rightarrow \exists e\, saw(e, y, k)))))$

The generalization for obtaining these representations is straightforward: the head that selects the plural arguments, if distributive in nature, introduces a distribution which is required to be subordinated to the respective argument NP and to outscope the head itself. All of the above readings can readily be captured in a semantic underspecification setting with the following representation:

[7]The only other constraint-based semantic underspecification accounts of plurals that I am aware of is Frank and Reyle (1995). However, that work subscribes to the idea that the distributive/collective ambiguity is located in plural NPs.

[8]Note that the reading illustrated in (26a) is not contemplated in Link (1984). Carpenter (1997, 304–306) on the other hand, allows for this possibility.

$$\begin{tikzcd} l_1{:}\exists x\,(students(x) \wedge l_2) & l_{11}{:}\exists z(teachers(z) \wedge l_{13}) \\ l_5{:}\forall y(y \in x \rightarrow l_6) \arrow[u, dashed] & l_8{:}\forall k(k \in z \rightarrow l_{10}) \arrow[u, dashed] \\ l_7{:}\exists e\, saw(e,y,k) \arrow[u, dashed] \arrow[ur, dashed] & \end{tikzcd}$$

Figure 4.3: Underspecified representation of (26)

Some authors have questioned the idea that distributivity has universal force, by noting the existence of non-maximality readings of definite NPs, as in Dowty (1986), Landman (1989), Link (1998b) and others. The distributive predications in (27) do not mean that every reporter in the room asked a question, that every person in town was asleep, or that each door was opened:

(27) a. At the end of the press conference, the reporters asked the president questions.

b. The townspeople were asleep.

c. The burglars opened the doors with their special tools.

It is well-known that the referential import of plural definite descriptions is context-dependent (see for instance von Fintel (1994)). Suppose that Fred has two sons and utters the sentence *School is out for the week and the boys seemed very happy about that.* It is quite plausible that he is referring to his two sons, but if Fred is also a teacher then he could be talking about all the boys at the school, rather than all the boys that he knows or all the boys in the world. All in all, the definite description presupposes the reference to context salient individuals. Thus, there is no reason to assume that *the townspeople* actually refers to each and every individual in the town, or that *the reporters* refers to each and every reporter in the room. The reference of the definite reference need only coincide with the salient individuals that the speaker has in mind, in that particular context.

Link (1983, 310) also notes that collective readings need not require that each and every individual had an equally prominent role in the collective state of affairs. This is illustrated in (28), which means that the children managed to build the raft collectively, without presupposing an active role in the action of every single child. Here is a place where things are best left indeterminate, rather than falling prey to over-representation.

(28) The children built the raft.

Link (1983), Dowty (1986), Roberts (1987) and others also noted that *all* can have the effect of asserting that each individual has an equally prominent role in the predication, cf. (28) with *All the children built the raft.* But the effect of *all* is basically the same regardless of whether the plural NP is interpreted collectively or distributively, which indicates that non-maximality effects reside in the interpretation of the NP rather than in the distribution.[9]

Finally, there is a third class of predicates which is most relevant for the present discussion. These are usually referred to as *mixed* (or *neutral*) predicates because they allow both collective and distributive readings (cf. Root (1986) and Dowty (1986)). Some examples of this class are activities that by their very nature can be done cooperatively like *lift*, *carry*, *push*, *support*, *hire*, *build*, *buy*, *receive*, *solve*, or quantitative predicates like *weigh*, *cost*, and *earn*. In the example below, the plural subject can have either a collective or a distributive interpretation:

(29) a. $\left\{\begin{array}{l}\text{The}\\ \text{Two}\\ \text{These}\\ \text{Several}\end{array}\right\}\left\{\begin{array}{l}\text{lawyers hired a detective last week.}\\ \text{kids took a blanket upstairs.}\\ \text{bodybuilders easily lifted the barbell.}\end{array}\right\}$

b. $\left\{\begin{array}{l}\text{The}\\ \text{These}\end{array}\right\}\text{ tables }\left\{\begin{array}{l}\text{weigh 50kg.}\\ \text{cost \$500}\end{array}\right\}$

Although the collective reading is often more salient, the above examples can also be interpreted distributively.[10] Thus in (29) different hirings could have taken place somewhere during the previous week. Because the complement has an indefinite NP, a scope ambiguity arises, regarding the hiring of either the same or of possibly different detectives. Similarly, each boy could have taken with him a different blanket upstairs. In (29), one can either mean that the combined weight of the boxes totals 50kg, or that each box weighs 50kg.

[9] See the '$\top$' (partake) operator of Link (1983) for capturing this meaning of *all*.

[10] See Frazier et al. (1999) for experimental results suggesting that a commitment to the collective reading is made in the absence of evidence for a distributive reading, as evidenced by a significant interaction of ambiguity and distributivity in first pass times, total times, and regressive saccades.

Many mixed predicates also allow collective and distributive readings of their object arguments as illustrated below. These are again ambiguous between two distinct (hiring/ carrying / lifting) situations and a single action:

(30) a. Fred hired two private detectives last year.

b. Sue took many blankets upstairs.

c. At the Strongman Competition, Yates easily lifted several boxes over his head.

As expected, scope ambiguities can arise with the distributive reading in case there are other scopal elements in the sentence. For example, (31) can be interpreted as the same lighting bolt collectively striking two individuals, or different lightning bolts striking in different occasions.

(31) A lightning bolt struck two people this month.

Other nominal predications interact with mixed predicates to impose a strong preference for the distributive reading, but they do not eliminate it entirely. For example, although (32) may seem to be necessarily distributive out of the blue (following the default processing tendency of attributing *in situ* scope), once contextualized the collective interpretation becomes more prominent. Compare the following:

(32) Exactly three students wrote a paper.

(33) As far as I know, there were no professors involved in these two drafts. Exactly three chemistry students wrote a paper on thermodynamics and exactly three physics students wrote a paper on Quantum Mechanics.

As one would expect, the collective reading is more visible with a definite object:

(34) Exactly three students wrote the paper / it / this paper.

Let us now take stock of what has been discussed. The issues involved in the interpretation of plurals may be intricate but the main conclusions are actually rather simple. Distributivity is a property introduced not by plural nominal structures, but by distributive predicates (e.g. *smile*, *die*, etc.). Collective predicates like *gather* and *be many* apply directly to the plurality denoted by their arguments. And finally, mixed predicates such as *hire* and *lift* can optionally introduce the distribution. The latter can therefore obtain both kinds of readings. Finally, because distributivity comes with universal force, it can give rise to scope ambiguities in the presence of other scopal elements in the sentence. This picture is not a particularly complicated one, and a syntax-semantics interface within the present framework is fairly straightforward. Since distributive and collective readings are governed by the verb meaning, it is also natural that the phenomena receive a lexicalist account. But matters become more complex when conjunction is brought into the picture.

4.1.2 Conjunctive Pluralities

Our account of distributive and collective readings should scale up in a straightforward manner to pluralities formed via conjunction. In what follows it is argued that the mechanisms needed for this purpose are essentially the same. All the relevant readings will emerge from the constraints stated at the lexical level.

Let us first consider distributive predicates. Semantically, these predicates only apply to atomic individuals, regardless of how complex the argument is. Thus a verb like *smile* predicates over each individual person denoted by the NP in (35) below.

$$\text{(35)} \left\{ \begin{array}{l} \text{The boys} \\ \text{Tom and Fred} \\ \text{Two boys and two girls} \end{array} \right\} \text{smile to the camera.}$$

Recall from §3 that copying out the verb phrase over each conjunct, as in Partee and Rooth (1983), misses the generalization by incorrectly assuming that NPs cannot conjoin. This kind of analysis is unable to scale to cases like (36):

(36) [[The boy and the girl] who are brothers] smile to the camera.

The data are also uniform with regard to collective readings. For example, intransitive collective verbs like *meet* and *collide* only apply to pluralic subject arguments. Thus the sentences in (37) describe a situation in which a collection of individuals met:

$$\text{(37)} \left\{ \begin{array}{l} \text{The boys} \\ \text{A boy and a girl} \end{array} \right\} \text{met in the yard.}$$

A plural NP like *Several boys* denotes a collection of at least two individuals. This can be modeled as a set of domain elements like $\{i_1, i_2, i_3\}$, or equivalently, as a sum of atomic elements from a Boolean domain such as $i_1 \vee i_2 \vee i_3$. In the brief exposition that follows I will use the set notation for clarity, but in the actual account put forth in §4.2 I use sums and not sets. Crucially, this kind of NP can obtain the same distributive and collective readings that a coordinate NP like *A boy and a girl* can obtain. As such, it is natural to assume that conjunction forms a plurality from each conjunct as discussed in Chapter 3. More specifically, if the NP *a boy* refers to some individual i_1 and the NP *a girl* refers to some individual i_2 then the NP *A boy and a girl* refers to $\{i_1, i_2\}$.

As a consequence, it follows that *two boys and two girls* forms a plurality composed of pluralities, e.g. $\{\{i_1, i_5\}, \{i_2, i_6\}\}$. At this point one should consider if there is independent evidence for the existence of layered pluralities. Such evidence was first noted in Link (1984) and Landman (1989). Consider for example the two possible interpretations of (38). In one reading the total of boys and girls got together (a collective reading) and in another reading there were two distinct gatherings (an *intermediate group reading*). In the latter case, the gatherings may have taken place in different locations or in different points in time.

(38) The boys and the girls met in one side of the fence.

Below I provide some of the classical examples given to show that conjunction can yield structured entities:

(39) a. [The red cards and the blue cards] have been shuffled.

b. [The boys and the girls] were separated.

c. [The landlords and the tenants who hate each other] argued endlessly.

d. [Blücher and Wellington] and [Napoleon Bonaparte] fought against each other.

The intermediate group reading shows that the information about the structure of each conjunct is not lost when the plurality is formed. The collective reading shows that the collective verb predicate can neglect the structure of the plurality, and apply to the total of atoms embedded therein. Distributive predicates also share this property. In (36) or in *The boys and the girls smiled* the only thing that is relevant for the matrix verb is the total set of atomic individuals.

Note also that the same pluralic argument can be simultaneously interpreted with a full collective reading, an intermediate group reading, and a distributive reading. Consider the example in (40), adapted from Landman (1989):

(40) The boys and the girls had to sleep in different dorms, congregated in the morning at breakfast, and were then wearing their blue uniforms.

The relevant reading of (40) is one in which the collective predicate *congregate* is true of the entire collection of individuals, the predication *sleep in different dorms* applies to the boys and the girls separately, and finally the distributive predicate *wearing* predicates over each atomic individual.

Further evidence for the existence of structured pluralities is found in the distribution of the correlative *both*, as noted in Lasersohn (1988). While *both* required conjunctions that contain exactly two conjuncts, plural conjuncts are felicitous, which suggests that these conjunctions have only two members, albeit non-atomic ones:

(41) a. Both the boys and the girls protested
b. In contrast, both [[Avery] and [Jones and Thomas]] need extra statements in their grammars to make the distinction.

Traditionally, the various readings that NP coordination can obtain is handled by assuming that conjunction is many-ways ambiguous, as in Link (1998b, 30), Landman (2000, 162–164), Carpenter (1997, 323) and many others. For example, Carpenter assumes that the conjunction of two NPs can be interpreted in four different ways:[11]

(42)
$$x \oplus y = \begin{cases} \{x\} \cup \{y\} \\ \{x\} \cup y \\ x \cup \{y\} \\ x \cup y \end{cases}$$

This non-uniformity is undesirable. There is no good reason why conjunction cannot systematically form one and the same kind of pluralic entity, as I have proposed.

The existence of intermediate group readings also has an effect on the model theory. There are many competing views on the formalization of logics for natural language pluralities, ranging from first-order approaches such as Link (1983), to higher-order approaches as in Landman (1989) or Carpenter (1997). Usually the matter is taken to be not so much linguistic, but rather a philosophical and a mathematical one, given that

[11]The actual definition is more complex as it also contains type-functional conditions. These were omitted for exposition purposes.

higher order logics can in general be recast back into first-order by using generalized models (also known as Henkin models).[12] Linguistically, the move towards higher-order structures is usually motivated by the existence of intermediate group readings. The question is then, how much structure does one really need for capturing conjunctive pluralities. The adoption of groups in the logic of pluralities can become formally very complex and somewhat redundant, as discussed in Hoeksema (1988), Krifka (1991), Link (1998b, 30), and Landman (2000, 162–164). Take for instance the case in Landman (1989, 84). The domain A_ω for the model is based on a set of atoms A and is defined inductively with the powerset of the preceding class, as follows:

(43)
$$\begin{aligned} A_0 &= A \\ A_{n+1} &= \wp(A_n) \setminus \{\emptyset\} \\ A_\omega &= \wp(\textstyle\bigcup_{m<\omega} A_m) \setminus \{\emptyset\} \end{aligned}$$

Landman then takes the domain of predicates to be A_ω. Note that ω is infinite, as it corresponds to the ordinal number of the set of natural numbers.[13] It is hard to make sense of this kind of approach in computational and in psycholinguistic terms, given that the combinatorial explosion for the possible denotations is enormous, even for very small domains and only a few iterations of group formation. Consider for instance a tiny model with two individuals, say John and Mary, we have $A = \{j, m\}$. According to the above definition, A_1 is the power set of A, that is, the set of all sets of A. Thus, $A_1 = \{\{j\}, \{m\}, \{j, m\}\}$. This is essentially Link's lattice domain, but because group formation can apply iteratively to these elements, the next set in the hierarchy is again the powerset of A_1. Thus $A_2 = \{\{\{j\}\}, \{\{m\}\}, \{\{j, m\}\}, \{\{j\}, \{m\}\}, \{\{j\}, \{j, m\}\}, \{\{m\}, \{j, m\}\}, \{\{j\}, \{m\}, \{j, m\}\}\}$ and so on, for all natural numbers. In this particular example with $A = \{j, m\}$ the set A_3 will have approximately $2^{33\,000}$ members.

The groups proposed in Link (1984) are much simpler because they cannot iterate. But if no iteration is possible then the account predicts that conjunction is bounded in the sense that second order groups are not possible. I believe that this is correct. Consider the sentence in (44) with the bracketing indicating the syntactic and prosodic nesting of the coordinate structures:

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[12] For a formal discussion and comparison of various different approaches see Lønning (1997). Mckay (2006, 36–42) offers a number of reasons for rejecting mereology which are misguided. The problem with the arguments is that they hinge more on Link's philosophical views than on the actual mathematical formalization, which leads to a misrepresentation of Link's theory.

[13] This formulation is based in Hoeksema (1983), where the recursion is not transfinite.

(44) The four colors were chosen so that [the circles and the squares] and [the rectangles and the triangles] matched.

This sentence can mean several things. The preferential reading is one in which circles and squares have one set of matching colors, and rectangles and triangle have another set of matching colors. This is the intermediate group reading, which is obtained by predicating over each of the bracketed conjuncts. The second reading is the one in which all figures match (collective interpretation).

What the sentence cannot mean is that circles had one matching color, squares had another matching color, and so on. It is not easy to construct an example where the latter interpretation cannot arise because of verbal ellipsis, e.g. [*The circles and the squares*] ~~*matched*~~ *and* [*the rectangles and the triangles*] *matched*. I believe this is a shortcoming of previous attempts to establish if second-order pluralities are needed or not, as for instance Lønning (1989) and Krifka (1991). Not only do the examples discussed therein lend themselves to an ellipsis analysis, but they are also very difficult to process. This makes it hard to draw conclusions from them. For completeness, the example from Krifka (1991) is reproduced below with its intended meaning:

(45) Mary and John and Lisa and Stefan, and Ann and Bill and Steffi and Boris, are similar in that they practice partner-swapping.

(Mary and John and Lisa and Stefan are similar to Ann and Bill and Steffi and Boris insofar as Mary and John practice partner-swapping with Lisa and Stefan, and Ann and Bill practice partner-swapping with Steffi and Boris)

I believe that the question about the need for higher-order entities is therefore answered in the negative by examples like (44).

Proponents of the indeterminancy/vagueness analysis like Schwarzschild (1990,1996) and others have offered a different interpretation of the intermediate group readings. The claim is that conjunction always yields a flat and homogeneous plurality, but that upon interpretation the plurality can be partitioned in many different ways. This is done via a second-order operation, a *cover* or some kind of *partition*, which splits the individuals in a number of (possibly overlapping) ways. We have seen in §4.1.1 that such an analysis allows for a combinatorial explosion of impossible readings.[14]

[14] Mckay (2006, 88–92) argues that neither covers nor structured pluralities are needed, and that context alone suffices to determine what kinds of subdivisions are in place. No actual account is given for how exactly context is to achieve this.

I argue that intermediate group readings should really be regarded as a kind of distributive reading. They do not pertain to the meaning of the NP, but rather to the semantic import of the verb. Thus the same coordinate NP can have an intermediate reading while at the same time having a full collective reading. For example, one of the readings for (46) pertains to a single gathering event in which hatred is openly displayed between the two political factions:

(46) The republicans and the democrats who are gathered in this room really hate each other.

The intermediate group reading can also trigger scope ambiguities, similarly to standard distributive readings previously discussed. In the example given below either each team met in a separate corner of the playing field or all the players converged to the same corner. The continuations shown below make each of these readings more prominent.

(47) Before the game, the blue players and the red players met in a corner of the playing field (to settle their differences / to discuss their strategies).

Of course, mixed predicates allow for the full range of ambiguity. In (48a) one can imagine a team effort in a strongman competition in which each pair of men collaborates in lifting the barbell (intermediate group reading), or that four individuals have to collaborate in order to position the barbell properly (full collective reading), or that each athlete lifted the barbell by himself (distributive reading).

(48) a. Two Russian athletes and two American athletes lifted this barbell.
b. These men and these women hired the detective I was telling you about.
c. Two associates and three collaborators earned exactly $10.000.
d. The boxes and the bags weigh more than 20lbs.
e. These tables and these chairs cost $600.

As expected, given the presence of other scopal elements, scope ambiguities can arise in either of the two kinds of distributive reading:

(49) a. The owners and the tenets hired a lawyer.
b. Two Russian athletes and two American athletes lifted a huge barbell.

Let us take stock of the foregoing discussion:

- Conjunction preserves structural information about the conjuncts.
- The complex pluralities that conjunction yields are generally not interpreted directly in the extension of predicates. No collective predicate seems to denote sets of sets of sets of atoms, and so on. Thus, there is no reason for having arbitrarily complex pluralities in the model and conjunction should be ontologically neutral.

One possibility is that conjunction forms pluralities *on-line*, as the meaning of the utterance is processed. Put informally, in a coordinate structure like $[$*Tom, Sue and Kim*$]^x_{NP}$ the referent x introduced by the conjunction lexeme starts out by denoting $\{\}$. As each conjunct is processed, their respective referential arguments are required to be members of the plurality. Thus, x is updated to $\{tom\}$, then to $\{tom,\ sue\}$ and finally to $\{tom,\ sue,\ kim\}$. Thus, the phenomenon of non-intersective conjunction is a purely dynamic mechanism and there is no need to make the model arbitrarily complex. Nothing here hinges on the notion of set, one might as well use a list data structure for the same purpose.

From the perspective of predicates taking arguments, business is as usual: collective verbs contain pluralities in their denotation, and distributive verbs contain atomic individuals. The question now is how the range of readings discussed above is obtained.

I thus propose that there are three different ways in which a nominal argument can be interpreted, captured in terms of three different relations (where y is the argument that the verb applies to, x is the argument that the NP contributes, and l is the argument slot where the verbal subordination is plugged in):

(50) a. $D_a(y, x, l)$

b. $=_a (y, x, l)$

c. $D_m(y, x, l)$

The relation in (50a) is *atom distribution*, used for distributive readings. This is a kind of distribution that ranges only over the atoms y that exist in a plurality x, no matter how complex x is. The relation in (50b) is *atom base equality*, and is used for collective readings. In this case the value of y is the collection of atoms that exist in x, no matter how complex x is. Finally, *member distribution* in (50c) is essentially set membership, and will be used for obtaining intermediate group readings, for instance.

Atom distribution and atom base equality both resort to an ancillary function $AT(x)$, that yields the collection of atoms in the plurality (the *atom base*). For example, if the value of x is $\{\{i_1, i_2\}, \{i_1, i_2\}\}$, then $[\![AT(x)]\!] = \{i_1, i_2, i_1, i_2\}$. If the value of x is $\{i_1, i_2\}$, then $[\![AT(x)]\!] = \{i_1, i_2\}$. Finally, if the value of x is an atom i_1 then $[\![AT(x)]\!] = i_1$. The three relations can thus be defined as follows (See §4.2 for the final version of these definitions):

(51) Definitions (preliminary)

a. $[\![D_a(y, x, \phi)]\!] = 1$ *iff* $[\![\forall y(y \in AT(x) \rightarrow \phi)]\!]$

b. $[\![=_a (y, x, \phi)]\!] = 1$ *iff* $[\![\exists y(y = AT(x) \wedge \phi)]\!]$

c. $[\![D_m(y, x, \phi)]\!] = 1$ *iff* $[\![\forall y(y \in x \rightarrow \phi)]\!]$

Distributive predicates are compatible with both D_a and $=_a$, collective predicates are compatible with both $=_a$ and D_m, and mixed predicates are compatible with all three possibilities. The predicate names D_a, $=_a$, and D_m are taken to be types in a polymorphic type hierarchy in Figure 4.4:

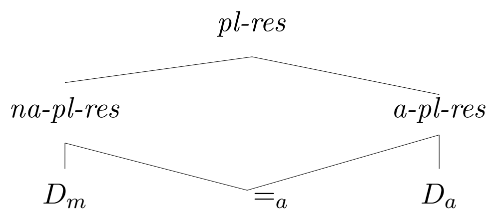


Figure 4.4: Type hierarchy of plural resolutions

The type *na-pl-res* encompasses the possible non-atomic predications, while the type *a-pl-res* covers the cases of atomic predication. Let us consider some illustrative examples.

Collective verbs like *gathered* require at least one pluralic argument and denotes nominal pluralities only, with respect to that argument. Accordingly, the lexical semantics of the verb includes an underspecified relation of the type *na-pl-res*. The hierarchy given above indicates that the type *na-pl-res* can be further instantiated either as membership distribution 'D_m' or as equality '$=_a$'. The former possibility enables intermediate group readings and the latter enables collective readings. The semantic components lexically associated to this verb are depicted below in Figure 4.5.[15]

[15]The depiction of the NP argument l_1 is included in the MRS representation for perspicuity.

$$\begin{tikzcd}
l_1{:}Qx\ (\ldots,l_3) & & \\
& l_5{:}\ \mathit{na\text{-}pl\text{-}res}(y,x,l_6) \arrow[ul, dashed] & \\
& & l_4{:}\exists e\, \mathit{gather}(e,y) \arrow[ul, dashed]
\end{tikzcd}$$

Figure 4.5: Depiction of the lexical semantic components of *gathered*

If the NP argument is a simple plural, like *several young kids*, then *na-pl-res* can only be felicitously resolved as $=_a$ as in (52). The D_m resolution is not felicitous for the same reason that *a kid gathered* is not felicitous: the collective predicate does not contain atoms in its denotation. On the other hand, if the NP is a complex plurality then it can either be resolved as $=_a$ or as D_m as illustrated in the corresponding first-order logic representations in (53).

(52) a. The boys gathered.

b. $\exists x(boys(x) \wedge =_a(y, x, \exists e\ gather(e, y)))$

(53) a. The boys and the girls gathered.

b. $\exists x((\exists x_1(boys(x_1) \wedge x_1 \in x) \wedge \exists x_2(girls(x_2) \wedge x_2 \in x)) \wedge =_a(y, x, \exists e\ gather(e, y)))$

c. $\exists x((\exists x_1(boys(x_1) \wedge x_1 \in x) \wedge \exists x_2(girls(x_2) \wedge x_2 \in x)) \wedge D_m(y, x, \exists e\ gather(e, y)))$

The same lexical entry can capture all the above possibilities, via type-underspecification of the plural resolution relation. Past form distributive verbs like *smiled* are compatible with both singular and plural subjects, and only apply to atoms. Thus they introduce an underspecified relation of the type *a-pl-res*, which allows the same lexical entry to handle both singular and pluralic arguments in a uniform way:

$$
\begin{array}{lll}
l_1{:}Qx\ (\ldots, l_3) & & \\
\quad\quad\quad\ \uparrow & & \\
 & l_5{:}\ \textit{a-pl-res}(y, x, l_6) & \\
 & \quad\quad\quad\quad\quad\quad\ \uparrow & \\
 & & l_4{:}\exists e\ \textit{smile}(e, y)
\end{array}
$$

Figure 4.6: Depiction of the lexical semantic components of *smiled*

For example, if the subject is singular then *a-pl-res* can only be resolved as equality:

(54) a. Each boy smiled.

b. $\forall x(boy(x) \rightarrow =_a (y, x, \exists e\ smile(e, y)))$

The distributive resolution D_a is not possible because it requires that x is pluralic. However, if the subject is pluralic then the only felicitous resolution is the distribution D_a, since distributive predicates denote atoms, not pluralities. Consider two examples of varying complexity:

(55) a. The boys smiled.

b. $\exists x(boys(x) \wedge D_a(y, x, \exists e\ smile(e, y)))$

(56) a. The boys and the girls smiled.

b. $\exists x((\exists x_1(boys(x_1) \wedge x_1 \in x) \wedge \exists x_2(girls(x_2) \wedge x_2 \in x)) \wedge D_a(y, x, \exists e\ smile(e, y)))$

The lexical entry for a past form like *hired* imposes no agreement constraints on any of the arguments. As such, the corresponding lexical entry is very general and can handle both pluralic and singular arguments as seen in Figure §4.7. Each of these *pl-res* relations can be resolved as '$=_a$', 'D_a', or as 'D_m', as described above. The main difference is that mixed predicates can denote atoms and pluralities, and thus all three kinds of plural resolutions are in principle available.

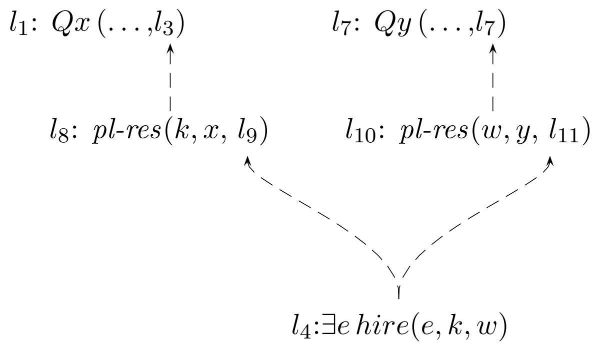


Figure 4.7: Depiction of the lexical semantic components of *hired*

Furthermore, the relative scope between the *pl-res* relations and the NP arguments is underspecified, so that a distributive reading of one NP allows for narrow or wide scope readings of the other NP. The present account thus allows the same lexical entry to accommodate singular and pluralic arguments in a uniform way. This is achieved via lexical underspecification of the plural ambiguity while at the same time allowing for the verb arguments to remain scopally underspecified. In subsequent chapters the kinds of readings that all of these verbs obtain will be discussed in more detail.

The *pl-res* relations proposed above contain a free variable that clashes with the assumption that MRS representations must not contain free variables after scope disambiguation. But in fact, the value of said free variables is defined in terms of the variable introduced by the NP argument as seen in (51). Thus, the MRS scope resolution algorithm should allow for the existence of free variable in *pl-res* relations without prejudice for the scope disambiguation procedure.

4.2 A Plural Logic with Dynamic Conjunction

I have argued that the pluralities that conjunction yields are best seen as dynamic entities rather than domain entities perceived as part of the world. Not only does this offer a computationally more tractable approach, it also offers a account which is superior in cognitive grounds because a massive (in some cases, infinite) combinatorial explosion is straightforwardly avoided. In what follows I provide a logical fragment and a model theory based on a mereological first-order framework. It is first-order in the sense that conjoined pluralities are ontologically vacuous, and have no persistent role in semantic interpretation.

I start by laying down the variables of the language and the syntax of the formulas:

(57) DEFINITION 1 *(Variables)*

Let V_i be the set of individual variables $\{x_1, x_2, ...\}$ and Let V_e be the set of event variables $\{e_1, e_2, ...\}$. The set VAR is $V_i \cup V_e$.

Let V_i^c be the set of conjunctive individual variables $\{x_1^c, x_2^c, ...\}$, and V_e^c the set of conjunctive eventuality variables $\{e_1^c, e_2^c, ...\}$. The set VAR^c is $V_i^c \cup V_e^c$.

I refer to variables generically, without committing to their types, as v, and to v^c to mean that $v \in$ VAR^c.

The sort of a given variable (individual or eventuality) will be accessible from the types in the HPSG grammar signature, in the feature [INDEX *index*], as discussed in Chapter 5. The variables in V_i are introduced by nominal determiners (*some*, *various*, *each*, etc.), while the variables in V_e correspond to eventualities introduced by non-nominal categories. The variables from VAR^c are exclusively reserved for the plurality referents introduced by the non-intersective conjunction lexeme *and*. Note that some relations are only defined for VAR variables, others are neutral, and others still are only defined for VAR^c variables.

(58) DEFINITION 2 *(Syntax)*

(a). If $v_1 \dots v_n$ are variables from VAR and if P is an n-place predicate, then $P(v_1 \dots v_n)$ is a formula

(b). If ϕ and ψ are formulas then $\phi \wedge \psi$, $\phi \vee \psi$, and $\phi \rightarrow \psi$ are formulas

(c). If ϕ is a formula, then $\neg\phi$ is a formula

(d). If ϕ is a formula, and v is a variable then $\exists v\, \phi$ and $\forall v\, \phi$ are formulas

(e). If ϕ is a formula, and v_1 and v_2 are variables then $D_a(v_1, v_2, \phi)$, $D_m(v_1, v_2, \phi)$, and $=_a (v_1, v_2, \phi)$ are formulas

(f). If v_1 and v_2 are variables from VAR, then $v_1 = v_2$ and $v_1 \preceq v_2$ are formulas

(g). If v_1 and v_2^c are variables, and v_2^c is from VAR^c $v_1 \in v_2^c$ are formulas

(h). If v is a variable and n is a numerical expression, then *cardinality*(v, n) and *at-least*(v, n) are formulas

(i). Nothing else is a formula.

Let us now consider the interpretation structures. A Boolean model structure for individuals is a tuple $\mathcal{I} = \langle I, A_I \rangle$ where I is a complete atomic Boolean algebra with

$\emptyset$ being the zero element of I, with A_I as the set of its individual atoms, $\vee_i$ as its join operation, and $\subset_i$ as its intrinsic ordering operation. An identical Boolean model for events is defined the same way, as a tuple $\mathcal{E} = \langle E, A_E \rangle$ with the respective join and ordering operations.

(59) DEFINITION 3 *(Model and Assignments)*

(a). A model for DPPL (Dynamic Plural Predicate Logic) is an ordered structure $\mathcal{M} = \langle \mathcal{I}, \mathcal{E}, N, F \rangle$, where N is a function that maps proper names to their bearers in A_I, and where the interpretation function F maps n-place predicate names to n-place relations: $F(\alpha) \subseteq E \times (I \setminus \{\emptyset\})^n$.

(b). An assignment function g is a function that maps variables in V_i to elements from $I \setminus \{\emptyset\}$ and variables in V_e to elements from $E \setminus \{\emptyset\}$. Conjunctive variables on the other hand, are mapped to subsets of their respective domains: a variable from V_i^c is mapped to a subset of I and a variable from V_e^c is mapped to a subset of E.

I will use $g[v]g'$ to state that the assignment g' extends the assignment g with regard to the variable v, i.e. $g \subseteq g'$ and $domain(g) = domain(g') \cup \{v\}$.

The case of V_i and V_e is standard, for example: $g(x) = i_k$ where $i_k \in I$ and $g(e) = e_n$ where $e_n \in E$. The case of conjunctive variables is different, however, as they are mapped into subsets of the Boolean domain. For example, a possible output evaluation for the NP *A man and two friends* could be $g(x^c) = \{i_1, i_4 \vee_i i_5\}$ where $\{i_1, i_4 \vee_i i_5\} \subseteq I$.

The function $AT_{\mathsf{b}}(v)$ previously discussed in §4.1.2 is defined below in (60). This function always outputs a join of domain elements. If the input is a set of elements, the *atomic base* is computed by obtaining the join (either the individual join $\vee_i$ or the eventuality $\vee_e$) of the members:

(60) Function AT_{b}

$$AT_{\mathsf{b}}(\alpha) = \begin{cases} \alpha_1 \vee ... \vee \alpha_n & : \alpha = \{\alpha_1, ..., \alpha_n\} \\ \alpha & : \alpha \subset_i I \text{ or } \alpha \subset_e E \end{cases}$$

The interpretation function ${}_{g1}[\![\cdot]\!]^{\mathcal{M}}_{g2}$ takes as input an assignment function g_1 and outputs an assignment function g_2. In DEFINITION 4.1 the interpretation conditions for various components of the logical fragment are provided, with the exception of the conditions that concern VAR^c formulas, which are defined later in DEFINITION 4.2.

The object language operator 'ϵ' corresponds to set membership, '&' corresponds to conjunction, and '$\Rightarrow$' to the conditional. Other object language operators will not be distinguished from the target language operators, whenever their usage is clear. The definitions in 4.1 are for the most part very similar to the Dynamic Predicate Logic in Groenendijk and Stokhof (1991).

(61) DEFINITION 4.1

(a). ${}_{g1}[\![P(v_1,\ldots,v_n)]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $\langle g_1(v_1),\ldots,g_1(v_n)\rangle \,\epsilon\, F(P)$

(b). ${}_{g1}[\![\phi \wedge \psi]\!]^{\mathcal{M}}_{g2}$ *iff* $\exists g_3({}_{g1}[\![\phi]\!]^{\mathcal{M}}_{g3}$ & ${}_{g3}[\![\psi]\!]^{\mathcal{M}}_{g2})$

(c). ${}_{g1}[\![\phi \vee \psi]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $\exists g_3({}_{g1}[\![\phi]\!]^{\mathcal{M}}_{g3}$ or $\exists g_3\ {}_{g1}[\![\psi]\!]^{\mathcal{M}}_{g3})$

(d). ${}_{g1}[\![v_1 = v_2]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $g_1(v_1) = g_1(v_2)$

(e). ${}_{g1}[\![\phi \rightarrow \psi]\!]^{\mathcal{M}}_{g2}$ *iff* $\forall g'({}_{g1}[\![\phi]\!]^{\mathcal{M}}_{g'} \Rightarrow \exists g_2\ {}_{g'}[\![\psi]\!]^{\mathcal{M}}_{g2})$

(f). ${}_{g1}[\![\neg\phi]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $\neg\exists g'\,{}_{g1}[\![\phi]\!]^{\mathcal{M}}_{g'}$

(g). ${}_{g1}[\![\exists v\,\phi]\!]^{\mathcal{M}}_{g2}$ with v in VAR *iff* $g_1[v]g_2$ & ${}_{g1}[\![\phi]\!]^{\mathcal{M}}_{g2}$

(h). ${}_{g1}[\![\forall v\,\phi]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $\forall g_3\,(g_1[v]g_3 \Rightarrow \exists g_4\ {}_{g3}[\![\phi]\!]^{\mathcal{M}}_{g4})$

(i). ${}_{g1}[\![cardinal(v,n)]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $|g_1(v)| = n$

(j). ${}_{g1}[\![\textit{at-least}(v,n)]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $|g_1(v)| \geq n$

(k). ${}_{g1}[\![v_1 \preceq v_2]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $g_1(v_1)\epsilon A_I$ & $g_1(v_1) \subset_i g_1(v_2)$

The definitions in (i) and (j) correspond to cardinality conditions that numeral expressions such as *twenty* and certain determiners can introduce. The predicate $cardinal(v,n)$ thus means that the variable v contains n members, $\textit{at-least}(v,n)$ means that the variable v contains n or more members. Note that the cardinality function '$|\cdot|$' is polymorphic, and applies both to joins and to sets, e.g. $|i_1 \vee i_2 \vee i_3| = |\{i_4, i_6, i_7\}| = 3$.

The relation '$\preceq$' in (k) is interpreted as the partial order relation $\subset_i$, and holds between an atom of the domain of individuals A_I and the full domain of individuals $\mathcal{I}$. As a special case, note that $[\![x \preceq y]\!]$ is true if $g(x) = g(y)\,\epsilon\, A_I$. This will be necessary for a uniform and systematic account of the semantics of pluralized nouns, to be discussed in §6.3 in more detail.

The satisfaction conditions in DEFINITION 4.1 do not specify what happens in the case of existentially quantified conjunctive variables v^c, nor how the membership relations '$v \in v^c$' are evaluated. These cases are formalized in DEFINITION 4.2 below. For this purpose I will use a shorthand notation for the notion of *assignment update*. I will write $g' := \mathsf{upd}(g, v, a)$ to mean that the assignment functions g and g' differ only in the value of v so that $g(v) \neq g'(v) = a$. In other words, the function $\mathsf{upd}(g, v, a)$ is a shorthand for $g' = (g \setminus \{(v, b)\}) \cup \{(v, a)\}$ for whatever value b is assigned to v in g.

Below, DEFINITION 4.2 specifies that the evaluation of $[\exists v^c(\phi)]$ amounts to assigning the empty set to the variable v^c. Next, the membership relations '$v \in v^c$' – which are introduced for each conjunct in a coordination structure – dynamically extend the set with the value of v:

(62) DEFINITION 4.2 *(Dynamic Conjunction)*

(m). $_{g_1}[\![\exists\, v^c\, \phi]\!]^{\mathcal{M}}_{g3}$ *iff* $\exists g_2\, g_2 := \mathsf{upd}(g_1, v^c, \emptyset)$ & $_{g2}[\![\phi]\!]^{\mathcal{M}}_{g3}$

(n). $_{g_1}[\![v_1 \in v^c_2]\!]^{\mathcal{M}}_{g_2}$ *iff* $\exists g_2\ g_2 := \mathsf{upd}(g_1, v_1, g_1(v^c_2) \cup \{AT(g_1(v_1))\})$

The satisfaction condition in (m) states that the value of v^c variables is not taken from the domain. Rather, it is initialized with the empty set. The case in (n) states that $v \in v^c$ causes the value of v^c to be updated with the atomic base of v. The usage of the AT function guarantees that higher-order sets like $\{..., \{...\}, ...\}$ are never construed. Thus, if $[\textit{some girls}]^{x1}_{NP}$ has $g_1(x_1) = i_2 \vee_i i_7$ and if $[\textit{a boy}]^{x2}_{NP}$ has $g_2(x_2) = i_3$, then the coordination $[\textit{some girls and a boy}]^{x}_{NP}$ denotes a doubleton set: $g_3(x) = \{i_2 \vee_i i_7\, , i_3\}$.

Finally, DEFINITION 4.3 specifies how the plural resolution relations introduced by predicates are interpreted:

(63) DEFINITION 4.3

(o). $_{g1}[\![=_a (v_1, v_2, \phi)]\!]^{\mathcal{M}}_{g3}$ *iff* $\exists g_2\, (g_1[v_1]g_2\ \ \&\ \ g_2(v_1) = AT(g_2(v_2))\ \&\ {}_{g2}[\![\phi]\!]^{\mathcal{M}}_{g4})$

(p). $_{g1}[\![D_m(v_1, v^c_2, \phi)]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ &
$\forall g_3\, (g_1[v_1]g_3\ \ \&\ \ g_3(v_1) \in g_3(v^c_2)\ \Rightarrow\ \exists g_4\ {}_{g3}[\![\phi]\!]^{\mathcal{M}}_{g4})$

(q). $_{g1}[\![D_a(v_1, v_2, \phi)]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ &
$\forall g_3\, (g_1[v_1]g_3\ \ \&\ \ g_1(v_1) \in A_I\ \ \&\ \ g_1(v_2) \not\in A_I\ \ \&$
$g_1(v_1) \subset_i AT(g_1(v_2))\ \Rightarrow\ \exists g_4\ {}_{g3}[\![\phi]\!]^{\mathcal{M}}_{g4})$

In (o) is it stated that atom base equality is satisfied if there is an assignment extension with respect to v_1 such that the value of v_2 is the atom base of v_1 and ϕ is satisfied. This is relevant for various cases, given that all predicates in the lexicon will be compatible with this equality predication. I briefly illustrate this with some examples.

- The verb *smiled* can take both singular a pluralic subjects. Consider the case in which it takes a singular NP^x subject like *a boy*, where $g(x) = i_1$. The AT equality relation allows the predicate to apply directly to that individual: $AT(g(x)) = i_1$. If the NP is pluralic however, then equality cannot apply felicitously because distributive predicates do not denote pluralities.

- Consider now the collective readings that can be obtained by a verb like *gathered*. If the subject is $[Two\ kids]^x_{NP}$ then the verb predicate can apply to the collection of two kids because $g(x) = AT(g(x)) = i_1 \vee_i i_2$ (for some plurality of kids $i_1 \vee_i i_2$). In the case of a more complex subject such as $[A\ boy\ and\ a\ girl]^x_{NP}$, the verb can again predicate over the collection of two kids given that $g(x) = \{i_1, i_2\}$ and $AT(g(x)) = i_1 \vee_i i_2$. Finally, in more complex cases involving plural conjuncts like $[a\ boy\ and\ two\ girls]^x_{NP}$ where $g(x) = \{i_1 \vee_i i_2, i_3 \vee_i i_4\}$ the verb can apply to $i_1 \vee_i i_3 \vee_i i_4$ given that $AT(g(x)) = i_1 \vee_i i_2 \vee_i i_3 \vee_i i_4$.

- In the case of mixed predicates the AT equality allows both of the above cases: direct predication of an atomic argument or a collective reading obtained with the atom base of an arbitrarily complex pluralic argument.

In (p) from Definition 4.3 defines set membership. Every assignment extension for v_1 in which v_1 is a member of the set v_2 must satisfy ϕ. This is relevant for obtaining intermediate group readings. For example, assume that a coordination [*a teacher, some girls, and some boys*]$^x_{NP}$ denotes a set with two pluralic members, e.g. $g(x) = \{i_4,\ i_2 \vee_i i_7\ ,\ i_1 \vee_i i_3\}$. Each of the three members can be picked up by 'D_m' as standard set membership.

The case in (q) defines atomic membership. This kind of membership ranges over the atoms in v_2, no matter how complex the plurality is. The value of v_1 is required to be a member of the set A_I of atoms of the domain and the value of v_2 is required to be a plurality, flattened via AT. This relation allows a distributive verb such as *smiled* to apply to atoms only, regardless of how complex the NP argument is. Consider for instance a plural NP like [*Some kids*]^x. Let us assume that $g(x) = i_1 \vee_i i_2$. Then, $\forall y(y \in_a x \rightarrow ...)$ can pick up each of the two atoms because trivially $AT(g(x)) = i_1 \vee_i i_2$. In the case of $[A\ boy\ and\ a\ girl]^x$ something very similar occurs: $g(x) = \{i_1, i_2\}$ and $AT(g(x)) = i_1 \vee_i i_2$. Finally, although $[Two\ boys\ and\ two\ girls]^x$ yields a complex plurality such as $g(x) = \{i_1 \vee_i i_2, i_3 \vee_i i_4\}$, the distribution can range over the atoms in $i_1 \vee_i i_2 \vee_i i_3 \vee_i i_4$ because $AT(g(x)) = i_1 \vee_i i_2 \vee_i i_3 \vee_i i_4$.

4.2.1 On Cumulative Readings

The traditional analysis of cumulativity consists in a special interpretation rule as in Kroch (1974, 205) or as a meaning postulate as in Scha (1981, 497). In both cases a collective predicate P that takes two arguments is interpreted as follows:

(64) $P(X,Y) = (\forall x \in X \wedge \exists y \in Y \wedge P(x,y)) \wedge (\forall y \in Y \wedge \exists x \in X \wedge P(x,y))$

However, it is not clear how this approach can be scaled to data like (65), where cumulativity arises in the presence of intransitive predicates and their adjuncts. For example, in (65a) different cities may have been where only certain customers protested with certain letters.

(65) a. In six cities, twenty customers protested with four open letters.
b. Five alarms malfunctioned in two locations, causing four accidents.
c. Nine people were arrested traveling in four cars, with three kilos.

Roberts (1987) argues that one does not need to generate cumulative readings because they can be reduced to (double) collective readings. I agree with this position. Since we have mereologic domains for both individuals and eventualities, the interpretation of n-place predicates can be reformulated so that cumulative readings can also be obtained. Consider the revised truth-conditional definition in (66). Below, the target language operator $\bigvee$ is used here to abbreviate the join of the set members: $\bigvee\{a,b,c\} = a \vee b \vee c$.

(66) $$\begin{aligned} {}_{g1}[\![P(v_1,...,v_n)]\!]^{\mathcal{M}}_{g2} \ \textit{iff} \quad & g_1 = g_2 \ \& \\ & M = \{\langle a_1,...,a_n\rangle : \langle a_1,...,a_n\rangle \in F(P) \ \& \\ & \qquad a_1 \subset g(v_1) \ \& \ ... \ \& \ a_n \subset g(v_n)\} \ \& \\ & \bigvee\{a_1 : \langle a_1,...\rangle \in M\} = g_1(v_1) \ \& \\ & \qquad \vdots \\ & \bigvee\{a_n : \langle ...,a_n\rangle \in M\} = g_1(v_n) \end{aligned}$$

A set M is assembled containing tuples found in the denotation of the verb predicate. These tuples are required to contain the mereological parts denoted by the arguments of the predicate. The equality constraints at the end of the definition ensure that all the mereological parts satisfy the predicate at least once.

Let us go through some examples. I start by showing how direct predication is obtained, then proceed to show how cumulative readings can be captured.

- **Direct Predication**

  Suppose that the sentence in question is *A person wrote a letter*, represented as $\exists x\,(person(x) \wedge \exists y\,(letter(y) \wedge \exists e\,write(e,x,y)))$. Assume also that $g(e) = e_1$ is an eventuality, $g(x) = i_3$ is a person, and that $g(y) = i_4$ is a letter.

  Take the denotation of *write* to be $F(write)= \{\langle e_1, i_1, i_2\rangle, \langle e_2, i_1, i_3\rangle, \langle e_3, i_3, i_4\rangle\}$. This means that there are three events in which things were written by someone, one of which, e_3, involves exactly one person and one letter.

  Given the above definition, $[\![write(e,x,y)]\!]$ yields $M = \{\langle e_3, i_3, i_4\rangle\}$ because $i_3 \subset i_3$ and $i_4 \subset i_4$, and $\langle e_1, i_3, i_4\rangle \,\epsilon\, F(write)$. The evaluation succeeds because the cardinality conditions are also satisfied: since $\bigvee\{e_1\} = e_1$ then $e_1 = g_1(e)$. Similarly, $\bigvee\{i_3\} = i_3 = g_1(x)$, and $\bigvee\{i_4\} = i_4 = g_1(y)$.

  A collective reading is obtained basically in the same way. Suppose that the sentence in question is *Three people gathered outside*, and that $g(e) = e_1$ is a eventuality and $g(x) = i_1 \vee_i i_2 \vee_i i_3$ is the subject plurality. If $\langle e_1, i_1 \vee_i i_2 \vee_i i_3\rangle \,\epsilon\, F(gather)$ then M is again singleton and the predicate is evaluated as true.

  The cardinality constraints ensure that all elements assigned to a variable are present in the denotation of a predicate. Consider for example a case in which the sentence is false: $g(x) = i_1 \vee_i i_3 \vee_i i_3$ but only two people gathered: $\langle e_1, i_1 \vee_i i_2\rangle \,\epsilon\, F(gather)$. The satisfaction conditions fail because $\bigvee\{i_1 \vee_i i_2\} \neq g_1(x)$, since $\bigvee\{i_1 \vee_i i_2\} = i_1 \vee_i i_2$ and $g_1(x) = i_1 \vee_i i_3 \vee_i i_3$.

- **Vague Predication**

  A cumulative reading amounts to a case where M is not singleton, and the various tuples therein exhaust the members of the pluralic arguments of the verb. Put differently, a cumulative reading is one in which $g_1(e)$ maps into several situations.

  Suppose that the sentence in question is *Three people recognized two suspects*, and that $g(e) = e_1 \vee_e e_2 \vee_e e_3$ is a non-atomic eventuality, $g(x) = i_1 \vee_i i_2 \vee_i i_3$ is a plurality composed of people, and finally that $g(y) = i_4 \vee_i i_5$ is a plurality of suspects.

  Let us take the denotation of *recognize* as: $F(recognize)= \{\langle e_1, i_1, i_4\rangle, \langle e_2, i_2, i_4\rangle, \langle e_3, i_3, i_5\rangle, \langle e_4, i_5, i_4\rangle\}$. The last element of the extension is irrelevant for the evaluation of the sentence, and is just added for exposition purposes.

In this case we obtain $M = \{\langle e_1, i_1, i_4\rangle, \langle e_2, i_2, i_4\rangle, \langle e_3, i_3, i_5\rangle\}$. These are the only mereological parts of $g_1(e)$, $g_1(x)$, and $g_1(y)$ that are present in the denotation of the verb.

Taking the tuples together, it is also the case that the elements in each argument slot exhaust the plurality. For example, the join of the three eventualities in the first argument slot is $e_1 \vee_e e_2 \vee_e e_3$, which in turn satisfies the equality constraint $g(e) = e_1 \vee_e e_2 \vee_e e_3$. The case is similar for the other argument slots. All equality conditions are satisfied and the predicate is evaluated as true.

Note that if the assignment were $g(e) = e_9 \vee_e e_2$ or $g(e) = e_1 \vee_e e_2 \vee_e e_3 \vee_e e_4$ instead then the equality conditions would fail: $e_2 \neq g(e)$ and $e_1 \vee_e e_2 \vee_e e_3 \neq g(e)$.

This account can thus cover cases like *500 ships passed under the bridge*, which can be interpreted as meaning that 500 passages took place, but the exact number of total ships is unknown.

Because the account is located in the predicate rather than in the NPs, this account is consistent with cases where the same plural expression is simultaneously interpreted with different cumulative readings by different verbs as in (67a), or even with distributive readings as in (67b) below:

(67) a. The soldiers who had the hollow point bullets hit the targets.

b. The soldiers who had a gun hit the targets.

This account presents a unified view of predication that encompasses the standard cases in which the values of variables are directly mapped into a unique tuple in the denotation of the predicate to more complex cases in which the mapping is vague and can be achieved in many different ways according to the mereological parts of the pluralities involved. This avoids having to introduce meaning postulates or having to stipulate special semantic representations just for cumulativity.

4.2.2 On *Respectively* Readings

It is often suggested that conjunction yields an ordered plurality, or at least, that it somehow preserves the surface order of conjuncts. One of many examples is Link (1991), where it is assumed that a special kind of conjunction *and* yields ordered tuples of individuals. The evidence for this comes from so-called *respectively* readings:

(68) a. Fred and Mary $\left\{\begin{array}{l}\text{moved to Paris and to London}\\\text{hate Martha and Sue}\\\text{are husband and wife}\end{array}\right\}$ (respectively).

b. The boy and the girl washed the dishes and dusted the room, respectively.

Here, conjuncts are paired up in the order that they occur in. Thus, reversing the order of the conjuncts yields a semantic contrast. A crucial aspect of these readings is that the presence of the adverb *respectively* is not obligatory. Context and world knowledge can make the respectively reading the preferential one, as in well-known examples like (69) (see also Gawron and Kehler (2004) many naturally occurring data):

(69) Tolstoy and Dostoyevsky wrote Anna Karenina and The Idiot.

Several hypothesis have been raised in the literature. Goodall (1987) and Moltmann (1992) for example, claim that these examples involve a syntactic dependency between coordinate structures requiring an equal number of conjuncts. But McCawley (1968b, 164), Pullum and Gazdar (1982) and others note that no such dependency exists:

(70) These five men are Polish, Irish, Armenian, Italian, and Chinese, respectively.

Gawron and Kehler (2004) propose that conjunction preserves surface order semantically. This is done with extra machinery that allows one to talk about the order of conjuncts. The details of the analysis are a bit complex but in general terms the proposal is as follows. Gawron and Kehler propose an adverbial operator $Resp_f$ that takes two arguments: the meaning of the VP and the meaning of the external argument. This operator is very similar to a Linkean distribution operator *Distr* in the sense that it attaches to a pluralic entity and operates over its mereological parts. Let us consider the analysis of the example in (69), as taken from Gawron and Kehler (2004) in a simplified form. Below I abbreviate *Tolstoy and Dostoyevsky* as T and D , and *Anna Karenina and The Idiot* as AK and TI, respectively.

Since the complement NP is interpreted distributively, a distribution applies and copies the verb meaning over each conjunct: $Distr(write(AK \vee TI)) = write(AK)$ & $write(TI))$. This occurs at the level of the VP. Next, the operator $Resp_f$ can apply. The operator takes two arguments, the VP denotation and the Subject denotation. At the clausal level thus we get $Resp_f[write(AK)$ & $write(TI)](T \vee D)$. The application of $Resp_f$ obtains the intended result by distributing the conjuncts in the appropriate order: $write(AK)(T)$ & $write(TI)(D)$. Note that this analysis hinged on the copying of the verb meaning: there is only one verb realized, but Gawron and Kehler (2004) follow the Partee and Rooth (1983) analysis that distributivity amounts to distributing the meaning of the verbal head over to each of the NP conjuncts. But as discussed in §3, there are a number of well-known problems with this analysis because it rejects the notion that NPs are actually conjoined. A counter example for the analysis of *respectively* in Gawron and Kehler (2004) is therefore easy to construct. One such case is a sentence with a *respectively* reading in which one of the NP coordination structures contains a relative clause with a collective reading:

(71) a. The boy and the girl who are kissing each other are from Italy and from Greece, respectively.
b. The man and the woman who are brothers washed the dishes and dusted the room respectively.
c. Anna Karenina and The Idiot were respectively written by a certain novelist and a certain prose writer who actually never met.

Because of the collective reading in the relative clause, one cannot felicitously separate the conjoined NPs and place them in different verb representations. The analysis is therefore flawed because it hinges on a untenable analysis of NP coordination. One conclusion to draw from this problem is by now familiar. Pluralic NPs are not the locus of ambiguity. The various kinds of readings that such NPs can have are brought about by something else external to the NP.

Many authors such as McCawley (1968b, 297) assume that *respectively* is an adjunct to a conjoined constituent. However, *respectively* readings can arise in sentences that do not have any kind of coordination structure:

(72) a. This controversy revolved around the place where a new meeting house should be set, and as the parties could not agree, they built two in places they respectively chose.[16]
b. Two different formulations were tested, respectively, by two groups of patients with various periodontal disorders.

These examples involve plural NPs, but examples with *singular* NPs also exist:

[16](`http://www.fbinstitute.com/baptist-in-america/benedict16.htm`) [20 June 2007]

(73) a. Every student was assigned to one tutor, respectively.

b. Each boy kissed his girlfriend, respectively.

Link (1991) and Gawron and Kehler (2004) wrongly predict that the sentences in (73) are impossible.[17] The data in (73) indicate that *respectively* readings have nothing to do with pluralities or with conjunction. The adverb is thus much closer to metalinguistic expressions like *the former*, *the latter*, *in X order*, and *vice-versa*:

(74) Each bus was washed and waxed, $\left\{\begin{array}{c}\text{respectively}\\ \text{in that order}\end{array}\right\}$.

Note also that the latter are not restricted to coordination in any way:

(75) a. The books should not be piled in that order.

b. [Craig Jones] is a different kind of film-maker from his friend and colleague [Stuart Lee]. While [the latter] is more philosophically minded and comfortable with abstract concepts, [the former] likes to convey his thoughts and experiences as directly as possible.

I will not discuss *respectively* readings further in this work, but I conclude that one does not need to make the semantics for conjunction and the model theory more complex just to accommodate ordered conjuncts, since these readings also occur in non-coordinate and in singular NPs.

4.3 Summary

§4.1 Pluralities can be interpreted in various ways, but they are not ambiguous. Rather, the ambiguity is part of the meaning of the lexical heads that subcategorize for pluralic arguments. There are essentially three predication possibilities: atom predication, atomic distribution, and conjunct distribution. The simplest case is when a predicate can apply to the atom(s) denoted by the argument NP, irrespective of how complex that argument is. Atomic distribution consists in individually predicating over the atoms denoted by a plurality, and conjunct distribution consists in predicating over each member of a conjunctive plurality.

[17]Note that in some examples the usage of the adverb may even be odd, as in *Each shaft has a different diameter, respectively.*

It is also argued that conjunction is best viewed as ontologically neutral. The entities that conjunction forms are in general never interpreted directly since no verb has arbitrarily complex entities in its denotation. Accordingly, the model should not have arbitrarily complex entities either. This leads to the idea that conjunction is a dynamic mechanism, building ontologically neutral pluralities. The model theory can remain first-order and does not have to assume that conjunction is many-ways ambiguous. Some of the previous accounts assume that conjunctive pluralities are infinitely ambiguous, which is problematic both on linguistic and on cognitive grounds.

§4.2 A logical framework is provided for the grammar fragment under discussion. This consists in a Dynamic Predicate Logic enriched with a Linkean mereological model for pluralities. The account formalizes the model theory and the dynamic semantics of conjunction, as well as the modes of predication discussed above. The fact that conjunction is ontologically neutral and dynamic allows it to deal with complex conjunctions without resorting to generalized models and without obtaining a combinatorial explosion in interpretations.

Finally, it is also proposed a way to extend the satisfaction conditions for n-place predicates so that cumulative readings are also captured, and argued that conjunction does not yield ordered pluralities, contrary to what is sometimes assumed with regard to so-called *respectively* readings.

Chapter 5

HPSG Syntax-Semantics Interface

In the previous chapters evidence was provided in favor of a unique coordination construction encompassing conjunction and disjunction, as well as symmetrical and asymmetrical readings, and of a uniform semantic composition process for coordination that builds on the presence of neo-Davidsonian referential arguments. The main goal of this chapter is to explicitly flesh out these notions, and to capture the various coordination patterns with exactly the same underlying construction.

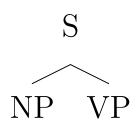
The heart of the syntax-semantics interface boils down to one coordination rule and to four lexical entries (corresponding to non-intersective conjunction *and*, adversative conjunction *but*, disjunction *or*, and intersective conjunction *and*). The coordination rule is generalized over the various coordination types and provides a uniform account of the structure and meaning of coordination. This goal is achieved by exploiting the constraint-based nature of HPSG and the semantic underspecification formalism of MRS. The coordination rule and the lexical entries of coordination lexemes are underspecified with regard to certain syntactic and semantic information.

Coordination can interact with the overall grammar to yield a complex and wide range of structures. This chapter also shows how other constructions interact with coordination in a uniform way, so that coordinate constituents behave essentially the same way as non-coordinate constituents. The next two chapters extend the grammar coverage further, by considering various kinds of headed constructions.

5.1 Core Aspects of the Grammar

This section is devoted to the core aspects of the HPSG theory adopted in this work. Although the basic underpinnings of the account are discussed, I assume some familiarity with the HPSG framework. The adopted feature geometry and grammar principles are inspired on the construction-based HPSG laid out in Sag et al. (2003, Ch.16). I have so far used the terms 'structure' and 'construction' somewhat interchangeably, but henceforth the former is used to refer to the linguistic entities that the grammar describes while the latter refers to (hierarchical) the grammar constraints/rules.[1]

As mentioned in Chapter 1, an HPSG grammar is nothing but a set of constraints expressed in terms of feature structures descriptions. These constraints are used to formulate rules which define the set of grammatical linguistic entities. Instead of postulating a separate level of representation to express syntax, the tree structures that a HPSG grammar licenses are also described via features, in a uniform way. A feature MOTHER specifies the information concerning the mother node of a given construction, while a feature DAUGHTERS lists the daughters of that mother node (these are henceforth abbreviated as MTR and DTRS). A third feature HD-DTR identifies which of the daughters is the head. The intended representation is illustrated below in Figure §5.1. Here it is shown how a familiar tree structure can be encoded in terms of a description of type *cx* (construction) and of the three features.[2]



$$= \begin{bmatrix} \textit{cx} & \\ \text{MTR} & \text{S} \\ \text{HD-DTR} & \boxed{1} \\ \text{DTRS} & \langle \text{NP}\,, \boxed{1}\text{VP} \rangle \end{bmatrix}$$

Figure 5.1: A tree viewed as a feature structure

The boxed tags like $\boxed{1}$ are very much like variables. Thus, in this example the two occurrences of $\boxed{1}$ above indicate that the value of the feature HD-DTR and the second member in the DTRS list are *exactly* the same entity. In other words, the VP daughter is the head daughter of this tree.

[1]See the terminology in Sag et al. (2003, 477).

[2]As a matter of convention, the tree notation is reserved for examples of structures licensed by the grammar while the feature structure notation is employed in the formulation of grammar rules.

The values of the feature MTR are not atomic categories, but rather information-rich entities of the type *sign*. Similarly, the value of DTR is a list of signs corresponding to the local daughters. Since there are no interface stages such as PF and LF, all the relevant content about a given linguistic expression is encoded as part of the sign. Thus, grammar rules can locally access various kinds of phonological, syntactical and semantic information, and capture interactions between these levels of description. The information introduced by the type *sign* is valid for both lexical and phrasal expressions, and is given in (1).

(1)
$$\left[\begin{array}{ll} \multicolumn{2}{l}{\textit{sign}} \\ \textsc{mp} & \left[\begin{array}{ll} \textsc{phonology} & \textit{list(phon)} \\ \textsc{form} & \textit{list(form)} \end{array}\right] \\ \textsc{syn} & \left[\begin{array}{ll} \textsc{head} & \textit{head} \\ \textsc{valence} & \left[\begin{array}{ll} \textsc{subj} & \textit{list(sign)} \\ \textsc{comps} & \textit{list(sign)} \end{array}\right] \\ \textsc{inherited} & \left[\begin{array}{ll} \textsc{gap} & \textit{list(sign)} \\ \textsc{rel} & \textit{list(index)} \end{array}\right] \end{array}\right] \\ \textsc{sem} & \left[\begin{array}{ll} \textsc{gtop} & \textit{label} \\ \textsc{key} & \textit{pred} \\ \textsc{rels} & \textit{list(pred)} \\ \textsc{cons} & \textit{list}(\leq) \end{array}\right] \\ \textsc{dom} & \textit{list(sign)} \end{array}\right]$$

Note that everything is uniformly represented as features. Even the list representation ⟨NP,VP⟩ is just a notational abbreviation for a feature structure:

(2)
$$\left[\begin{array}{ll} \textsc{top} & \text{NP} \\ \textsc{tail} & \left[\begin{array}{ll} \textsc{top} & \text{VP} \\ \textsc{tail} & \textit{empty} \end{array}\right] \end{array}\right]$$

The types that HPSG employs are polymorphic: whatever is stated about a given type is also valid for all subtypes. For example, there are two subtypes of *sign* as seen in Figure 5.2. One type for lexical items and another for phrases. Signs of type *lexical* introduce an additional feature ARG(UMENT)-ST(RUCTURE) which is relevant for binding theory, among other things.

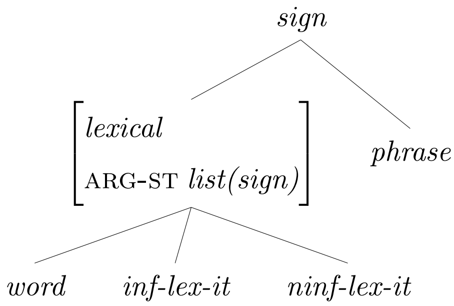


Figure 5.2: Type Hierarchy of signs

Items of the type *word* are fully-formed lexical elements that can participate in syntactic structures. The items of the type *inf(lected)-lex(ical)-it(em)* and *n(on)inf(lected)lex(ical)-it(em)* live only on the morphological realm.

Inflection lexical rules map elements of the type *ninf-lex-it* into elements of the type *inf-lex-it*, derivational lexical rules map elements of type *ninf-lex-it* into other element of type *ninf-lex-it*, and post-inflectional lexical rules map *inf-lex-it* into either *inf-lex-it* or *word*. The lexicon therefore lists a finite set of lexemes of type *ninf-lex-it*, from which a potentially infinite set of items of type *word* can be obtained. Further subtypes can be introduced to capture sub-regularities and exceptions, as well to provide more information about levels of affixation.[3]

Since both *word* and *phrase* are sub-types of *sign*, then all of the information in (1) is adequate to describe words and phrases alike: the feature M(ORPHO)P(HONOLOGY) encodes information about morphology and phonology, SYN(TAX) encodes various kind of syntactic information (such as valence specifications, part-of-speech, etc.), SEM(ANTICS) encodes semantic representations, and the feature DOM(AIN) encodes linearization information. The feature INHER(ITED) introduces information about unbounded dependencies, the treatment of which is discussed in detail in Chapter 7.

Let us consider each of these levels of description in turn. There will be more to say about MP in Chapter 8, but for now I will assume that the type *phon* corresponds to phonological segments such as /laɪ/ and that *form* corresponds to morph forms (formatives). For example, there are at least two lexical entries with the same PHON value /laɪ/ but with different FORM values. One contains a verb morph form lie_1, which inflects as *lay*, *lain*, *laid*, while the other lexical entry contains a verb morph form lie_2,

[3]For realizational and morpheme-based morphology in HPSG see Trost (1993), Krieger and Nerbonne (1993), Orgun (1996), Riehemann (1998), Koenig (1999) among others.

which inflects as *lied* and derives the nouns *lie* and *liar*, for example. Both morph forms can also have a common supertype over which certain derivational patterns can apply (e.g. both verbs have the same present and present participle forms *lies* and *lying*).

The feature HEAD contains grammatical information that is both associated with the head daughter and the mother node, along the lines of X-bar Theory. The type *head* therefore subsumes the various parts-of-speech as shown in Figure §5.3. These include nouns, verbs, adjectives, adverbs, prepositions, and functional categories.

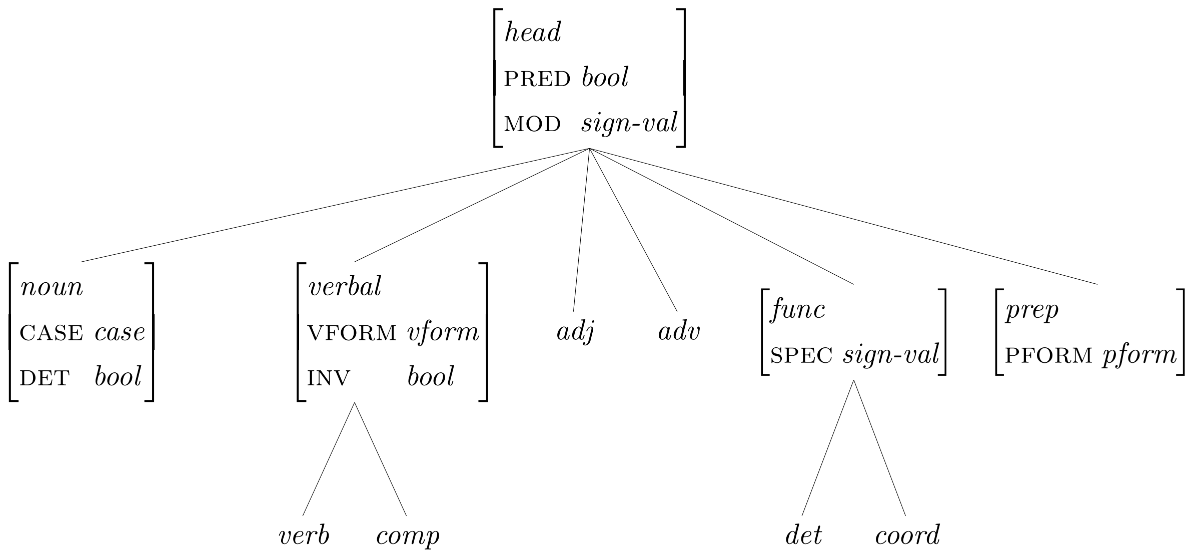


Figure 5.3: Type hierarchy of parts-of-speech

The type *head* introduces two features which are valid for all of the subtypes in the hierarchy: PRED and and MOD. The former indicates if that structure can occur in a predicative environment and the latter allows certain heads to impose constraints on the constituents that they modify.

The feature PRED has a boolean value, consisting in the subtypes + and −. Many adjectives, nouns, participles and prepositions have a predicative use and are specified as [PRED +], as illustrated below:

(3) Kim is $\left\{ \begin{array}{l} \text{tired.} \\ \text{in Oslo.} \\ \text{sleeping.} \\ \text{pursued by the Police.} \end{array} \right\}$

Most adjectives can be realized as [PRED +] or as [PRED −], as illustrated in examples like *the boy is tired* and *The tired boy*, respectively. Some adjectives like *ablaze* and *asleep* only have a [PRED +] usage: **The asleep baby is fine* with *The baby was asleep* (Pollard and Sag 1987, 64). Finally, other categories including non-predicative adjectives like *former* and *mere* are systematically specified as [PRED −] because they cannot be realized in predicative environments.

The value of the feature MOD(IFIED) is typed as *sign-val*, which in turn has two subtypes *sign* and *none*. Thus, certain heads (adjectives, adverbs, prepositions and certain verbs) can project phrases that adjoin to the sign specified in MOD. Elements that cannot adjoin to anything are specified as [MOD *none*].

The feature SPEC(IFIED) has a similar purpose. It is also of the type *sign-val*, but it enables functional categories to impose selectional restrictions of the heads that they attach to. One example is determiners attaching to their N' hosts and coordination lexemes attaching to conjuncts. It is true that adjunction and specification share some syntactic properties, and that these differ from the ones observed in complementation, but as will become clearer in §6.1, they also differ with regard to how semantic content is construed (e.g. scopal adjuncts are similar to determiners, but intersective adjuncts are not).

The feature CASE is responsible for identifying the case of nominal expressions. Pronouns like *him* are specified as *acc*(*usative*), and pronouns like *I* are *nom*(*inative*), and expressions like *who* or *Robin* are left underspecified for case. I will follow Levine et al. (2001, 207) in general lines and adopt the multi-inheritance type hierarchy for *structural* case assignments in Figure 5.4.

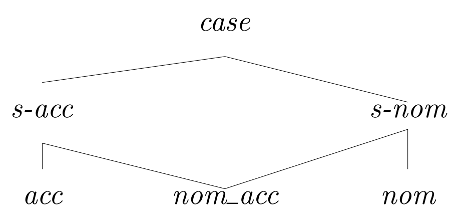


Figure 5.4: Type hierarchy of (structural) case assignments

The type *nom_acc* is both nominative and accusative. This is motivated by syncretism cases like (4), noted in Levine et al. (2001). In this sentence the same noun can simultaneously satisfy both an accusative and a nominative case assignment.

(4) Robin is someone who$_i$ even [good friends of _ $_i$] believe _ $_i$ should be closely watched.

The above hierarchy copes with these cases as follows. Verbs subcategorize for *s-nom* NP subjects and *s-acc* NP complements. Nouns that are underspecified for case are typed as *case*, and thus are consistent with both nominative and accusative assignments. The type *case* can be instantiated as *nom_acc*, which is a subtype of both *s-nom* and *s-acc*.[4] In the case of a nominal such as *whom*, it is typed as *acc* and thus it is inconsistent with the typing *s-nom*:

(5) *Robin is someone whom$_i$ even [good friends of _ $_i$] believe _ $_i$ should be closely watched.

The feature DET(ERMINED) is used to indicate whether a noun phrase is overtly specified by determiner. This feature allows the grammar to distinguish between bare nominal phrases and phrases that contain an overt determiner. Nouns are lexically underspecified as [DET *bool*], determiners require a '+' instantiation, and the lexical derivation of bare plurals require a '–' instantiation.

The feature VFORM is only appropriate for *verbal* parts-of-speech and is used to specify the morphosyntactic category of a verb.[5] For example, an uninflected verb form like *eat* is specified as [VFORM *base*], a finite verb form (i.e. present or part tense like *eats* or *ate*) is specified as [VFORM *fin*], a present participle is [VFORM *prp*], a past participle is [VFORM *psp*], and a passive verb form is [VFORM *pass*].

As Pollard and Sag (1987, 60) point out, this is relevant for a number of independent reasons. The main verb in a root sentence must be finite and modal auxiliary verbs like *may* only have finite forms, e.g. **Pat* [*will may take the exam*]/[*is maying take the exam*]. Many verbs and adjectives in English select for verbal complements that are restricted to one or another VFORM value. For example, modal auxiliaries require *base* form VP complements (*Kim may leave/*leaves/*leaving/*left*), while progressive-aspect *be* and perfective-aspect *have* take VP complements with *psp* and *prp* forms respectively.

[4]Levine et al. (2001) take non-pronominal nominals to be overspecified as *nom_acc*. This is problematic because it entails that [*him and Fred*] is ungrammatical: the type *acc* is incompatible with *nom_acc*. The underspecification analysis just proposed does not have this problem because structure-sharing *acc* and *case* necessarily resolves into the most specific type: *acc*.

[5]Following Ginzburg and Sag (2000, 24) the complementizer part-of-speech (e.g. *that*, *for*, *whether*, *if*, etc.) is assumed to be verbal in nature.

The feature PFORM is used to identify the preposition heading a PP constituent. For example, some verbs like *talk* exclusively require PP complements headed by *to*. The feature PFORM allows the verbal head to restrict the preposition heading the PP complement. Thus, an argument-marking prepositions like *to* is specified as [PFORM *to*]. However, not all prepositions work in the same way. Some have null PFORM values. It is well-known that prepositions in languages like English possess two distinct semantic functions. In one use, they are semantically vacuous and simply behave as argument markers but in the other use, the preposition is semantically potent and a thematic role is assigned. One example of the latter is the preposition *without*. No verbal head specifically requires a PP headed by this preposition, and as such this kind of preposition is specified as [PFORM *none*]. This makes it impossible for a head to select for a PP headed by *without*, for example.

The feature INV(ERTED) is appropriate for verbal categories, and is used to distinguish auxiliary verbs heading inverted phrases from all other verbs. It allows to accommodate lexical exceptions to inversion, for example. Palmer (1968) and Hudson (1976a) note that there are inflected forms that only occur in inversion environments, e.g. the first person singular negative contracted form of the copula: **I aren't going* (cf. with *Aren't I going?*). Gazdar et al. (1982) also note that some finite auxiliary verbs cannot appear in inverted position, such as **Better I get out of here?* (cf. *I better get out of here!*). See also Fillmore (1999) and Bresnan (2000) for more discussion.

5.1.1 Semantics

The intuitive nature of the SEM feature was already discussed in Chapter 1. Basically, it contains the underspecified MRS semantic representations in the form of a list of relations and a list of subordination constraints '$\leq$'. The former is given as the value of the feature RELS, which contains objects of the type *pred*(*ication*), and the latter is given in CONS. Predications are simply relations of the form $R(\alpha_1, ..., \alpha_n)$ where R is a relation symbol and α is an argument. These are cast in terms of feature structures as shown in (6), where RELN introduces R, INDEX introduces the referential argument (if any), and ARGS contains the arguments $\alpha_1, ..., \alpha_n$ of the relation R:

(6) $\begin{bmatrix} \textit{pred} & \\ \textsc{lbl} & \textit{label} \\ \textsc{reln} & \textit{reln} \\ \textsc{index} & \textit{index} \\ \textsc{args} & \textit{list(arg)} \end{bmatrix}$

The type *reln* introduces the inventory of relations used to build semantic representations. The current logical fragment includes quantifiers, some standard connectors and n-ary predicate symbols for verbs, nouns, adjectives, adverbials, and prepositions. The latter are all subsumed by the type *pred-reln*:

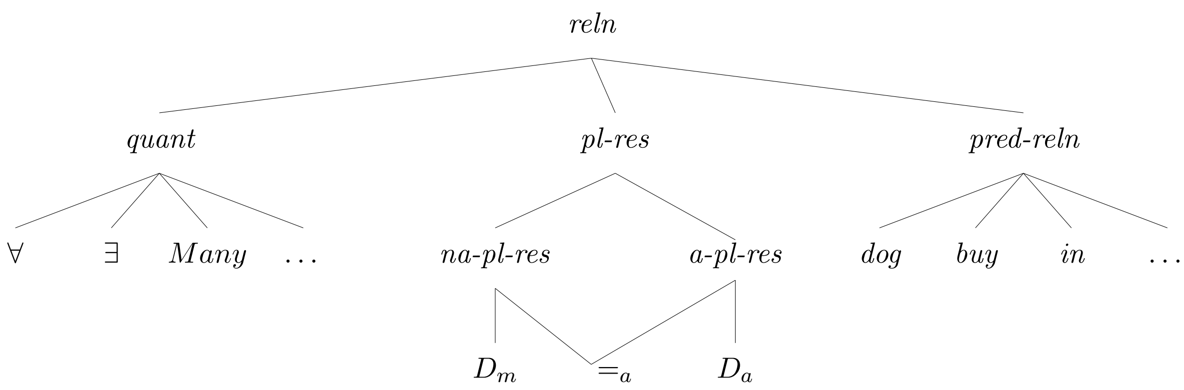


Figure 5.5: Type hierarchy of relations

For example, a predication of the form $l_1 : buy(e, x, y)$ is represented in this notation as seen in (7). I will henceforth alternate between the two notations, using the FOL format for brevity and illustration of the meaning of a given expression and resorting to the feature structure format instead whenever it is needed to provide the exact HPSG semantic representations and constraints.

(7) $\begin{bmatrix} \textit{pred} & \\ \text{LBL} & l_1 \\ \text{RELN} & \textit{buy} \\ \text{INDEX} & e \\ \text{ARGS} & \langle x, y \rangle \end{bmatrix}$

The type hierarchy of *agr* and *index* is given in Figure 5.6. Predicate arguments can either be labels like l_1 above, when a formula is embedded in another, or referential indices. Conversely, indices can either be referential or non-referential. For perspicuity, the type of index will not be explicitly mentioned, and eventualities will be represented by e_1 ... e_n while nominal indices are represented by x_1 ... x_n, y_1... y_n, and so forth. Finally, agreement information is specified in AGR, via the usual features NUM(BER), GEN(DER) and PER(SON). For illustration, the agreement information associated with the pronoun *her* is depicted in (8):

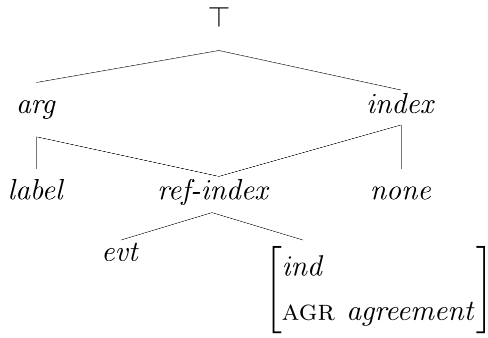


Figure 5.6: Type hierarchy of argument and index types (preliminary version)

(8) $\begin{bmatrix} \textit{agreement} \\ \textsc{num}\ \textit{sg} \\ \textsc{gen}\ \textit{fem} \\ \textsc{per}\ \textit{3rd} \end{bmatrix}$

There are three basic subtypes of *pred*(*ication*). These correspond to two place quantifiers *2-place-q* (typically introduced by determiners, ranging over individuals and containing two argument slots), one-place quantifiers *1-place-q* (existentially quantifying Neo-Davidsonian variables introduced by verbs, adjectives, etc.), and non-quantificational predications *non-q-pred*.

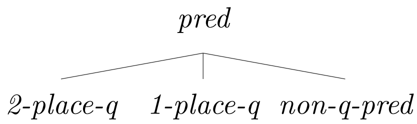


Figure 5.7: Type hierarchy of predications

Non-quantificational predications correspond to nouns, adjective, verbs, prepositions, etc.. There are also well-formedness conditions that the quantificational predications must obey. Two place quantifiers can only bind individuals while one place quantifiers are necessarily existential and can only bind eventualities.

(9) a. $\textit{2-place-q} \Rightarrow \begin{bmatrix} \textsc{reln} & \textit{quant} \\ \textsc{index} & \textit{ind} \\ \textsc{args} & \langle \textit{label}, \textit{label} \rangle \end{bmatrix}$

$$\text{b.}\quad \textit{1-place-q} \;\Rightarrow\; \begin{bmatrix} \text{RELN} & \exists \\ \text{INDEX} & \textit{evt} \\ \text{ARGS} & \langle \textit{label} \rangle \end{bmatrix}$$

The rules in (9) basically establish what kinds of quantifications are well-formed. This will play an important role in the grammar of coordination. The quantifier introduced by the coordination is '∃' but the type of the predication is left underspecified. It can therefore either be resolved as a two-place quantifier or as a one place quantifier. The resolution will depend on the type of variable that is associated to each conjunct

For an illustration of the HPSG feature geometry discussed so far consider the word *Kim* given in (10). This is a non-predicative noun that does not select any kind of constituent and thus all the subcategorization lists are saturated.

$$(10)\quad \begin{bmatrix} \textit{word} & \\ \text{MP} & \begin{bmatrix} \text{PHON} & \langle \text{kɪm} \rangle \\ \text{FORM} & \langle \textit{Kim} \rangle \end{bmatrix} \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{noun} & \\ \text{PRED} & - \\ \text{MOD} & \textit{none} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \\ \text{INHER} & \begin{bmatrix} \text{GAP} & \langle\rangle \\ \text{REL} & \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{KEY} & \boxed{k} \\ \text{RELS} & \left\langle \boxed{k}\begin{bmatrix} \text{LBL} & l_\top \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle \boxed{l1}, \boxed{l2} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l1} \\ \text{RELN} & \textit{Kim} \\ \text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle\rangle \end{bmatrix} \right\rangle \\ \text{CONS} & \langle\rangle \end{bmatrix} \end{bmatrix}$$

The label $l_\top$ is a constant that is identified with the top of the entire MRS representation. This guarantees that proper nouns always have widest scope.[6] I depict the semantic content of this word graphically in Figure 5.8.

[6]As a matter of convention, any formula that is lexically identified with $l_\top$ has either wide scope, or is embedded in another formula also lexically identified with $l_\top$. Otherwise a sentence like *Kim saw*

$$\begin{array}{c} l_{\top}\!:\!\exists x\,(l_1 \wedge l_2) \\ \updownarrow \\ l_1 : Kim(x) \end{array}$$

Figure 5.8: MRS representation in (10)

The double arrow notation means that the formula $Kim(x)$ is directly plugged into the argument slot l_1. This mirrors the structure-sharing of $\boxed{l_1}$ between the noun predicate and the first argument of the quantifier in (10).

The feature KEY is here used for the purpose of singling out the label, index, relation and argument information that are relevant for the syntax-semantics interface and semantic composition. Often the value of KEY will correspond to one of the predications in the list RELNS as in (10), but this not need be the case. As it will become clear later on, there are certain instances where the index and label relevant for semantic composition are not from the same predication.

The feature KEY has multiple purposes. For example, KEY|RELN allows access to the NP quantifier. This offers a handle on *There*-insertion phenomena (Milsark 1977), which are sensitive to the quantificational nature of the determiner, as seen in (11):

(11) a. There are $\left\{\begin{array}{l} \emptyset \text{ / some / two / several / many} \\ \text{* all / most / the} \end{array}\right\}$ students in the garden.

b. There is $\left\{\begin{array}{l} \text{ a} \\ \text{*every / the} \end{array}\right\}$ student in the garden.

The relevant distribution may be captured by using a more elaborate type hierarchy for *quant*, partitioning the space of quantification accordingly. In §5.3 the feature KEY is used to ensure that conjuncts are not quantificationally defective as argued in §3.2, in §6.6 it is used to control the adnominal distribution of adjectives like *similar*, in §6.2.2 the possibility of accessing KEY|RELN is relevant for certain phenomena in the distribution and interpretation of English collective nouns, and in §6.4 I discuss how

Fred would be impossible to represent because both NPs would require wide scope over each other. Thus, $\exists x(Kim(x) \wedge \exists y(Fred(y) \wedge saw(x, y)))$ is valid because both NPs are lexically labeled as $l_{\top}$, but $\forall x(student(x) \rightarrow \exists y(Fred(y) \wedge saw(x, y)))$ is not.

the feature KEY can be used to allow partitive determiners like *many* to select for a PP[PFORM *of*] with an embedded definite NP complement.[7]

Now let us consider the lexical entry of a distributive verb such as *laughed* in (12). This finite verb requires a subject NP and requires no complements. Semantically, the verb introduces an underspecified relation of the type *a-pl-res* that allows the verb to take both singular and pluralic arguments, as discussed in §4.1.2.

(12)
$$
\begin{bmatrix}
\textit{word} \\
\text{MP} \begin{bmatrix} \text{PHON} \ \langle \text{læft} \rangle \\ \text{FORM} \ \langle \textit{laugh+ed} \rangle \end{bmatrix} \\
\text{SYN} \begin{bmatrix}
\text{HEAD} \begin{bmatrix} \textit{verb} \\ \text{PRED} \ - \\ \text{MOD} \ \textit{none} \\ \text{VFORM} \ \textit{fin} \end{bmatrix} \\
\text{VAL} \begin{bmatrix}
\text{SUBJ} \ \left\langle \text{NP} \begin{bmatrix} \text{SYN} \mid \text{HEAD} \mid \text{CASE} \ \textit{s-nom} \\ \text{SEM} \mid \text{KEY} \begin{bmatrix} \text{INDEX} \ \boxed{x} \\ \text{ARGS} \ \langle \ldots, \boxed{l3} \rangle \end{bmatrix} \end{bmatrix} \right\rangle \\
\text{COMPS} \ \langle \rangle
\end{bmatrix} \\
\text{INHER} \begin{bmatrix} \text{GAP} \ \langle \rangle \\ \text{REL} \ \langle \rangle \end{bmatrix}
\end{bmatrix} \\
\text{SEM} \begin{bmatrix}
\text{KEY} \ \boxed{k} \\
\text{RELS} \ \left\langle \begin{bmatrix} \text{LBL} \ \boxed{l5} \\ \text{RELN} \ \textit{a-pl-res} \\ \text{ARGS} \ \langle \boxed{y}, \boxed{x}, \boxed{l6} \rangle \end{bmatrix}, \boxed{k} \begin{bmatrix} \text{LBL} \ \boxed{l4} \\ \text{RELN} \ \exists \\ \text{INDEX} \ \boxed{e} \\ \text{ARGS} \ \langle \boxed{l5} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} \ \boxed{l5} \\ \text{RELN} \ \textit{laugh} \\ \text{INDEX} \ \boxed{e} \\ \text{ARGS} \ \langle \boxed{y} \rangle \end{bmatrix} \right\rangle \\
\text{CONS} \ \left\langle \begin{bmatrix} \boxed{l4} \leq \boxed{l6} \end{bmatrix}, \begin{bmatrix} \boxed{l5} \leq \boxed{l3} \end{bmatrix} \right\rangle
\end{bmatrix}
\end{bmatrix}
$$

Put graphically, the MRS semantic representation encoded in SEM is as follows:

[7]One might argue that KEY allows too much access to semantics and that it should be dropped. However, as the examples above show, there is independent motivation for using it. Moreover, the objection is somewhat misguided since the entire list RELN is accessible anyway, which constitutes a far more promiscuous access to semantics in standard MRS. Still, nothing in my account hinges on KEY since the above can be recast as specialized features, albeit in a less parsimonious fashion.

$$
\begin{array}{l}
l_1{:}Qx\ (\ldots, l_3) \\
\quad\quad \uparrow \\
\quad\quad l_5{:}\ \textit{a-pl-res}(y, x, l_6) \\
\quad\quad\quad\quad\quad \uparrow \\
\quad\quad\quad\quad\quad l_4{:}\exists e(l_5) \\
\quad\quad\quad\quad\quad\quad \updownarrow \\
\quad\quad\quad\quad\quad\quad l_5{:}laugh(e, y)
\end{array}
$$

Figure 5.9: MRS representation in (12)

To conclude the discussion about semantic representations, I will discuss how the grammar and how the meaning representations that it describes are to be understood. In this work I subscribe to the view in Nerbonne (1993) in which the feature structure descriptions in SEM describe expressions of a semantic representation logic, in this case, underspecified representations. I assume that a scope resolution mechanism obtains scopally resolved MRS representations quite separately from the grammar, in much the same way as I assume that a parser is something separate from the grammar. Once scope ambiguities are resolved, the obtained semantic representations consist in dynamic predicate logic formulas, which obtain a denotation with regard to a first-order mereological model, as defined in §4.2.

$$
\begin{array}{ccccccc}
\begin{bmatrix} \text{LBL} & l \\ \text{RELN} & laugh \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{x} \rangle \end{bmatrix} & \overset{\textit{describes}}{\longmapsto} & l : laugh(e, x) & \overset{\textit{describes}}{\longmapsto} & laugh(e, x) & \overset{\textit{describes}}{\longmapsto} & \{\langle s, i \rangle, \ldots\} \\
\textit{Feature structure descriptions} & & \textit{Underspecified semantic representations} & & \textit{Dynamic predicate logic} & & \textit{Model Theory}
\end{array}
$$

Figure 5.10: The relation of feature descriptions to underspecified semantic representations, logical semantic representations, and model theory.

5.1.2 Linearization and Grammar Rules

The feature DOM captures word order phenomena. This feature introduces a list of signs, the order of which models the linearization possibilities that are available for a given mother node. For words, the DOM list contains one sign that has the same MP, SYN, and SEM information as the word itself. Thus, I generally assume that all lexical items exhibit the pattern illustrated below:

(13)
$$\begin{bmatrix} \textit{word} \\ \text{MP } \boxed{1} \\ \text{SYN } \boxed{2} \\ \text{SEM } \boxed{3} \\ \text{DOM } \left\langle \begin{bmatrix} \text{MP } \boxed{1} \\ \text{SYN } \boxed{2} \\ \text{SEM } \boxed{3} \\ \text{DOM } \langle\rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

Following Reape (1994) and Kathol (1995) in general terms, the content of MP in a phrasal structure is not determined by the syntactic tree, but by the MP values of the elements in the DOM list. This is formalized by a universal principle called LINEARIZATION PRINCIPLE, valid for all the constructions that the grammar licenses:

(14) LINEARIZATION PRINCIPLE
$$cx \Rightarrow \begin{bmatrix} \text{MTR} \begin{bmatrix} \text{MP} \mid \text{FORM } \boxed{1} \oplus \ldots \oplus \boxed{n} \\ \text{DOM } \left\langle \begin{bmatrix} \text{MP} \mid \text{FORM } \boxed{1} \end{bmatrix}, \ \ldots, \ \begin{bmatrix} \text{MP} \mid \text{FORM } \boxed{n} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

This principle states that in every construction it must be the case that the FORM value of the mother node corresponds to the concatenation of the FORM value in the signs linearized in DOM. Thus, the linear word order of a given sentence need not correspond to the yield of the syntactic trees. It all depends on how the DOM lists of the daughters are allowed to combine in the DOM list of the mother node.

This kind of approach to word order stems from Curry (1961) and Dowty (1995). Languages like English, German, and Russian are viewed as having essentially the same syntax and the same semantic composition processes, but differ with regard to linearization freedom allowed in DOM. For this purpose it is usually adopted a *shuffle* relation '$\bigcirc$' from Reape (1994), which can combine two lists in various ways, as long as the order in the original lists is not altered. For example, the relation $\bigcirc(\langle a, b \rangle,$

$\langle c, d\rangle$) can yield any of the following: $\langle a, b, c, d\rangle \vee \langle a, c, b, d\rangle \vee \langle a, c, d, b\rangle \vee \langle c, a, b, d\rangle \vee \langle c, a, d, b\rangle \vee \langle c, d, a, b\rangle$. In languages like Finnish the shuffling of domains can occur in almost any kind of construction. All the possible word permutations for the sentence *Jussi rakasti Liisaa* ('John loved Lisa') in (15) are grammatical and have the same basic meaning (Karttunen 1989, 48):

(15) a. Jussi rakasti Liisaa.
  b. Jussi Liisaa rakasti.
  c. Liisaa Jussi rakasti.
  d. Liisaa rakasti Jussi.
  e. Rakasti Jussi Liisaa.
  f. Rakasti Liisaa Jussi.

Because of the '$\bigcirc$' operator, the syntactic structure of the sentences in (15) can be one and the same, as illustrated in Figure 5.11.

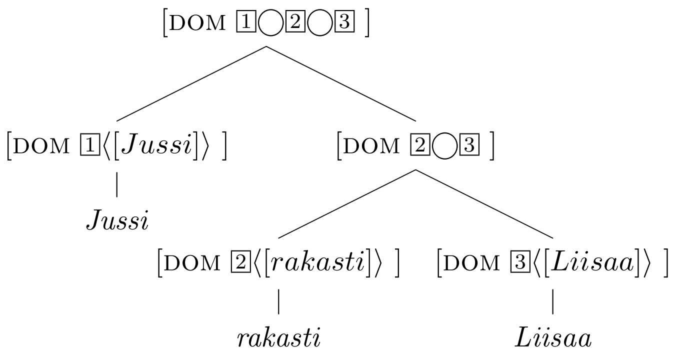


Figure 5.11: One syntactic tree *vs.* six possible DOM values

In a DOM-based setting exactly the same syntactic and semantic structure is attributed to all of these realizations. The observed linearizations are a result of shuffling of DOM lists. Different surface realizations often depend on discourse-driven strategies, syntactic and semantic factors, information structure, weight, prosodic conditions, etc.. All of these factors can be taken into account since the elements in DOM are signs. For various linearization-based accounts of German, Scandinavian, Serbo-Croatian, Warlpiri, and English, see for instance Reape (1994), Pollard et al. (1994), Kathol (1995,2000), Penn (1999), and Donohue and Sag (1999), and Maekawa (2007).

English is fairly restricted with regard to word order, and thus by and large the current grammar fragment will resort to the usual append '⊕' constraints to capture linearization phenomena. One could also employ Linear Precedence rules to achieve the same effect, but nothing in the present account hinges on this. For example, the rule that captures head-subject constructions in (16) states that subjects precede the subcategorizing head:

(16) HEAD-SUBJECT CONSTRUCTION

$$
h\text{-}subj\text{-}cx \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN}\,|\,\text{VAL} & \begin{bmatrix}\text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle\end{bmatrix} \\ \text{SEM}\,|\,\text{KEY} & \boxed{k} \\ \text{DOM} & \langle\boxed{1}\rangle \oplus \boxed{3}\end{bmatrix} \\ \text{HD-DTR} & \boxed{2} \\ \text{DTRS} & \left\langle \boxed{1}, \boxed{2}\begin{bmatrix} \text{SYN}\,|\,\text{VAL} & \begin{bmatrix}\text{SUBJ} & \langle\boxed{1}\rangle \\ \text{COMPS} & \langle\rangle\end{bmatrix} \\ \text{SEM}\,|\,\text{KEY} & \boxed{k} \\ \text{DOM} & \boxed{3}\end{bmatrix}\right\rangle \end{bmatrix}
$$

The head daughter $\boxed{2}$ has a saturated complements list and a singleton subject list. For the rule to apply successfully a suitable subject argument $\boxed{1}$ must satisfy all the constraints that are imposed on the subject, with regard to agreement, case, part of speech, as well as the semantic constraints.

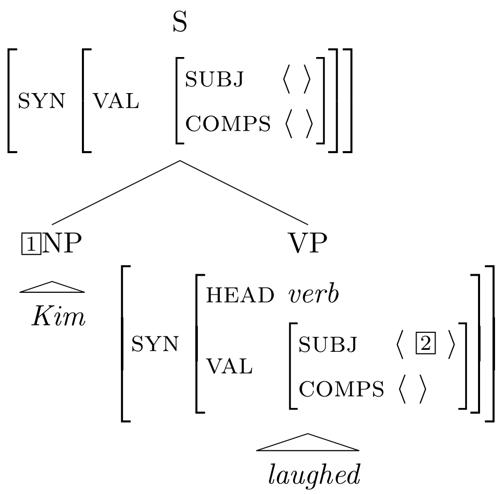


Figure 5.12: Example of a structure licensed by *h-subj-cx*

Apart from subcategorization and linearization constraints, the *h-subj-cx* rule also requires that the KEY information of the head and of the mother are the same. This allows adverbs that attach to S to semantically access and predicate over the event variable introduced by the verb.

With regard to word order, the subject phrase necessarily precedes the head daughter because of the concatenation constraint '$\oplus$'. But note also that in (16) the entire sign $\boxed{1}$ of the subject phrase is placed in DOM. This is referred to as *compaction*, since $\boxed{1}$ becomes a domain element itself rather than the domain elements in $\boxed{1}$[DOM $\langle ... \rangle$]. This process is illustrated in the abbreviated tree structure in Figure 5.13. The NP daughter contains two domain elements, one contributed by the determiner and another by the noun, but the entire NP sign is placed in the S node, thus 'sealing off' the linearization of the NP from the rest of the structure.

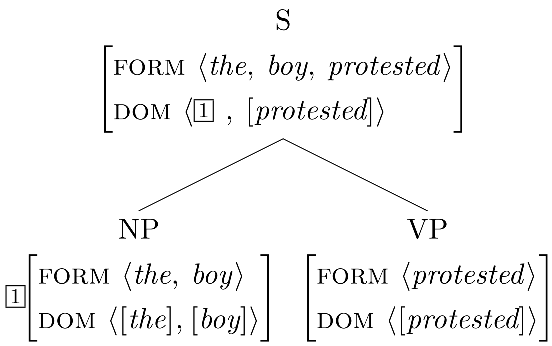


Figure 5.13: Illustration of domain compaction (abbreviated)

Domain compaction allows one to control the distribution of elements that are freer to combine with sister domain lists. Thus, even though some adverbs can be realized in various positions, they cannot appear between a determiner and a N' for example. In §6.2 and in §6.5.4 I will show how the compaction of subject phrases ensures that (17a,b) are allowed by the grammar but that (17c,d) are rejected.

(17) a. [The boy] [either] [will] [write] [a mystery] [or] [he'll] [write] [a romance].

b. [The boy] [will] [write] [either] [a mystery] [or] [he'll] [write] [a romance].

c.*The either boy will write a mystery or he'll write a novel.

d.*The boy will write an either mystery or he'll write a novel.

The rule that governs complement constructions is given in (18). It saturates one complement $\boxed{1}$ at a time and shares with the mother node the remainder subcategorized valents $\boxed{3}$. In this case the head is required to precede the complement phrase in DOM, but compaction is determined by a function C:

(18) HEAD-COMPLEMENT CONSTRUCTION

$$h\text{-}comp\text{-}cx \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} \mid \text{VAL} & \begin{bmatrix} \text{SUBJ} & \boxed{1} \\ \text{COMPS} & \boxed{3} \end{bmatrix} \\ \text{SEM} \mid \text{KEY} & \boxed{k} \\ \text{DOM} & \boxed{4} \oplus C(\boxed{2}) \end{bmatrix} \\ \text{HD-DTR} & \boxed{5} \\ \text{DTRS} & \left\langle \boxed{5} \begin{bmatrix} \text{SYN} \mid \text{VAL} & \begin{bmatrix} \text{SUBJ} & \boxed{1} \\ \text{COMPS} & \langle \boxed{2} \rangle \oplus \boxed{3} \end{bmatrix} \\ \text{SEM} \mid \text{KEY} & \boxed{k} \\ \text{DOM} & \boxed{4} \end{bmatrix}, \boxed{2} \right\rangle \end{bmatrix}$$

The purpose of C is to allow verb clusters to remain uncompacted but to compact all other kinds of complements. The reason for this is that *either* and certain adverbs can interleave with VPs, but not with other kinds of complements:

(19) a. [Fred] [wanted] [to] [either] [open] [the door], [or] [he] [wanted] [to] [close] [the window].

b.*Fred wanted two either drinks or two burgers.

c.*Fred said Mary either lost or suggested she would loose.

I will thus define that $C(\boxed{2}[\text{DOM}\,\boxed{0}])$ yields $\boxed{0}$ if $\boxed{2}$=VP and yields $\boxed{2}$ otherwise. In other words, complement VPs are not compacted while other kinds of complements are compacted (e.g. noun phrases, prepositional phrases and clauses).[8]

The *h-subj-cx* and *h-comp-cx* types are only two of the various kind of constructions that the grammar contains. The inventory of constructions is listed in the type hierarchy in Figure 5.14. This hierarchy identifies several classes and sub-classes of construction types, over which different generalizations can be stated. First of all, lexical constructions (*lex-cx*) are distinguished from phrasal constructions (*phrasal-cx*). The former are partitioned into derivational, inflectional and post-inflectional lexical

[8]See Kathol and Pollard (1995) for more on this kind of compaction function.

constructions, while the latter are partitioned into two major classes, *headed-cx* and *non-headed-cx*, following Chapter 2.

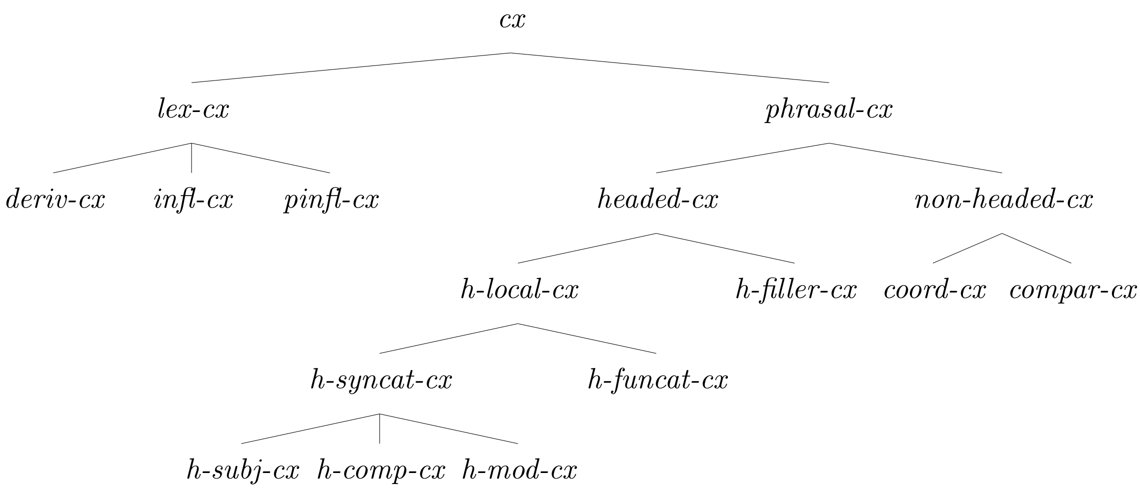


Figure 5.14: Type Hierarchy of grammar constructions

One important sub-distinction in headed constructions concerns ‘head-local’ and ‘head-filler’ constructions. In the former, one daughter is taken as argument of the other but in the latter the head daughter is the sister of a phrase which was extracted from an arbitrarily embedded position. A *h-filler-cx* constructions captures topicalization structures, for instance.

The *h-local-cx* constructions subsume two types of construction: *h-syncat-cx* and *h-funcat-cx*. The former concerns structures in which the selector is a major syntactic category (Noun, Adjective, Verb, Preposition, Adverb) and the latter concerns structures where the selector is a functional category (Determiner and Coordinator). The types *h-subj-cx* and *h-comp-cx* govern head-subject and head-complement constructions respectively, and the type *h-mod-cx* concerns adjunction structures. The rules governing each construction are discussed in Chapter 6.

The hierarchy in Figure 5.14 allows for various generalizations and sub-generalizations. One case in point is semantic composition. The semantic composition process in all phrasal nodes is obtained in exactly the same way, via the Semantic Inheritance Principle provided in (20). This principle states that the semantic content of any phrasal node corresponds to the concatenation of the content of the local daughters.

Because all variable binding and scope subordination is stated lexically, the semantics of any given phrasal node amounts to appending lists of underspecified semantic representations.

(20) SEMANTIC INHERITANCE PRINCIPLE

$$
\textit{phrasal-cx} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SEM} & \begin{bmatrix} \text{RELS} & \boxed{R_0}\oplus\boxed{R_1}\oplus\ldots\oplus\boxed{R_n} \\ \text{CONS} & \boxed{C_0}\oplus\boxed{C_1}\oplus\ldots\oplus\boxed{C_n} \end{bmatrix} \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SEM} & \begin{bmatrix} \text{RELS} & \boxed{R_1} \\ \text{CONS} & \boxed{C_1} \end{bmatrix} \end{bmatrix}, \ldots, \begin{bmatrix} \text{SEM} & \begin{bmatrix} \text{RELS} & \boxed{R_n} \\ \text{CONS} & \boxed{C_n} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{CX-SEM} & \begin{bmatrix} \text{C-RELS} & \boxed{R_0} \\ \text{C-CONS} & \boxed{C_0} \end{bmatrix} \end{bmatrix}
$$

Note however that the construction itself can make a semantic contribution, via a feature CX-SEM, due to Sag et al. (2003, 480). It is therefore more accurate to say that SEMANTIC INHERITANCE PRINCIPLE requires that the semantic content of any given phrasal node corresponds to the content of each daughter plus any semantic contribution made by the construction itself. In the current fragment the coordination construction is the only one in which a semantic contribution is made via CX-SEM. All other constructions are assumed to have empty list values for the features in CX-SEM.

All kinds of headed constructions share a fundamental property that can be stated in a uniform fashion: the head daughter and the mother node share the same part-of-speech information (as well as other HEAD specifications). This can be succinctly formalized by stating that in any headed construction the value of HEAD of the mother node is identical to the head daughter's HEAD value:

(21) HEAD FEATURE PRINCIPLE

$$
\textit{headed-cx} \Rightarrow \begin{bmatrix} \text{MTR} \mid \text{SYN} \mid \text{HEAD} & \boxed{1} \\ \text{HD-DTR} \mid \text{SYN} \mid \text{HEAD} & \boxed{1} \end{bmatrix}
$$

This essentially corresponds to the basic intuition behind X-Bar Theory. There are also sub-generalizations within headed constructions. For instance, the feature INHER encodes the existence of unbounded dependencies that arise when an argument is extracted and is not realized *in situ*. If a given head contains information about missing elements then the mother node should also contain this information, in order to ensure that the unbounded dependency is propagated in the tree structure and is not interrupted before a filler is found. This is valid for all headed construction types, except *hd-filler-cx* structures, in which extracted elements are canceled off instead of also present in the mother node. The percolation of the unbounded dependency is therefore a property common to all *h-local-cx* constructions:

(22) NON-LOCAL INHERITANCE PRINCIPLE

$$\textit{h-local-cx} \Rightarrow \begin{bmatrix} \text{MTR} \mid \text{SYN} \mid \text{INHER} & \boxed{1} \\ \text{HD-DTR} \mid \text{SYN} \mid \text{INHER} & \boxed{1} \end{bmatrix}$$

Thus, a root node S can thus be defined as a finite verbal structure with all subcategorization lists saturated and with no non-local dependencies in INHER:

(23)

$$\text{S}_{root} = \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{VFORM} & \textit{fin} \\ \text{MOD} & \textit{none} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \\ \text{INHER} & \begin{bmatrix} \text{GAP} & \langle\rangle \\ \text{REL} & \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Now let us turn to non-headed constructions. With regard to linearization, the domains of the daughters are simply concatenated. The crucial property of non-headedness however, is that the syntactic properties of the mother node are not determined by a single daughter, but by all the daughters. This characteristic is captured in a natural way by structure-sharing the SYN values of the mother and of the daughters:[9]

(24) NON-HEADED STRUCTURE PRINCIPLE:

$$\textit{non-headed-cx} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \boxed{1} \\ \text{DOM} & \boxed{2} \oplus \boxed{3} \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \boxed{1} \\ \text{DOM} & \boxed{2} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \boxed{1} \\ \text{DOM} & \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix}$$

[9]A similar constraint is adopted in Pollard and Sag (1994, 202), but then revised because of coordination of unlikes phenomena. Given the discussion in §2.1 and the ellipsis account provided in Chapter 8, the current proposal has no such shortcoming.

This is a simple constraint but it is one with a great deal of immediate empirical consequences. In §5.2 I discuss the consequences and predictions that (24) makes for coordination structures.

I conclude this overview of the grammar signature and constraints by providing some general well-formedness conditions for phrasal and lexical constructions. These basically prevent uninflected lexemes from being realized in syntax, and phrases from being realized in morphology. In phrasal constructions the daughters must be *word* or *phrase*, and in lexical constructions the daughters must be of type *lexical*:

(25) a. *phrasal-cx* $\Rightarrow$ $\left[\text{DTRS } \mathit{list}(\mathit{word}) \oplus \mathit{list}(\mathit{phrase})\right]$

b. *lex-cx* $\Rightarrow$ $\left[\text{DTRS } \mathit{list}(\mathit{lexical})\right]$

5.2 Empirical Aspects of Non-Headedness

In the grammar architecture defined above there is a number of syntactic information which is encoded in the value of SYN. In headed constructions the basic intuition in X-bar Theory applies: a certain amount of information – the HEAD information – is shared between the mother and the head daughter. But in non-headed constructions a different pattern is in place: the category of the whole is the same as the category of the daughters. The *non-headed-cx* rule provided in (24) captures this by requiring that the daughters and the mother node have the same SYN values.

$$\begin{array}{ccc} & \left[\text{SYN } \boxed{1}\right] & \\ \swarrow & & \searrow \\ \left[\text{SYN } \boxed{1}\right] & & \left[\text{SYN } \boxed{1}\right] \end{array}$$

Figure 5.15: Common property to all non-headed structures

Although I have yet to define how the *coord-cx* rule works, one can already observe that requiring that the daughters of non-headed constructions have identical SYN values has many predictions for a theory of coordination. Consider the information encoded in the feature SYN, for example, in a VP structure like (26):[10]

[10]The full path of some features is omitted for legibility whenever this does not cause any ambiguity.

(26) $$\begin{bmatrix} \textit{phrase} \\ \textsc{mp} \mid \textsc{form}\ \langle \textit{ate}, \textit{cheese}, \textit{pizza} \rangle \\ \textsc{syn} \begin{bmatrix} \textsc{head} \begin{bmatrix} \textit{verb} \\ \textsc{vform}\ \textit{fin} \end{bmatrix} \\ \textsc{val} \begin{bmatrix} \textsc{subj} & \left\langle \text{NP}[\textsc{case}\ \textit{s-nom}] \right\rangle \\ \textsc{comps} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \\ \textsc{inher} \mid \textsc{gap}\ \langle\rangle \end{bmatrix}$$

This VP consists in a phrase headed by a finite verb requiring a nominative subject NP. When two constituents are coordinated they are required to have the same SYN values. This in turn means that VP conjuncts have the same head and valence information: both have empty COMPS lists and both select for one and the same nominative subject NP, as is illustrated in Figure 5.16.

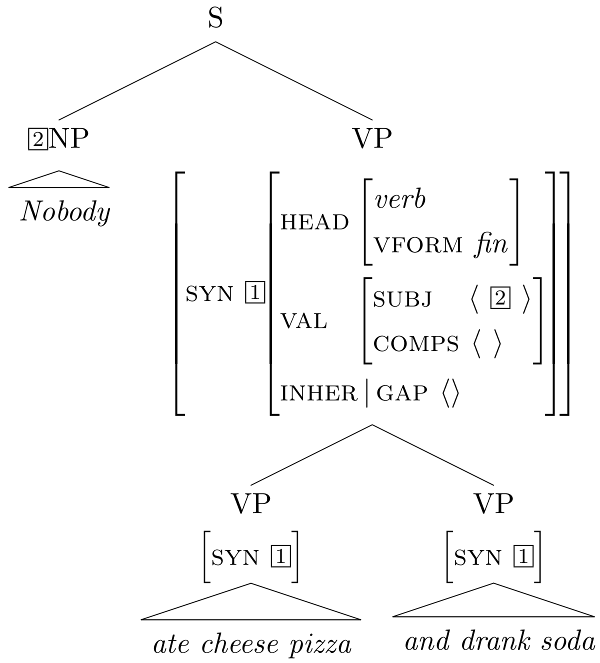


Figure 5.16: Valence identity in coordination

Exactly the same occurs when any other kind of category is coordinated: all the unsaturated valence arguments become one and the same for all conjuncts, and it becomes impossible to have daughters with different subcategorization information. For example, if one daughter requires a complement while the other does not, identity of SYN values is impossible. This correctly rules out a coordination of VP and V categories like the one in (27a), or S and VP as in (27b):

(27) a.*Fred [read a book]$_{\text{COMP}\langle\,\rangle}$ and [opened]$_{\text{COMP}\langle\text{NP}\rangle}$.

b.*Fred [she has a hat]$_{\text{SUBJ}\langle\,\rangle}$ and [smiled]$_{\text{SUBJ}\langle\text{NP}\rangle}$.

This is not only valid for VAL features but also for the feature GAP, which is also embedded inside SYN. This feature contains information about extracted elements, as observed in topicalized phrases, clefts, relativized complements, or in *tough*-constructions. Requiring that conjuncts have the same GAP values therefore has the consequence that either none of the conjuncts is gapped or that they all have the same gaps. This is illustrated with a topicalization structure in Figure 5.17.

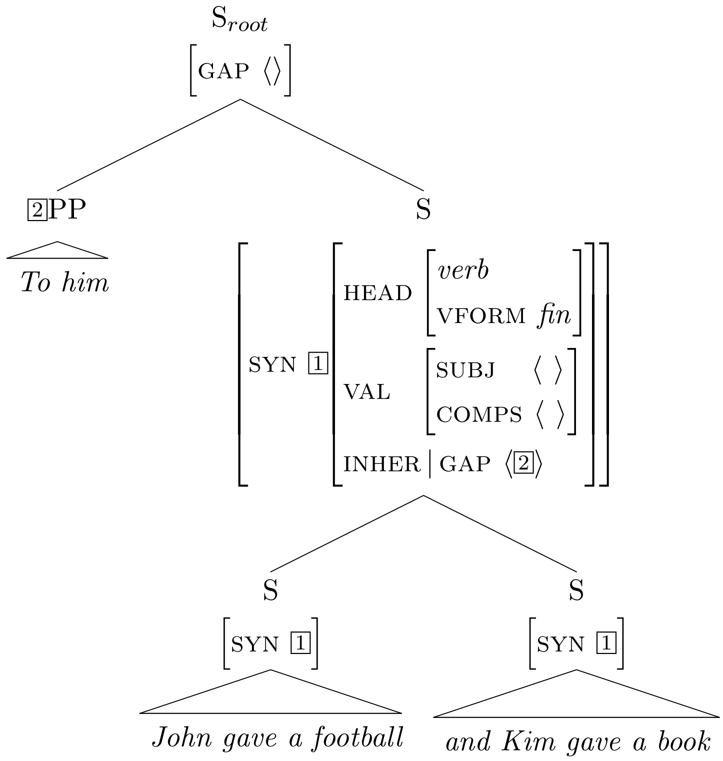


Figure 5.17: GAP identity in coordination

As noted in Pollard and Sag (1994, 202–205), this kind of approach predicts the Coordinate Structure Constraint as well as the ATB exceptions:[11]

[11]This insight is originally due to the Categorial Grammar account in Gazdar (1981), which was later adapted to GPSG (Gazdar et al. 1985) and to HPSG (Pollard and Sag 1994).

(28) a. [To him]$_{\boxed{1}NP}$ [Fred gave a football _]$_{GAP\langle\boxed{1}\rangle}$ and [Kim gave a book _]$_{GAP\langle\boxed{1}\rangle}$

b.*[To him]$_{\boxed{1}NP}$ [Fred gave a football _]$_{GAP\langle\boxed{1}\rangle}$ and [Kim gave me a book]$_{GAP\langle\rangle}$

c.*[To him]$_{\boxed{1}NP}$ [Fred gave a football to me]$_{GAP\langle\rangle}$ and [Kim gave a book _]$_{GAP\langle\boxed{1}\rangle}$

(29) a. It offers [something]$_{\boxed{1}NP}$ [that every kid wants _]$_{GAP\langle\boxed{1}\rangle}$ and [that every parent tries to help their child to achieve _]$_{GAP\langle\boxed{1}\rangle}$

b.*It offers [something]$_{\boxed{1}NP}$ [that every kid wants _]$_{GAP\langle\boxed{1}\rangle}$ and [that every parent tries to help their child to achieve it]$_{GAP\langle\rangle}$

c.*It offers [something]$_{\boxed{1}NP}$ [that every kid wants it]$_{GAP\langle\rangle}$ and [that every parent tries to help their child to achieve _]$_{GAP\langle\boxed{1}\rangle}$

As Bouma et al. (2001) note, the Conjunct Constraint simply follows from a traceless analysis: traces do not exist, and thus cannot be coordinated. In other words, examples like the ones below are ungrammatical simply because there are no conjuncts:[12]

(30) a. *I wonder who you saw [[_] and [_]].

b. *[Which of her books] did you find both [[a review of _] and [_]].

c. *[Which person] would it be ridiculous to compare [[_] and [_]].

The type hierarchy for *case* in Figure 5.4, due to Levine et al. (2001, 207), ensures that there is no problem in identifying gapped elements bearing different case assignments. A verb like *praise* requires a complement of type $\boxed{1}$*s-acc* and a verb like *would* requires a subject of type $\boxed{1}$*s-nom*. Since non-pronominal nouns are typed as *case*, the noun *movie* can satisfy both constraints because the type *nom_acc* is subsumed by both *s-acc* and *s-nom*:

(31) We went to see [a movie]$_{\boxed{1}nom\_acc}$ [which the critics praised _]$_{GAP\langle\boxed{1}\rangle}$ but [that Fred said _ would probably be too violent for my taste]$_{GAP\langle\boxed{1}\rangle}$

Pronouns like *him* or *she*, are lexically specified as *acc* and *nom* respectively, and thus cannot simultaneously be consisted with the case assignments *s-acc* and *s-nom*:

(32)*[Him]$_{acc}$, [all the critics like to praise _]$_{GAP\langle \mathrm{NP}acc\rangle}$ but [I think _ would probably not be present at the awards]$_{GAP\langle \mathrm{NP}nom\rangle}$

[12]For more on extraction without traces see Sag and Fodor (1994) for instance, as well as Sag (2000) for empirical arguments against the existence of *wh*-traces.

In §7.1 I flesh out the theory of extraction that obtains these structures. This part of the grammar specifies how the feature GAP comes to contain the arguments that are not realized *in situ*, how the unbounded dependency is propagated in the tree structure, and how the 'gaps' are matched with their respective 'fillers'.

Note also that the fact that nominal expressions like *Tom* and *a friend* are underspecified for case means that they can be coordinated, but that pronouns typed as *nom* and *acc* cannot be coordinated. This occurs because CASE is a head feature, embedded in SYN. Some examples are provided below for illustration:[13]

(33) a. I saw [Tom and a friend]$_{s-acc}$

b.*I saw [her$_{acc}$ and he$_{nom}$].

c.*He likes [she$_{nom}$ and me$_{acc}$].

Part-of-speech information is specified in HEAD, and thus it must also be identical across conjuncts. Consequently, different parts-of-speech cannot be coordinated:[14]

(34) a.*[Tim smiled]$_{\mathrm{S}}$ and [the book]$_{\mathrm{NP}}$.

b.*[Yesterday]$_{\mathrm{AdvP}}$ and [Fred overslept today]$_{\mathrm{S}}$.

c.*I made Mary [laugh]$_{\mathrm{VP}}$ and [happy]$_{\mathrm{AP}}$.

Similarly, NPs with different DET values cannot be coordinated as shown in (35). For example, *cats* is specified as [DET–] because it is a NP which is not overtly determined, while *the dog* is [DET+] because it is overtly determined by *the*.

(35) a. *[Cats and the dog] were here.

b. *The car is parked between [motorcycles and a bus].

c. *I bought both [a CD and books].

Now take for instance other head features such as VFORM. This feature is appropriate for verbs only and encodes the verb form, not tense or aspectual information. The coordination of inconsistent VFORM values is ruled out as ungrammatical as seen in (36), while consistent values of VFORM are accepted as illustrated by (37):

(36) a.*Tom [whistled]$_{\mathrm{VFORM}\ fin}$ and [walking]$_{\mathrm{VFORM}\ prp}$.

[13]For a discussion on some exceptions with regard to case and conjunction see §7.3.

[14]But see §2.1.1 and Chapter 8 for an account that predicts coordination of 'unlikes' phenomena.

b.*Sue [buy something]$_{\text{VFORM } prs}$ and [came home]$_{\text{FORM } fin}$.

(37) a. Tom [is married]$_{\text{VFORM } fin}$ and [bought a house in the suburbs]]$_{\text{VFORM } fin}$.
b. Sue [buys groceries here]$_{\text{VFORM } fin}$ and [could be interested in working with us]$_{\text{VFORM } fin}$.
c. Dan [protested for two years]$_{\text{VFORM } fin}$ and [will keep on protesting]$_{\text{VFORM } fin}$.

Other languages like Romance exhibit the same pattern, even though some combinations of verb tenses are harder to conjoin. This is likely to be due to low frequency and to the fact these are harder to motivate contextually. In some cases there are simpler alternative constructions that express the same proposition. For instance, Abeillé and Godard (2002) claims that the Spanish tense auxiliary (*haber*) cannot be combined with a coordination of participle VPs. Indeed these are rare and often somewhat degraded, but with the proper conjuncts and contextual setting these kinds of structures can become acceptable in Spanish and Portuguese. Below I present data from these two languages, respectively:

(38) a. Juan ha [comprado un coche nuevo] y [vendido el anterior].
'Juan has bought$_{prp}$ a car new and sold$_{prp}$ the old-one'
b. Eu tenho [trabalhado diariamente] e [feito tudo o que posso].
'I have worked$_{prp}$ daily and done$_{prp}$ all the what I-can'

Let us now consider the head feature PRED. This identifies the various cross-categorial expressions that can appear in predicative positions. Since this is a head feature, expressions with different values cannot be conjoined as in (39).

(39) a.*I became [former]$_{\text{PRED}-}$ and [happy]$_{\text{PRED}+}$
b.*He is [happy]$_{\text{PRED}+}$ and [Fred]$_{\text{PRED}-}$.
c.*[Mere]$_{\text{PRED}-}$ and [happy]$_{\text{PRED}+}$, Fred rode on into the sunset.

In the case of inverted clauses, the feature INV makes it impossible to coordinate inverted with non-inverted structures as illustrated below:[15]

[15]Note however that asymmetric readings (which are non-reversible and have added semantic import) are often grammatical, as illustrated by *Did you ever wake up and your hand is still asleep?* and *Did Kim enter the room and I didn't wake up?* These cases are addressed in §7.1.3.

(40) a. [Sue has sang in public]$_{\text{INV}-}$ and [Kim has tap-danced]$_{\text{INV}-}$?

b.* [Sue has sang in public]$_{\text{INV}-}$ and [has Kim tap-danced$_{\text{INV}+}$?

(41) a. [Elvis is alive]$_{\text{INV}-}$ and [there was a CIA conspiracy]$_{\text{INV}-}$?

b.* [Elvis is alive]$_{\text{INV}-}$ and [was there a CIA conspiracy]$_{\text{INV}+}$?

The SYN feature geometry currently adopted does not distinguish structures headed by auxiliary verbs from structures headed by non-auxiliary verbs. Thus, the grammar does not rule out mixed coordination cases:

(42) a. [I stayed home]$_{\text{AUX}-}$ but [Fred could have gone fishing]$_{\text{AUX}+}$.

b. [Tom went to NY yesterday]$_{\text{AUX}-}$ and [he will return next Tuesday]$_{\text{AUX}+}$.

c. Fred [sang well]$_{\text{AUX}-}$ and [will keep on singing]$_{\text{AUX}+}$.

However, standard HPSG accounts of auxiliary structures such as Pollard and Sag (1987) and many others since then resort to a head feature AUX, which is used to account for the distribution of auxiliary verbs. If AUX were to be a head feature then this would incorrectly rule out the data in (42) as ungrammatical. In order to avoid this and similar problems, Pollard and Sag (1994, 203) assumed that the coordination rule was special in some sense: certain inconsistent head information would not cause the grammar to reject the coordination. This move can be done but only at the expense of introducing complex machinery such as type-underspecification constraints (Sag 2002), default inheritance logic (Ginzburg and Sag 2000), or exhaustively positing a construction type for each kind of head value combination, as in Drellishak and Bender (2005).

But there may be independent reasons for not taking AUX to be a head feature. McCawley (1988, Ch.6) has provided arguments in favor of accounting the distribution of auxiliaries by semantic/aspectual properties rather than syntax proper. I agree with this position and offer some arguments for viewing AUX as a semantic feature. The data below suggest that if one conjunct is [AUX +] and the other is [AUX –] then the mother node exhibits a [AUX +] behavior. If *do* is taken to be an auxiliary verb which selects for non-auxiliary VP complements (e.g. *Kim did help* and **Kim did have called*), then examples such as (43) indicate that the coordinate VP is [AUX +] and therefore incompatible with the matrix verb:

(43) *Kim did [[have called]$_{\text{AUX}-}$ and [help]$_{\text{AUX}-}$].

The conjunct values of AUX should not be identified, but rather resolved in a principled way similarly to how first person agreement wins over second person in NP coordination: [AUX +] wins over [AUX –]. Thus, the following examples are grammatical because the mother node is resolved as [AUX +]:

(44) a. [[Tom went to NY yesterday]$_{\text{AUX}-}$ and [he will return next Tuesday]$_{\text{AUX}-}$]$_{\text{AUX}-}$.

b. Fred [[sang well]$_{\text{AUX}-}$ and [will keep on singing]$_{\text{AUX}-}$]$_{\text{AUX}-}$.

In order to accommodate this view, I propose that AUX is an *index* feature that is appropriate for eventuality indices. Thus, auxiliary *do* selects a VP complement that is specified as [VFORM *base*] and as [SEM|KEY|INDEX|AUX –]. The type hierarchy of referential indices provided in Figure 5.6 is thus revised to include [AUX *bool*]:

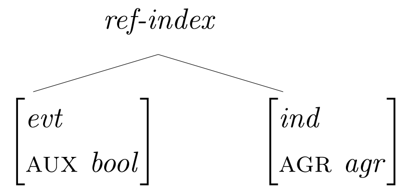


Figure 5.18: Revised *ref-index* type hierarchy

The various particularities of English auxiliary verbs can be treated as the result of lexical rules. For instance, inversion can be captured with the subject-auxiliary inversion lexical rule in Pollard and Sag (1994, 388), and the selection/contraction of a negative lexeme and omission of the VP argument from the COMPS list can both be captured as lexical rules as in Sag et al. (2003).

A similar problem arises for the standard treatment of the head feature PFORM in Pollard and Sag (1994, 45). This feature is usually used to identify the preposition that heads a given PP, but in my account only argument marking prepositions have a non-null specification for PFORM. These are semantically vacuous and are controlled by verbs that select for PPs, as in *Kim depends on/*to/*in Sandy.* Since PFORM identifies the preposition heading the PP, the coordination of PPs with different argument marking prepositions is ungrammatical:

(45) a. *Kim depends [[on Sandy]$_{\text{PFORM } on}$ or [to Fred]$_{\text{PFORM } to}$]?

b. *Kim is afraid [[of Sandy]$_{\text{PFORM } of}$ and [to Fred]$_{\text{PFORM } to}$].

Semantically potent prepositions are specified as [PFORM *none*] because no verb can control for their presence (e.g. *We conducted surveys on/ under/ near/ inside homeless centers*). This in turn allows PPs headed by semantically potent prepositions to be coordinated as in (46):

(46) We conducted surveys both on the streets and in homeless centers.

This concludes the the main set of predictions that a non-headed analysis has in the current theory. I now turn to the account of coordination structures.

5.3 Coordination Construction

The account of coordination abstracts away from category and from the coordination type. The same grammar rule is general enough to capture in a uniform fashion various kinds of coordination structures, resorting to exactly the same semantic composition process. Let us begin by considering the following familiar rules:

(47) a. $\mathrm{X}_{crd+} \rightarrow \; \textit{coord} \;\; \mathrm{X}_{crd-}$

b. $\mathrm{X} \rightarrow \; \mathrm{X}_{crd-} \;\; \mathrm{X}_{crd+}$

The rule in (47a) allows a coordination particle to attach to a conjunct, while (47b) allows the recursive iteration of a left conjunct. As it turns out (47a) is unnecessary, and a more general rule can account for all structures in which a functional category attaches to a head constituent. Thus, the rule that licenses a structure like [*and Fred smiles*] or [*and each man*] will be the same one that allows a determiner to attach to a nominal structure.

But before fleshing out these rules, the feature CRD must be formalized so that the presence of a coordinate structure can be identified. All coordinate lexemes are lexically specified as [CRD *crd+*] and all other lexemes are specified as [CRD *crd-*]. This new feature is appropriate for signs, as shown below:

(48) $\begin{bmatrix} \textit{sign} \\ \ldots \\ \text{CRD} \begin{bmatrix} \textit{crd} \\ \text{MODE} \;\; \textit{crd-mode} \end{bmatrix} \end{bmatrix}$

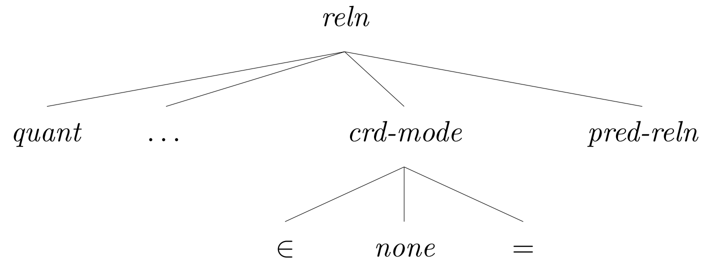


Figure 5.19: Type hierarchy of relation types (extended with *crd-mode*)

An additional feature MODE records the semantic relation contributed by the coordination lexeme. This second feature will allow us to ensure that all conjuncts are consistently connected via the same kind of semantic relation. The type *crd-mode* is a semantic relation type as seen in the (abbreviated) type hierarchy in Figure 5.19.

The rationale is as follows. Both non-intersective conjunction and adversative conjunction are plurality-forming, and thus both are specified as [MODE $\in$]. This relation '$\in$' is a dynamic set formation relation defined in §4.2, which must hold between the referents contributed by each conjunct and the pluralic referent introduced by the conjunction lexeme. The coordination rule is then responsible for introducing the relevant relation for every conjunct that is added. In simplified terms, a conjunction [X^{δ} and X^{β}] yields a mother node X^{α} where $\delta \in \alpha$ and $\beta \in \alpha$.[16]

Conversely, disjunction introduces an equality condition '=' rather than a membership condition. In simplified terms, a disjunction [X^{δ} or X^{β}] yields a mother node X^{α} where $\delta = \alpha$ or $\beta = \alpha$. The type *crd-mode* can be extended to also include other types of conjunction such as arithmetical and packaging conjunction. This simplification is made without loss of generalization.

In what follows I will propose a lexical entry for conjunction and then introduce the coordination rule. All the other lexical entries that are proposed interact with the same coordination rule, but yield different semantic representations.

[16]Greek letters are used to refer to indices that can be resolved either as *ind* or as *evt*. I also assume that $\in$ can only take arguments of the same type. Thus, only an individual can be a member of a plurality of individuals, and only an eventuality can be a member of a plurality of eventualities. This can be left as a matter of semantic interpretation or ensured by the grammar with an extra constraint.

5.3.1 Non-Intersective Conjunction

Let us start with the lexical entry for the non-intersective conjunction *and* given in (49). The VAL and INHER lists are omitted for simplification, but in these are empty.

(49) NON-INTERSECTIVE CONJUNCTION LEXEME

$$
\left[\begin{array}{l}
\textit{word} \\
\text{MP}\,|\,\text{FORM}\ \langle\ \textit{and}\ \rangle \\
\text{SYN}\,|\,\text{HEAD} \left[\begin{array}{l} \textit{coord} \\ \text{SPEC} \left[\begin{array}{l} \text{SEM}\,|\,\text{KEY} \left[\begin{array}{ll} \text{RELN} & \textit{quant} \\ \text{INDEX} & \boxed{\beta} \\ \text{ARGS} & \langle \ldots \boxed{l7} \rangle \end{array}\right] \\ \text{CRD}\ \textit{crd-} \end{array}\right] \end{array}\right] \\
\text{SEM} \left[\begin{array}{l} \text{KEY}\ \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \left[\begin{array}{ll} \text{RELN} & \exists \\ \text{INDEX} & \boxed{\alpha} \\ \text{ARGS} & \langle\ \boxed{l2} \ldots\ \rangle \end{array}\right], \left[\begin{array}{ll} \text{LBL} & \boxed{l4} \\ \text{RELN} & \in \\ \text{ARGS} & \langle \boxed{\beta}, \boxed{\alpha} \rangle \end{array}\right] \right\rangle \\ \text{CONS} \left\langle \left[\boxed{l4} \leq \boxed{l2}\right], \left[\boxed{l4} \leq \boxed{l7}\right] \right\rangle \end{array}\right] \\
\text{CRD} \left[\begin{array}{l} \textit{crd+} \\ \text{MODE}\ \in \end{array}\right]
\end{array}\right]
$$

The lack of part-of-speech constraints in the value of SPEC allows this word to attach to any kind of category, as long as it is not quantificationally defective ([RELN *quant*]), nor already marked by a coordination lexeme ([CRD *crd-*].

Semantically, the conjunction introduces an existentially quantified variable β which is required to contain the referential argument of the specified conjunct via the membership relation $\beta \in \alpha$. Since the types of α and β are underspecified, these can either be of type *evt* (eventuality indices) or of type *ind* (individual/nominal indices).

The fact that the conjunct is required not to be quantificationally defective via [KEY|RELN *quant*] ensures that the conjunction is not able to attach to N' categories to yield a plurality as seen in (50):

(50) a. *These [man and woman] were married.

b. *Two [man and woman] were neighbors.

c. *She is a both [wife and mother].

These are ruled out because the value of [KEY|RELN] of the second conjunct is a nominal predicate *woman* instead of a quantifier. As discussed in §3.2, cases like *Another dog and cat left the building* are predicted by peripheral ellipsis.

The subordination constraints $l_4 \leq l_2$ and $l_4 \leq l_7$ lexically introduced by the coordinator ensure that the membership relation is embedded under the existential quantifier introduced by the conjunction and under whatever quantifier is introduced by the conjunct. The underspecified representation in the SEM value of (49) is depicted in Figure 5.20 for perspicuity.

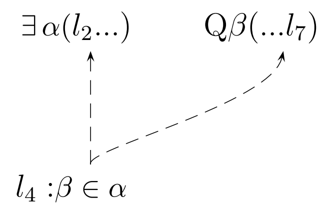


Figure 5.20: Semantics of the conjunction particle and a conjunct Q

Note that the constraints [ARGS $\langle\boxed{l2}...\rangle$] and [ARGS $\langle...\boxed{l7}\rangle$] do not require that the quantifiers have two argument slots. These constraints simply access the first argument label l_2 and the last argument label l_7. The quantifier '$\exists$' and the quantifier introduced by the conjunct can either be two-place quantifiers (*2-place-q*) binding an individual variable, or one-place existential quantifiers (*1-place-q*) binding a eventuality variable. This depends on whether the indices $\boxed{\alpha}$ and $\boxed{\beta}$ are typed as *ind* or *evt*. This kind of type-underspecification enables the conjunction to obtain the correct semantic representation regardless of the part-of-speech of the conjuncts. For example, in standard NP coordination the type of $\boxed{\alpha}$ and $\boxed{\beta}$ will be *ind*, and the well-formedness conditions for *2-place-q* quantifiers cause the existential quantifier to have two argument slots: $\exists\alpha(l_2 \wedge l_3)$. In the case of non-nominal conjuncts $\boxed{\alpha}$ and $\boxed{\beta}$ will be of type *evt* and the well-formedness conditions for *1-place-q* quantifiers force the existential quantifier to have only one argument: $\exists\alpha(l_2)$.

I now formalize in (51) the *h-func-cx* rule that allows functional categories to attach to a head that they select via SPEC:

(51) HEAD-FUNCAT CONSTRUCTION:

$$h\text{-}funcat\text{-}cx \Rightarrow \left[\begin{array}{ll} \text{MTR} & \left[\begin{array}{ll} \text{SYN} & \boxed{1} \\ \text{SEM}\,|\,\text{KEY} & \boxed{k} \\ \text{CRD} & \boxed{2} \\ \text{DOM} & \boxed{A}\oplus\boxed{B} \end{array}\right] \\ \text{HEAD-DTR} & \boxed{3} \\ \text{DTRS} & \left\langle \left[\begin{array}{ll} \text{SYN}\,|\,\text{HEAD}\,|\,\text{SPEC} & \boxed{3} \\ \text{SEM}\,|\,\text{KEY} & \boxed{k} \\ \text{CRD} & \boxed{2} \\ \text{DOM} & \boxed{A} \end{array}\right], \boxed{3}\left[\begin{array}{ll} \text{SYN} & \boxed{1}\left[\text{HEAD}\ \neg func\right] \\ \text{DOM} & \boxed{B} \end{array}\right] \right\rangle \end{array}\right]$$

The SYN value of the head is the same as the mother, which ensures that valence and unbounded dependencies of the head daughter are also the same. The value of KEY of the mother is required to be the same as the one for the specifier. This ensures that a structure like $[and\ \mathrm{X}^{\beta}]^{\alpha}$ is associated to the referent α introduced by the conjunction rather than to the referent β introduced by the conjunct. Thus, for all external subcategorization purposes, the relevant index and labels are the ones introduced by the functional category rather than the ones introduced by the head constituent.

The head daughter is required to not be functional because coordination markers do not attach to other coordinator markers or to determiners. The linearization domains of the daughters are concatenated given that functional categories always precede the head constituent. Finally, note that the coordination marking CRD value of the functional daughter is identified with the CRD value of the mother. Given that *and* is specified as [CRD *crd+*], the *h-funcat-cx* rule causes the mother node $[and\ \mathrm{XP}]_{XP}$ to be specified as [CRD *crd+*] also. Of course, this also means that the mother node has the same MODE value as the coordination lexeme.

The grammar formulated so far suffices to analyze a simple structure like [*and Kim*]:

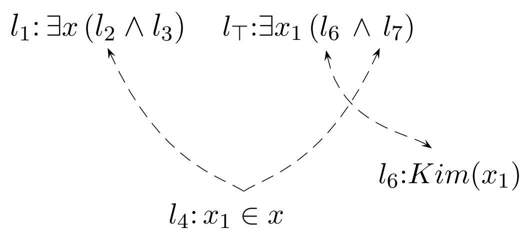


Figure 5.21: Semantic representation of $[and\ Kim]_{NP[\text{CRD}+]}$

The syntactic tree that obtains this MRS representation is given in Figure 5.22.

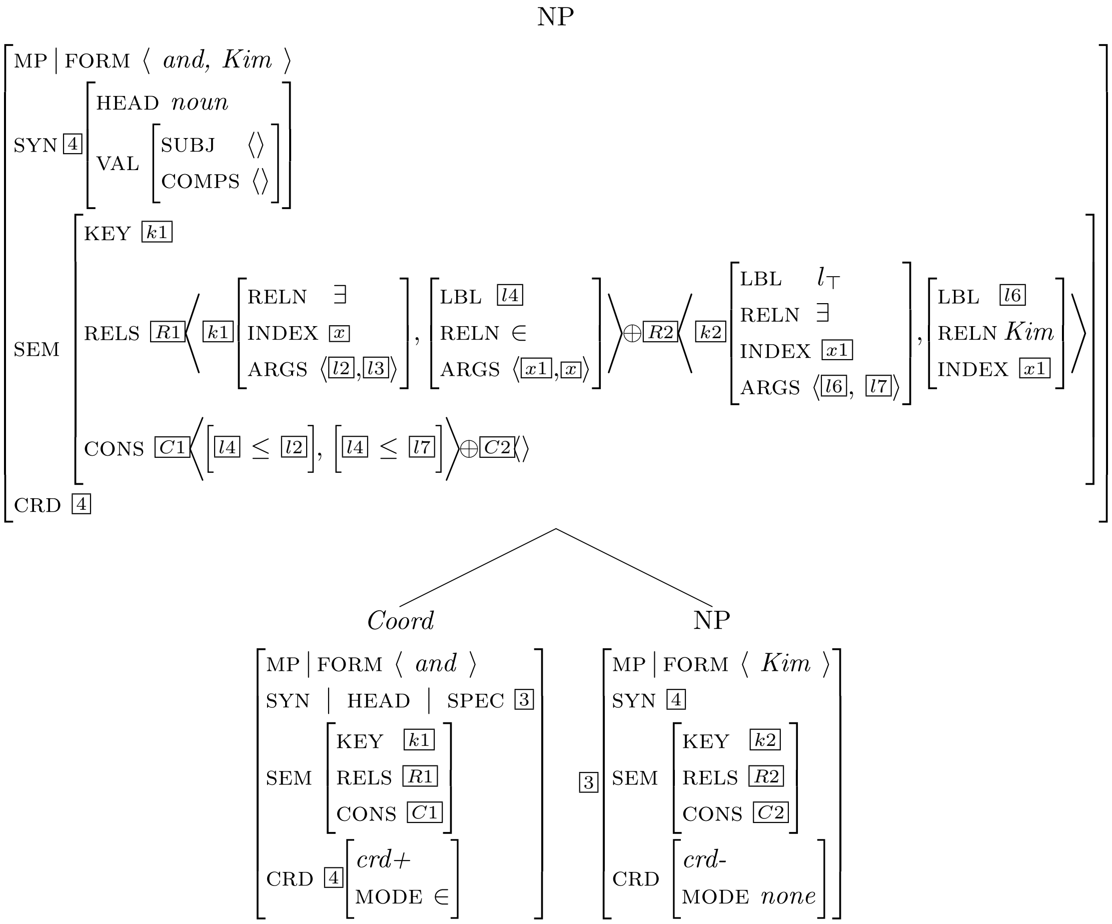


Figure 5.22: Analysis of $[and\ Kim]$

This phrase satisfies all of the grammar principles, including the HEAD FEATURE PRINCIPLE (the nominal daughter projects a nominal mother), the LINEARIZATION PRINCIPLE (the values of FORM of the daughters are concatenated in the mother), and the Semantic Inheritance Principle (the semantics of the mother node corresponds to the concatenation of the semantics of the daughters).

We can now proceed to formalize the coordination rule. The constraints imposed on the left conjunct are basically identical to the ones that the coordination lexeme imposes on the rightmost conjunct. A conjunct must not be quantificationally defective, must be *crd*–, and a relation holds between its referent δ and the referent α from the coordination lexeme. The latter semantic contribution is made via CX-SEM:

(52) Coordination Construction:

$$
\textit{coord-cx} \Rightarrow \begin{bmatrix}
\text{MTR} & \begin{bmatrix} \text{SEM} \mid \text{KEY } \boxed{k} \\ \text{CRD} \mid \text{MODE } \boxed{1} \end{bmatrix} \\
\text{CX-SEM} & \begin{bmatrix} \text{C-RELS} & \left\langle \begin{bmatrix} \text{LBL} & \boxed{l9} \\ \text{RELN} & \boxed{1} \\ \text{ARGS} & \langle \boxed{\delta}, \boxed{\alpha} \rangle \end{bmatrix} \right\rangle \\ \text{C-CONS} & \left\langle \begin{bmatrix} \boxed{l9} \leq \boxed{l12} \end{bmatrix}, \begin{bmatrix} \boxed{l9} \leq \boxed{l2} \end{bmatrix} \right\rangle \end{bmatrix} \\
\text{DTRS} & \left\langle \begin{bmatrix} \text{SEM} \mid \text{KEY} & \begin{bmatrix} \text{RELN} & \textit{quant} \\ \text{INDEX} & \boxed{\delta} \\ \text{ARGS} & \langle \ldots \boxed{l12} \rangle \end{bmatrix} \\ \text{CRD} & \textit{crd-} \end{bmatrix}, \begin{bmatrix} \text{SEM} \mid \text{KEY } \boxed{k} & \begin{bmatrix} \text{INDEX} & \boxed{\alpha} \\ \text{ARGS} & \langle \boxed{l2} \ldots \rangle \end{bmatrix} \\ \text{CRD} & \begin{bmatrix} \textit{crd+} \\ \text{MODE } \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle
\end{bmatrix}
$$

A relation $\boxed{1}$ must hold between the index $\boxed{\delta}$ of the new conjunct and the coordinate index $\boxed{\alpha}$. The relation $\boxed{1}$ is required to be the same as the relation that the coordinator particle lexically inserts via MODE. Thus $\boxed{1}$ is resolved on-the-fly as either '$\in$' or '$=$', according to the value of [MODE $\boxed{1}$] of the coordination lexeme. The same coordination rule can thereofore deal with the semantics of various kinds of coordination structures, including conjunction and disjunction. Finally, the value of CRD is underspecified in the mother note, allowing it to either be taken as a regular NP [CRD-] in *Sue and Kim laughed*, or to be instantiated as [CRD+], as the rightmost daughter of the *coord-cx* rule. Only the latter allows for the iteration of conjuncts, e.g. *Fred, Sue and Kim.*

The application of the coordination rule is illustrated in the tree in Figure 5.23. The MRS semantic representations are depicted in FOL notation for brevity and clarity.

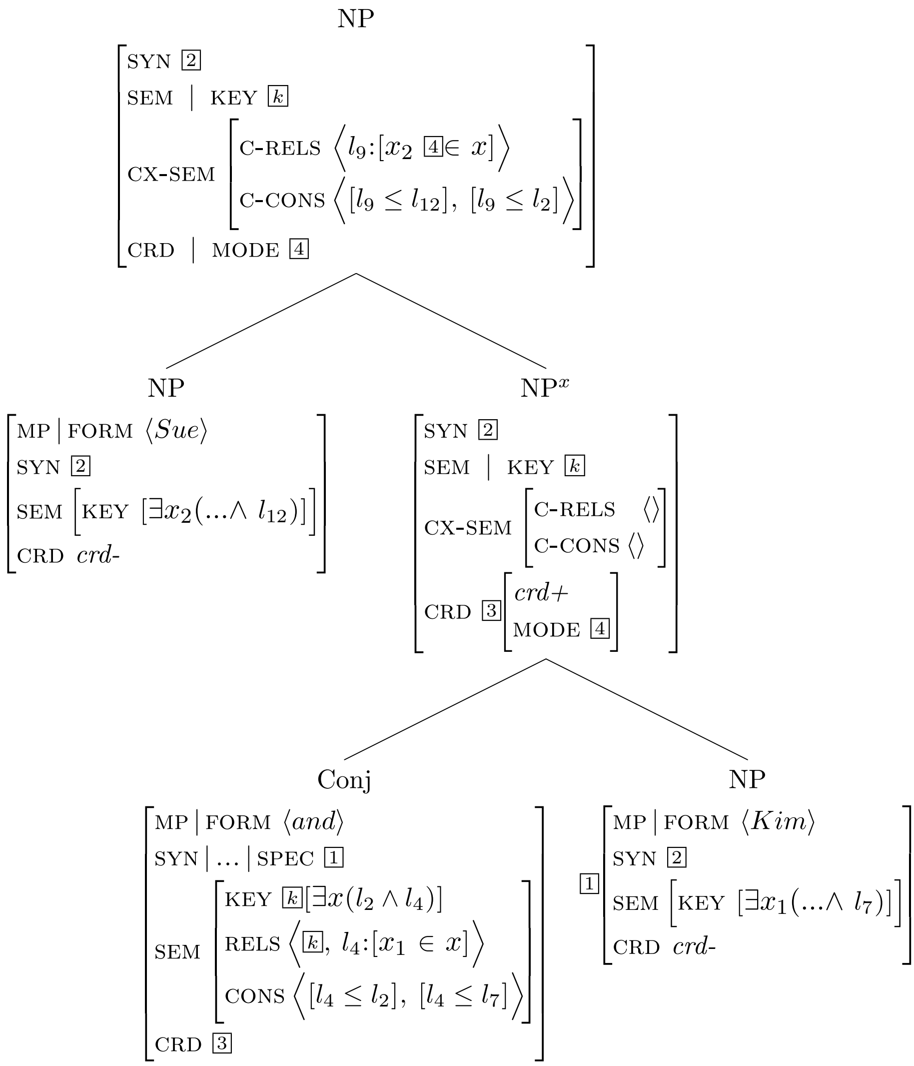


Figure 5.23: NP coordination [*Sue and Kim*]

The Semantic Inheritance Principle ensures that the semantic relations are always concatenated in each of the phrasal nodes. The semantics of the NP is therefore composed of the semantics of the two NPs plus the semantics of the conjunction and one extra membership relation, given below in full:

(53)
$$\begin{bmatrix} \text{MP} \,|\, \text{FORM} \ \langle \ \textit{Sue},\ \textit{and},\ \textit{Kim} \ \rangle \\ \text{SEM} \begin{bmatrix} \text{KEY } \boxed{k} \\ \text{RELS} \left\langle \begin{matrix} \begin{bmatrix} \text{LBL} & \boxed{l_9} \\ \text{RELN} & \in \\ \text{ARGS} & \langle \boxed{x2}, \boxed{x} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & l_\top \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{x2} \\ \text{ARGS} & \langle \boxed{l11}, \boxed{l12} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l11} \\ \text{RELN} & \textit{Sue} \\ \text{INDEX} & \boxed{x2} \end{bmatrix}, \boxed{k} \begin{bmatrix} \text{LBL} & l_1 \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle \boxed{l2}, \boxed{l3} \rangle \end{bmatrix}, \\ \begin{bmatrix} \text{LBL} & \boxed{l_4} \\ \text{RELN} & \in \\ \text{ARGS} & \langle \boxed{x1}, \boxed{x} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & l_\top \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{x1} \\ \text{ARGS} & \langle \boxed{l6}, \boxed{l7} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l6} \\ \text{RELN} & \textit{Kim} \\ \text{INDEX} & \boxed{x1} \end{bmatrix} \end{matrix} \right\rangle \\ \text{CONS} \left\langle \left[\boxed{l9} \leq \boxed{l12}\right], \left[\boxed{l9} \leq \boxed{l2}\right], \left[\boxed{l4} \leq \boxed{l2}\right], \left[\boxed{l4} \leq \boxed{l7}\right] \right\rangle \end{bmatrix} \end{bmatrix}$$

The KEY value of the coordinate structure is $\boxed{k}$, which corresponds to the quantifier introduced by the conjunction. This means that any structure that combines with the NP only has access to the pluralic referent x and to the two quantifier argument slots l_2 and l_3. The constraints lexically introduced by verbs are independent from the kind of NP that it combines with: in general, the verb is subordinate to the scopal argument and binds whatever variable is in the KEY value of the NP. In this case, the argument labeled with l_3.

For perspicuity, the MRS representation in (53) is depicted in Figure 5.24:

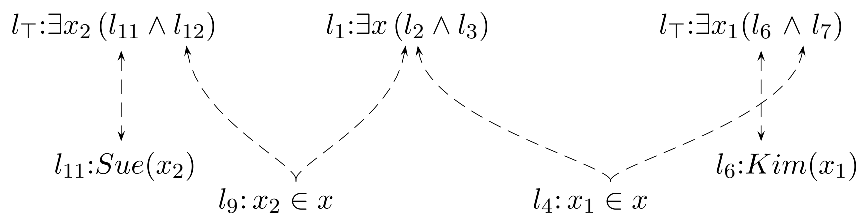


Figure 5.24: MRS representation in (53)

This offers a general account of argument selection that generalizes over both coordinate and non-coordinate NP arguments. Consider the tree below, licensed by the *h-subj-cx* rule already discussed in §5.1.

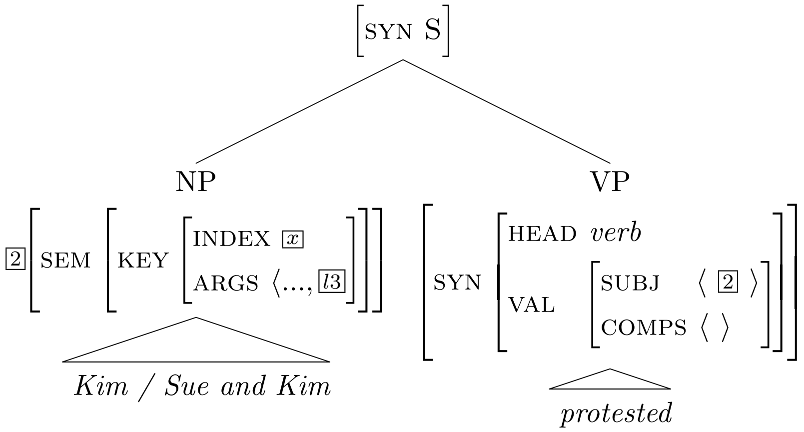


Figure 5.25: Uniform selection of coordinate and non-coordinate arguments

Let us first consider the simple NP. A sentence like *Kim laughed* obtains the MRS representation depicted in Figure 5.26. The semantics of the mother node corresponds to the concatenation of the semantics of the daughters. The constraints stated in the lexical entry of the verb bind the variable x and require that the NP outscopes the verbal semantics:

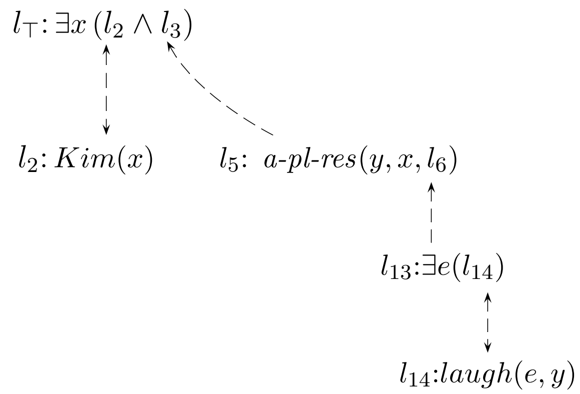


Figure 5.26: MRS representation of [*Kim protested*]

This MRS representation describes the following formula:

(54) $\exists x(Kim(x) \wedge a\text{-}pl\text{-}res(y, x, \exists e\, laugh(e, y)))$

The subject referent x denotes an atom and thus the type *a-pl-res* can only be felicitously be resolved as equality $=_a(y, x, \exists e\, laugh(e, y))$.

The *h-subj-cx* rule applies as usual if the NP argument is coordinate, and the VP only needs to add the information in KEY. The MRS representation obtained for a sentence like *Sue and Kim laughed* is provided in Figure 5.27.

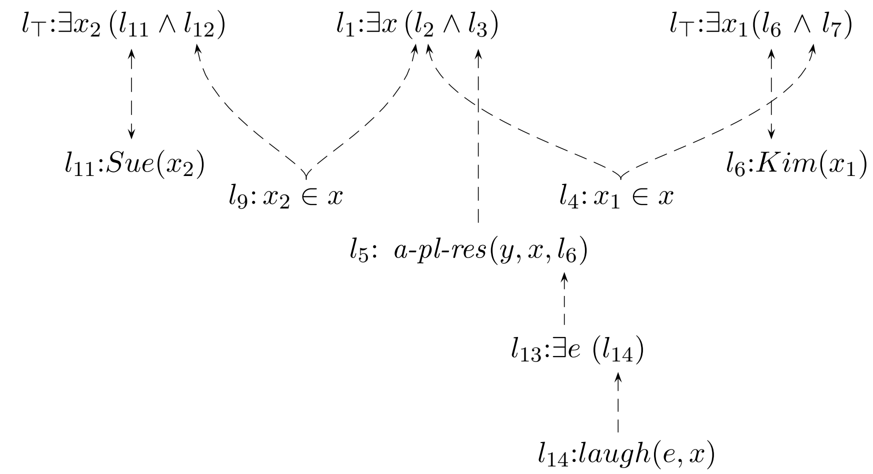


Figure 5.27: MRS representation of [*Sue and Kim laughed*]

Since the label $l_\top$ ensures that proper nouns necessarily take wide scope, the quantifier labeled by l_1 must take narrow scope under l_{12} and l_7. The membership conditions l_9 and l_4 are likewise forced to be plugged under the plurality quantifier because of the subordination constraints. Finally, *a-pl-res* can only be felicitously resolved as D_a (the $=_a$ resolution is not felicitous because this verb does not allow for collective readings).

(55) $\exists x_1(Sue(x_1) \wedge \exists x_2(Kim(x_2) \wedge \exists x(x_1 \in x \wedge x_2 \in x \wedge\ D_a(y, x, \exists e\, laugh(e, y)))))$

This representation obtains a distributive reading, as discussed in 4.1.2.

The same syntactic and semantic analysis applies to the conjunction of non-nominal categories: a plurality is formed and the subordination constraints require that the membership relations are subordinated to the quantifier introduced by the conjuncts. Consider the VP coordination *laughed and sang.* As far as coordination is concerned, this kind of structure is essentially the same as the one obtained for NP coordination. The main differences are the type of the plurality which is formed (an eventuality instead of an individual) and the fact that the non-saturated subject valent is shared between conjuncts. Since non-headed structures require that daughters have the same valence information, the coordinated verb phrases are subordinate to the same scope label and bind the same nominal referent.

The syntactic tree for *laughed and sang* is provided in Figure 5.28.

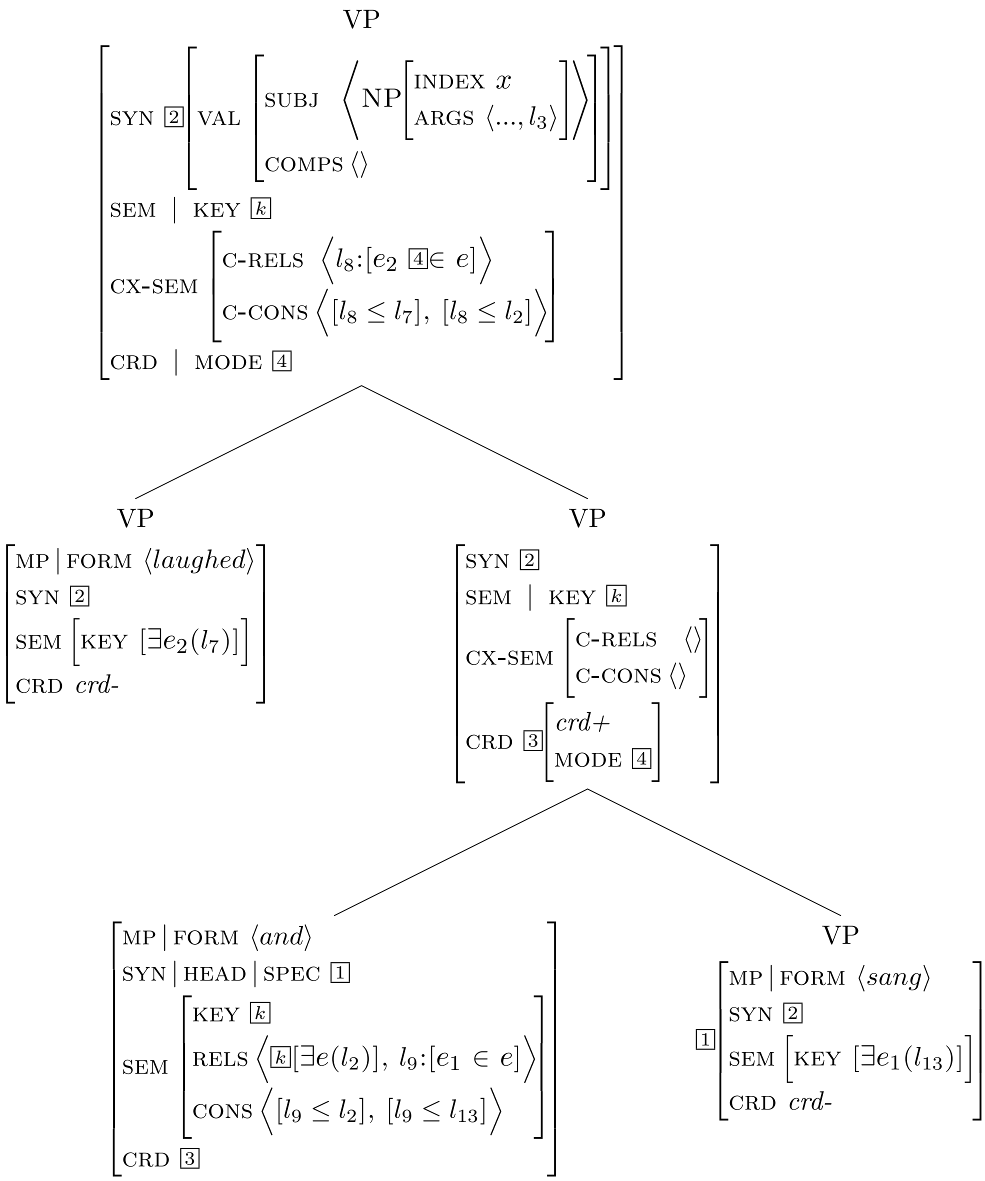


Figure 5.28: Verbal Phrase coordination [*laughed and sang*]

A plurality e is formed from the eventualities associated with each conjunct, and thus a collective reading can be obtained in the presence of adverbs like *simultaneously* or *alternately.* Note that in the obtained MRS representation the subject NP identified by l outscopes and is predicated by each conjunct simultaneously:

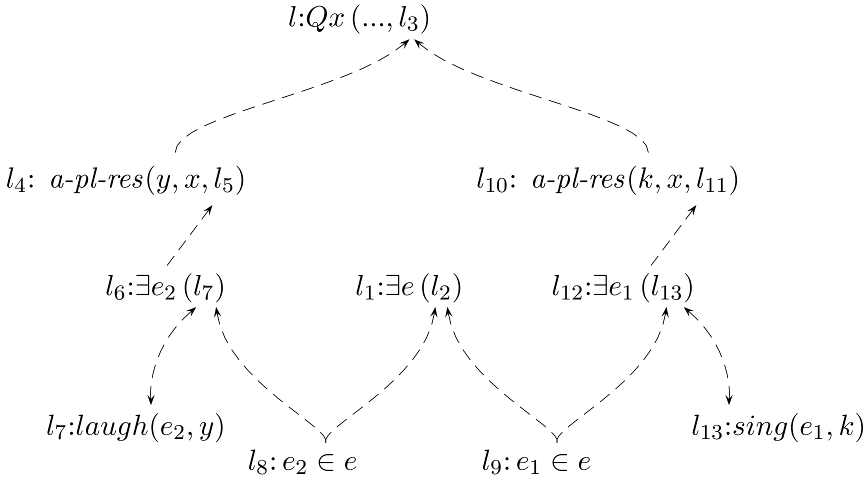


Figure 5.29: MRS representation of the VP [*laughed and sang*]

The VP behaves like any other VP with regard to the syntax-semantics interface, and thus it can combine with a subject phrase in the usual way. A full sentence is provided in (56) to illustrate the obtained representation:

(56) Kim laughed and sang.

$$\exists x(Kim(x) \wedge \exists e(=_a(y, x, \exists e_2(laugh(e_2, y) \wedge e_2 \in e))\wedge$$
$$=_a(k, x, \exists e_1(sing(e_1, k) \wedge e_1 \in e))\ ))$$

The conjunction of two sentences proceeds in a very similar fashion. A plural eventuality is also obtained given that the KEY value in both *h-comp-cx* and *h-subj-cx* constructions is percolated from the head daughter.[17] The sentence in (57) obtains the same kind of parse and a semantic composition process than all other cases of coordination discussed so far:

(57) Kim danced and Sue sang.

[17]The term percolation is used here metaphorically, as there is no actual motion in the satisfaction of these structures. All the constraints consist in structure-sharing of feature values. I also allude to a bottom-up analysis for convenience only, given that nothing in the grammar forces any kind of parsing strategy.

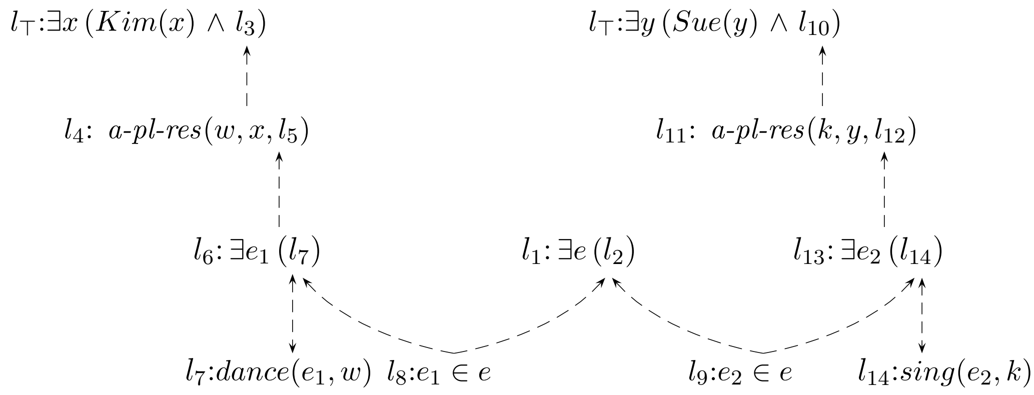


Figure 5.30: Semantic representation of (57)

Since all of the quantifiers are of the same kind, there are no scope ambiguities. As discussed in §5.1.1, the two proper nouns have wide scope. The only interpretation is one in which Kim danced and Sue sang, as shown in the corresponding formula in (58).

(58) $\exists x(Kim(x) \wedge \exists y(Sue(y) \wedge$
$\exists e(\ =_a(w, x, \exists e_1(dance(e_1, w) \wedge e_1 \in e)) \wedge$
$=_a(k, y, \exists e_2(sing(e_2, k) \wedge e_2 \in e))\ )\ ))$

In the next chapter I will show how the plural eventuality e can be predicated by adverbs like *often*, so that a collective reading is obtained.

It is important to stress that the syntactic and semantic information associated with each verb is always the same, regardless of a NP coordination or/and a VP coordination occurring. In general, when a head selects a subject or a complement, it is required to be subordinated to their scopal labels and bind the respective variable. Conjunction is simply building an existentially quantified plurality which stands for the combinatorial pivot for the whole coordinate structure with regard to variable binding and scopal subordination. In the next section multiple examples of NP coordination, V coordination, VP coordination, S coordination, PP coordination, AP coordination, and so forth, using the very same lexical entries and the same coordination rule.

5.3.2 Adversative Conjunction

The lexical entry for the adversative coordination *but* differs from conjunction only in that it does not attach to non-predicative NPs. All other aspects are exactly the same: *but* combines with the rightmost conjunct via exactly the same *h-funcat-cx* rule and the coordination structure is assembled by the *coord-cx* rule. All the other aspects of the analysis remain unchanged. The lexical entry for *but* is given in (59):

(59) ADVERSATIVE CONJUNCTION LEXEME

$$
\left[\begin{array}{l}
\textit{word} \\
\text{MP}\,|\,\text{FORM} \ \langle \textit{ but } \rangle \\
\text{SYN}\,|\,\text{HEAD} \left[\begin{array}{l} \textit{coord} \\ \text{SPEC} \left[\begin{array}{l} \text{SEM}\,|\,\text{KEY} \left[\begin{array}{ll} \text{INDEX} & \boxed{e1} \\ \text{ARGS} & \langle \boxed{l7} \rangle \end{array}\right] \\ \text{CRD} \ \textit{crd-} \end{array}\right] \end{array}\right] \\
\text{SEM} \left[\begin{array}{l} \text{KEY} \ \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \left[\begin{array}{ll} \text{RELN} & \exists \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{l2} \rangle \end{array}\right], \left[\begin{array}{ll} \text{LBL} & \boxed{l3} \\ \text{RELN} & \in \\ \text{ARGS} & \langle \boxed{e1}, \boxed{e} \rangle \end{array}\right] \right\rangle \\ \text{CONS} \left\langle \left[\boxed{l3} \le \boxed{l2} \right], \left[\boxed{l3} \le \boxed{l7} \right] \right\rangle \end{array}\right] \\
\text{CRD} \left[\begin{array}{l} \textit{crd+} \\ \text{MODE} \ \in \end{array}\right]
\end{array}\right]
$$

The lexeme only attaches to constituents that have an eventuality as a referential argument. This readily excludes non-predicative NPs as in **I saw Mary but Fred*, and allows the adversative conjunction of predicative NPs as in *Fred is a man but a short one*, as well as any kind of verbal structure, adjectival structure, etc.. I will discuss the formation of predicative nominals in §6.5.4. Since the coordinate VP is specified as [CRD–] nothing prevents it from being embedded as a left- or as a rightmost conjunct, as part of another coordination structure: *She* [*smiled but turned away*] *or* [*smiled and held it all in?*]

Adversative conjunction also carries a contrastive import, as discussed in §3.4. I will not attempt to deal with the pragmatics of adversative coordination. There are in my view no major technical problems with the introduction in the this lexical entry of pragmatical expectation-canceling conditions of the kind that *but* seems to convey, using for this purpose the CONTEXT and BACKGROUND features (Pollard and Sag 1994). This requires an independent theory of pragmatics which I cannot explore here.

5.3.3 Disjunction

The analysis of disjunction is very much the same as the account of conjunction, as far as syntactic structure and the semantic composition process are concerned. The same coordination rule and the same semantic principle are responsible for obtaining disjunctive coordination.

Disjunction is like non-intersective conjunction in that no categorial information is present in the value of SPEC, thus allowing the coordinator to attach to a constituent of virtually any category. Disjunction introduces a referent β which is also type-underspecified. Thus, depending on the constituent that the disjunction lexeme attaches to, the type of the index β can be resolved as *evt* or as *ind*. Similarly, it is also required that the conjunct is not quantificationally defective and that it is typed as *crd-*. The main differences lie in the morphophonological and semantic content of lexical entry for *or*, as seen in (60).

(60) DISJUNCTION LEXEME

$$
\left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{word}} \\
\text{MP}\,|\,\text{FORM} & \langle\ \textit{or}\ \rangle \\
\text{SYN}\,|\,\text{HEAD} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{coord}} \\
\text{SPEC} & \left[\begin{array}{ll}
\text{SEM}\,|\,\text{KEY} & \left[\begin{array}{ll}
\text{INDEX} & \boxed{\beta} \\
\text{RELN} & \textit{quant} \\
\text{ARGS} & \langle \ldots \boxed{l7} \rangle
\end{array}\right] \\
\text{CRD} & \textit{crd-}
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \left\langle \boxed{k} \left[\begin{array}{ll}
\text{RELN} & \exists \\
\text{INDEX} & \boxed{\alpha} \\
\text{ARGS} & \langle\ \boxed{l2}\ \ldots\ \rangle
\end{array}\right], \left[\begin{array}{ll}
\text{LBL} & \boxed{l2} \\
\text{RELN} & \bigvee \\
\text{ARGS} & \langle \boxed{l4} \rangle
\end{array}\right], \left[\begin{array}{ll}
\text{LBL} & \boxed{l5} \\
\text{RELN} & = \\
\text{ARGS} & \langle \boxed{\beta}, \boxed{\alpha} \rangle
\end{array}\right] \right\rangle \\
\text{CONS} & \left\langle \left[\boxed{l5} \leq \boxed{l4}\right], \left[\boxed{l5} \leq \boxed{l7}\right] \right\rangle
\end{array}\right] \\
\text{CRD} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{crd+}} \\
\text{MODE} & =
\end{array}\right]
\end{array}\right]
$$

The fact that MODE introduces an equality means that the coordination rule equates the referential argument of the disjunct and α. But the semantic content of this lexical item requires some additional explanation.

A disjunction '$\bigvee$' is plugged directly in the argument of the quantifier, and an equality condition is subordinated to the disjunction. The semantic content of (60) is depicted in Figure 5.31, with the disjunction directly plugged in l_2 for perspicuity:

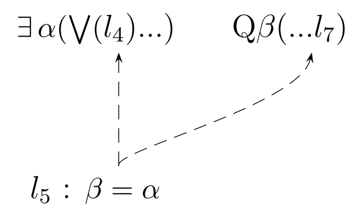


Figure 5.31: Semantics of the disjunction particle and a conjunct Q

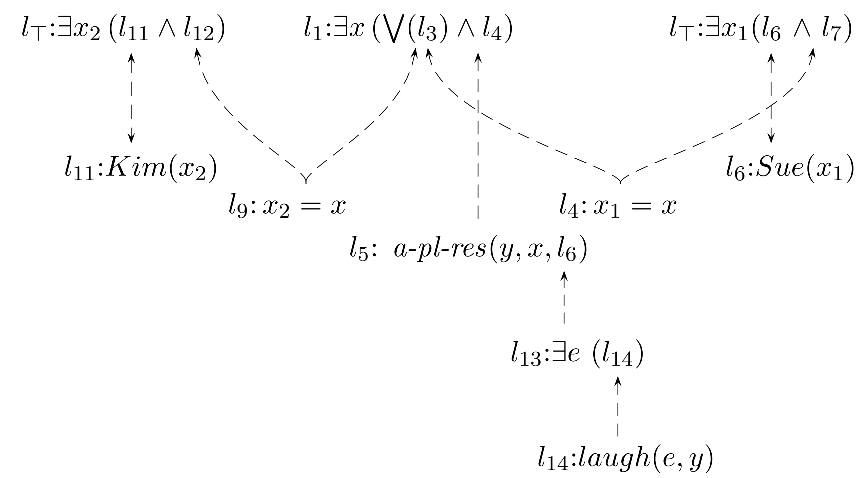
Consider for instance three relations $l_4\colon x_1 = x$, $l_5\colon x_2 = x$, and $l_6\colon x_3 = x$. Suppose that all of these are plugged (i.e. intersectively combined) with the argument slot of the disjunction: $l_4 = l_5 = l_6$. The result is an implicit conjunction of the form $\bigvee(x_1 = x \wedge x_2 = x \wedge x_3 = x)$. This disjunction will be interpreted as follows:

(61) $_{g1}[\![\bigvee(\phi_1 \wedge \ldots \wedge \phi_n)]\!]^{\mathcal{M}}_{g2}$ *iff* $\exists g_2\ _{g1}[\![\phi_1 \vee \ldots \vee \phi_n]\!]^{\mathcal{M}}_{g2}$

In other words, one takes the conjoined disjuncts and interprets them disjunctively. This shorthand allows us to obtain a uniform semantic composition for disjunction, which differs only minimally from conjunction.

Consider the example provided in (62), and the corresponding MRS:

(62) [Kim or Sue] laughed.



Since proper nouns must have wide scope, the existential quantifier l_1 is necessarily subordinated to both NPs, as shown in the scopally resolved representation:

(63) $\exists x_2(Kim(x_2) \wedge \exists x_1(Sue(x_1) \wedge \exists x(\bigvee(x_2 = x \wedge x_1 = x) \wedge =_a (y, x, \exists e\ laugh(e, y)))))$

The syntax-semantics interface for disjunction proceeds in exactly the same way as it did for conjunction. Consider for instance the parse tree in Figure 5.32.

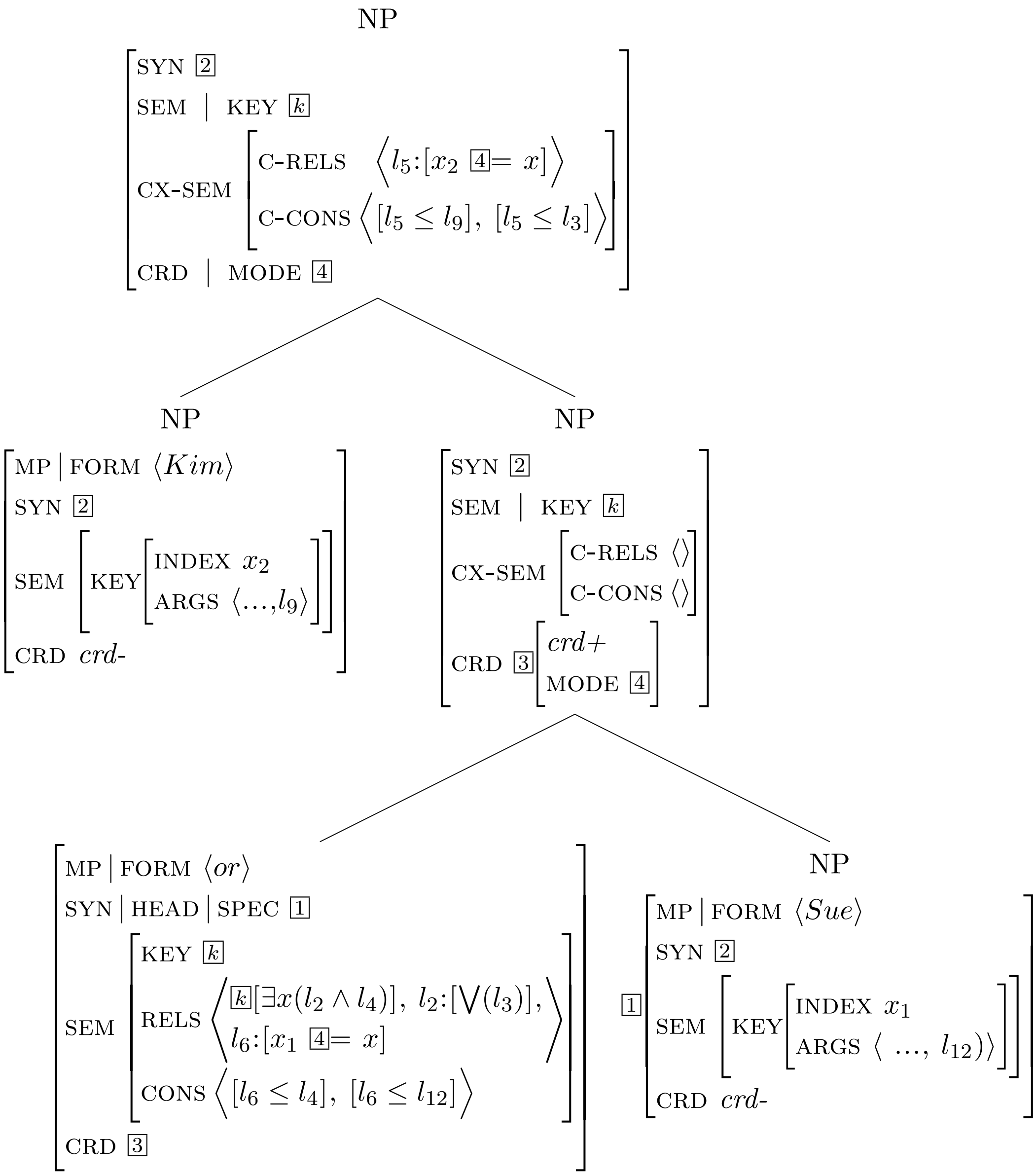


Figure 5.32: NP coordination [*Kim or Sue*]

The value of MODE is lexically specified as '=' and thus the coordination rule introduces exactly the same kind of relation via CX-SEM each time a new conjunct is iterated. Again, from the perspective of a verb selecting an NP argument for instance, there is no difference between a subject like *Kim* or *Sue or Kim*. The verb binds the referential argument of the NP, and is subordinated to the scopal argument slot:

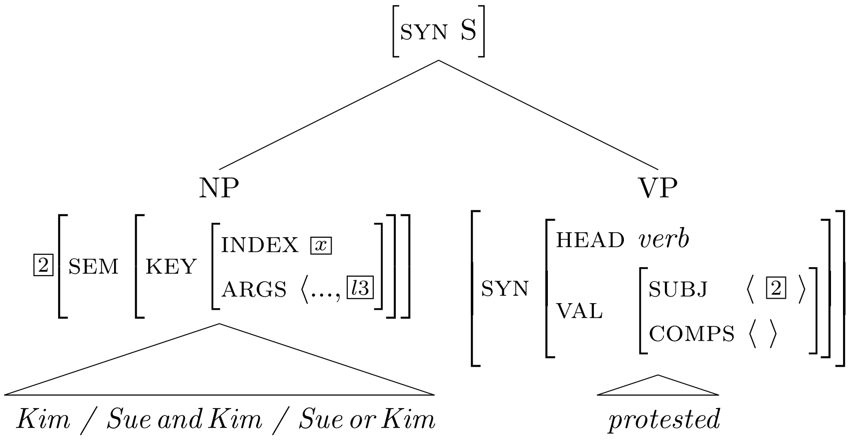


Figure 5.33: Uniform selection of coordinate and non-coordinate arguments

Indefinite descriptions are well-known for having specific or non-specific readings in the presence of certain scopal operators. This fact has consequences for the grammar defined so far. Consider for instance the MRS representation of *A dog or a wolf howled*:

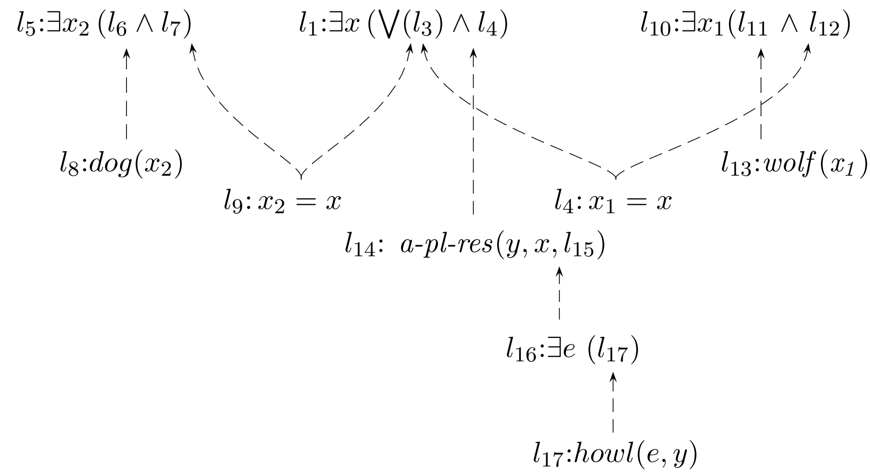


Figure 5.34: MRS representation for *A dog or a wolf howled*

The choice of scope for the indefinite NPs yields semantic contrast. For example, if both NPs are interpreted under the scope of disjunction then the existence of the two animals is not asserted. But if the NPs are interpreted specifically, outside the scope of the disjunction, then the speaker is committed to the existence of a dog and a wolf, one of which howled. These two readings are provided below, respectively.

(64) a. $\exists x((\exists x_2(dog(x_2) \wedge x_2 = x) \vee (\exists x_1(wolf(x_1) \wedge x_1 = x))) \wedge =_a(y, x, \exists e\, howl(e, y)))$

b. $\exists x_2(dog(x_2) \wedge \exists x_1(wolf(x_1) \wedge \exists x((x_1 = x) \vee (x_2 = x) \wedge =_a(y, x, \exists e\, howl(e, y)))))$

Nothing in this account prevents asymmetric cases in which the speaker has in mind a particular dog and a nondescript wolf, for example. However, these asymmetric readings are harder to contextualize and harder to compute, given that conjuncts are preferentially interpreted in a parallel fashion. The asymmetric scoping can be made more prominent with a prosodic cue, emphasizing the hypothesized animal.

I conclude with two remarks about the semantics of disjunction. First, there is one additional restriction on scope resolution. Only disjuncts that correspond to existentially quantified individuals are allowed to take wide scope. All other kinds of disjuncts must take narrow scope under the disjunction $\bigvee(...)$. For example, in S disjunction the scope of '$\vee$' only makes sense if it ranges over both S disjuncts, informally: $\exists e((S^{e2} \wedge e_2 = e) \vee (S^{e1} \wedge e_1 = e))$. In other words, in this account disjunction establishes a scope island for non-nominal disjuncts. This could be ensured in a number of ways. Perhaps the simplest is to use a feature TOP that sets the local top scope domain. For example, one could include in the lexical entry of verbs one more '$\leq$' constraint requiring that the verbal predication is subordinated to the label in TOP. Next, the coordination construction would structure-share the TOP value from each conjunct with the argument slot of the quantifier introduced by the coordination lexeme, available in KEY. This would prevent Neo-Davidsonian verbal quantifiers from outscoping coordination in general. I will not augment the grammar fragment in either way, as I would prefer that these facts would follow from an independent theory of scope processing.

The second remark about disjunction concerns quantificational NPs, as in *Every boy or every girl must sing*. The present account does not yield the correct representation of these kinds of disjunctions, regardless of how the disjuncts scope. For example, if both NPs take narrow scope under '$\bigvee$' then there is a unique individual x that is simultaneously equated to all the boys or all the girls. In order to avoid this problem, I suggest treating these sentences as instances of ellipsis: *Every boy ~~must sing~~ or every girl must sing.* It would thus suffice to prohibit the disjunction of universally quantified NPs, by placing a constraint on *coord-cx* structures. I leave this as an open question because I have found no conclusive test that can help decide whether these kinds of quantificational disjunctions truly exist or can all be viewed as elliptical.

5.3.4 Intersective Conjunction

As discussed in §3.3 this kind of conjunction does not form pluralities and only conjoins non-predicative nominal phrases. Semantically, it requires that the denotation of each conjunct is the same, which also shows up in the fact that only singular verb agreement is triggered when conjuncts are singular. Some examples are provided in (65):

(65) $\left\{ \begin{array}{l} \text{A mother and (a) wife} \\ \text{Every father and (every) husband} \end{array} \right\}$ knows this.

This conjunction can be treated as a separate lexical entry which differs from non-intersective conjunction in two aspects. First, it introduces an equality relation '=' for referents of type *ind*, rather than a type-underspecified '∈' relation, and second, the semantics of the conjunction is subordinated to the rightmost conjunct.

(66) Intersective Conjunction Lexeme

$$\begin{bmatrix} \textit{word} \\ \text{MP}\,|\,\text{FORM}\ \langle\ \textit{and}\ \rangle \\ \text{SYN}\,|\,\text{HEAD} \begin{bmatrix} \textit{coord} \\ \text{SPEC} \begin{bmatrix} \text{SEM}\,|\,\text{KEY} \begin{bmatrix} \text{RELN}\ \textit{quant} \\ \text{INDEX}\ \boxed{y} \\ \text{ARGS}\ \langle \ldots, \boxed{l1} \rangle \end{bmatrix} \\ \text{CRD}\ \textit{crd-} \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY}\ \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \begin{bmatrix} \text{LBL}\ \boxed{l1} \\ \text{RELN}\ \exists \\ \text{INDEX}\ \boxed{x} \\ \text{ARGS}\ \langle\ \boxed{l2}, \ldots\ \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL}\ \boxed{l2} \\ \text{RELN}\ = \\ \text{ARGS}\ \langle \boxed{y}, \boxed{x} \rangle \end{bmatrix} \right\rangle \\ \text{CONS}\ \langle\rangle \end{bmatrix} \\ \text{CRD} \begin{bmatrix} \textit{crd+} \\ \text{MODE}\ = \end{bmatrix} \end{bmatrix}$$

Everything with regard to the syntax-semantics interface operates in the same way as before. Because the MODE value is set to '=', the coordination rule causes the index of the rightmost conjunct to be equated to all of the preceding conjuncts. For example, assuming that an NP like *a father* is represented as $l_1{:}\exists x_2(father(x_2) \wedge\, l_3)$ and that an NP like *a husband* is represented as $l_5{:}\exists x_1(husband(x_1) \wedge\, l_7)$ we get the analysis in (67). The NP *a father and a husband* thus yields a structure where the referents of the two NPs are equated and the conjunction semantics is nested in the rightmost conjunct.

(67) [A father and a husband]$^x_{NP}$ complains.

$$\exists x_2(father(x_2) \wedge \exists x_1(husband(x_1) \wedge$$
$$\exists x(x_2 = x\ \wedge x_1 = x \wedge\ =_a(w, x, \exists e\, complain(e, w))\,)))$$

The situation is similar for cases with quantificational conjuncts. The representation below means that for any wife and any mother there is some individual who is both and who knows something.

(68) [Every wife and every mother]$^x_{NP}$ knows about this.

$$\forall x_2(wife(x_2) \rightarrow \forall x_1(mother(x_1) \rightarrow$$
$$\exists x(x_2 = x\ \wedge x_1 = x \wedge\ =_a(w, x, \exists e\, know\text{-}about(e, w, z))\,)))$$

In §3.3 I also noted that not all nouns are suitable for this kind of conjunction. Only conjuncts that are semantically compatible such as *lawyer*, *poet*, *father*, *fireman* can trigger this reading. Given the knowledge that someone is a poet, nothing rules out the possibility of this person being a lawyer, for instance. This is not the case for other nouns such as *cat* and *rat*, which describe entities with at least some mutually contradictory properties. I will not attempt to capture these properties here.

This concludes the discussion about the grammar fragment of coordination. It boils down to four lexical entries and one coordination rule. In the following chapters I discuss how various other kinds of structures are formed, and how they interact with coordination.

5.4 Summary

§5.1 The basic foundations of the HPSG formalization are put forth, including the syntactic and semantic levels of description.

§5.2 It is shown how many of the properties of coordination discussed in Chapter 2 follow as predictions from a non-headed analysis. Since the conjuncts and the mother have the same SYN specifications, a number of phenomena are obtained without stipulation.

§5.3 The theory of coordination consists in one rule and four lexical entries for the coordination lexemes (disjunction and non-intersective, adversative, and intersective conjunction). These cover a wide range of cross-categorial syntactic and semantic phenomena in a uniform and general way. Both the coordination rule and the coordination lexemes are underspecified in such a way as to allow for many different semantic and categorial combinations. The semantic representations themselves are semantically underspecified, using the Minimal Recursion Semantics framework, as discussed in Chapter 3.

Chapter 6

Headed Constructions

In previous chapters it is argued that the interpretation of pluralic arguments is driven by the lexical content of verbs and other predicates that combine with nominal arguments. Some predicates are intrinsically distributive, others are intrinsically collective, other still remain neutral. The semantic analysis that I propose allows for the underspecification of both the interpretation of plurals and of scope ambiguities. Moreover, one can disambiguate scope without disambiguating the plural reading, and vice-versa. Semantic disambiguation is seen as an incremental and monotonic process that simply consists in adding subordination constraints. These constraints can in principle capture in a straightforward fashion the disambiguation preferences that humans exhibit because subordination constraints can be locally tied to syntactic, semantic, pragmatic, prosodic, contextual, and world knowledge information.

This chapter extends the grammar coverage to various kinds of nominal structures, ranging from singular NPs, collective nominals, pluralized nominals, and pluralic quantificational NPs, with the goal of showing how the very same verbal lexical entry can cope with all of the above in a uniform way. In general, verbal heads combine with NP arguments and predicate over them with the same operations, regardless of their complexity. The result is a uniform view of the grammar of pluralities and of plural and scope ambiguities.

6.1 Basic Setup

This chapter focuses on the formation of various kinds of headed structures of the type *local-cx*. Nothing new is put forth with regard to coordination, but a preliminary note is in order. The coordination construction governs how the information conveyed by the feature CRD propagates through the tree structure, but something else must be said about how this information propagates in headed constructions. For example, one must prevent the grammar from allowing a *crd+* verb from attaching to a complement *[*He* [*and saw*]$_V$ *him*]$_{VP}$]$_S$ or *crd+* modifiers from adjoining to a head: *[*The* [[*or yellow*]$_A$ *house*]$_{N'}$]$_{NP}$.

All of these cases can be ruled out by requiring that in headed constructions involving syntactic categories the CRD value of the mother, the daughters and any unbounded dependencies is *crd-*. I thus propose the rule in (1), which states that *crd+* constituents have no place in these structures:

(1)
$$h\text{-}syncat\text{-}cx \Rightarrow \begin{bmatrix} \text{MTR} \begin{bmatrix} \text{INHER} \mid \text{GAP } \textit{list}([\text{CRD } \textit{crd-}]) \\ \text{CRD } \textit{crd-} \end{bmatrix} \\ \text{DRS } \textit{list}([\textit{crd-}]) \end{bmatrix}$$

6.2 Singular Nominal Structures

I will start by discussing determiners. These categories combine with other elements via the feature SPEC, and are assumed to have empty valence specifications. I omit valence from the lexical entries for brevity.[1]

Consider the singular indefinite determiner in (2). This word attaches to a N' constituent, requires the nominal to signal that it is specified by an over determiner (as indicated by [DET+]), and binds the nominal index $\boxed{1}$ to the index quantified by the determiner. Finally, the nominal semantics l_4 is required to be subordinate to the first argument slot l_2 of the quantifier:

[1]This is not a property of all determiners however, given that partitive determiners can be seen as selecting PP complements, but in this work I will not have much to say about partitives.

(2)
$$\begin{bmatrix}
\text{MP}\,|\,\text{FORM}\ \langle\ a\ \rangle \\
\text{SYN}\begin{bmatrix}\text{HEAD}\begin{bmatrix} \textit{det} \\ \text{SPEC N'}\begin{bmatrix}\text{DET}\ + \\ \text{KEY}\begin{bmatrix}\text{LBL} & \boxed{l4} \\ \text{RELN} & \textit{pred-reln} \\ \text{INDEX} & \boxed{1}\textit{ref-index}\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix} \\
\text{SEM}\begin{bmatrix}\text{KEY}\ \boxed{k} \\ \text{RELS}\ \left\langle \boxed{k}\begin{bmatrix}\text{RELN} & \exists \\ \text{INDEX} & \boxed{1} \\ \text{ARGS} & \langle\ \boxed{l2}\ \ldots\rangle\end{bmatrix}\right\rangle \\ \text{CONS}\ \left\langle\begin{bmatrix}\boxed{l4} \leq \boxed{l2}\end{bmatrix}\right\rangle\end{bmatrix}
\end{bmatrix}$$

The symbol N' is used as an abbreviation for the description given in (3). A N' category is a structure of nominal part-of-speech, quantificationally defective (i.e. not bearing a quantifier in KEY), and with an empty COMPS list.

(3)
$$\text{N'} = \begin{bmatrix}\text{SYN}\begin{bmatrix}\text{HEAD}\ \textit{noun} \\ \text{VAL}\,|\,\text{COMPS}\ \langle\rangle\end{bmatrix} \\ \text{SEM}\,|\,\text{KEY}\,|\,\text{RELN}\ \neg\textit{quant}\end{bmatrix}$$

Note that the index $\boxed{1}$ is type-underspecified as *ref-index*, and thus it can be further resolved as *ind* or as *evt*. Similarly, the number of arguments in ARGS is also underspecified, as this list is only required to start with the label l_2. The reason for this will become clearer below, but it is motivated by the fact that this determiner can attach to both predicative and non-predicative nominals. Non-predicative nominals like $man(x)$ have a referential argument x typed as *ind*, which in turn causes the quantifier to be resolved as a two-place predication like $\exists x(l_2 \wedge l_3)$ as it binds the variable x. The well-formedness conditions defined for quantificational predications in §5.1 make sure of this. On the other hand, predicative nominals like $liar(e, x)$ contain a referential argument e typed as *evt*, and thus cause the quantifier to be a one-place relation $\exists e(l_2)$. As a result, *A man complained* will yield something like the formula $\exists x(man(x) \wedge \exists e\, complain(e, x))$ and *Kim is a liar* will obtain $\exists x(Kim(x) \wedge \exists e\, liar(e, x))$. Other determiners like *no* are similarly underspecified, and in the process yield a striking difference in meaning. For example, *No doctor complained* yields $\neg\exists x(doctor(x) \wedge \exists e\, complain(e, x))$ while *Kim is no doctor* yields $\exists x(Kim(x) \wedge \neg\exists e\, doctor(e, x))$. The point is that the lexical entry in (2) is compatible with both predicative and non-predictive N' constituents, and can yield different kinds of interpretations. Predicative nouns are addressed in §6.5.4.

In the non-predicative realization, the determiner has two arguments and therefore the MRS representation of the indefinite quantifier translates as usual:

(4) $$\begin{bmatrix} \textit{1-place-q} \\ \text{LABEL } \boxed{l1} \\ \text{RELN } \exists \\ \text{INDEX } \boxed{x} \\ \text{ARGS } \langle \boxed{l2}, \boxed{l3} \rangle \end{bmatrix} \equiv \quad l_1{:}\exists x(l_2 \wedge l_3)$$

A second particularity of the lexical entry in (2) is that although the determiner is singular, and is supposed to combine only with singular nominal heads, it does not impose agreement constraints on the nominal index. The reason for this will become clearer in §6.2.2 when English collective nouns are discussed. As it turns out, certain cases of English determiner-noun agreement are semantic in nature, rather than morphological. For example, the indefinite cannot attach to a plural-denoting singular collective as in **A crew are pleased.* Note that definite determiners do not exhibit this restriction, as shown in examples like *The crew are pleased.* As will become clearer in §6.2.2, the constraint [RELN *pred-reln*] that the indefinite imposes suffices to guarantee that the noun does not denote a plurality of any kind.

According to (3), the noun *boy* seen in (5) qualifies as a N' category.

(5) $$\begin{bmatrix} \text{MP} \mid \text{FORM } \langle \textit{ boy } \rangle \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{noun} \\ \text{PRED } - \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SUBJ } \langle\rangle \\ \text{COMPS } \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY } \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \begin{bmatrix} \text{RELN } \textit{boy} \\ \text{INDEX } \boxed{x} \\ \text{ARGS } \langle\ \rangle \end{bmatrix} \right\rangle \\ \text{CONS } \langle\rangle \end{bmatrix} \end{bmatrix}$$

The *h-funcat-cx* rule defined in §5.3.1 is in general responsible for licensing structures where functional categories attach to a non-functional host. So far we have seen this rule licensing the formation of conjuncts, but the rule also allows determiners to attach to nominal structures. For convenience, the *h-funcat-cx* rule is repeated here in (6).

(6) HEAD-FUNCAT CONSTRUCTION:

$$h\text{-}funcat\text{-}cx \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN } \boxed{1} \\ \text{SEM} \mid \text{KEY } \boxed{k} \\ \text{CRD } \boxed{2} \\ \text{DOM } \boxed{A} \oplus \boxed{B} \end{bmatrix} \\ \text{HEAD-DTR } \boxed{3} & \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} \mid \text{HEAD} \mid \text{SPEC } \boxed{3} \\ \text{SEM} \mid \text{KEY } \boxed{k} \\ \text{CRD } \boxed{2} \\ \text{DOM } \boxed{A} \end{bmatrix}, \boxed{3} \begin{bmatrix} \text{SYN } \boxed{1} \begin{bmatrix} \text{HEAD } \neg func \end{bmatrix} \\ \text{DOM } \boxed{B} \end{bmatrix} \right\rangle \end{bmatrix}$$

The indefinite determiner and the noun *boy* can therefore combine as follows:

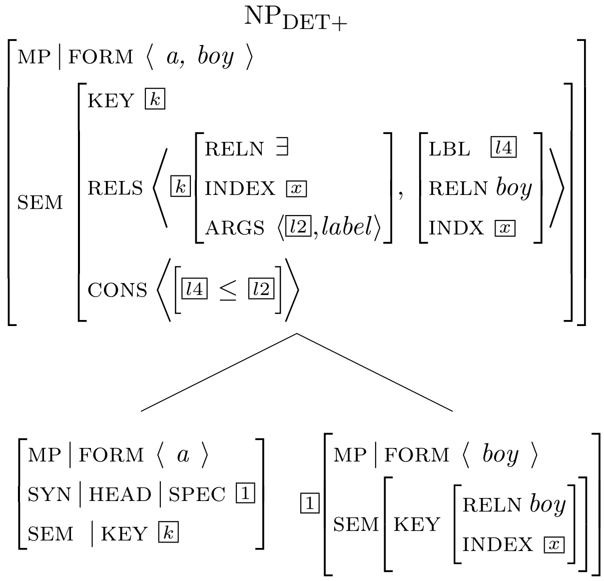


Figure 6.1: An indefinite noun phrase structure

The KEY value contains the quantifier predication, as required by the *h-funcat-cx* rule. Therein lies the relevant index and labels for semantic combination with other structures. The above MRS representation is cast in graphical form in Figure 6.2.

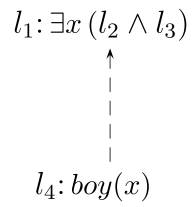


Figure 6.2: MRS representation of [*A boy*]

The coordination rule in §5.3 allows NP coordination to proceed exactly the same way as before. The coordination rule needs only to access the index and the scopal label of each conjunct. Thus, one obtains the familiar MRS representation for a NP coordination like *a girl and a boy*:

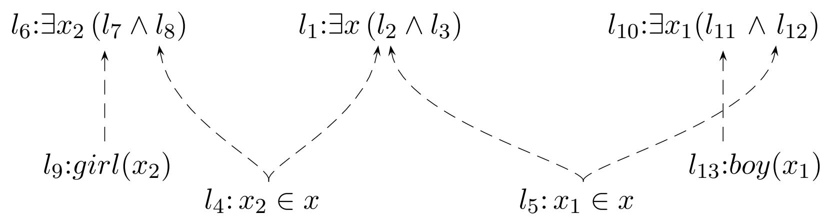


Figure 6.3: Underspecified representation of [*A girl and a boy*]

In all respects this is an NP that can combine with verbal structures in the same way as all other NPs described so far. As usual, the verbal predicate will be plugged in the scope argument slot l_3 and the variable x is bound.

(7) a. A girl and a boy laughed.

b. $\exists x(\ (\exists x_2(girl(x_2) \wedge x_2 \in x) \wedge$
$\exists x_1(boy(x_1) \wedge x_1 \in x)\ \ ) \wedge\ \ D_a(y, x, \exists e\ laugh(e, y)\ ))$

Let us now consider the case of the universal quantifier *every*. Generally speaking it behaves very similarly to the existential counterpart. It attaches to a singular N' category and binds the individual index to the two-place predication that the quantifier introduces:[2]

[2]The lexical entry for determiners such as *every* and *each* can also contain a subordination constraint requiring that the quantifier is subordinated to a local top label. This allows the grammar

(8)
$$\begin{bmatrix} \text{MP}\,|\,\text{FORM}\ \langle\ \textit{every}\ \rangle \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{det} \\ \text{SPEC N'} \begin{bmatrix} \text{DET}+ \\ \text{KEY} \begin{bmatrix} \text{LBL} & \boxed{l4} \\ \text{RELN} & \textit{pred-reln} \\ \text{INDEX} & \boxed{x}[\text{NUM}\ sg] \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY}\ \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \begin{bmatrix} \text{RELN} & \forall \\ \text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle\ \boxed{l2},\ \textit{label} \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \left\langle \left[\boxed{l4} \le \boxed{l2} \right] \right\rangle \end{bmatrix} \end{bmatrix}$$

The MRS representation of the quantifier translates to FOL in the usual way:

(9)
$$\begin{bmatrix} \text{LABEL}\ \boxed{l1} \\ \text{RELN}\ \ \forall \\ \text{INDEX}\ \boxed{x} \\ \text{ARGS}\ \langle \boxed{l2}, \boxed{l3} \rangle \end{bmatrix} \quad \equiv \quad l_1{:}\forall x(l_2 \rightarrow l_3)$$

The coordination rule makes no distinction with regard to the quantificational import of the conjuncts, and so the conjunction of all kinds of NPs proceeds in exactly the same fashion, and yields basically the same kind of MRS representation. Consider for example the sentence in (10) and the respective MRS representation in Figure 6.4.

(10) Every soldier and every officer met.

The intransitive usage of the verb *meet* requires a pluralic subject, as argued in Chapter 3, and thus it lexically introduces a *na-pl-res* relation. Recall that the *na-pl-res* type subsumes two types: D_m and $=_a$. The former distributes over set members and the latter yields the join of atoms (the atom base). Since the NP conjunction in (10) denotes a set of atoms and since *meet* is a collective verb, the only felicitous resolution for *na-pl-res* in this case is $=_a$.

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to straightforwardly prevent universal quantifier from having arbitrary wide scope. For example, it is usually assumed that these quantifiers cannot scope out of embedded clauses. I will presently not discuss scope processing in embedded environments, but such a HPSG fragment see Chaves (2002).

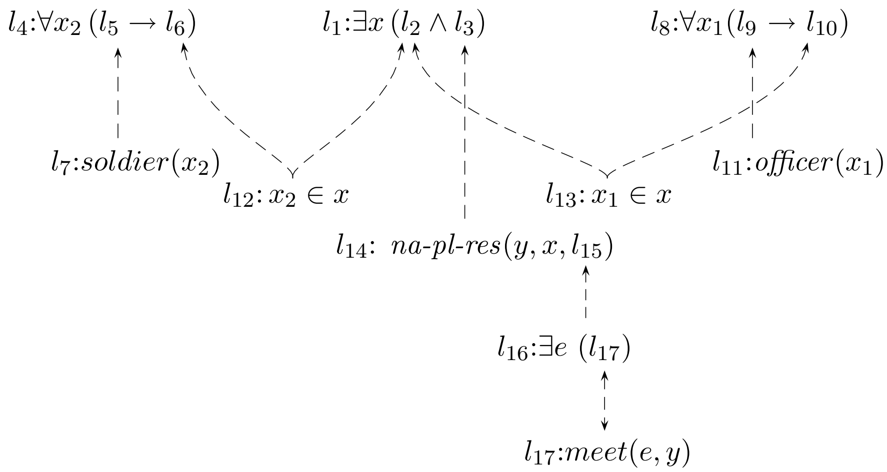


Figure 6.4: MRS representation of (10)

Now let us consider the range of readings that the underspecified structure in Figure 6.4 describes. If the existential quantifier l_1 has wide scope over the conjuncts as seen in (11) then there is a plurality composed of all soldiers and officers, and the elements composing this plurality met. In other words, everyone is meeting everyone else.

(11) $\exists x(\ (\forall x_2(soldier(x_2) \rightarrow x_2 \in x) \wedge$
$\forall x_1(officer(x_1) \rightarrow x_1 \in x)\quad) \wedge\ =_a(y, x, \exists e\ meet(e, y))\ )$

This reading obtains if the subordination constraints are resolved as $l_4 = l_2 = l_8$. For the structure to be a tree, then it also must hold that $l_6 = l_{12}$ and $l_{10} = l_{13}$.

If both conjuncts outscope the existential quantifier then one obtains a representation with different truth-conditions, seen in (12). In this reading all pairs of soldier-officer met (i.e. soldiers met officers and vice-versa).

(12) $\forall x_2(soldier(x_2) \rightarrow \forall x_1\,(officer(x_1)\ \rightarrow \exists x((x_2 \in x \wedge x_1 \in x) \wedge\ =_a(y, x, \exists e\, meet(e, y)))))$

The remaining scopal resolutions do not yield different truth-conditions, and thus need not be taken into consideration, just the same way as only one of the two logically equivalent scope resolutions of *Every critic saw every movie* is relevant for interpretation of the sentence. See for instance Koller and Thater (2006) which provides an efficient scope resolution algorithm that avoids the generation of logically equivalent quantifier scopings in MRS representations.

If conjuncts have a different quantificational import however, several other readings emerge. Not only the conjunct can interact scopally with the conjunction, but also with the other conjuncts. Consider the following example:

(13) Every soldier and an officer met.

This sentence yields a MRS representation which is isomorphic to the one in (10). One reading is in fact similar to the scope resolution in (11). The plurality takes wide scope, and the two conjuncts do not interact. The reading captured in (14) is one where there is a plurality composed of all the soldiers and at least one officer, such that all these individuals met each other.

(14) $\exists x(\ (\forall x_2(soldier(x_2) \rightarrow x_2 \in x) \wedge$
$\exists x_1(officer(x_1) \wedge x_1 \in x)\quad) \wedge\ =_a(y, x, \exists e\ meet(e, y))\ )$

However, if the existential conjunct takes narrow scope under the first conjunct then yet another reading emerges, one in which there is a potentially different officer for each soldier. Imagine for example a context in which three soldiers from different military branches are to meet each other and their respective officers.

(15) $\exists x(\ (\forall x_2(soldier(x_2) \rightarrow \exists x_1\ (officer(x_1) \wedge x_2 \in x \wedge x_1 \in x)\ ) \wedge\ =_a(y, x, \exists e\ meet(e, y))\ )$

It can also be the case that there is a specific officer that all of the soldiers meet. This is obtained if the second conjunct takes wide scope over the first conjunct instead:

(16) $\exists x(\ (\exists x_1\ (officer(x_1) \wedge \forall x_2(soldier(x_2) \rightarrow x_2 \in x \wedge x_1 \in x)\ ) \wedge\ =_a(y, x, \exists e\ meet(e, y))\ )$

Finally, the conjuncts can also take wide scope over the conjunction. Only soldiers meet officers and vice-versa, but two possibilities arise depending on the relative scope of the conjuncts. A narrow scope of the indefinite means that there is a potentially different officer per soldier as in (17a), and a wide scope of the indefinite means that there is only one officer, as in (17b).

(17) a. $\forall x_2(soldier(x_2) \rightarrow \exists x_1(officer(x_1) \wedge \exists x(\ (x_2 \in x \wedge x_1 \in x) \wedge\ =_a(y, x, \exists e\, meet(e, y)\,)))$

b. $\exists x_1(officer(x_1) \wedge \forall x_2(soldier(x_2) \rightarrow \exists x(\ (x_2 \in x \wedge x_1 \in x) \wedge\ =_a(y, x, \exists e\, meet(e, y)\,)))$

In sum, the very same lexical entry for the verb *meet* and the very same MRS representation can capture various kinds of readings as scope interactions, rather than via covert meaning-shifting operations, as in Hoeksema (1988) for example.

6.2.1 NP-Internal Modification

The grammar rule that licences adjunction in general is provided in (18). It allows a modifier to select a head constituent via MOD. The valence and category of the head daughter $\boxed{1}$ are the same as the mother node, and the modifier daughter is required to have saturated valency. Among other things, the latter prevents prepositions and relativized verbs from adjoining without first saturating their valents.

(18) HEAD-MODIFIER CONSTRUCTION:

$$
\textit{h-mod-cx} \Rightarrow \left[\begin{array}{l} \text{MTR} \left[\begin{array}{l} \text{SYN } \boxed{1} \\ \text{SEM}\,|\,\text{KEY} \left[\begin{array}{ll} \text{LBL} & \boxed{l} \\ \text{INDEX} & \boxed{4} \\ \text{RELN} & \boxed{5} \\ \text{ARGS} & \boxed{6}\end{array}\right] \\ \text{DOM } \langle\boxed{2}\rangle \bigcirc \boxed{7}\end{array}\right] \\ \text{HD-DTR } \boxed{3} \\ \text{DTRS} \left\langle \boxed{2} \left[\begin{array}{l} \text{SYN}\left[\begin{array}{l} \text{HEAD}\,|\,\text{MOD } \boxed{3} \\ \text{VAL}\left[\begin{array}{ll}\text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle\end{array}\right]\end{array}\right] \\ \text{SEM}\,|\,\text{KEY}\,|\,\text{LBL } \boxed{l}\end{array}\right], \boxed{3}\left[\begin{array}{l}\text{SYN } \boxed{1} \\ \text{SEM}\,|\,\text{KEY}\left[\begin{array}{ll}\text{INDEX} & \boxed{4} \\ \text{RELN} & \boxed{5} \\ \text{ARGS} & \boxed{6}\end{array}\right] \\ \text{DOM } \boxed{7}\end{array}\right]\right\rangle\end{array}\right]
$$

Note that the KEY specification of the mother node is *composite*: the label is contributed by the adjunct while the remaining information is contributed by the head. The fact that ARGS is percolated from the head daughter will play a major role in NP-adjoining constituents, discussed in §6.6, as in a uniform account of intersective and of scopal modifiers.

Many modifiers are relatively free with regard to word order, and thus the domain of the modifier daughter $\boxed{2}$ in (18) is compacted and *shuffled* '$\bigcirc$' with the domain $\boxed{7}$ of the head, rather than concatenated with it. For example, in languages like Portuguese the distribution of some adnominal adjectives is relatively free with regard to the head:

(19) a. Eu comprei um luxuoso barco
I bought a luxurious boat

b. Eu comprei um barco luxuoso
I bought a boat luxurious

For English I assume that all adjectival or adverbial domain elements are required to precede the (non-verbal) heads they attach to. I thus propose the linear precedence constraint in (20), in order to rule out **The car big* and **The false apparently jacket.*

(20) $$\begin{bmatrix}\text{SYN}\,|\,\text{HEAD}\begin{bmatrix} \textit{adj} \vee \textit{adv} \\ \text{MOD}\ \boxed{1}\end{bmatrix}\end{bmatrix} < \boxed{1}\begin{bmatrix}\text{SYN}\,|\,\text{HEAD}\ \textit{adj} \vee \textit{noun}\end{bmatrix}$$

This linear precedence rule requires that nominal or adjectival modifiers must precede in the DOM list the modified adjectival or adverbial signs, if any exist.

A similar constraint can be used to specify that the nominal head precedes post-nominal modifiers such as PPs and relative clauses:

(21) $$\boxed{1}\begin{bmatrix}\text{SYN}\,|\,\text{HEAD}\ \textit{noun}\end{bmatrix} < \begin{bmatrix}\text{SYN}\,|\,\text{HEAD}\begin{bmatrix} \textit{prep} \vee \textit{verb} \\ \text{MOD}\ \boxed{1}\end{bmatrix}\end{bmatrix}$$

Only adjectives with a non-null MOD value can adjoin to N'. As it turns out, these are all non-predicative adjectives, lexically specified as [PRED–]. For illustration consider the lexical entry for the adjective *big* in (22). English adjectives do not impose agreement constraints on the nominal structures that they adjoin to, and thus the adjective can attach to any kind of nominal structure, singular, plural or conjoined.

(22) $$\begin{bmatrix}
\text{MP}\,|\,\text{FORM}\ \langle\ \textit{big}\ \rangle \\
\text{SYN}\begin{bmatrix}
\text{HEAD}\begin{bmatrix}\textit{adj}\\ \text{PRED}\ - \\ \text{MOD}\ \text{N'}\begin{bmatrix}\text{KEY}\begin{bmatrix}\text{LBL} & \boxed{l1}\\ \text{INDEX} & \boxed{x}\end{bmatrix}\end{bmatrix}\end{bmatrix}\\
\text{VAL}\begin{bmatrix}\text{SUBJ} & \langle\ \rangle\\ \text{COMPS} & \langle\ \rangle\end{bmatrix}
\end{bmatrix}\\
\text{SEM}\begin{bmatrix}
\text{KEY}\ \boxed{k}\\
\text{RELS}\left\langle\begin{bmatrix}\text{LBL} & \boxed{l1}\\ \text{RELN} & \textit{a-pl-res}\\ \text{ARGS} & \langle\boxed{y},\boxed{x},\boxed{l2}\rangle\end{bmatrix}, \boxed{k}\begin{bmatrix}\text{LBL} & \boxed{l2}\\ \text{RELN} & \exists\\ \text{INDEX} & \boxed{e}\\ \text{ARGS} & \langle\boxed{l3}\rangle\end{bmatrix}, \begin{bmatrix}\text{LBL} & \boxed{l3}\\ \text{RELN} & \textit{big}\\ \text{INDEX} & \boxed{e}\\ \text{ARGS} & \langle\boxed{y}\rangle\end{bmatrix}\right\rangle\\
\text{CONS}\ \langle\rangle
\end{bmatrix}
\end{bmatrix}$$

Semantically, the adjective meaning is $\textit{a-pl-res}(y, x, \exists e\, \textit{big}(e, y))$ which allows the adjectival predicate to always predicate over the atom(s) in x. If x is atomic then the only felicitous resolution is '$=_a$' because the adjective is distributive on its nominal argument. The alternative resolution – D_a – requires x to be pluralic. Thus the very same adjectival lexical entry can combine with any kind of nominal.

Independent evidence was provided in §3.2 for adjectives and other categories introducing an eventuality. Thus, an adjective is semantically very similar to an intransitive verb in the sense that it contains a referential argument e and an individual argument x. One crucial aspect to note is that the adjective is *intersectively combined* with the nominal phrase: the label of the adjective l_1 and the label of the nominal are required to be identical. In MRS terms, the sharing of the same label means that the respective conditions are conjoined. Consider the following example:

$$l_5{:}\exists x\,(l_6 \wedge l_7)$$

$$l_1{:}animal(x) \wedge \textit{a-pl-res}(y, x, l_2)$$

$$l_2{:}\exists e\,(l_3)$$

$$l_3{:}big(e, y)$$

Figure 6.5: Semantic representation of $[a\ big\ animal]_{NP}$

The adjective attaches to the N' category via the *h-mod-cx* rule and the determiner attaches the complex N' category via the *h-funcat-cx* rule. The obtained syntactic structure is depicted in Figure 6.6.

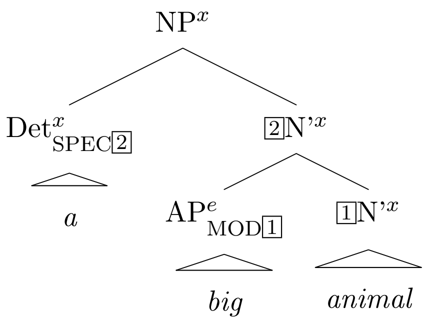


Figure 6.6: NP with a simple AP modifier

Assuming that the adjective *scary* has similar syntactic and semantic specifications, then the NP *a big and scary animal* obtains as follows:

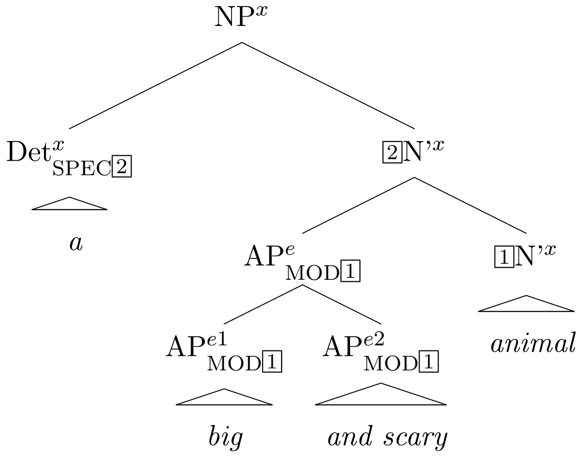


Figure 6.7: NP with a coordinate AP modifier

The coordination rule can conjoin AP constituents just like any other case of coordination discussed so far. A eventuality plurality is formed and SYN values are structure-shared. The latter is of major importance because it means that the value of MOD is also structure-shared. Consequently, all APs predicate over the same nominal variable x and are intersectively combined with the same label l_1. The MRS representation of the NP *a big and scary animal* is given in Figure 6.8.

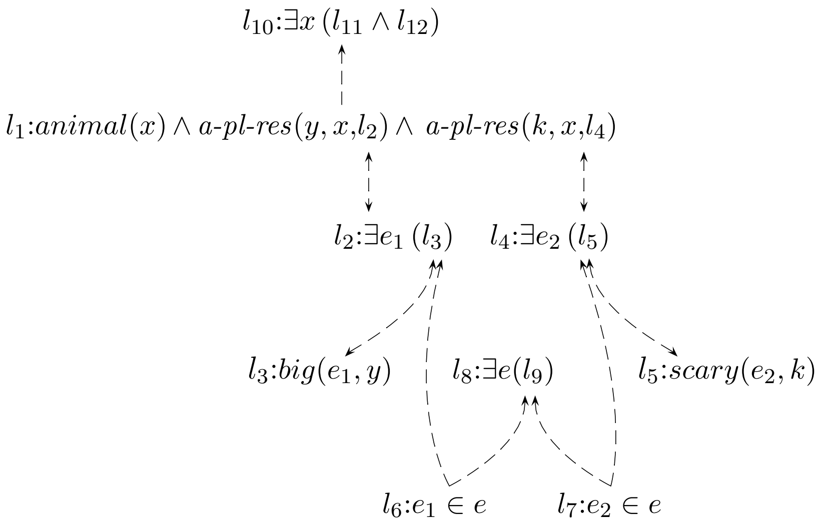


Figure 6.8: Underspecified representation of *a big and scary animal*

There is little room for scope ambiguity given that most formulas are directly plugged in their respective arguments. For perspicuity, I provide the full HPSG representation of the coordinate AP below.

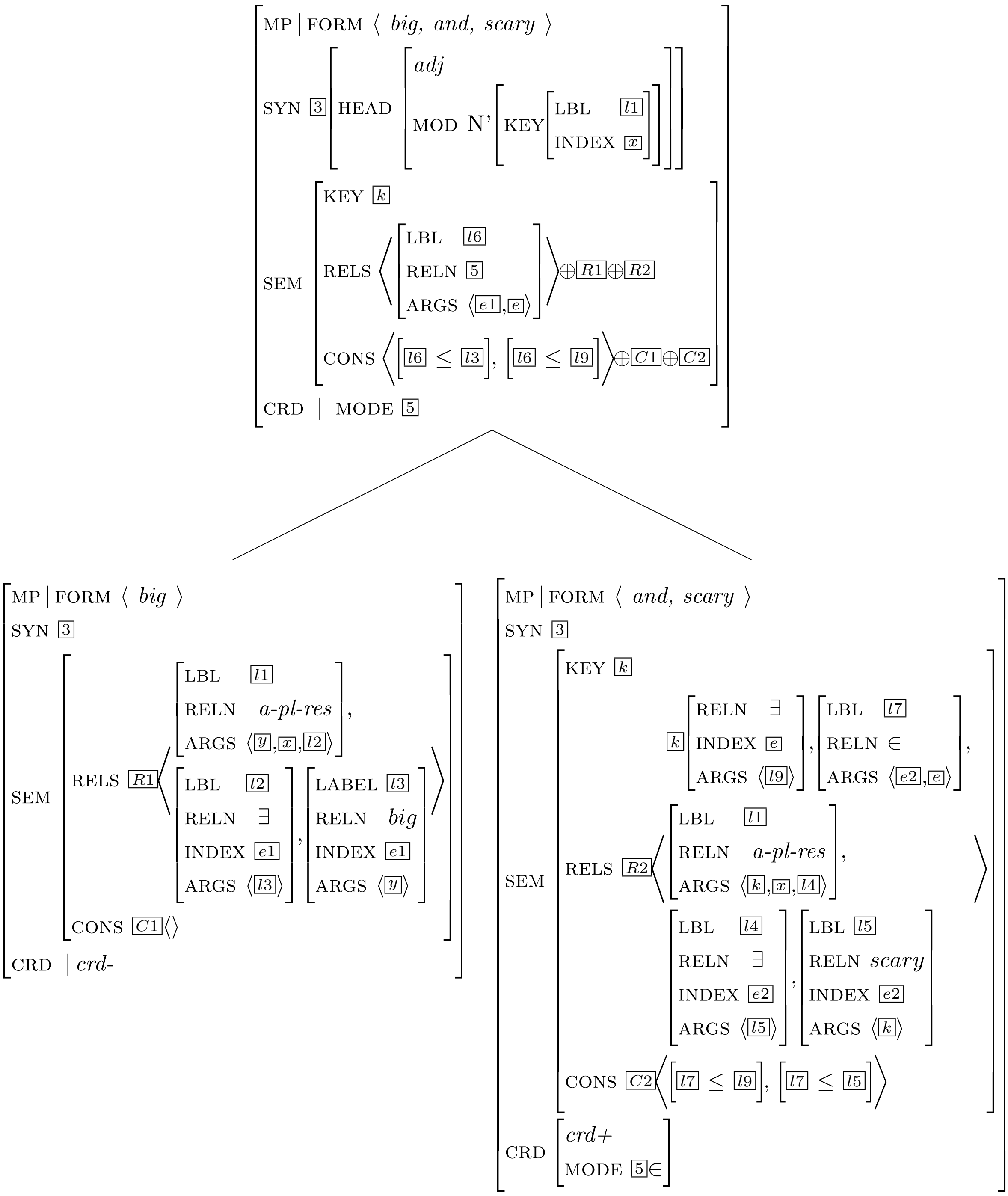


Figure 6.9: AP coordination

Any verb that combines with the NP *a big and scary animal* or with the NP *an animal* accesses exactly the same kind of KEY information: the nominal index x and the scopal argument slot of the determiner. The result is a uniform articulation of syntax and semantics where coordinate structures essentially behave in the same way as non-coordinate structures. Once the MRS representation is scopally resolved, the FOL representation in (23) is obtained:

(23) A big and scary animal yawned.

$$\exists e\,(\exists x(animal(x) \wedge$$
$$=_a(y, x, \exists e_1\,(big(e_1, y) \wedge e_1 \in e)) \wedge$$
$$=_a(k, x, \exists e_2\,(scary(e_2, k) \wedge e_2 \in e)) \wedge =_a(w, x, \exists e\; yawn(e, w)))$$

Note that nothing in the grammar requires that conjuncts must be semantically compatible. If contextualized, semantically incompatible conjuncts are felicitous:

(24) You can't possibly believe that [Schrödinger's cat is both alive and dead].

Scopal adjectives differ from intersective adjectives in several aspects. First, I will assume that no referential argument is introduced. I have found no clear cases where scopal adjectives can be said to be conjoined. The data like (25) suggest that apparent exceptions are best seen as Right-Periphery Ellipsis:

(25) a. ?* This is a real and alleged concern.
b. These are both real ~~concerns~~ and alleged concerns.

I will thus keep the lexical semantics of scopal adjectives simpler, although nothing in the present account prevents one from assuming that they also introduce a referential argument. Without such a quantificational relation, the coordination of these adjectives is not permitted. Consider the lexical entry for *alleged*:

(26)
$$\left[\begin{array}{l}
\text{MP}\,|\,\text{FORM}\ \langle\ \textit{alleged}\ \rangle \\
\text{SYN}\ \left[\begin{array}{l}
\text{HEAD}\ \left[\begin{array}{l}
\textit{adj} \\
\text{PRED}\ - \\
\text{MOD N'}\left[\text{KEY}\left[\text{LBL}\ \ \boxed{l1}\right]\right]
\end{array}\right] \\
\text{VAL}\ \left[\begin{array}{ll}
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle
\end{array}\right]
\end{array}\right] \\
\text{SEM}\ \left[\begin{array}{l}
\text{KEY}\ \boxed{k} \\
\text{RELS}\ \left\langle \boxed{k}\left[\begin{array}{ll}
\text{LBL} & \boxed{l2} \\
\text{RELN} & \textit{alleged} \\
\text{INDEX} & \boxed{e} \\
\text{ARGS} & \langle\ \boxed{l3}\ \rangle
\end{array}\right]\right\rangle \\
\text{CONS}\ \left\langle\left[\boxed{l1} \leq \boxed{l3}\right]\right\rangle
\end{array}\right]
\end{array}\right]$$

A second important aspect is that these adjectives are not intersectively combined with the N' head. Instead they are required to have scope over it as illustrated below:

(27) a. The alleged killer was captured.

b. $\exists x(alleged(killer(x)) \wedge \exists e\, captured(e, x))$

Note that the KEY label of the adjective corresponds to the adjectival predication and not to the nominal predication. Since the *h-mod-cx* rule specifies that the label of the mother node corresponds to the label of the adjunct, the result is that extra scopal adjectives are required to outscope the label l_2, not the nominal label. Similarly, determiners plug the higher adjectival label in the restrictor argument, not the nominal label. These two effects are illustrated in (28):

(28) a. The [alleged [false [jacket]]] was recovered.

b. $\exists x(alleged(false(jacket(x))) \wedge \exists e\, recovered(e, x))$

The grammar also scales up in a straightforward manner to PPs. These are also of interest to a semantic underspecification account because of scope ambiguites that they can introduce. For instance (29a) can either mean that every computer that has some operative system crashed (∀>∃) or that all the computers running a particular kind of operative system crashed (∃>∀).

(29) a. Every computer with a recent operating system crashed.

b. A backup program in every computer crashed.

The sentence (29b) on the other hand can either mean that a particular kind of backup program that runs in all the computers has crashed (∃>∀) or that every computer has at least one (possibly different) backup program which crashed (∀>∃).

The generalization that emerges essentially draws both from adjectives and verbs. On the one hand, the preposition selects for a complement NP and requires that the prepositional predication resides under the scope of that NP. On the other, the preposition carries a constraint [MOD N'] that allows the PP to attach to an N' constituent. The nominal expression can be singular or plural, and thus an *a-pl-res* relation is used to interpret the nominal variable x distributively. These constraints are captured in the lexical entry in (30):

(30)
$$
\left[\begin{array}{ll}
\text{PHON} & \langle\ \textit{in}\ \rangle \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{l} \textit{prep} \\ \text{MOD}\ \text{N'}\left[\begin{array}{ll}\text{LBL} & \boxed{\textit{l1}}\\ \text{INDEX} & \boxed{\textit{x}}\end{array}\right]\end{array}\right] \\
\text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \langle\ \rangle \\ \text{COMPS} & \left\langle \text{NP}\left[\begin{array}{ll}\text{INDEX} & \boxed{\textit{y}} \\ \text{ARGS} & \langle \ldots, \boxed{\textit{l5}}\rangle\end{array}\right]\right\rangle\end{array}\right]
\end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{\textit{k}} \\
\text{RELS} & \left\langle \left[\begin{array}{ll}\text{LBL} & \boxed{\textit{l1}} \\ \text{RELN} & \textit{a-pl-res} \\ \text{ARGS} & \langle\boxed{\textit{k}},\boxed{\textit{x}},\boxed{\textit{l2}}\rangle\end{array}\right], \boxed{\textit{k}}\left[\begin{array}{ll}\text{LBL} & \boxed{\textit{l3}} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{\textit{e1}} \\ \text{ARGS} & \langle\boxed{\textit{l4}}\rangle\end{array}\right], \left[\begin{array}{ll}\text{LBL} & \boxed{\textit{l4}} \\ \text{RELN} & \textit{in} \\ \text{INDEX} & \boxed{\textit{e1}} \\ \text{ARGS} & \langle\boxed{\textit{k}},\boxed{\textit{y}}\rangle\end{array}\right] \right\rangle \\
\text{CONS} & \left\langle \left[\boxed{\textit{l1}} \leq \boxed{\textit{l5}}\right] \right\rangle
\end{array}\right]
\end{array}\right]
$$

Thus, the preposition is outscoped by the complement NP and is intersectively combined with the nominal head l_1. The complement NP can therefore have narrow scope by scoping immediately over l_1 or have wide scope over the entire NP headed by N'. The MRS representation of an NP is provided in Figure 6.10 for illustration.

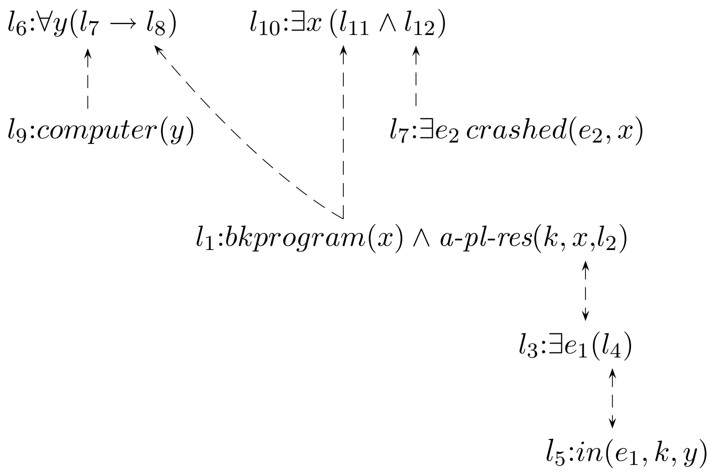


Figure 6.10: Semantic representation of [*A backup program in every computer crashed*]

The structure that the *h-comp-cx* and the *h-mod-cx* rules license is provided below in abbreviated form. Recall the the linear precedence constraints require that the nominal domain element precedes the PP modifier. Since word order is computed in DOM, it is irrelevant what is the order in the tree structure (i.e. in the value of DTRS).

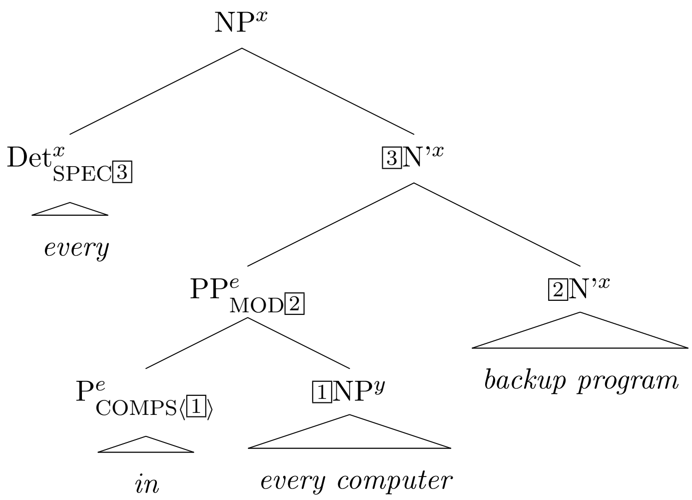
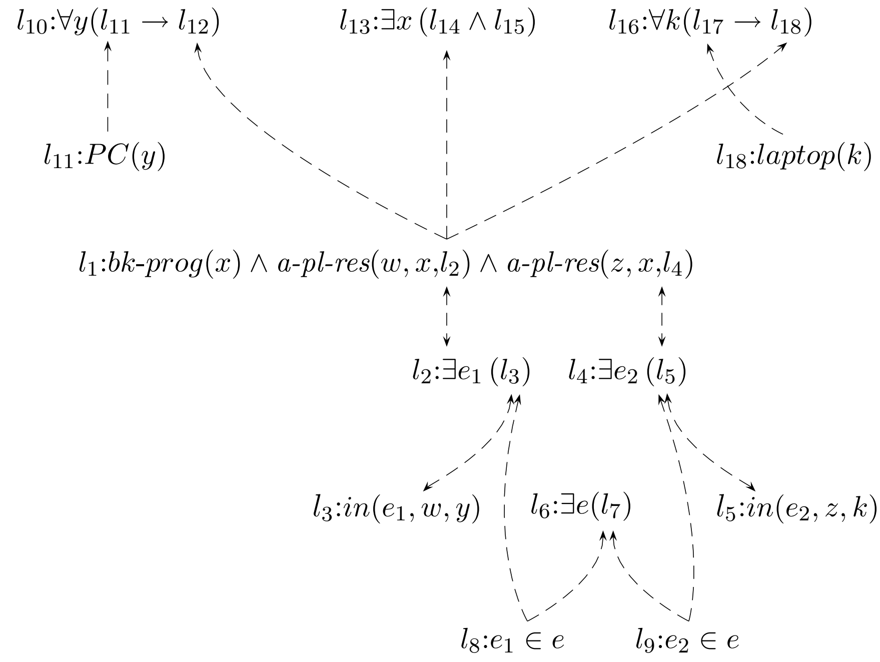


Figure 6.11: NP with a prepositional modifier

As in the case of AP coordination, the coordination of PP categories entails that all the conjuncts have the same MOD specifications. Thus, all the PPs bind the same N' variable and are intersectively combined with the same nominal predication. The

COMPS list is saturated at the level of the PP, and so complements are not required to be coreferential.[3] An example of PP conjunction is provided in (31).

(31) [A backup program [in every PC and in every laptop]$^{e}_{PP}$]$^{x}_{NP}$



Note that although the structure is large, most argument slots are directly plugging their respective arguments. The relevant underspecification between the indefinite l_{13} and the universally quantified complement NPs l_{10} and l_{16} is maintained however, and thus the scope ambiguities are captured.

6.2.2 Collective nouns

Collective nouns are known to correspond to an entity over and above standard individuals. For example, a committee can formally and legally approve a decision even though it may be the case that only a majority of committee members voted in favor. Similarly, a rock band can be said to have formed in 1997, even though none of the band members were also formed in the process. The standard view in the literature

[3]Non-ambiguous cases of P coordination are hard to come by given that many cases are reducible to Right-Periphery Ellipsis, e.g. *It seems that the dust particles are both on and under the table.* The current account however, has no problem in allowing for P coordination.

is that collectives are different from plural nouns in that they correspond to a group entity rather than to a collection of individuals.

Apart from the semantic evidence just mentioned, there are good empirical reasons for this. For example, certain metonymic predicates only apply to collective nouns (Bennet 1974; Lønning 1987; Copestake 1995; Schwarzschild 1996):[4]

(32) a. The committee consists of experts.
b. #The men consist of experts.

(33) a. The team has five members.
b. #The women have five members.

(34) a. Fred is a member of the crew.
b. #Fred is a member of the men.

Secondly, as pointed out by Bennet (1974), Link (1984), Lasersohn (1988), Landman (1989), Krifka (1991) and many others, collective nouns and plurals can have different properties. For instance, the individuals that make up a committee can meet without entailing that the committee met. Assume that committee c is composed of John, Mary and Kim. These three individuals can meet $meet(\{j, m, k\})$ without contradicting $\neg met(c)$. Moreover, the committee can meet even in the absence of a member even though $meet(\{j, m, k\})$ would then be false. Also, all kinds of different committees composed by the same individuals and yet must be kept distinct: one committee can meet without entailing that the others are also meeting. Finally, one can also consider the possibility of a committee still existing legally, but being without any members. In sum, collectives cannot in general be reduced to their members.

I will therefore assume that a predicate such as $team(x)$ denotes a set of atoms from the domain, e.g. $[\![team(x)]\!] = \{t_1, t_2, t_3, ...\}$, and that such atoms that are associated with collections of individuals. In other words, a team t_n is an atomic individual, but one which stands for a group of individuals. For this purpose I introduce a function G_m that maps these atoms to the corresponding pluralities from the Boolean domain, for example $G_m(t_1) = i_2 \vee_i i_4 \vee_i i_6$ and $G_m(t_2) = i_6 \vee_i i_7 \vee_i i_9$, or even $G_m(t_3) = \emptyset$.

The G_m function can also be used to allow for metonymic collective and distributive readings that many collective nouns allow. For example, a verb may predicate over

[4] Other metonymic predicates can apply to any plurality: *One of my cats/friends/team/staff.*

the members of the group rather than the group itself. In (35) illustrates collective readings and in (36) distributive readings:

(35) a. The crowd dispersed from the main plaza.

b. The current scattered the fleet.

c. A group of particles collided.

d. The computer cluster is interconnected.

e. A dog is among the cattle.

(36) a. The crowd laughs.

b. This team is happy with the results.

c. The shuttle crew smiles to the world as they prepare for three weeks in quarantine.

This can be explained if one assumes that the collective noun is coerced into denoting the individuals that are associated to the group, via G_m. In British English and in some varieties of American English this process is more noticeable because coerced collective nouns are compatible with both singular and plural verb agreement. Thus, while the specifier must be singular, the verb can exhibit plural morphology, as Corbett (1979) and Hoeksema (1983) observe:

(37) a. The committee has/have decided.

b. My family is/are arriving tonight.

c.*These committee/family arrived yesterday.

Copestake (1995) notes that the agreement pattern is similar for pronouns, as in (38).

(38) The band played well tonight. Its/their tour has sold out.

This process does not occur in languages such as German, French, or Portuguese:

(39) a.

Das	Komitee	ist/*sind	zu	einer	Entscheidung	gekommen.
the-SG	committee-SG	has/*have	to	a	decision	arrived

b.

Le	comité	est/*sont	arrivé/*arrivés	à	une	décision.
the-SG	committee-SG	has/*have	arrived-SG/*PLU	to	a	decision

c. O comité chegou/*chegaram a uma decisão.
the-SG committee-SG arrived-SG/*PLU to a decision

There is also other kind of evidence showing that coerced collective nouns denote the members of the collective entity. For example, Copestake also points out that for nouns that denote collections of humans, a relative clause is introduced with *who* if plural agreement is used and by *which* if it is not:

(40) a. The band who get/*gets top billing at the festival receive/*receives £20,000.
b. The band which *get/gets top billing at the festival *receive/receives £20,000.

This can readily be explained if collective nouns in English are ambiguous between a standard collective (denoting atoms and therefore having singular agreement) and a *coerced* collective that denotes a plurality but is compatible with both plural and singular agreement. The latter case corresponds to the application of function G_m.

Copestake thus proposes a `group-to-plural` lexical rule for English, that coerces nouns into a standard plurality. Locating the coercion in the nominal head makes sense because of examples like (41), which show that agreement must be consistent across different subcategorizing heads:

(41) *[The committee] who has$_{sg}$ arrived have$_{pl}$ decided to vote.

A similar point is made in Pollard and Sag (1994, 70–71), who show that once a choice is made for the interpretation, the mode of individuation is immutable:

(42) a. The faculty is voting itself a raise.
b. The faculty are voting themselves a raise.
c.*The faculty is voting themselves a raise.
d.*The faculty are voting itself a raise.

Let us take stock of the observations made so far. In English, a morphologically singular collective noun always yields singular determiner-noun agreement but exhibits a dual behavior with regard to noun-verb agreement. In the canonical realization, the noun denotes individuals, which are in fact groups, and thus only singular verb agreement is possible. On the metonymic realization the noun denotes a plurality (the members of the group) and is thus not only compatible with singular and plural verb agreement but it also allows for both collective and distributive readings.

If is often assumed that English determiner-noun agreement is morphosyntactic while subject-verb agreement is semantic. For example, Wechsler and Zlatic (2003) propose that determiners agree with nouns via a head feature AGR and that verbs agree with nouns via a semantic feature named CONCORD. But the data above suggest otherwise. A morphologically singular distributive verb can combine with a coerced collective as in (36). If subject-verb agreement were semantic one would expect such examples to be ungrammatical.

Because a coerced collective noun is compatible with both singular and plural agreement, as seen in *The crew is/are happy*, then this also raises a problem for the idea that determiner-noun agreement is not sensitive to semantics. Plural determiners like *several*, *many*, *these*, *those* and so on only combine with pluralized nouns like *cats* and *mice*, and never combine with coerced collective nouns: **These crew are happy.* I will thus view the agreement that plural determiners trigger as semantic rather than morphosyntatic. The value of KEY|RELN will suffice to determine whether the noun is pluralized, singular, or coerced. Other determiners, like *no* for example, are insensitive both to agreement and to semantic import (e.g. *no man / men / team / teams*). Others still can be argued to only attach to mereological nominals: pluralized nouns as in *most books* or mass nouns as in *most beer.* See also §6.4.

In order to model the coercion process I will adopt a lexical rule which takes as input a singular collective noun like $team(x)$ and outputs a phonologically identical noun that denotes the plurality y composed of the members of the collective: $\exists x\,(metonym(x,y) \wedge team(x))$. Metonymic coercion is interpreted via G_m as follows:

(43) ${}_{g1}[\![metonym\text{-}rel(v_1,v_2)]\!]^{\mathcal{M}}_{g2}$ *iff* $g_1 = g_2$ & $G_m(g_1(v_1)) = g_1(v_2)$

The canonical usage of an NP like *a team* therefore denotes a set of group individuals $[\![\exists x\, team(x)]\!] = \{t_1, t_2, t_3, ...\}$ while the coerced variant denotes the set of team members: $[\![\exists y\, \exists x\, metonym\text{-}rel(x,y) \wedge team(x)]\!] = \{i_2 \vee_i i_4 \vee_i i_6\,,\, i_6 \vee_i i_7 \vee_i i_9\,, ...\}$ for $G_m(t_1) = i_2 \vee_i i_4 \vee_i i_6$, $G_m(t_2) = i_6 \vee_i i_7 \vee_i i_9$, and so on.

In order to restrict the coercion process to collective nouns these must be somehow singled out from the other nouns in the grammar. I thus assume that all collective noun predicate relations have the same supertype *coll-reln*:

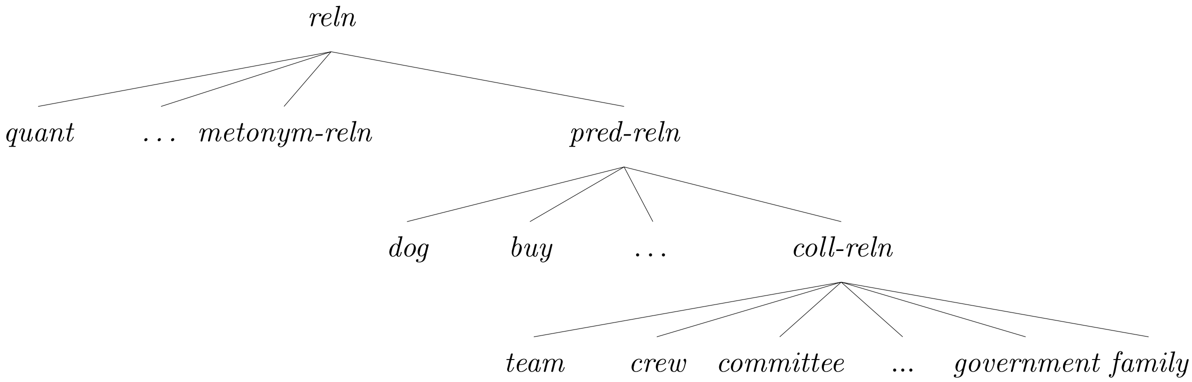


Figure 6.12: Type hierarchy of semantic relations

Perhaps there should also be a sub-distinction between castes and social organizations as discussed in Pollard and Sag (1994, 87). For example, the nouns *faculty* and *government* allow plural quantification as in *All faculty are here*. Wechsler and Zlatic (2003, 80) observe that, unlike *committee*, this noun is ambiguous between denoting an institutional group, and denoting a member of such group. In the former case the noun pluralizes as *faculties*, and in the latter both the singular and the plural forms are *faculty*. Wechsler and Zlatic (2003) suggest that the different behavior of this noun is due to ellipsis of a noun *member*. The possibility of plural quantification is therefore expected (cf. *All faculty (members) are here*) as well as the 'singular member' sense realization as in *One faculty (member) disagreed with the proposal*. The current account is compatible with this view.

The new lexical rule is a post-inflectional lexical construction (thus, a subtype of *pi-lex-cx*) typed as *pi-coll-metonym-cx*. Note that the KEY information is composite: the value of KEY reflects the fact that the relevant label for combining the coerced noun with the determiner is $\boxed{l}$ while the relevant index is $\boxed{y}$:

(44) *pi-coll-metonym-cx* ⇒

$$
\begin{bmatrix}
\text{MTR} & \begin{bmatrix}
\textit{inf-lex-it} \\
\text{MP } \boxed{1} \\
\text{SYN } \boxed{2} \\
\text{SEM} \begin{bmatrix}
\text{KEY} \begin{bmatrix} \text{LBL} & \boxed{l} \\ \text{RELN} & \boxed{3} \\ \text{INDEX} & \boxed{x} \end{bmatrix} \\
\text{RELS } \boxed{R} \oplus \left\langle \begin{bmatrix} \text{LBL} & \boxed{l} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle \boxed{l2}, \boxed{l1} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l2} \\ \text{RELN} & \boxed{3}\textit{metonym-reln} \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle \boxed{x}, \boxed{y} \rangle \end{bmatrix} \right\rangle \\
\text{CONS } \boxed{C}
\end{bmatrix} \\
\text{DOM } \boxed{4} \\
\text{ARG-ST } \boxed{5}
\end{bmatrix} \\
\text{DTRS} & \left\langle \begin{bmatrix}
\textit{inf-lex-it} \\
\text{MP } \boxed{1} \\
\text{SYN } \boxed{2} \\
\text{SEM} \begin{bmatrix}
\text{KEY} \begin{bmatrix} \text{LBL} & \boxed{l1} \\ \text{RELN} & \textit{coll-reln} \\ \text{INDEX} & \boxed{x}[\text{NUM } \textit{sg}] \end{bmatrix} \\
\text{RELS } \boxed{R} \\
\text{CONS } \boxed{C}
\end{bmatrix} \\
\text{DOM } \boxed{4} \\
\text{ARG-ST } \boxed{5}
\end{bmatrix} \right\rangle
\end{bmatrix}
$$

The agreement information of the coerced noun is underspecified. This allows a coerced collective to be compatible with either plural or singular verb agreement. The fact that HPSG constraints are monotonic entails that once agreement is resolved then all further predications of the same index must be consistent with that agreement information. This is as intended, as previously shown in (42).

6.3 Noun Pluralization

There is ample evidence that pluralization is a process governed by rules that speakers acquire. For example, children can produce in a systematic way the plural counterparts of singular pseudo-words. The *-s* rule for formation of English plurals is fairly regular although there are several complications and exceptions. On the one hand, there are several sub-cases with regard to spelling (e.g. *dish*/*dishes*, *hero*/*heroes* and *lady*/*ladies*), while on the other, some plurals are formed via vowel changes rather then affixation, as in *foot/feet* and *mouse/mice*. The plural formation rule targets the head of the lexical item so that in compounds only the head is pluralized as in *son-in-law/sons-in-law* and *court martial/courts martial*. Many animal names are ambiguous between the singular and plural, such as *deer* and *sheep*. It is clear that the plural formation rule applies without producing an overt morphophonological effect given the singular and plural counterparts exhibit different semantic interpretations and agreement patterns:

(45) a. This sheep$_{sg}$ ran away / *dispersed.

b.*The sheep$_{??}$ that were under the tree is sleeping.

c.*The sheep$_{??}$ were under the tree and was sleeping.

In short, the morphophonology of pluralization has various strategies for the formation of the plural, all of which exhibit sub-regularities, and idiosyncrasies. I assume that a function F_{PL} maps singular morphophonological descriptions and yields the pluralized form, according to the parochial rules of English plural formation:

(46)
$$F_{PL}\left(\left\langle\begin{bmatrix}\text{PHON} \ \langle \ \text{kæt} \ \rangle \\ \text{FORM} \ \langle \ \textit{cat} \ \rangle\end{bmatrix}\right\rangle\right) = \left(\left\langle\begin{bmatrix}\text{PHON} \ \langle \ \text{kætz} \ \rangle \\ \text{FORM} \ \langle \ \textit{cat+s} \ \rangle\end{bmatrix}\right\rangle\right)$$

Semantically however, there seem to be no irregularities in pluralization: the singular noun refers to an atomic element of the domain while the plural refers to a non-atomic element. The latter observation is too strong however. Consider the sentence in (47a).

(47) a. Zero cats died (in the making of this movie).

b. I found zero references to him in the social sciences.

c. So far, zero WMDs were found in Iraq.

d. (Exactly) zero employees gathered outside.

The sentence in (47a) means that no single cat or cats were killed, that is, the set of individuals that died does not include any cat. This is problematic for the view that the plural noun *cats* strictly denotes a nonempty set of collections of individuals. In collective readings like (47d) the verb denotes a set of collections of employees, and as such the sentence means that no two individuals gathered outside.

The case is identical for the negative determiner *no*, as the examples below show. For example, it suffices that one computer was damaged for (48a) to be false:

(48) a. No computers were damaged.

b. No students dispersed from the square.

c. No computers were actually interconnected.

This means that plural nouns denote a set containing both atomic and non-atomic elements of the domain.

This matter has not received much attention in the literature. The determiner *no* is typically considered to be a generalized quantifier over atoms, cf. Kamp and Reyle (1993, 333), or in the accounts where the plural case is considered like Carpenter (1997, 314), it is assumed to range over pluralities (in that case, sets of atoms).

The possibility of ranging over both atoms and pluralities is less clear in the case of *less than n*, *at most n*, and *fewer than n* because these expressions are often accompanied by the presupposition that at least some individuals did participate in the state of affairs. The examples in (49) are usually interpreted as meaning that at least some people dispersed/protested.

(49) a. Less than sixty people dispersed.

b. Less than three customers protested.

c. Less than twelve subjects were interested in cooperating with each other.

However, in contexts that are known to block presuppositions the existential import of the presupposition is canceled as in (50):

(50) a. If less than twenty people call, I win the bet.

b. The game is over whenever less than two players are holding a card.

c. Perhaps the boat was carrying less than three passengers.

d. Do not go on this boat with less than three passengers.

Link (1987) notes other examples, like the one in (51), which do not necessarily commit the speaker to conveying that anybody is still left in the house. Imagine a context in which the house is being evacuated and that all but three people are accounted for.

(51) At most three people are left in the house.

In this work I will concentrate on semantics proper and not discuss the computation of presupposition projection and accommodation.

The possibility of a plural noun denoting both atomic and non-atomic elements has been discussed before in McCawley (1968a, 568) and Roberts (1987, 174ff). More recently, Ojeda (2001) provides other arguments for doing so. The first argument is based in the fact that an interrogative with the NP *any daughters* can be answered with a singular NP:

(52) A: Do you have any daughters?

B: Yes. Her name is Alejandra.

The second argument in Ojeda (2001) consists in the observation that comparatives like (53a) are true even if there happens to be one governor and no states, and that (53b) is true even if there is only one Mac and one PC (or in fact if there are no computers at all).

(53) a. There are more governors than states.

b. We have as many Macs as we have PCs.

In sum, singular nouns bear singular agreement specifications and denote atomic individuals, e.g. $[\![cat]\!] = \{c_1, c_2, c_3\}$, while plural nouns bear plural agreement specification but are semantically neutral: they can range over any element of the domain, $[\![cats]\!] = \{c_1, c_2, c_3, c_1 \vee c_2, c_1 \vee c_3, c_2 \vee c_3, c_1 \vee c_2 \vee c_3\}$. It falls upon the determiner to add further constraints on the ontological status of the nominal.

Although Link (1983) does not note the above phenomena, a '*' operator is proposed which transforms a predicate P of atomic individuals into one that is true not only of the individuals in the extension of P but also of all collections consisting exclusively of those individuals. This allows the extension of mixed predicates like *hire* or *lift* to range over both atomic and non-atomic elements in a uniform way. However, Link does not discuss the determiner *no*, and defines the truth-conditions of numerals with the general schema: $[\![n]\!] = \lambda X \lambda Y.\exists x(|x| = n \wedge x \in X \cap Y)$. The latter fails to account for the case of *zero* because Link (correctly, in my view) assumes that predicates cannot denote the empty set. More formally, the denotation of an n-place predication is defined as $[\![P^n]\!] \subseteq (E \setminus \{\mathbf{0}\})$, given a constant P^n, and the bottom empty element $\mathbf{0}$. But all in all, Link provides the right tools for dealing with these phenomena in a general way.

Note that some proposals actually take the position that the semantics of pluralized nominals is intrinsically asystematic. In Kamp and Reyle (1993) it is assumed that the plural noun in *most books* is a predicate over individual atoms $book(x)$, as if no pluralization occurred, but when it occurs in *several books*, it has a plural denotation. The root of the problem resides in the fact that Kamp and Reyle (1993) view all generalized quantifiers as ranging over atoms. Kamp and Reyle (1993, 314) write: 'Although *most books* is syntactically a plural, the discourse referent it introduces is an individual discourse referent. (...) As a consequence we cannot hope for a simple correlation between syntactic plurality and the type of discourse referent involved'. I disagree with this view, and will treat plural quantifiers and nominal pluralization in a systematic and uniform way, without exceptions or inconsistencies between morphology and semantics. Moreover, the assumption that plural quantifiers like *most* ranges over atoms is problematic, as already noted in §4.1.1 with data like the one below:

(54) Most lawyers who died$_D$ yesterday were friends$_C$.

Thus, a singular noun like *cat*, represented as $cat(x)$, only contains atomic individuals in the extension of the predicate. But a plural noun like *cats* will be allowed to denote both cat-individuals and collections of cats. This is made possible by resorting to the partial order $\subset_i$ over the mereological domain of individuals, in the spirit of Massey (1976) or Link (1983). The object language operator in question is '$\preceq$', the part-of relation that is interpreted as the partial order relation of the Boolean algebra of individuals. The definition from §4.2 is repeated below as (55):

(55) $_{g1}[\![v_1 \preceq v_2]\!]^{\mathcal{M}}_{g2} \quad \textit{iff} \quad g_1 = g_2 \;\&\; g_1(v_1) \,\epsilon\, A_I \;\&\; g_1(v_1) \subset_i g_1(v_2)$

The noun *cats* will therefore be represented as $\forall x(x \preceq y \rightarrow cat(x))$. The crucial aspect of this analysis is that y can be atomic or non-atomic and '$\subset_i$' is reflexive. Thus $\alpha \preceq \beta$ is true if α is identical to β or if α is a strict part of β in the Boolean model structure. It falls upon the determiner that attaches to the nominal expression to bind the variable y, and to impose further constraints on it. For example, consider the determiner *several*, which will be represented as $\exists y(|y| \geq 2 \wedge l_2 \wedge l_3)$. As usual, l_2 is the restrictor argument and l_3 is the scopal argument of the determiner. This way, a sentence like $[[\textit{Several cats}]^y_{NP}\ [\textit{gathered outside}]^e_{VP}]$ can be represented as:

(56) $\exists y(|y| \geq 2 \wedge \forall x(x \preceq y \rightarrow cat(x)) \wedge \exists e\, gather(e, y))$

The above is true if there is an element in the mereological domain composed of at least two cat individuals that was gathering. The determiner *no* can thus be seen as a negative existential that imposes no cardinality conditions: $\neg\exists y(l_2 \wedge l_3)$. Thus a sentence type like [[*No cats*]$^y_{NP}$ VP] is represented as $\neg\exists y(\forall x(x \preceq y \rightarrow cat(x)) \wedge \mathrm{VP}(y))$, and comes out true if no element from the domain, atomic (a cat) or non-atomic (a collection of cats), is such that the VP conditions are satisfied.

The pluralization rule basically takes a singular noun $l_3{:}\phi(x)$ and obtains a plural noun with l_3 embedded in a mereological distribution: $l_4{:}\forall x(x \preceq y \rightarrow l_3)$. The mereological distribution is abbreviated in MRS terms as a relation typed as *plur(alization)-reln*:

(57) $$\begin{bmatrix} \text{LBL} & \boxed{l4} \\ \text{RELN} & \textit{plur-reln} \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle \boxed{x}, \boxed{y}, \boxed{l5} \rangle \end{bmatrix} \equiv \quad l_4{:}\forall x(x \preceq y \rightarrow l_5)$$

The pluralization process for the noun *cat* is depicted below:

$$\begin{array}{c}
\begin{bmatrix} \text{RELS} & \left\langle \begin{bmatrix} \text{RELN} & \textit{plur-reln} \\ \text{INDEX} & \boxed{y}\begin{bmatrix}\text{NUM} & \textit{pl}\end{bmatrix} \\ \text{ARGS} & \langle \boxed{x},\boxed{y},\boxed{l2} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{cat} \\ \text{INDEX} & \boxed{x}\begin{bmatrix}\text{NUM} & \textit{sg}\end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \\
| \\
\begin{bmatrix} \text{RELS} & \left\langle \begin{bmatrix} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{cat} \\ \text{INDEX} & \boxed{x}\begin{bmatrix}\text{NUM} & \textit{sg}\end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}
\end{array}$$

Figure 6.13: Semantic pluralization of the noun *cat*

In (58) the pluralization rule is formalized as an inflectional lexical construction only applies to count nouns, which I assume are subsumed by the type *count-reln*:

(58) PLURAL NOUN LEXICAL RULE

$$
\textit{inf-plur-cx} \Rightarrow \left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}
\textit{inf-lex-it} & \\
\text{MP} & F_{\text{PL}}(\boxed{1}) \\
\text{SYN} & \boxed{2} \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \left\langle \boxed{k}\left[\begin{array}{ll}
\text{RELN} & \textit{plur-reln} \\
\text{INDEX} & \boxed{y}\left[\text{NUM}\ \textit{pl}\right] \\
\text{ARGS} & \langle \boxed{x},\boxed{y},\boxed{l2} \rangle
\end{array}\right] \right\rangle \oplus \boxed{R} \\
\text{CONS} & \boxed{C}
\end{array}\right] \\
\text{DOM} & \boxed{3} \\
\text{ARG-ST} & \boxed{4}
\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\textit{ninf-lex-it} & \\
\text{MP} & \boxed{1} \\
\text{SYN} & \boxed{2} \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \left[\begin{array}{ll}
\text{LBL} & \boxed{l2} \\
\text{INDEX} & \boxed{x}\left[\text{NUM}\ \textit{sg}\right] \\
\text{RELN} & \textit{count-reln}
\end{array}\right] \\
\text{RELS} & \boxed{R} \\
\text{CONS} & \boxed{C}
\end{array}\right] \\
\text{DOM} & \boxed{3} \\
\text{ARG-ST} & \boxed{4}
\end{array}\right] \right\rangle
\end{array}\right]
$$

The pluralized counterpart, seen in the mother node of the lexical construction, is plural both with regard to morphopohonology and semantics. Note also that the KEY values for LABEL and the INDEX are contributed by the distribution, not by the nominal predicate. These are the relevant pieces of information that are necessary for the specifier to plug and bind, when attaching to a phrase headed by a pluralized noun.

Nothing prevents some lexemes from dispensing any application of this rule by being listed in the lexicon as containing a *plur-reln* relation. This may be the case of nouns that lack a singular counterpart such as *trousers*, *pliers*, and *glasses*, which are also arguably perceived as pluralic in some sense due to the fact that they refer to entities that have a prominent bipartite structure (e.g. *I need a pair of glasses*).

On the other hand, a non-coerced singular collective denotes (group) individuals from the domain. Nothing prevents the rule in (58) from deriving a plural *crews* denoting a plurality of groups: $crew(x)$ into $\forall x(x \prec y \rightarrow crew(x))$. All that is required is that the type *count-reln* subsumes all count nouns, including *coll-reln*. We thus obtain a uniform account of (individuated) nominal pluralization that encompasses both collective and non-collective nouns.

For completeness, the full derivation of a plural noun is shown in Figure 6.14.

$$
\left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{inf-lex-it}} \\
\text{MP} & \left[\begin{array}{ll} \text{PHON} & \langle\ \text{kætz}\ \rangle \\ \text{FORM} & \langle\ \textit{cat+s}\ \rangle \end{array}\right] \\
\text{SYN}\ \boxed{2} & \left[\begin{array}{ll} \text{HEAD} & \textit{noun} \\ \text{VAL} & \left[\begin{array}{ll} \text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{array}\right] \end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll} \text{KEY} & \boxed{k2} \\ \text{RELS} & \left\langle \boxed{k2} \left[\begin{array}{ll} \text{RELN} & \textit{plur-reln} \\ \text{INDEX} & \boxed{y}\left[\text{NUM}\ \textit{pl}\right] \\ \text{ARGS} & \langle \boxed{x},\boxed{y},\boxed{l2} \rangle \end{array}\right] \right\rangle \oplus \boxed{R} \\ \text{CONS} & \boxed{C} \end{array}\right] \\
\text{DOM} & \boxed{3} \\
\text{ARG-ST} & \boxed{4}
\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{ninf-lex-it}} \\
\text{MP} & \left[\begin{array}{ll} \text{PHON} & \langle\ \text{kæt}\ \rangle \\ \text{FORM} & \langle\ \textit{cat}\ \rangle \end{array}\right] \\
\text{SYN} & \boxed{2} \\
\text{SEM} & \left[\begin{array}{ll} \text{KEY} & \boxed{k1} \\ \text{RELS} & \boxed{R}\left\langle \boxed{k1} \left[\begin{array}{ll} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{cat} \\ \text{INDEX} & \boxed{x}\left[\text{NUM}\ \textit{sg}\right] \end{array}\right] \right\rangle \\ \text{CONS} & \boxed{C}\langle\rangle \end{array}\right] \\
\text{DOM} & \boxed{3} \\
\text{ARG-ST} & \boxed{4}\langle\rangle
\end{array}\right] \right\rangle
\end{array}\right]
$$

Figure 6.14: Derivation of the noun *cats*

Note that the KEY value of the pluralized noun is the pluralization relation itself. This is due to three main reasons. First, the plural determiner that will syntactically attach to this nominal head must require that the mereological distribution be subordinate to the restrictor argument, rather than the noun embedded inside it. Second, the variable that the determiner binds is now y rather than the singular variable x. The third reason is more subtle. The fact that a noun has plural agreement is irrelevant for plural determiners. Some nouns that exhibit plural agreement with verbs do not exhibit plural agreement with their specifiers. One case already discussed is coerced collective nouns in English, e.g. *The crew are ready* and **These crew are ready*. Although the noun *crew* can be interpreted as a plural entity and denote a collection of elements, it does not co-occur with plural determiners.

The value of KEY provides the relevant information about the semantic nature of the noun. The KEY value of a coerced collective is *metonym-reln* while a pluralized noun it is *plur-reln*. Thus, determiners like *several*, *most*, *these*, and *those* attach to pluralized nouns while other determiners like *no* impose no such condition.

6.4 Plural Noun Phrases

This section discusses plural determiners and how these combine with plural nouns. In (59) is put forth the lexical entry for *several*. Semantically, it consists of an existential quantifier and a cardinality condition imposing the existence of at least two elements. The lexical entries for *various*, *a couple of*, and *some* are identical in these respects.[5] Another candidate is the indefinite *a few* in examples like *a few women gathered*.

(59)
$$
\begin{bmatrix}
\text{MP} \mid \text{FORM} \ \langle \textit{several} \rangle \\
\text{SYN} \mid \text{HEAD} \begin{bmatrix} \textit{det} \\ \text{SPEC N'} \begin{bmatrix} \text{DET}+ \\ \text{LBL} \ \boxed{l4} \\ \text{INDEX}\ \boxed{y} \\ \text{RELN}\ \textit{plur-reln}\end{bmatrix}\end{bmatrix} \\
\text{SEM} \begin{bmatrix} \text{KEY}\ \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \begin{bmatrix}\text{RELN}\ \exists \\ \text{INDEX}\ \boxed{y} \\ \text{ARGS}\ \langle \boxed{l2}, \ldots \rangle\end{bmatrix}, \begin{bmatrix}\text{LBL}\ \boxed{l2}\\ \text{RELN}\ \textit{at-least} \\ \text{ARGS}\ \langle \boxed{y}, 2\rangle\end{bmatrix}\right\rangle \\ \text{CONS} \left\langle \left[\boxed{l4} \le \boxed{l2}\right]\right\rangle \end{bmatrix}
\end{bmatrix}
$$

Everything is essentially identical to singular determiners. The value of SPEC of the determiner in (59) selects a N', binds the key index $\boxed{y}$, and subordinates the semantics

[5]There is a pragmatic difference between plural *some* and singular *some* that offers some independent support for having two different lexical entries for the indefinite. The latter usage necessarily refers to one individual who is not known or unimportant to the speaker. Confront *Some students congratulated me* and *Some student congratulated me*.

of the nominal to the restrictor argument. The difference for plural determiners is that the nominal head that the determiner attaches to must be pluralized. This is done by requiring that the KEY value of RELN is *plur-reln*. Recall that the *plur-reln* relation entails that $\boxed{y}$ has plural agreement, but that the reverse does not hold: some nouns have plural agreement but do not have pluralized semantics. This readily rules out both **several book* as well as **several team*. The case is the same for *these* and *those*.

Semantically, the determiner *several* also requires that the nominal denotes a plurality containing at least two elements: $|y| \geq 2$. The underspecified representation of the lexical entry for *several* is therefore $\exists y(|y| \geq 2 \wedge\ l_2\ \wedge\ l_3)$, where l_2 is the restrictor argument slot, and l_2 the scopal argument slot. The analysis of an NP like *several cats* yields l_1: $\exists y(|y| \geq 2 \wedge \forall x(x \preceq y \rightarrow cat(x)) \wedge l_3)$ and is depicted in full in Figure 6.15. Recall from §6.6 that nouns are lexically underspecified for DET, but the determiner will force this value to be '+' as seen below.

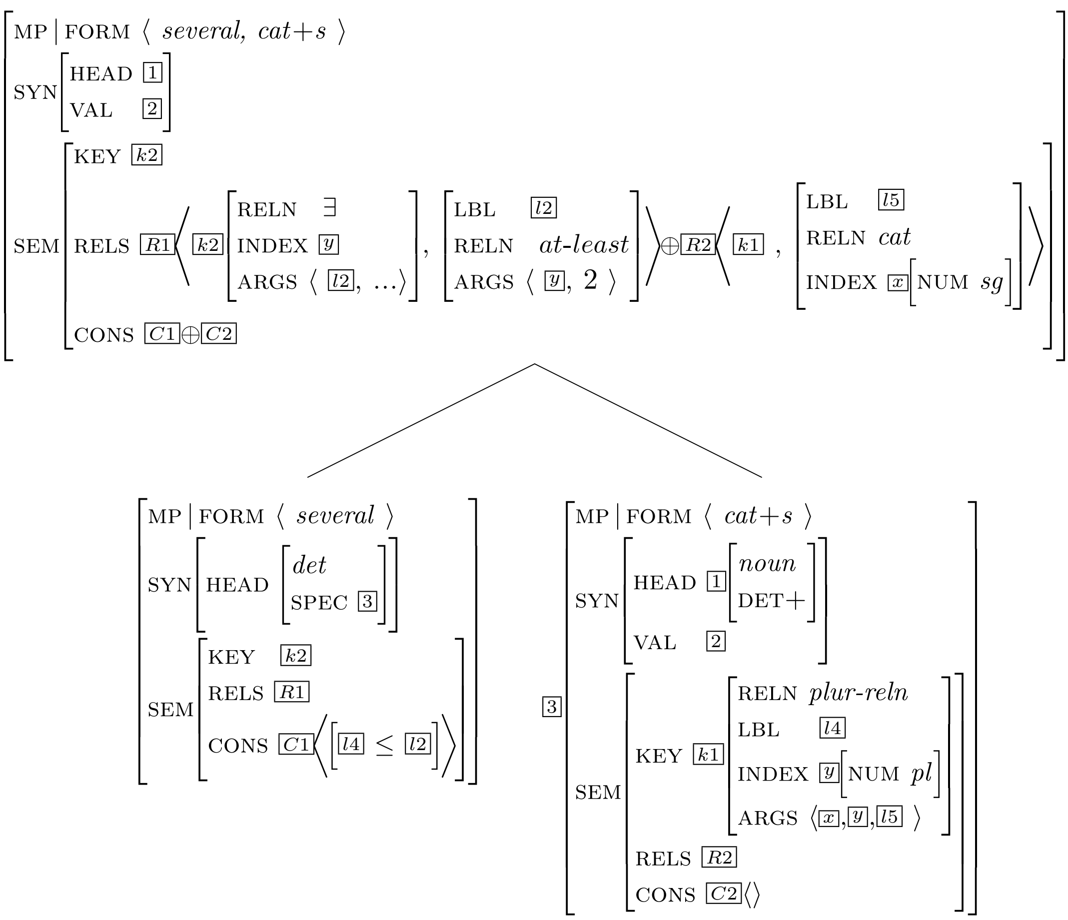


Figure 6.15: Analysis of [*Several cats*]$_{NP}$.

With the exception of *zero*, plural numeral determiners can be treated in a very similar way. The main difference resides in the cardinality constraint imposed on the non-atomic referent y. In this account the representation for *six*, for instance, is $\exists y(|y| = 6 \wedge l_2 \wedge l_3)$. Some authors have argued that a cardinal n actually denoted 'exactly n' and other that it denotes 'at least n' (see for instance Barwise and Cooper (1981) and others). For example, the sentence in (60a) is true even if there are more students smiling, while the collective reading for the sentence in (60b) does not mean that at least six books cost \$130.

(60) a. Six students smiled.

b. Six books cost \$130.

But there is no paradox here, as Link (1987) notes. In our account of distributive readings (60a) comes out true if there is some plurality composed of six students such that each student in this plurality smiled. In no way does this require that no other individuals smiled. On the other hand, our account of collective readings has it that (60b) is true if the extension of *cost* contains a plurality composed of exactly six books and a monetary value of \$130. If the plurality contains more or fewer individuals, then the collective interpretation is false. This yields the correct results.

(61)
$$\begin{bmatrix} \text{MP} \mid \text{FORM} \ \langle \textit{six} \rangle & \\ \text{SYN} \mid \text{HEAD} & \begin{bmatrix} \textit{det} & \\ \text{SPEC N'} & \begin{bmatrix} \text{DET}+ & \\ \text{KEY} & \begin{bmatrix} \text{LBL} & \boxed{l4} \\ \text{INDEX} & \boxed{y} \\ \text{RELN} & \textit{plur-reln} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{KEY} \ \boxed{k} & \\ \text{RELS} & \left\langle \boxed{k} \begin{bmatrix} \text{RELN} & \exists \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle \boxed{l2}, \ldots \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{cardinal} \\ \text{ARGS} & \langle \boxed{y}, 6 \rangle \end{bmatrix} \right\rangle \\ \text{CONS} & \left\langle \begin{bmatrix} \boxed{l4} \leq \boxed{l2} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

Recall from 6.2 that determiners like *every* and *each* select singular nominal expressions and thus cannot licence cases like **Every students*. Semantically, they require that the KEY value of the N' is *pred-reln*. This type subsumes all predicate relation types in the grammar such as *dog*, *chair*, *team*, *smile*, but it does not subsume the type *metonym-reln*. Thus, the constraint rules out the universal quantification of coerced collective nouns as in **Every team were late*, while allowing for quantification of non-coerced collectives: *Every team was late*. The lexical entry for *every* is repeated below for convenience.

(62)
$$\begin{bmatrix} \text{MP}\,|\,\text{FORM} & \langle\ \textit{every}\ \rangle \\ \text{SYN}\,|\,\text{HEAD} & \begin{bmatrix} \textit{det} & \\ \text{SPEC N'} & \begin{bmatrix} \text{DET}+ & \\ \text{KEY} & \begin{bmatrix} \text{LBL} & \boxed{l4} \\ \text{INDEX} & \boxed{y}\begin{bmatrix}\text{AGR } \textit{sg}\end{bmatrix} \\ \text{RELN} & \textit{pred-reln} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{KEY } \boxed{k} & \\ \text{RELS} & \left\langle \boxed{k}\begin{bmatrix} \text{RELN} & \forall \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle\ \boxed{l2},\ \ldots\ \rangle \end{bmatrix} \right\rangle \\ \text{CONS} & \left\langle \begin{bmatrix}\boxed{l4} \leq \boxed{l2}\end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

Of course, in some cases a plural NP can be realized without an overt determiner. So-called *bare plurals* have a very similar behavior as existentially quantified plural NPs, and usually come with two different interpretations: a purely existential reading and a generic reading. Confront the following:

(63) a. Cats are chasing a rat.

b. Cats are cute.

The traditional view on bare plurals is that these have a covert plural existential quantifier (cf. Chomsky (1965) and Dowty (1972) for instance). But other authors such as Carlson (1977) propose a semantic analysis that treats all bare plurals as *kind-denoting* terms, and argued that bare plurals are very different from overtly quantified existential NPs. This claim is based in contrasts observed with regard to scope and opacity. I will not go into all of the details of the argumentation here, but as Kratzer (1980) and Link (1991) point out, the purported missing parallels between overt existential NPs and bare plurals can be observed if one provides a suitable contextualization for the data. For instance, Carlson (1987) argues that bare plurals have a non-specific reading in the presence of scope bearing operators, whereas a singular indefinite NP normally gives rise to a scope ambiguity. One argument that illustrates the scope asymmetry runs as follows. The sentence in (64a) is claimed to have only the [∀>∃] reading while the sentence in (64b) is claimed to only have the reading [∃>∀] (which is pragmatically deviant, and hence the oddness which is observed).

(64) a. Dogs were everywhere.
b. ?A dog was everywhere.

But this is a standard case of preferential scope resolution, not of hard linguistic constraints. The purported impossible scopings are in fact possible. Link (1991) provides a variation of (64b) in which the missing narrow scope of the indefinite also becomes available, refuting the asymmetry:

(65) A strange voice was to be heard everywhere.

More natural counterexamples are cases like *A dog was in every dog house.* Moreover, Link (1991) also provides examples in which the wide scope of the bare plural is quite prominent, again refuting Carlson's asymmetry claim:

(66) a. CIA agents mined all Nicaraguan harbors.
b. Revolting generals occupied all centers of power.

See also Kratzer (1980) for a similar discussion on the opacity differences that Carlson argues to exist between singular indefinites and bare plurals.

I will thus follow the standard assumption that bare plurals come at least in two flavors. One is an existentially quantified nominal while the other is quantified by a generic quantifier. Both cases can be accounted for in the present analysis via rules that essentially add quantificational force to a plural N' structure. Drawing from the approach in Ginzburg and Sag (2000, 191), I propose a unary branching rule *bare-nom-cx* that adds the relevant quantificational force.[6] The fact that the NP is bare is signaled by the feature DET−, which will play an important role in §6.6 with regard to phenomena that only occur in the presence of bare NPs.

[6] I am assuming that the type *bare-nom-cx* is a subtype of *cx*. The rule can thus apply to words and to phrases alike, and to add the semantics of the indefinite determiner without need to reformulate the SEMANTIC INHERITANCE PRINCIPLE.

(67) Bare Plural NP Construction

$$
\textit{bare-nom-cx} \Rightarrow
\left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN} & \boxed{2}\left[\text{SYN} \mid \text{HEAD} \mid \text{DET}-\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \left\langle \boxed{k}\left[\begin{array}{ll}
\text{RELN} & \exists \\
\text{INDEX} & \boxed{y} \\
\text{ARGS} & \langle\, \boxed{l2},\ \ldots\ \rangle
\end{array}\right],
\left[\begin{array}{ll}
\text{LBL} & \boxed{l2} \\
\text{RELN} & \textit{at-least} \\
\text{ARGS} & \langle \boxed{y},\ 2\ \rangle
\end{array}\right] \right\rangle \oplus \boxed{R} \\
\text{CONS} & \boxed{C}
\end{array}\right]
\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN} & \boxed{2} \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \left[\begin{array}{ll}
\text{LBL} & \boxed{l2} \\
\text{RELN} & \textit{plur-reln} \\
\text{INDEX} & \boxed{y}
\end{array}\right] \\
\text{RELS} & \boxed{R} \\
\text{CONS} & \boxed{C}
\end{array}\right]
\end{array}\right] \right\rangle
\end{array}\right]
$$

This rule can for instance take a plural noun predication like $\forall x(x \preceq y \rightarrow cat(x))$ and yield an existentially quantified counterpart $\exists y(|y| \geq 2 \wedge \forall x(x \preceq y \rightarrow cat(x)) \wedge l_3)$. Given that the KEY value is an existential quantifier, the resulting expression behaves for all purposes as an existentially quantified NP.

The value of [KEY *plur-reln*] requires the presence of a pluralized noun. This correctly rules out the possibility of deriving bare nouns from collectives, even though such nouns can be coerced into denoting pluralities. In neither of these cases is [KEY *plur-reln*] satisfied. Thus, the *bare-nom-cx* rule makes it impossible to obtain (68a) because the noun is not pluralized, while allowing for bare pluralized collective nouns as in (68b):

(68) a.*There were team in the field.

b. There were teams in the field.

I now move on to the subject of definite determiners. It is widely accepted that the definite determiner, unlike the indefinite, does not assert the existence of a unique collection of individuals. Rather, definites introduce the presupposition of a contextually salient entity which is preferentially interpreted with wide scope. As such, it is possible to cancel the existential import of the definite and to arrive at a narrow scope interpretation. To give one well-worn kind of example, consider the discourse in (69).

(69) The monarchs of France didn't sign the declaration. There are no monarchs of France.

Other cases of narrow scope readings are possible in the proper context, as shown in the example below from Allen (1995):[7]

(70) The dogs that won each race were hungry.

Given that plural nouns denote both atomic and non-atomic elements from the domain it falls upon determiners to introduce cardinality constraints. I thus propose a plural *the* determiner, which is homophonous to the singular counterpart. The plural realization requires a plural nominal and imposes a cardinality of at least two individuals. This prevents *The boys are late* to be true if only one boy was late. Setting aside the presuppositional import, and leaving the preferential wide scope interpretation for a different grammar component, the lexical entry is as follows:[8]

(71)
$$
\begin{bmatrix}
\text{MP} \mid \text{FORM} \ \langle \textit{the} \rangle \\
\text{SYN} \mid \text{HEAD} \begin{bmatrix} \textit{det} \\ \text{SPEC N'} \begin{bmatrix} \text{DET}+ \\ \text{KEY} \begin{bmatrix} \text{LBL} & \boxed{l4} \\ \text{INDEX} & \boxed{y}\begin{bmatrix}\text{NUM} \ \textit{pl}\end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\
\text{SEM} \begin{bmatrix} \text{KEY} \ \boxed{k} \\ \text{RELS} \left\langle \boxed{k}\begin{bmatrix} \text{RELN} & \exists \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle \boxed{l2}, \ldots \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{at-least} \\ \text{ARGS} & \langle \boxed{y}, 2 \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \left\langle \begin{bmatrix} \boxed{l4} \leq \boxed{l2} \end{bmatrix} \right\rangle \end{bmatrix}
\end{bmatrix}
$$

This determiner attaches to plural nominal structures, but does not require the nominal head to be pluralized. As such, this determiner is compatible with pluralized nouns as in [*The cats were sleeping*] or with plural coerced collective nouns as in [*The committee are meeting in this room*].

I now turn to pluralic quantifiers like *many*, *most*, *few*, and *all*. These are traditionally seen as relations between sets. While singular quantifiers like *every* and *each*

[7]The case is similar for singular definites, as in *Every trainee completed the task he had been assigned* or *The slush fund that every minister needs is kept by his private secretary* (Pereira 1990).

[8]The semantic backbone that I am assuming can be extended with a dynamic account of presupposition such as Beaver (2001) for instance, or in alternative, with a van der Sandtian account, such as Keller (1997). The latter is a DRT semantic underspecification formalization in HPSG.

ranging over atoms, pluralic quantifiers are best seen as ranging over non-atomic elements. In this regard, the latter are closer to plural existential NPs. These are similar in that both trigger plural agreement and allow for collective and distributive readings:

$$\text{(72)} \left\{ \begin{array}{l} \text{Many} \\ \text{Most} \\ \text{Few} \\ \text{The} \\ \text{Several} \end{array} \right\} \left\{ \begin{array}{l} \text{pilgrims who gathered}_C \text{ in Jerusalem were foreigners}_D. \\ \text{transistors that were defective}_D \text{ were piled}_C \text{ in a corner.} \end{array} \right\}$$

Root (1986) and Kamp and Reyle (1993, 480) prefer to view such quantifiers as ranging over atoms, and thus do not agree with this interpretation of the data. As a solution, the authors propose that a predicate like *gather* be decomposed into a predication over atoms. In particular, Root (1986) proposes an operator '$x\, Ind_y[Y\, gathered]$' that mediates between each individual and the collective event, yielding an interpretation that is paraphrasable as 'x preforms the individual contribution to some collective gathering'. This would in turn allow quantifiers like *most* to range over atoms, like *every*.

But this kind of decomposition analysis cannot in general account for all collective predications, as it is only possible for predicates that come with sub-entailments as pointed out by Dowty (1986). He notes that the collective use of *count* ('assign a number to'), as in *I counted many proposals*, cannot be intuitively decomposed this way. Many other cases exist, consider for instance *be similar*, *be few*, *be paired*, or *disagree*. In what sense is an individual contribution being made to a 'be few' collective state of affairs? The collective interpretation arises precisely from a reciprocal relation that is established between the individual members of the plurality, not from an independent contribution of each individual. Also problematic is the object position of predicates such as *add up to*, in examples like *Many numbers add up to a prime number*. There is no sense in which each number makes an individual contribution to some collective state of affairs. The quantifier is ranging over *collections* of numbers. This provides another deep problem for a quantification over atoms analysis.

Roberts (1987) and Link (1987) have also noted cases in which the quantification is clearly ranging over pluralities. Consider for example (73a) and (73b). In the former the quantifier *most* ranges over pairs of siblings and in the latter it ranges over collections of competing companies.

(73) a. Most twin boys like each other.

b. Most competing companies have common interests.

Thus, apart from the fact that the decompositional analysis does not seem to scale up to all kinds of collective predications, the assumption that plural quantifiers range over atoms is simply not tenable. I will therefore pursue an account in which plural quantifiers are not only morphologically plural, but also semantically plural.

Another similarity between plural quantifiers and plural indefinites and numerals is that both are uniform in respect to scope ambiguities. These only arise in the presence a distributive predicate. The examples given in (74) cannot be interpreted as sub-groups of soldiers surrounding different buildings each:

$$(74)\quad \left\{\begin{array}{l}\text{Several}\\ \text{Twenty}\\ \text{Many}\\ \text{Most}\\ \text{Few}\end{array}\right\} \left\{\begin{array}{l}\text{soldiers surrounded a building.}\\ \text{boxes were piled in a corner.}\end{array}\right\}$$

Examples like (75) are again uniform in that they introduce a scope ambiguity. This is because of the distribution operation introduced by the matrix verb:

$$(75)\quad \left\{\begin{array}{l}\text{Several}\\ \text{Twenty}\\ \text{Most}\\ \text{Many}\\ \text{Few}\end{array}\right\} \text{visitors are staying in a hotel downtown.} \qquad [Q_D{>}\exists\ /\ \exists{>}Q_D]$$

This shows that pluralic quantifiers do not behave like *each* and *every* at all, and that they are best seen as quantificational plural determiners.

I will begin the analysis by assuming that *most* is a relation that means 'more than half of', on a finite universe. There is some vagueness involved as the threshold can vary in different contexts. I am not dealing with vagueness here, and will assume that a fixed context assumption chooses a suitable meaning and that default the threshold is 1/2. Thus I will define that for $Most(y, \phi, \psi)$ to be true there must be a plurality b assigned to y such that b contains more than half of the elements in the largest plurality a that satisfies ϕ. This assignment of b to y is in addition required to make both ϕ and ψ come out true. This is formalized below in (76).

(76) $_{g1}[\![\mathsf{Most}(y,\phi,\psi)]\!]^{\mathcal{M}}_{g3}$ *iff*

$$\begin{aligned}\exists a(a = Supr(\{a' \subset_i A_I : \exists g'\ _{g1\cup\{(y,a')\}}[\![\phi]\!]^{\mathcal{M}}_{g'}\}) \wedge \\ \exists b\,(b\subset_i a \wedge |b| > \tfrac{|a|}{2} \wedge \exists g_2\ (_{g1\cup\{(y,b)\}}[\![\phi]\!]^{\mathcal{M}}_{g2} \wedge \exists g_3\ _{g2}[\![\psi]\!]^{\mathcal{M}}_{g3})\ ))\end{aligned}$$

The first conjunct in the satisfaction conditions obtains the largest plurality a that satisfies ϕ, by computing the supremum of all the elements a' that satisfy ϕ (recall that A_I is the set of individual atoms of the domain). The second conjunct specifies that some b is composed of more than half of the elements in a and that assigning b to y makes both arguments of the quantifier true.

The lexical entry is rather straightforward, as seen in (77):

(77)
$$\begin{bmatrix}
\textsc{mp} \mid \textsc{form}\ \langle\ \textit{most}\ \rangle \\
\textsc{syn} \mid \textsc{head} \begin{bmatrix} \textit{det} \\ \textsc{spec}\ \text{N'} \begin{bmatrix} \textsc{det}+ \\ \textsc{key} \begin{bmatrix} \textsc{lbl} & \boxed{l4} \\ \textsc{reln} & \textit{plur-reln} \\ \textsc{index} & \boxed{y} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\
\textsc{sem} \begin{bmatrix} \textsc{key}\ \boxed{k} \\ \textsc{rels} \left\langle \boxed{k} \begin{bmatrix} \textsc{reln} & Most \\ \textsc{index} & \boxed{y} \\ \textsc{args} & \langle \boxed{l2},\ \ldots \rangle \end{bmatrix} \right\rangle \\ \textsc{cons} \left\langle \begin{bmatrix} \boxed{l4} \leq \boxed{l2} \end{bmatrix} \right\rangle \end{bmatrix}
\end{bmatrix}$$

The N' head is required to be of the type *plur-reln* and thus the quantifier can only attach to pluralized nominals. This not only rules out singular nouns of any kind, but also coerced nominals as in **Most crew is/are happy.*

This account also has no problem handling NPs such as *Most competing companies.* The plural noun *companies* is represented by $\forall x(x \preceq y \rightarrow company(x))$ and thus denotes a set of atoms and collections of companies, say $\{c_1, c_2, ..., c_9, c_1 \vee_i c_2, ..., c_1 \vee_i c_2 \vee_i c_9\}$. The adjective *competing* is collective in the sense that it denotes a set of pluralities composed of atoms that compete, e.g. $[\![competing]\!] = \{c_1 \vee_i c_2, c_4 \vee_i c_5 \vee_i c_3, ...\}$. As expected, *competing companies* corresponds to the intersection of the two denotations, which is composed of pluralities only: $\forall x(x \preceq y \rightarrow company(x)) \wedge competing(y)$. Finally, the quantifier *most* ranges over any element y of the domain, atomic or not, and combines with the nominal expression in the usual way, by plugging it in the restrictor.

(78) [Most competing companies]$^{y}_{NP}$ VP(y)

$$Most(y, \forall x(x \preceq y \rightarrow company(x)) \wedge competing(y),\ \text{VP}(y))$$

Other pluralic quantifiers can be encoded in a similar way. For example, *few* can be defined as 'less than half' (or contextually-dependent variations thereof, as suggested by Barwise and Cooper (1981) and others) and *many* can be defined as 'more than a certain contextually dependent threshold'.

The determiner *no* attaches to any kind of noun except to coerced collectives, can attach to a predicative or non-predicative head, and can range over atoms and non-atoms alike:

(79)
$$\begin{bmatrix} \text{MP}\,|\,\text{FORM}\ \langle\ \textit{no}\ \rangle \\ \text{SYN}\ \begin{bmatrix}\text{HEAD}\ \begin{bmatrix} \textit{det} \\ \text{SPEC N'} \begin{bmatrix}\text{DET}+ \\ \text{KEY} \begin{bmatrix}\text{LBL} & \boxed{l4} \\ \text{RELN} & \neg\textit{metonym-reln} \\ \text{INDEX} & \boxed{1}\textit{ref-index}\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix} \\ \text{SEM} \begin{bmatrix}\text{KEY}\ \boxed{k} \\ \text{RELS}\ \left\langle \boxed{k}\begin{bmatrix}\text{RELN} & No \\ \text{INDEX} & \boxed{1} \\ \text{ARGS} & \langle\ \boxed{l2}\ \ldots\rangle\end{bmatrix}\right\rangle \\ \text{CONS}\ \left\langle \left[\boxed{l4} \leq \boxed{l2}\right]\right\rangle\end{bmatrix}\end{bmatrix}$$

The fact that $\boxed{1}$ is type-underspecified and the list ARGS is only partially instantiated allows the quantifier to attach to both non-predicative and predicative nominals, as in *No cat(s) died* and *Kim is no doctor*, exactly as discussed for the singular indefinite *a* in §6.2. The typing $\neg$*metonym-reln* prevents obtaining phrases with coerced collective nouns such as **No team is/are smiling.*

The interpretation of the quantifier amounts to requiring that no element from the domain satisfies both ϕ and ψ:

(80)
$${}_{g1}[\![\mathsf{No}(y,\phi,\psi)]\!]^{\mathcal{M}}_{g2} \quad \textit{iff} \quad g_1 = g_2\ \ \&\ \ \neg\exists g_3(g_1[y]g_3\ \ \&\ \ \exists g_4\ {}_{g3}[\![\phi]\!]^{\mathcal{M}}_{g4} \wedge \exists g_5\ {}_{g4}[\![\phi]\!]^{\mathcal{M}}_{g5})$$

The case of *nobody* and *zero* are similar in that both range over atoms and non-atoms and are compatible with collective readings. Still, the former differs in that it requires singular agreement for the nominal head that it attaches to. Confront *Nobody met over there* and *Nobody was there* with **Nobody were there*.

The above quantifiers can also have a partitive realization. This can be seen as an alternation, captured in terms of a lexical rule that takes a quantifier like *most* or a numeral and specifies that the determiner attaches to a PP[PFORM *of*] constituent instead. As already discussed in §6.5.4, the preposition is semantically vacuous and thus the KEY value of the PP is identical to that of the NP. The quantifier can therefore require that the embedded NP is definite, if the type hierarchy of quantifiers is made to encode that distinction.

Some determiners, like [*n per cent*], are directly specified in the lexicon as they only have the partitive distribution. In the case of *all*, the presence of the marker *of* is optional. For the semantics of the latter, I will follow Link (1984) in assuming that this expression merely emphasizes that each individual partakes in the (collective or distributive) state of affairs in question. This can be captured with the *partake* operator '$^{\top}$' proposed in Link (1984). It basically states each part of the whole has an equally active role in the predication, while other plurals do not. In (81a) one is merely committed to the children being collectively responsible for building the boat, not that each child was equally or actively involved, as in the counterpart with *all*.

(81) a. The children built the boat.

b. All the children built the boat.

The partake analysis may also be relevant elsewhere. In considering the sentence in (82), Scha (1981) claims that there could be in fact two different gatherings taking place, each with three individuals.

(82) Six boys gather.

I don't think a speaker would ever utter (82) to convey that three boys gathered in one corner of the bar while three others gather in the opposite corner. I agree with Link and Schütze (1991) that these kinds of readings are best seen as a matter of indeterminacy in the interpretation of the verb meaning. For example, if one perceives *gathering* decompositionally as 'joining some other person' then each individual is indeed gathering in the aforementioned situation, and there is no need to logically represent each and every possible combination of individuals in the semantics. The partake operator '$^{\top}$' can be used precisely to talk about the involvement of individual atoms in collective readings. Thus, a sentence like *Half a million people gathered throughout the country* can be true if each individual converges to a gathering taking place in any part of the country. For this reason I follow Link in assuming that cumulative readings are best left to vagueness in the interpretation of standard collective readings, and thus avoid over-representation in the treatment of plural interpretations.

The mereological view that Link provides also offers an insight into why the *all* expression can occur in count nouns as well as in mass nouns.

(83) a. All letters must be revised before being sent.

b. All the vehicles collided.

c. All (our / sixteen) computers are interconnected via the WWW.

d. All (the) water was gone.

I will not pursue the matter here, since the present analysis can be augmented with a mass mereological domain as in Link (1983).

6.5 Verbal Structures

The grammar fragment defined so far covers a wide range of nominal structures, but attributes simple plural NPs and conjoined NPs a uniform analysis, in as much as both non-ambiguously correspond to pluralities. Henceforth I adopt the shorthand $\exists x\, cats(x)$... instead of writing the full representation plural noun: $\exists x(|x| \geq 2 \wedge \forall y(y \preceq x \rightarrow cat(y))...)$. Consider some examples of NPs allowed by the grammar:

(84) a. $[\text{The team}]^x_{NP}$

l_1: $\exists x(team(x) \wedge\ l_3)$

b. $[\text{The team}]^x_{NP}$ (coerced)

l_1: $\exists x(\exists y(metonym\text{-}rel(y,x) \wedge team(y)) \wedge\ l_3)$

c. $[\text{Several men}]^x_{NP}$

l_1: $\exists x(|x| \geq 2 \wedge men(x) \wedge\ l_3)$

d. $[\text{Kids}]^x_{NP}$

l_1: $\exists x(|x| \geq 2 \wedge kids(x) \wedge\ l_3)$

e. $[\text{Most women}]^{x}_{NP}$

l_1: $Most(x, \forall y(y \preceq x \rightarrow woman(y)), l_3)$

f. $[\text{Tom and Mary}]^{x}_{NP}$

l_1: $\exists x((\exists x_1(Tom(x_1) \wedge x_1 \in x) \wedge \exists x_2(Mary(x_2) \wedge x_2 \in x)) \wedge l_3)$

g. $[\text{A man and two dogs}]^{x}_{NP}$

l_1: $\exists x((\exists x_1(man(x_1) \wedge x_1 \in x) \wedge \exists x_2(|x_2| = 2 \wedge \forall y(y \preceq x_2 \rightarrow dog(y)) \wedge x_2 \in x)) \wedge l_3)$

h. $[\text{Fred and every kid}]^{x}_{NP}$

l_1: $\exists x((\exists x_1(Fred(x_1) \wedge x_1 \in x) \wedge \forall x_2(kid(x_2) \rightarrow x_2 \in x)) \wedge l_3)$

i. $[\text{Two novels, a novella, and many short stories}]^{x}_{NP}$

$$
\begin{aligned}
l_1\text{: } \exists x((&\exists x_1(|x_1| = 2 \wedge \forall y(y \preceq x_1 \rightarrow novel(y)) \wedge x_1 \in x) \wedge \\
&\exists x_2(novella(x_2) \wedge x_2 \in x) \wedge \\
&Many(x_3, \forall w(w \preceq x_3 \rightarrow short\text{-}story(w)), x_3 \in x) \qquad) \wedge l_3)
\end{aligned}
$$

The main generalization is that all of the above are the same from the perspective of a head that selects for an argument. All of these are essentially quantified noun phrases with a referential argument x, restrictor l_2 and scope argument l_3. The description in (85) is compatible with all of the above, and contains all the information that a non-nominal head needs for subcategorization and semantic composition purposes:

(85)
$$
\text{NP}\begin{bmatrix} \text{KEY} \begin{bmatrix} \text{LBL} & \boxed{l1} \\ \text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle \boxed{l2}, \boxed{l3} \rangle \end{bmatrix} \end{bmatrix}
$$

An NP is used here as an abbreviation for the following description.

(86)
$$
\text{NP} = \begin{bmatrix} \text{SYN} \mid \text{CAT} \mid \text{HEAD} & noun \\ \text{SEM} \mid \text{KEY} & quant \end{bmatrix}
$$

In what follows I review how the HPSG grammar provides a uniform account of the various kinds of collective and distributive readings – as well as scoping ambiguities – that pluralic NPs can give rise to.

6.5.1 Distributive Predication

Distributive predicates are words that apply only to atomic elements, by virtue of the state of affairs that they describe. Consider the case of present or past tense distributive verbs. These do not impose agreement constraints on their arguments, and as such can co-occur with singular or with plural NPs alike.

(87) $\left\{\begin{array}{l}\text{I}\\ \text{Fred}\\ \text{Kids}\\ \text{The crew}\\ \text{Two students}\\ \text{Most boys}\\ \text{A man and a woman}\\ \text{Each boy and each girl}\end{array}\right\}$ smiled.

In all of the above cases the verb predicate must apply to the atomic individuals in the denotation of the NP. The relation type *a(atomic)-pl(ural)-res(olution)* encompasses the two relevant cases: D_a (which distributes over the atoms in a plurality) and $=_a$ (which in the case of distributive predicates is only felicitous with non-pluralic NPs). The type hierarchy of plural resolutions is repeated in Figure 6.16.

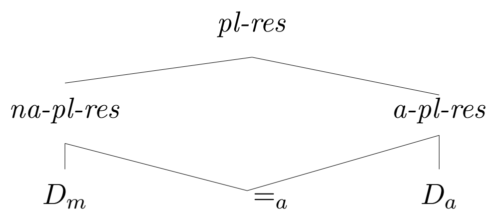


Figure 6.16: Type hierarchy of plural resolutions

The lexical entry for the verb form *smiled* is shown in (88). Note that the agreement specification is type-underspecified for number and gender. This lexical entry is therefore compatible with all the cases in (87).

(88)
$$\left[\begin{array}{ll}
\text{FORM} & \langle\ \textit{smiled}\ \rangle \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{l} \textit{verb} \\ \text{VFORM}\ \textit{fin} \end{array}\right] \\
\text{VAL} & \left[\begin{array}{ll}
\text{SUBJ} & \left\langle \text{NP}_{\textit{s-nom}} \left[\begin{array}{ll} \text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle \ldots, \boxed{l3} \rangle \end{array}\right] \right\rangle \\
\text{COMPS} & \langle\ \rangle
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \left\langle \left[\begin{array}{ll} \text{LBL} & \boxed{l4} \\ \text{RELN} & \textit{a-pl-res} \\ \text{ARGS} & \langle \boxed{w}, \boxed{x}, \boxed{l5} \rangle \end{array}\right], \boxed{k} \left[\begin{array}{ll} \text{LBL} & \boxed{l6} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{l7} \rangle \end{array}\right], \left[\begin{array}{ll} \text{LBL} & \boxed{l7} \\ \text{RELN} & \textit{smile} \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{w} \rangle \end{array}\right] \right\rangle \\
\text{CONS} & \left\langle [\boxed{l4} \leq \boxed{l3}],\ [\boxed{l6} \leq \boxed{l5}] \right\rangle
\end{array}\right]
\end{array}\right]$$

The fact that the lexical entry is underspecified for agreement constraints and for plural resolution constraints, this one verb can combine with a very wide range of subject NPs, as in the fragment illustrated below:

(89) a. A kid smiled.

$$\exists x(\mathit{kid}(x) \wedge =_a (w, y, \exists e\, \mathit{smile}(e, w)))$$

b. The crew smiled.

$$\exists x(\exists y(\mathit{metonym\text{-}rel}(y, x) \wedge \mathit{crew}(y)) \ \wedge\ D_a(w, x, \exists e\, \mathit{smile}(e, w)))$$

c. Several men smiled.

$$\exists x(|x| \geq 2 \wedge \forall y(y \preceq x \rightarrow \mathit{man}(y)) \ \wedge\ D_a(w, x, \exists e\, \mathit{smile}(e, w)))$$

d. Most women smiled.

$$Most(x, \forall y(y \preceq x \rightarrow \mathit{woman}(x))\, , D_a(w, x, \exists e\, \mathit{smile}(e, w)))$$

e. A man and two women smiled.

$$\exists x(\ (\exists x_1(\mathit{man}(x_1) \wedge x_1 \in x) \wedge \\ \exists x_2(|x_2|{=}2\ \wedge \forall y(y \preceq x_2 \rightarrow\ \mathit{women}(y)\ \wedge x_2 \in x)) \wedge\ D_a(w, x, \exists e\, \mathit{smile}(e, w)))$$

The lexical entry for the singular form *smiles* differs only with regard to agreement. The nominal head is required to be specified as $\boxed{x}$[NUM *sg*]. Note that there is no change in the semantics. If the subject is a singular NP like *a man* then the only felicitous reading is an equality '$=_a$', but if the subject is a coerced collective noun then a distributive reading can also be obtained via D_a, as in *The crew smiles and is very pleased with the results.*

(90) The crew smiles.

$$\exists x(\exists y(\mathit{metonym\text{-}rel}(y,x) \wedge \mathit{crew}(y)) \wedge D_a(w,x,\exists e\, \mathit{smile}(e,w)))$$

In the case of **This crew are smiling* the determiner requires the nominal to be singular, similarly to other determiners like *every*, but the verb requires a plural subject NP, which is inconsistent.

The present account can also scale to distributive verbs that require a singular subject but that remain neutral with regard to the number agreement of the complement. The latter can be plural or singular, even though they are always interpreted distributively. For example, it is implausible that a collective reading can be obtained for the complement of *read*. For example, *Kim read the books* cannot mean that Kim read the collection of books but not each book individually. As before, the lexical entry for the verb form *likes* directly predicates the singular subject but contains a *a-pl-res* relation for the interpretation of the complement NP. The very same verb lexical entry should therefore be able to capture all of the cases in (91):

$$\text{(91) Kim likes} \left\{ \begin{array}{l} \text{the book.} \\ \text{(two) books.} \\ \text{each book.} \\ \text{the book and the magazine.} \\ \text{most books and most magazines.} \end{array} \right\}$$

The lexical entry is shown in full in (92). The subject NP is required to be singular third person and is semantically taken directly as an argument of the verb predicate, while the complement NP can exhibit any kind of number agreement:

$$
(92)\quad \begin{bmatrix}
\text{FORM} \; \langle \textit{likes} \rangle \\
\text{SYN} \begin{bmatrix}
\text{HEAD} \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\
\text{VAL} \begin{bmatrix}
\text{SUBJ} \left\langle \text{NP}_{s\text{-}nom} \begin{bmatrix} \text{INDEX } \boxed{x} \begin{bmatrix} \text{NUM } \textit{sg} \\ \text{PER } \textit{3rd} \end{bmatrix} \\ \text{ARGS } \langle \ldots, \boxed{l3} \rangle \end{bmatrix} \right\rangle \\
\text{COMPS} \left\langle \text{NP}_{s\text{-}acc} \begin{bmatrix} \text{INDEX } \boxed{y} \\ \text{ARGS } \langle \ldots, \boxed{l7} \rangle \end{bmatrix} \right\rangle
\end{bmatrix}
\end{bmatrix} \\
\text{SEM} \begin{bmatrix}
\text{KEY } \boxed{k} \\
\text{RELS} \left\langle \begin{array}{l}
\begin{bmatrix} \text{LBL} & \boxed{l8} \\ \text{RELN} & \textit{a-pl-res} \\ \text{ARGS} & \langle \boxed{z}, \boxed{x}, \boxed{l9} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l10} \\ \text{RELN} & \textit{a-pl-res} \\ \text{ARGS} & \langle \boxed{w}, \boxed{y}, \boxed{l11} \rangle \end{bmatrix}, \\
\boxed{k} \begin{bmatrix} \text{LBL} & \boxed{l12} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{l13} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} & \boxed{l13} \\ \text{RELN} & \textit{like} \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{z}, \boxed{w} \rangle \end{bmatrix}
\end{array} \right\rangle \\
\text{CONS} \left\langle \begin{bmatrix} \boxed{l12} \leq \boxed{l9} \end{bmatrix}, \begin{bmatrix} \boxed{l12} \leq \boxed{l11} \end{bmatrix}, \begin{bmatrix} \boxed{l8} \leq \boxed{l3} \end{bmatrix}, \begin{bmatrix} \boxed{l10} \leq \boxed{l7} \end{bmatrix} \right\rangle
\end{bmatrix}
\end{bmatrix}
$$

As far as the syntax-semantics interface is concerned, there is nothing new here. The verb selects a subject NP and a complement NP and the interpretation of each NP is mediated through a *a-pl-res* relation. The SEMANTIC INHERITANCE PRINCIPLE and all other principles are in effect as usual.

As already suggested in §6.2.1, the same account is uniformly applied to attributive adjectives like *tall*, *big*, *happy*, and *old*. These are distributive in the sense that they denote a set of atoms. No agreement specifications are imposed on the nominal structures they predicate, and thus the *a-pl-res* relation can once again take care of the interpretation of singular and plural nominal expressions alike.

$$
(93)\quad \left\{ \begin{array}{l} \text{A boy is} \\ \text{Two boys are} \\ \text{A girl and a boy are} \\ \text{Every boy and every girl were} \\ \text{Many boys and several girls were} \end{array} \right\} \text{tall.}
$$

In languages where adjectives do show number agreement the plural form should again be derived by a lexical rule. This rule is fairly straightforward and should do three things: pluralize the morphophonology of the adjective, add agreement constraints to the nominal expression it selects in MOD and specifiy that *a-pl-res* is resolved as a D_a distribution.

6.5.2 Collective Predication

In §4.1.2 it was shown that collective predicates in general allow for at least two kinds of readings. One is referred to as intermediate group reading and is only possible in the presence of pluralic NP conjuncts. Collective readings, on the other hand, are always possible in general as long as the relevant NP argument denotes a plurality. The two possibilities are accounted for via the relations 'D_m' and '$=_a$'.

Let us consider collective predicates like *gather*, *outnumber*, *meet*, *disperse*, or *be many*. The account can be illustrated with the lexical entry given in (94):

(94)
$$
\begin{bmatrix}
\text{FORM} & \langle \textit{ gathered } \rangle \\
\text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \left\langle \text{NP}_{s\text{-}nom} \begin{bmatrix} \text{INDEX } \boxed{x}[\text{NUM } pl] \\ \text{ARGS } \langle ..., \boxed{l3} \rangle \end{bmatrix} \right\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \end{bmatrix} \\
\text{SEM} & \begin{bmatrix} \text{KEY} & \boxed{k} \\ \text{RELS} & \left\langle \begin{bmatrix} \text{LBL } \boxed{l4} \\ \text{RELN } \textit{na-pl-res} \\ \text{ARGS } \langle \boxed{w}, \boxed{x}, \boxed{l5} \rangle \end{bmatrix}, \boxed{k} \begin{bmatrix} \text{LBL } \boxed{l6} \\ \text{RELN } \exists \\ \text{INDEX } \boxed{e} \\ \text{ARGS } \langle \boxed{l7} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL } \boxed{l7} \\ \text{RELN } \textit{gather} \\ \text{INDEX } \boxed{e} \\ \text{ARGS } \langle \boxed{w}[\text{NUM } pl] \rangle \end{bmatrix} \right\rangle \\ \text{CONS} & \left\langle \left[\boxed{l6} \leq \boxed{l5} \right], \left[\boxed{l4} \leq \boxed{l3} \right] \right\rangle \end{bmatrix}
\end{bmatrix}
$$

The verb *gathered* selects for a plural subject NP and allows for two different interpretations of the plurality, depending on how the type *na-pl-res* is resolved. For (95), the *na-pl-res* can only be felicitously resolved with the equality '$=_a$'. This is because the satisfaction conditions of D_m require a conjunctive plurality, as defined in §4.2.

(95) Some onlookers gathered.

$$\exists x\, (\textit{onlookers}(x) \wedge =_a (y, x, \exists e\, \textit{gather}(e, y)))$$

Note that the current grammar fragment analyzes this sentence in the same way as any other sentence headed by an intransitive verb, via the *hd-subj-cx* construction. A very similar parse and semantic representation is obtained for the examples in (96). The main difference is that the subject NP is a plurality obtained via conjunction. In all other regards the case is identical to (95).

(96) a. Tom, Fred and Sue gathered outside.

b. Tom and the girls gathered outside.

Only the collective reading is available because the distribution D_m is non-felicitous. For the latter to be felicitous each member of the conjunction would have to be gathering separately, and since the denotation of collective verbs is a set of pluralities, an individual atom like *Tom* cannot felicitously gather by himself.

The situation changes with cases like (97a). Exactly the same syntactic parse is obtained, but the underspecified relation *na-pl-res* can now be felicitously resolved in two ways, capturing the collective and the intermediate group readings:

(97) a. Some boys and some girls gathered outside.

b. $\exists x\,(\,((\exists x_1\ boys(x_1) \wedge x_1 \in x) \wedge (\exists x_2\ girls(x_2) \wedge x_2 \in x)) \wedge =_a (y, x, \exists e\, gather(e, y))\,)$

c. $\exists x\,(\,((\exists x_1\ boys(x_1) \wedge x_1 \in x) \wedge (\exists x_2\ girls(x_2) \wedge x_2 \in x)) \wedge D_m(y, x, \exists e\, gather(e, z))\,)$

In sum, the very same lexical entry for *gather* can account for all of the above cases. In fact, it can also account for the fact that coerced collective nouns can be predicated collectively. Recall that canonical collective nouns have singular agreement and denote an atomic element (a group) from the mereological domain as discussed in 6.2.2. However, coerced collectives denote a plurality and are underspecified for number agreement. This allows a verb like *gathered* to accept such nouns as in (98). This sentence is not ambiguous, as the only possible interpretation is a collective reading of the plurality of committee members.

(98) The committee gathered.
$\exists y(\exists x(metonym\text{-}rel(y, x) \wedge committee(x)) \wedge =_a (k, y, \exists e\, gather(e, k)))$

6.5.3 Neutral Predication

Mixed predicates such as *hire*, *lift*, *buy*, *weigh*, *protest* and others allow for both atomic and non-atomic elements in their denotation, and thus behave like distributive and collective verbs. Basically, they are compatible with all of the plural resolutions '$=_a$', 'D_a', and 'D_m'. Take for instance the verb form *hired*, which does not impose agreement constraints on either argument:

(99) $$\left\{\begin{array}{l} \text{Tom} \\ \text{A woman} \\ \text{Each lawyer} \\ \text{Some actors} \\ \text{A man and two assistants} \\ \text{Many men and many women} \end{array}\right\} \text{hired} \left\{\begin{array}{l} \text{Fred.} \\ \text{that babysitter.} \\ \text{many bodyguards.} \\ \text{a trainer and a chef.} \\ \text{every trainer and every chef.} \end{array}\right\}$$

In the current approach, one can capture the full set of phenomena with a single lexical entry:

(100) $$\begin{bmatrix} \text{FORM } \langle \textit{ hired } \rangle \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SUBJ} \left\langle \text{NP}_{s\text{-}nom} \begin{bmatrix} \text{INDEX } \boxed{x} \\ \text{ARGS } \langle \ldots, \boxed{l3} \rangle \end{bmatrix} \right\rangle \\ \text{COMPS} \left\langle \text{NP}_{s\text{-}acc} \begin{bmatrix} \text{INDEX } \boxed{y} \\ \text{ARGS } \langle \ldots, \boxed{l12} \rangle \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY } \boxed{k} \\ \text{RELS} \left\langle \begin{bmatrix} \text{LBL } \boxed{l4} \\ \text{RELN } \textit{pl-res} \\ \text{ARGS } \langle \boxed{z}, \boxed{x}, \boxed{l5} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL } \boxed{l6} \\ \text{RELN } \textit{pl-res} \\ \text{ARGS } \langle \boxed{w}, \boxed{y}, \boxed{l7} \rangle \end{bmatrix}, \boxed{k} \begin{bmatrix} \text{LBL } \boxed{l8} \\ \text{RELN } \exists \\ \text{INDEX } \boxed{e} \\ \text{ARGS } \langle \boxed{l9} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL } \boxed{l9} \\ \text{RELN } \textit{hire} \\ \text{INDEX } \boxed{e} \\ \text{ARGS } \langle \boxed{z}, \boxed{w} \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \left\langle \left[\boxed{l4} \leq \boxed{l3}\right], \left[\boxed{l8} \leq \boxed{l5}\right], \left[\boxed{l6} \leq \boxed{l12}\right], \left[\boxed{l8} \leq \boxed{l7}\right] \right\rangle \end{bmatrix} \end{bmatrix}$$

As far as the verbal head is concerned, all of the sentences in (99) are instances of the same parse tree. The verb selects a complement and a subject and lexically introduces the same general semantic conditions. Again, if a given argument is singular than the only felicitous resolution is '$=_a$'. The distributive resolutions 'D_m' and 'D_a' are only felicitous with plural arguments. The interpretation of the arguments is underspecified as well as the scope interactions between the two argument NPs. This allows for a truly uniform account since as the lexical entry given above accounts for all the sentences in (99).

If a distributive reading is obtained then scope ambiguities can arise. But since the current approach decouples scope from plural resolution, the obtained underspecified representations describe in a compact way all the possible scopings. Thus, one can monotonically disambiguate scope without having to disambiguate plural interpretations and vice-versa, simply by adding more information to the underspecified descriptions. Consider for instance the sentence in (101), which can have distributive or collective readings as well as scope ambiguities:

(101) Every lawyer hired two private detectives.

The respective MRS representation is depicted in Figure 6.17. It describes a total of four readings, depending on whether the same or different detectives were hired, and on weather these individuals were hired collectively or separately, possibly at different moments in time. Some readings are more prominent than others, but each of them can be made preferential in a proper context or with a proper discourse continuation.

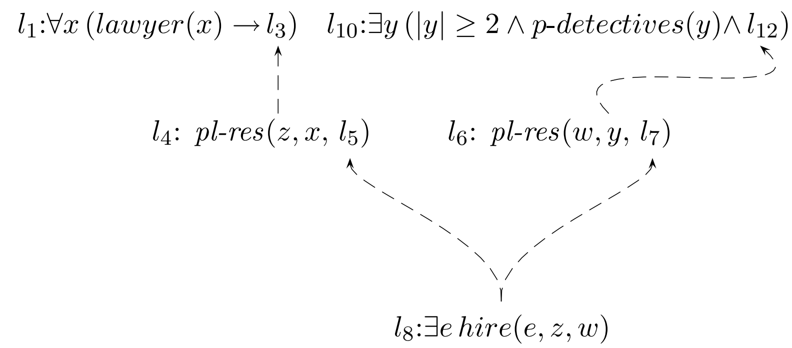


Figure 6.17: Underspecified representation of (101)

For example, if $l_3 = l_{10}$ and if both *pl-res* relations are resolved as '$=_a$' then one obtains the reading in (102a) in which each lawyer has hired different pairs of detectives. If the plural is interpreted distributively (i.e. if l_6 is resolved as 'D_a') then the reading in (102b) obtains, in which each lawyer has made two distinct hirings, possibly in different moments in time.

(102) a. $\forall x(lawyer(x) \rightarrow \exists y(|y| \geq 2 \wedge p\text{-}detves(y) \wedge =_a(z, x, =_a(w, y, \exists e\, hire(e, z, w)))))$

b. $\forall x(lawyer(x) \rightarrow \exists y(|y| \geq 2 \wedge p\text{-}detves(y) \wedge =_a(z, x, D_a(w, y, \exists e\, hire(e, z, w)))))$

If on the other hand $l_{12} = l_1$ then two other interpretations are possible. Either l_6 is resolved as '$=_a$' as in (103a), or l_6 is resolved distributively as 'D_a' as in (103b). The former captures the reading where the same pair of detectives was hired by each lawyer, and the latter captures the reading where each detective was separately hired by each lawyer.

(103) c. $\exists y(|y| \geq 2 \wedge p\text{-}detves(y) \wedge \forall x(lawyer(x) \rightarrow =_a (z, x, =_a (w, y, \exists, e\, hire(e, z, w)))))$

d. $\exists y(|y| \geq 2 \wedge p\text{-}detves(y) \wedge \forall x(lawyer(x) \rightarrow =_a (z, x, D_a(w, y, \exists e\, hire(e, z, w)))))$

A more complex case is depicted below for perspicuitiy. The subject phrase is a complex plurality, and as such can be interpreted collectively, distributively or with an intermediate group reading. Again, the two distributive resolutions interact with the singular indefinite NP and yield scope ambiguities (the conjuncts are depicted as plugged in the MRS representation for brevity of exposition):

(104) A man and two women hired two private detectives.

$$l_1\text{: } \exists x\, (\exists x_1(man(x_1) \wedge x_1 \in x) \wedge \exists x_2(women(x_2) \wedge |x_2| = 2 \wedge x_2 \in x) \wedge l_3) \qquad l_{10}\text{: } \exists y\, (|y| = 2 \wedge p\text{-}detectives(y) \wedge l_{12})$$

$$l_4\text{: } pl\text{-}res(z, x,\, l_5) \qquad l_6\text{: } pl\text{-}res(w, y,\, l_{11})$$

$$l_8\text{:}\exists e\, hire(e, z, w)$$

6.5.4 Predicative Structures

I follow the account in Pollard and Sag (1987) for control and raising verbs. Pollard and Sag (1987) draws a generalization over the class of raising verbs, arguing that these verbs select for a predicative XP complement phrase. The latter XP is in turn selecting for an external argument. In this account, the effect of 'raising' is purely semantic and boils down to the structure-sharing of indices:

$$\text{(105) Kim}_i \text{ is } \left\{ \begin{array}{l} [\text{laughing}]_{\text{VP[SUBJ}\langle \text{NP}_i \rangle]} \\ [\text{in Pisa}]_{\text{PP[SUBJ}\langle \text{NP}_i \rangle]} \\ [\text{happy}]_{\text{AP[SUBJ}\langle \text{NP}_i \rangle]} \\ [\text{a lawyer}]_{\text{NP[SUBJ}\langle \text{NP}_i \rangle]} \end{array} \right\}$$

Thus, all of the above are an instance of the *h-comp-cx* structure, depicted below:

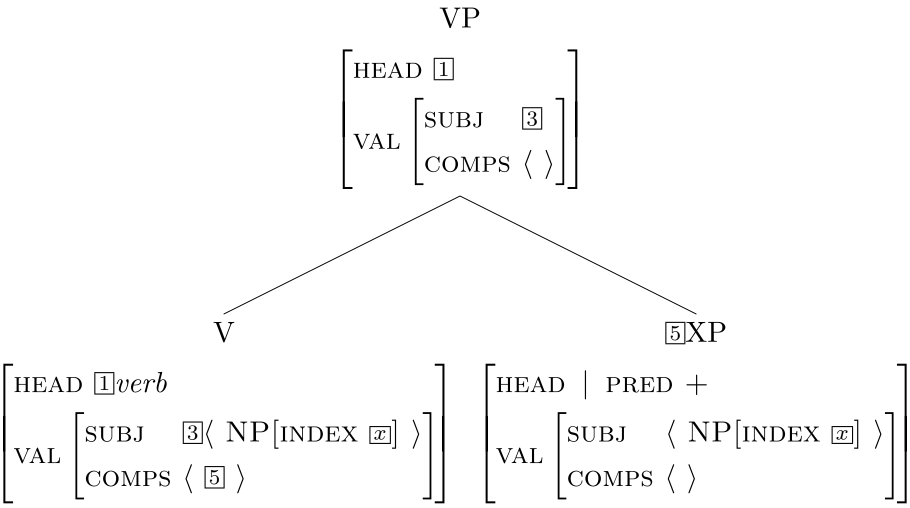


Figure 6.18: Generic tree structure for a 'raising' structure

The predicative realization of adjectives is a matter of lexical specification and can be captured as illustrated in (106) for *big*. Unlike the non-predicative counterpart, the predicative use bears a specification [PRED +], does not modify anything (has a null value for MOD), and selects an external argument via SUBJ.

(106)
$$\begin{bmatrix} \text{MP} \mid \text{FORM} \ \langle \textit{big} \rangle \\ \text{SYN} \ \begin{bmatrix} \text{HEAD} \ \begin{bmatrix} \textit{adj} \\ \text{PRED} \ + \\ \text{MOD} \ \textit{none} \end{bmatrix} \end{bmatrix} \\ \text{VAL} \ \begin{bmatrix} \text{SUBJ} \ \langle \text{NP}[\text{INDEX} \ \boxed{x}] \rangle \\ \text{COMPS} \ \langle \ \rangle \end{bmatrix} \\ \text{SEM} \ \begin{bmatrix} \text{KEY} \ \boxed{k} \\ \text{RELS} \ \left\langle \begin{bmatrix} \text{RELN} \ \textit{a-pl-res} \\ \text{ARGS} \ \langle \boxed{y}, \boxed{x}, \boxed{l2} \rangle \end{bmatrix}, \boxed{k} \begin{bmatrix} \text{LBL} \ \boxed{l2} \\ \text{RELN} \ \exists \\ \text{INDEX} \ \boxed{e} \\ \text{ARGS} \ \langle \boxed{l3} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} \ \boxed{l3} \\ \text{RELN} \ \textit{big} \\ \text{INDEX} \ \boxed{e} \\ \text{ARGS} \ \langle \boxed{y} \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \ \langle \rangle \end{bmatrix} \end{bmatrix}$$

Predicative adjectives can be derived from non-predicative adjectives in a systematic way via a lexical rule that takes a [PRED–] adjective and yields a predicative counterpart with null value for MOD and with a non-saturated subject list. This rule is rather straightforward, but it should also impose conditions on the kind of adjective that can undergo this process given that some adjectives do not have predicative counterparts, e.g. *former*, *alleged*, *mere*, or *utter*. I will not provide this rule here but I will assume that it is in place.

Semantically, copula verbs make no contribution besides tense and aspectual information. I have so far ignored these levels of representation for the sake of simplification, since it bears no direct connection with the topic at hand, and I will remain agnostic about how exactly this information is to be encoded. Still, nothing in this account prevents from adopting an approach in the spirit of Reichenbach (1947), and many others since then, such as Partee (1984) and Kamp and Reyle (1993, Ch.5). But apart from tense and aspectual information, the semantics of the copula is assumed to be empty as shown in (107).

(107)
$$\begin{bmatrix} \text{MP}\,|\,\text{FORM}\ \langle\ \textit{is}\ \rangle \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{verb} \\ \text{VFORM}\ \textit{fin} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SUBJ} & \left\langle \text{NP}_{\textit{s-nom}}\Big[\text{INDEX}\ \boxed{x}[\text{NUM}\ \textit{sg}]\Big] \right\rangle \\ \text{COMPS} & \left\langle \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{HEAD}\ |\,\text{PRED}\ + \\ \text{VAL} \begin{bmatrix} \text{SUBJ} & \langle\, \text{NP}\Big[\text{INDEX}\ \boxed{x}\Big] \rangle \\ \text{COMPS} & \langle\,\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM}\,|\,\text{KEY}\ \boxed{k} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY}\ \boxed{k} \\ \text{RELS}\ \langle\rangle \\ \text{CONS}\ \langle\rangle \end{bmatrix} \end{bmatrix}$$

The value of KEY is identified with the value of the XP complement. Thus in the coordination of copula verbs the plurality that emerges is one composed of the eventualities denoted by the complements. At this point, it is not clear whether the copula should introduce an eventuality also. Such eventualities may play an important role in coping with contrasts involving stage and individual level predications, as in *Kim is (*being) tired* and *Kim is (being) shy*. For now I will leave this matter open and assume that no eventuality is introduced.

Upon scopal disambiguation, the subject NP must have wide scope over the XP complement in order to prevent the variable x to be free. Recall from §4.2 that y is assumed to be allowed to remain free, precisely because it is actually anchored to x. If the complement is non-coordinate then the KEY value corresponds to the existential quantifier of the adjective, yielding the following result:

(108) The dog is big.

$$\exists x(dog(x) \wedge =_a (y, x, \exists e\, big(e, y)))$$

If the complement is a coordinate structure however, then KEY value corresponds to a pluralic eventuality:

(109) The dog is big and scary.

$$\begin{aligned} \exists x(dog(x) \wedge \exists e(\; & =_a (y, x, \exists e_1(big(e_1, y) \wedge e_1 \in e)) \wedge \\ & =_a (k, x, \exists e_2(scary(e_2, k) \wedge e_2 \in e)) \;\;)) \end{aligned}$$

The case of predicative prepositions is very much the same with regard to what occurs in the predicative counterpart. The value of MOD is null, an external object is selected, and the word is specified as [PRED+]. All else functions as described above for adjectives. The lexical entry for predicative *in* is provided below.

(110)

$$\begin{bmatrix} \text{MP} \mid \text{FORM} \; \langle \; \textit{in} \; \rangle \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{prep} \\ \text{PRED} \; + \\ \text{PFORM} \; \textit{none} \\ \text{MOD} \; \textit{none} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SUBJ} \; \left\langle \text{NP}\begin{bmatrix}\text{INDEX} \; \boxed{x}\end{bmatrix} \right\rangle \\ \text{COMPS} \; \left\langle \text{NP}\begin{bmatrix} \text{INDEX} \; \boxed{y} \\ \text{ARGS} \; \langle \; \ldots, \; \boxed{l5} \rangle \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY} \; \boxed{k} \\ \text{RELS} \left\langle \begin{bmatrix} \text{LBL} \; \boxed{l1} \\ \text{RELN} \; \textit{a-pl-res} \\ \text{ARGS} \; \langle \boxed{z}, \boxed{y}, \boxed{l2} \rangle \end{bmatrix}, \boxed{k} \begin{bmatrix} \text{LBL} \; \boxed{l3} \\ \text{RELN} \; \exists \\ \text{INDEX} \; \boxed{e} \\ \text{ARGS} \; \langle \boxed{l4} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL} \; \boxed{l4} \\ \text{RELN} \; \textit{in} \\ \text{INDEX} \; \boxed{e} \\ \text{ARGS} \; \langle \boxed{x}, \boxed{z} \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \left\langle \begin{bmatrix} \boxed{l1} \leq \boxed{l5} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

For completeness I also provide the lexical entry for a argument-marking preposition. Verbs like *afraid* and *proud*, *tired*, *ahead* select as complements PPs headed by the preposition *of*. These verbs can thus control for the prepositional form by the feature [PFORM *of*] associated to the PP. No semantic contribution is made by the preposition.

(111)
$$\begin{bmatrix} \text{MP}\,|\,\text{FORM}\ \langle\ \textit{of}\ \rangle \\ \text{SYN}\begin{bmatrix} \text{HEAD}\begin{bmatrix} \textit{prep} \\ \text{PRED}\ - \\ \text{PFORM}\ \textit{of} \\ \text{MOD}\ \ \textit{none} \end{bmatrix} \\ \text{VAL}\ \begin{bmatrix} \text{SUBJ}\ \ \langle\ \rangle \\ \text{COMPS}\left\langle \text{NP}\begin{bmatrix}\text{KEY}\ \boxed{k}\end{bmatrix}\right\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM}\begin{bmatrix} \text{KEY}\ \boxed{k} \\ \text{RELS}\ \langle\rangle \\ \text{CONS}\ \langle\rangle \end{bmatrix} \end{bmatrix}$$

The value of KEY is percolated to the PP mother because the preposition is the head of the structure. This in turn allows an external head that subcategorizes for the PP to impose semantic constraints on the NP. One example is partitive determiners, which typically require a definite NP embedded in the PP[OF] as in *most of these/the/*some/*six students*. Recall also that PPs headed by argument marking prepositions like *of* cannot be coordinated because of incompatible PFORM values, as discussed in §5.2, and independently motivated by cases like **Kim is afraid* [[*of Sandy*]$_{\text{PFORM}\ \textit{of}}$ *and* [*to Fred*]$_{\text{PFORM}\ \textit{to}}$].

Finally we come to predicative nouns. On the one hand, these are very similar to predicative adjectives in the sense that their referential arguments are eventualities, but very different in that these nominals require an existential quantifier in order to form a grammatical NP:

(112) Kim is $\left\{\begin{array}{l} \text{a} \\ \text{the} \\ \text{no} \\ \text{*each} \\ {*}\emptyset \end{array}\right\}$ singer.

For this reason the lexical entry of existential determiners like *a* are left underspecified with regard to the type of variable they bind as well as their number of arguments. If the N' is predicative as in $singer(e, x)$ then the result is $\exists s(singer(e, x))$. Note that this account solves two open problems in Pollard and Sag (1994, 360, ft.20), regarding the distribution in (112) and the fact that predicative NPs also allow for degree specifiers (cf. *John is SUCH a fool* with **SUCH a fool walked in*). The latter can be accounted for because predicative nouns contain a Neo-Davidsonian referential argument.

An illustrative lexical entry for a predicative noun is provided below:

(113)
$$\begin{bmatrix} \text{MP} \mid \ \text{FORM} \ \langle \ \textit{singer} \ \rangle & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{noun} \\ \text{PRED} \ + \\ \text{MOD} \ \textit{none} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \ \text{NP}[\text{INDEX} \ \boxed{x}] \ \rangle \\ \text{COMPS} & \langle \ \rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{KEY} \ \boxed{k} \\ \text{RELS} \ \left\langle \boxed{k} \begin{bmatrix} \text{RELN} & \textit{singer} \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{x} \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \ \langle \rangle \end{bmatrix} \end{bmatrix}$$

Once this nominal head combines with a determiner, it behaves essentially like a predicative adjective in all regards concerning the current grammar fragment. The semantics is essentially of the same form and the valency also. Note that other quantifiers such as *every* cannot attach to a predicative N' because the former require an index of type *ind* rather than one of type *evt*. The structure of a predicative NP is illustrated in the tree seen below, using the lexical entry for the indefinite *a* in (2).

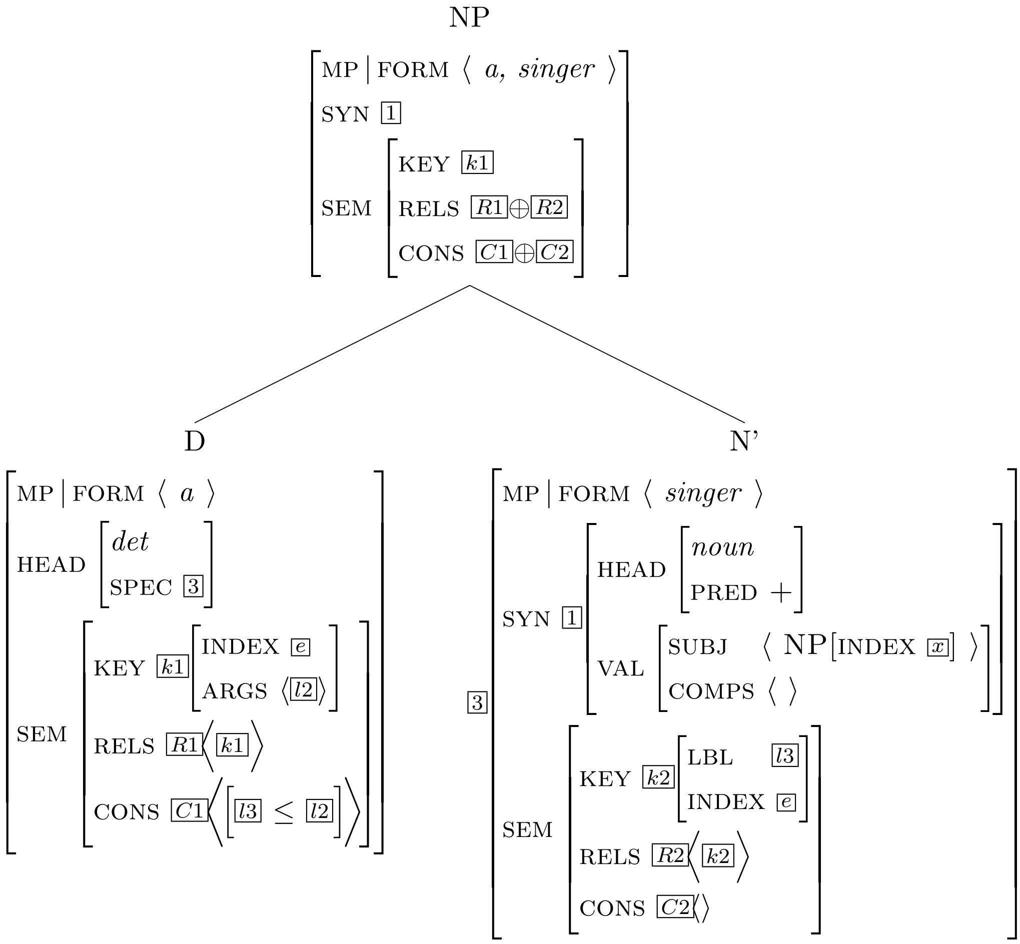


Figure 6.19: Analysis of an NP[PRED+].

The combination of the predicative NP with the verbal head proceeds as usual:

(114) a. Kim is a singer.

$\exists x(Kim(x) \wedge \exists\, e\ singer(e,x))$

b. Kim is singer and a composer.

$$\exists\, x(Kim(x) \wedge \exists\, e(\ \exists e_1(singer(e_1,x) \wedge e_1 \in e) \wedge \\ \exists e_2(composer(e_2,x) \wedge e_2 \in e)\ \ ))$$

The derivation of predicative nouns from non-predicative nouns appears to be a regular process, but as it turns out it cannot be captured as a lexical rule. The reason for this is that such nominal heads also combine with all sorts of adnominal modifiers such as adjectival phrases, prepositional phrases and relative clauses. All of these are required to bind an individual variable, not an eventuality. For example, the adjective in the NP *a great singer* does not seem to mean different things in predicative and non-predicative realizations of the NP. Confront *Kim is a great singer* with *Kim met a great singer*. The process that derives predicative nominals from non-predicative nominals should therefore be a phrasal coercion phenomenon, targeting N' categories. This would allow adnominal modifiers to attach to N' and bind the individual index as usual, and then the nominal head could be coerced into incorporating an eventuality argument, to be bound by an existential quantifier as illustrated in Figure 6.20.

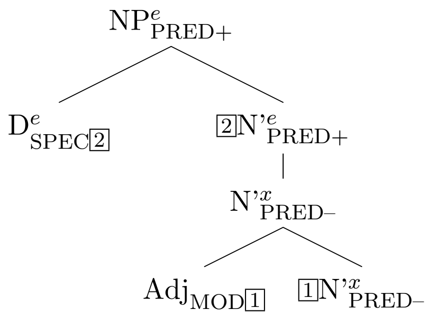


Figure 6.20: Predicative NP with an embedded non-predicative adjunct

This kind of coercion process entails changing SUBJ, HEAD, and SEM information. This cannot be modeled by a *phrasal-cx* construction because the SEMANTIC INHERITANCE PRINCIPLE requires the semantic content of the daughters to remain unchanged in the mother node. Thus, under the present assumptions, this coercion process is best viewed as an exocentric construction. A new type *npred-coer-cx* is therefore added to hierarchy of constructions:

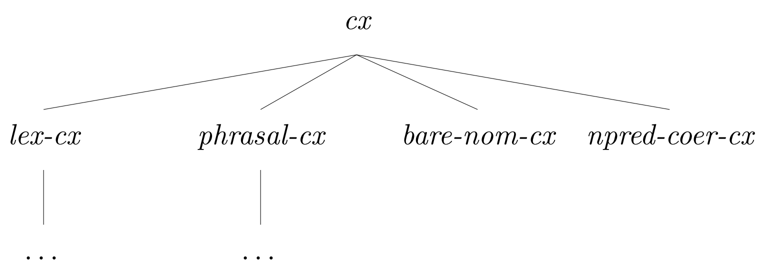


Figure 6.21: Type Hierarchy of constructions (extended)

The *pred-coer-cx* rule in nary-branching phrasal rule that changes the nominal predication $\boxed{k1}$, but does not alter the (possibly empty) sub-list $\boxed{R}$ of predications of the N' node. Morphophonology, complement valence and unbounded dependency specifications are maintained.

(115)

$$
\textit{npred-coer-cx} \Rightarrow
\left[\begin{array}{ll}
\textsc{mtr} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{phrase}} \\
\textsc{mp} & \boxed{1} \\
\textsc{syn} & \left[\begin{array}{ll}
\textsc{head} & \left[\begin{array}{l} \textit{noun} \\ \textsc{pred}\ + \\ \textsc{mod}\ \textit{none} \end{array}\right] \\
\textsc{val} & \left[\begin{array}{ll} \textsc{subj} & \langle\ \mathrm{NP}[\textsc{index}\ \boxed{x}]\ \rangle \\ \textsc{comps} & \boxed{2} \end{array}\right] \\
\textsc{inher} & \boxed{3}
\end{array}\right] \\
\textsc{sem} & \left[\begin{array}{ll}
\textsc{key}\ \boxed{k2} & \left[\begin{array}{ll} \textsc{label} & \boxed{4} \\ \textsc{reln} & \boxed{5} \\ \textsc{index} & \textit{evt} \\ \textsc{args} & \langle\boxed{x}\rangle \oplus \boxed{6} \end{array}\right] \\
\textsc{rels} & \langle\boxed{k2}\rangle \bigcirc \boxed{R} \\
\textsc{cons} & \boxed{C}
\end{array}\right] \\
\textsc{crd} & \textit{crd-}
\end{array}\right] \\
\textsc{dtrs} & \left\langle \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{phrase}} \\
\textsc{mp} & \boxed{1} \\
\textsc{syn} & \left[\begin{array}{ll}
\textsc{head} & \left[\begin{array}{l} \textit{noun} \\ \textsc{pred}\ - \end{array}\right] \\
\textsc{val} & \left[\textsc{comps}\ \boxed{2}\right] \\
\textsc{inher} & \boxed{3}
\end{array}\right] \\
\textsc{sem} & \left[\begin{array}{ll}
\textsc{key}\ \boxed{k1} & \left[\begin{array}{ll} \textsc{label} & \boxed{4} \\ \textsc{reln} & \boxed{5} \\ \textsc{index} & \boxed{x} \\ \textsc{args} & \boxed{6} \end{array}\right] \\
\textsc{rels} & \langle\boxed{k1}\rangle \bigcirc \boxed{R} \\
\textsc{cons} & \boxed{C}
\end{array}\right] \\
\textsc{crd} & \textit{crd-}
\end{array}\right] \right\rangle
\end{array}\right]
$$

Basically, the key predication of the N' is removed from the semantics, and a variant with an eventuality referential argument is specified as the new key $\boxed{k2}$. The index $\boxed{x}$ of the N' daughter is also identified with the nominal index in SUBJ.

6.5.5 Adverbial Structures

In (116) one can observe the lexical entry for the word *often*, which modifies a verbal structure and is intersectively combined with it. The syntax and semantics of this kind of adverbial is therefore identical to intersective adjectives.

$$
(116)\quad \begin{bmatrix}
\text{MP} \mid \text{FORM}\ \langle\ \textit{often}\ \rangle & \\
\text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{adv} \\ \text{MOD VP}\begin{bmatrix}\text{LBL} & \boxed{l1}\\ \text{INDEX} & \boxed{e}\end{bmatrix}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle\end{bmatrix}\end{bmatrix}\\
\text{SEM} & \begin{bmatrix} \text{KEY}\ \boxed{k} & \\ \text{RELS} & \left\langle \boxed{k}\begin{bmatrix}\text{LBL}\ \boxed{l1}\\ \text{RELN}\ \exists \\ \text{INDEX}\ \boxed{n} \\ \text{ARGS}\ \langle\boxed{l2}\rangle\end{bmatrix}, \begin{bmatrix}\text{LBL}\ \boxed{l2}\\ \text{RELN}\ \textit{often}\\ \text{ARGS}\ \langle\boxed{n},\boxed{e}\rangle\end{bmatrix}\right\rangle \\ \text{CONS}\ \langle\rangle & \end{bmatrix}
\end{bmatrix}
$$

The adverb introduces a degree index n which specifies a measure by which the predication holds of the eventuality e. Put in first-order logic, the semantics of the adverb is $\exists n\ \textit{often}(n, e)$ where e is the referential index of the verbal phrase that the adverb modifies. There is independent evidence for this kind of degree index n, as it seems to be the argument of expressions like *so*, *more* and *much*. In the examples below, the degree of speed is asserted to be much greater than some other degree of comparison.

(117) a. Fred calls so much more often.

b. Kim worked much more quickly.

Recall that the *h-mod-cx* discussed in (18) shuffles the domain objects of the daughters. In the case of adjectival modifiers I have introduced language-specific linear precedence constraints that limit the linearization possibilities, but in the case of adverbs like *often*, no such constraints are formulated. This allows the adverb to interleave with the VP domain list and yield a fair amount of flexibility as illustrated in (118).[9]

[9]Brackets indicate DOM element boundaries. Recall also that subjects and (non-verb cluster) complements are compacted by the *h-subj-cx* and the *h-comp-cx* rules, respectively.

(118) a. [Fred] [often] [sat] [on the blue couch].

b. [Fred] [sat] [often] [on the blue couch].

c. [Fred] [sat] [on the blue couch] [often].

The domain composition that *h-mod-cx* allows for is illustrated below, with the shuffling constraint ⟨[*often*]⟩$\bigcirc$⟨[*sat*], [*on the blue couch*]⟩ being resolved as ⟨[*sat*], [*on the blue couch*], [*often*]⟩:

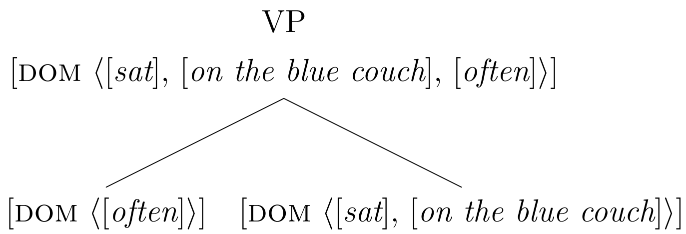


Figure 6.22: Illustration of adverbial interleaving

Not all cases are equally frequent of course, and certain distributions sound more natural if the adverbial phrase is longer, e.g. *very often* or *all too often.* I will ignore information structure, pragmatic and prosodic effects here, but I note that in some cases it is possible for this adverb to even interleave between complement phrases:

(119) a. [She] [gave] [blood] [quite often] [to the Red Cross].

b. [I] [gave] [money] [away] [often] [to people who I did not know very well].

The account of scopal adverbs is similar to scopal adjectives. The adverbial predicate scopes over the verbal structure l_3 selected by MOD:

(120)
$$
\begin{bmatrix} \text{MP} \mid \text{FORM} \ \langle \textit{probably} \rangle & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{adv} \\ \text{MOD VP}\big[\text{LBL } \boxed{l1}\big] \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{KEY } \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \begin{bmatrix} \text{RELN } \exists \\ \text{INDEX } \boxed{n} \\ \text{ARGS } \langle \boxed{l2} \rangle \end{bmatrix}, \begin{bmatrix} \text{LBL } \boxed{l2} \\ \text{RELN } \textit{probable} \\ \text{ARGS } \langle \boxed{n}, \boxed{l3} \rangle \end{bmatrix} \right\rangle \\ \text{CONS} \left\langle \big[\boxed{l1} \leq \boxed{l3}\big] \right\rangle \end{bmatrix} \end{bmatrix}
$$

The present discussion has nothing to add to the intricate matters of scope in coordination and islands discussed as §3.6. It is possible to use GTOP to the effect of localizing the scope of adverbs similarly to what is suggested for universal quantifiers in §6.2, or to stipulate special conditions for the scope resolution of adverbs in coordinate structures. But given the possibility of cases like (121), I will keep matters open instead of making the grammar more complex, since the proper solution for preferential local adverbial scope probably involves contextual and processing effects.

(121) a. He probably was not a Roman citizen and he had never even been to Rome.
probably(He was not a Roman citizen & he had never even been to Rome)

b. I usually open the window and the dog starts barking.
usually(I open the window & the dog starts barking)

6.6 NP Modification

There are a number of modifiers (relative clauses and certain adjectives for instance) that can adjoin to NP constituents. One simple example is given below:

(122) [[Everyone]$_{NP}$ who loved pizza]$_{NP}$ came with us.

The possibility of NP modification has been discussed in the literature in various places, including in Vergnaud (1974), Jackendoff (1977), Bach and Cooper (1978), von Stechow (1980), Link (1983), among many others.

In the formal semantics literature the cases where the NP that the adjunct attaches to is coordinate are often referred to as *hydras*:

(123) [[A man and a woman]$_{NP}$ [who were kissing and smiling at the barbecue]]$_{NP}$ came with us.

There is no reason to assume that anything special is going on in the syntax of relative clauses and NP coordination. In both cases (122) and (123) the modifier attaches to an NP, plural agreement is observed for the verb heading the relative clause, and both collective and distributive readings can be obtained. This means that the syntax and the semantic composition process should be exactly the same in the two cases. One can also easily provide examples with distributive, mixed distributive and collective readings. Again, these data simply point to the same conclusion that we have seen time and time again: that NP coordination exists, that the obtained pluralities can be interpreted distributively and/or collectively, and that the standard Partee-Rooth type-lifting style analysis is missing these generalizations:

(124) a. [[The boys and the girls] [who smiled$_D$]] are kissing$_C$.

b. [[A man and a woman] [who smiled$_D$ and who love$_C$ each other]] are happy$_D$.

c. [[Every woman and every child] [who were gathered$_C$ at the embassy]] were assisted$_D$ by a red cross medic.

Below I provide some more examples with various other kinds of NP modifiers. In (125a) the adjective *similar* attaches to an NP coordination of bare plurals, and yields a reading in which men are similar to women and vice-versa.[10] The case is similar for numeral expressions and finally in (125b) the PP *in the car* can be interpreted as attaching to the entire coordinate NP.

(125) a. [Similar [men and women]] probably have similar structural genes.

b. [Thirty [men and women]] were paired.

c. [[The boy and the girl] [in the car]] are kissing.

[10]This kind of example actually has two other, rather uninteresting readings. One concerns men who are similar to each other and women who are similar to each other. This is an instance of standard NP coordination and left-periphery ellipsis: [*similar men and ~~similar~~ women*]. The second reading is one where the adjective only adjoins to the first conjunct ([[*similar men*] [*and women*]]). This is of course obtained once the possibility of NP adjunction is allowed.

Of these examples, the ones involving the adjective *similar* and the numeral are the most remarkable. There is some evidence that the two are actually the same kind of construction. For example, the data in (126) show that numerals can have an adjectival distribution.

(126) $\left\{\begin{array}{l}\text{*Three the} \\ \text{The three}\end{array}\right\}$ results were obtained.

Further evidence for numerals having an adjectival usage is provided by the fact that these can occur arbitrarily embedded inside an NP:

(127) a. [The [remaining [three [individuals]]]] were interviewed.

b. I am interested in pursuing [the [following [main [three objectives]]]].

c. These are [the [best [last [three songs]]]] on any album.

d. [The [same [main [three components]]]] were used.

Other adjectives such as *similar* can also modify NPs and be embedded under the scope of determiners and numerals. Consider the example in (128a) and the reading where a collection of twenty similar individuals, composed of both men and women, protested.

(128) a. [Twenty [similar [men and women]]] protested.

b. [These [various [similar [myths]]] may have the exact same source.

These data suggest at least some adjectives attach to any kind of nominal expression, as long as the nominal is not overtly quantified. In other words, these adjectives attach to nouns, bare plurals, and bare noun coordination structures.

The categorial duality of numeral expressions has been noted before in Hoeksema (1983), Kadmon (1985), Partee (1987), and Link (1987), but not in terms of the coordination data presented above. It is well-known that some determiners exhibit similar dualities. For instance quantifiers like *many* and *most* also have adjectival usages as in *The president has spent the last many months working with his national security advisers on the most beautiful country house.* I will therefore propose that there are two realizations for numerals. One as an intersective adjective that attaches to non-overtly quantified plural nominal expressions, and another as a determiner.

The quantificational use has the same distribution as plural *many*, *few*, or *some*, and can also be realized as a partitive: *six/some/many of the boys*. In fact, expressions like *approximately* and *exactly* attach only to determiner numerals, and not adjectival numerals: (**The*) *exactly three coins*. The adjectival usage essentially adds a cardinality condition $|x| = n$ over the nominal referent, rather than an existential quantifier.

In order to account for the adjectival use, an additional lexical entry is proposed. The MOD value of numeral adjectives allows them to adjoin to either a plural N' or to a bare plural NP. Semantically, the numeral is intersectively combined with the relevant label of the nominal head. In the case of a N' category this is LABEL while in the case of an NP this is the restrictor label. These conditions are met in the following lexical entry for *six*:

$$
(129)\quad \begin{bmatrix}
\text{FORM} & \langle\ \textit{six}\ \rangle \\
\text{SYN} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix}
\textit{adj} & \\
\text{PRED} & - \\
\text{MOD} & \text{N'}\begin{bmatrix}\text{KEY}\ \boxed{k}\begin{bmatrix}\text{LBL} & \boxed{l1}\\ \text{RELN} & \textit{plur-reln}\\ \text{INDEX} & \boxed{x}\end{bmatrix}\end{bmatrix} \vee \text{NP}\begin{bmatrix}\text{DET-} \\ \text{KEY}\ \boxed{k}\begin{bmatrix}\text{INDEX} & \boxed{x}\\ \text{ARGS} & \langle\boxed{l1},\ldots\rangle\end{bmatrix}\end{bmatrix}
\end{bmatrix} \\
\text{VAL} & \begin{bmatrix}\text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle\end{bmatrix}
\end{bmatrix} \\
\text{SEM} & \begin{bmatrix}
\text{KEY} & \boxed{k} \\
\text{RELS} & \left\langle \begin{bmatrix}\text{LBL} & \boxed{l1}\\ \text{RELN} & =_a\\ \text{ARGS} & \langle\boxed{y},\boxed{x}\rangle\end{bmatrix}, \begin{bmatrix}\text{LBL} & \boxed{l1}\\ \text{RELN} & \textit{cardinal}\\ \text{ARGS} & \langle\boxed{y},6\rangle\end{bmatrix} \right\rangle \\
\text{CONS} & \langle\rangle
\end{bmatrix}
\end{bmatrix}
$$

The constraint [RELN *plur-reln*] prevents the adjective from attaching to singular nouns (as in **six boy were here*) or to coerced collective nouns, as in **similar team were here*. The constraint [DET $-$] only licences adjunction to bare plurals (or coordination of bare plurals), thus ruling out **six the boys* and **six the boys and the girls*.

The '$=_a$' relation is necessary to insure that the cardinality condition only applies to collections of atoms, not to complex pluralities. Thus, in cases like [*Six* [*men and women*]$^{x}_{NP}$] the numeral attaches to a plurality x with two members, but the cardinal condition applies to the atomic base of x.

Semantically, the adjective either combines with the nominal label or is plugged in the restrictor of the bare NP. There is an alternative analysis here, which does not resort to a disjunction. One can assume that the adjective is always combined intersectively. This would yield a formula with a free variable in the case of NP adjunction $\exists x\,(students(x) \wedge l_3) \wedge\ =_a (y, x, |y| = 6)$. The latter is not a problem for a dynamic semantics. In fact, Groenendijk and Stokhof (1991) devised dynamic predicate logic in such a way as to treat such formulas containing free variables as if they were in the scope of the preceding quantifier. It would therefore suffice to adopt the definitions for variable binding given in Groenendijk and Stokhof (1991) in order to obtain a more uniform account, rather than the standard first-order logic definitions of variable binding. I will not pursue this alternative here.

The lexical entry for *similar* is essentially the same. Semantically, the adjective differs in that it is interpreted with a reciprocal meaning, as discussed in §4.1 for intransitive usages of certain verbs like *collide* and *argue*.

6.6.1 Relative Clauses

Link (1984) provides an account of the semantics of relative clause adjunction but does not discuss an explicit syntax-semantics interface for obtaining these representations. The overall analysis seems to be correct, however. For example the modified NP in a sentence like *a boy and a girl who dated each other* is treated by Link as $\lambda z.\exists x\exists y[boy'(x) \wedge girl'(y) \wedge z = x \oplus y \wedge dated'(z)]$. In more complex cases, like *The landlords and the tenants who fought against each other protested*, the intermediate group reading is obtained with group formation of the members of the plurality z: $\lambda P.\lambda z.\exists x\exists y[land'(x) \wedge ten'(y) \wedge z = \langle x\rangle \oplus \langle y\rangle \wedge fight.e.o.'(z)]$. The angle brackets indicate that group formation occurred, in practice sealing off the collection of landlords from the collection of tenants. This allows the main verb to distribute over each conjunct and obtain the intermediate group reading.

The proposal that ensues obtains a straightforward analysis, based on the account developed so far for verbs. The syntax-semantics interface is fully uniform and dispenses with non-deterministic group formation operations. The central aspect of the syntax-semantics interface relies on the information made available in KEY. Simply put, the relative clause adjoins to NPs and requires that the label that identifies the semantic relation of the verb heading the relative clause must be subordinated to the restrictor argument slot of the NP. This is illustrated in the tree below, licensed by the the *h-mod-cx* rule.

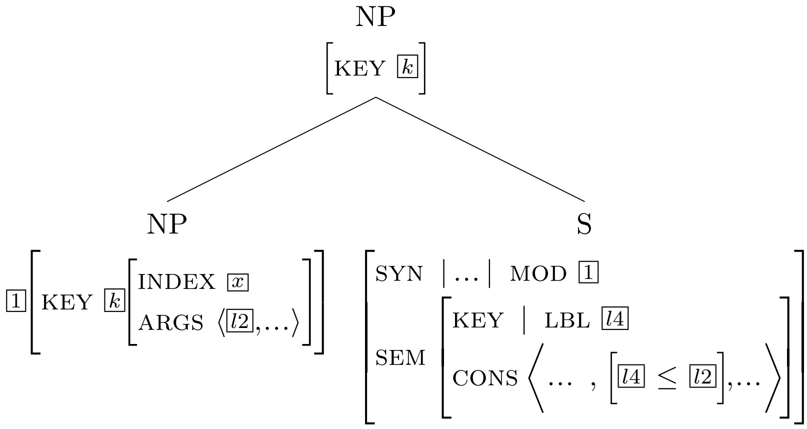


Figure 6.23: Generic parse tree for NP adjunction

For this analysis to work it is necessary to allow certain verbal structures to be specified as [MOD NP], to bind the index of the relative argument, and to insert the subordination constraint seen above. All else regarding the semantics of the verb is exactly the same as discussed previously. If the NP is singular then direct predication obtains, but if the NP is pluralic other kinds of readings are possible. There is nothing special about the case of NP coordination. This kind of constituent is quantified by $\exists$ and as such it has a restrictor argument, just like other quantifiers. This approach can therefore account for the data in (130) with exactly the same construction in Figure 6.23 and the same lexical entry for the verb:

(130) $\left\{\begin{array}{l}\text{[The man]}\\ \text{[Various lawyers]}\\ \text{[The secretary and several aides]}\\ \text{[Every man and every woman]}\end{array}\right\}$ who hired a private detective got fired.

There are several accounts of relative clause constructions in the HPSG literature that could be adopted for the present purposes, such as Pollard and Sag (1994, Ch. 5), Sag (1997), and Ginzburg and Sag (2000). However, these accounts encompass a wide range of other extraction phenomena, wh-interrogatives, bare relatives, reduced relatives, and so forth, that would require a fair amount of exposition in order to reproduce in an accurate way. Hence I will simplify the present analysis while noting that the cited accounts can be reconciled with the approach I have proposed for the predication of pluralities. In what follows, only *wh-* (subject and complement) restrictive relative clauses are considered.

The relative lexeme *who* projects an NP that can either be plural or singular, and thus can either be interpreted collectively or distributively. It is therefore natural to capture these possibilities with an underspecified *a-pl-res* relation. The lexical meaning of *who* thus requires that the relativized element is a person or a plurality of people:

(131) $[\textit{who}]^{y}_{NP}$

$$\exists y(y = x \wedge \textit{a-pl-res}(k, y, person(k)) \wedge l_4)$$

The referential argument of the NP is y, and x corresponds to the modified nominal. In the case of *who* both variables correspond to the same entity $x = y$, but in the case of *whose* the referential argument y corresponds to the possessor nominal argument. I start by providing the lexical entry of *who* in (132), loosely inspired in Sag (1997).

(132)
$$\left[\begin{array}{ll}
\text{MP} \mid \text{FORM} \ \langle \ \textit{who} \ \rangle & \\
\text{SYN} & \left[\begin{array}{ll} \text{HEAD} & \textit{noun} \\ \text{VAL} & \left[\begin{array}{ll} \text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{array}\right] \\ \text{INHER} & \left[\text{REL} \ \langle\boxed{x}\rangle\right] \end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll} \text{KEY} & \boxed{k} \\ \text{RELS} & \left\langle \boxed{k}\left[\begin{array}{ll} \text{LBL} & \boxed{l1} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle\boxed{l2},\ldots\rangle \end{array}\right], \left[\begin{array}{ll} \text{LBL} & \boxed{l2} \\ \text{RELN} & = \\ \text{ARGS} & \langle\boxed{y},\boxed{x}\rangle \end{array}\right], \left[\begin{array}{ll} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{a-pl-res} \\ \text{ARGS} & \langle\boxed{z},\boxed{y},\boxed{l3}\rangle \end{array}\right], \left[\begin{array}{ll} \text{LBL} & \boxed{l3} \\ \text{RELN} & \textit{person} \\ \text{INDEX} & \boxed{z} \end{array}\right] \right\rangle \\ \text{CONS} & \langle\rangle \end{array}\right]
\end{array}\right]$$

The feature REL is from Pollard and Sag (1994, Ch. 5), and is responsible for the propagation of the relativized index to the mother node. This mechanism is what allows for pied-piping, for instance.

The verb heading a relative clause must allow one of its valents to be relativized: the value of REL should contain an index, the value of MOD should specify for an NP, and the verb predicate must be subordinated to the restrictor of that modified NP. There is independent cross-linguistic evidence for viewing the derivation of relativized verbs as a lexical process. In Korean, the main verb of a relative clause is inflected with a morpheme *-(n)un*, which indicates that the clause is modifying a noun (Kim 1998). In Turkish the verb receives a different suffix depending on subject or non-subject relativization, thus if the subject is relativized then a suffix *-yEn* is added to the verb and if a non-subject is relativized then a suffix *-DIK* is added (Hankamer and Knecht 1976).[11] In languages like English no morphological change is necessary, and the process of relativization need only concern the syntax-semantics interface. The post-inflectional lexical rule that I propose for obtaining verbs with a relativized subject is given in (133):

(133)

$$
\textit{pinfl-subj-relativz-cx} \Rightarrow
\begin{bmatrix}
\text{MTR} & \begin{bmatrix} \text{MP} & \boxed{1} \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix}\text{FORM} & \textit{fin} \\ \text{MOD} & \text{NP}\begin{bmatrix}\text{KEY} & \begin{bmatrix}\text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle \boxed{l1}, \ldots \rangle\end{bmatrix}\end{bmatrix}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix}\text{HEAD} & \boxed{2}\\ \text{VAL} & \boxed{3} \\ \text{INHER} & \begin{bmatrix}\text{REL} & \langle\boxed{x}\rangle \\ \text{GAP} & \langle\rangle\end{bmatrix}\end{bmatrix} \\ \text{SEM} & \boxed{4}[\text{KEY}\,|\,\text{LBL}\ \boxed{l1}]\end{bmatrix}\right\rangle \\ \text{COMPS} & \boxed{5}\end{bmatrix} \\ \text{INHER} & \boxed{6}\end{bmatrix} \\ \text{SEM} & \boxed{7} \\ \text{ARG-ST} & \boxed{8}\end{bmatrix} \\
\text{DTRS} & \left\langle \begin{bmatrix} \text{MP} & \boxed{1} \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix}\text{FORM} & \textit{fin} \\ \text{MOD} & \textit{none}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \left\langle \begin{bmatrix} \text{SYN} & \begin{bmatrix}\text{HEAD} & \boxed{2}\\ \text{VAL} & \boxed{3} \\ \text{INHER} & \begin{bmatrix}\text{REL} & \langle\rangle \\ \text{GAP} & \langle\rangle\end{bmatrix}\end{bmatrix} \\ \text{SEM} & \boxed{4}\end{bmatrix}\right\rangle \\ \text{COMPS} & \boxed{5}\end{bmatrix} \\ \text{INHER} & \boxed{6}\end{bmatrix} \\ \text{SEM} & \boxed{7} \\ \text{ARG-ST} & \boxed{8}\end{bmatrix} \right\rangle
\end{bmatrix}
$$

In Turkish, the rule would also add the suffix *-yEn* to the verb form in $\boxed{1}$. Let us consider this rule in more detail. The value of VFORM is required to be *fin*. This

[11] For accounts of relative clauses in Turkish and Korean see Güngördü (1996) and Kim (1998).

means that only finite verbs can be targeted by the lexical rule, thus ruling out non-finite relative clauses, e.g. **A student who to talk to us just walked in*, **A student who Fred talking to just walked in*, and **A student who seen by Mary just left.*

The lexical rule states that the relative verb can adjoin to an NP via a non-empty value for MOD. However, this won't be possible until all the valents of the verb are saturated because the *h-mod-cx* required the modifier daughter to be fully saturated with regard to SUBJ and *comps*. Semantically, all that is required is that the label of the subject is identified with the *restrictor* of the modified NP. In other words, the semantics of the *wh-* word is intersectively combined with the restrictor argument slot of the modified NP. No change is done to the semantic or subordination conditions introduced by the lexical entry of the verb.

In (134) it is shown the lexical entry for *hired* after applying the rule in (133). The value of SEM is exactly the same as in §6.5.3.

(134)
$$
\begin{bmatrix}
\text{MP} \mid \text{FORM}\ \langle \textit{hired} \rangle & \\
\text{SYN} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \text{FORM}\ \textit{fin} \\ \text{MOD}\ \text{NP}\begin{bmatrix}\text{KEY}\begin{bmatrix}\text{INDEX}\ \boxed{x} \\ \text{ARGS}\ \langle \boxed{l2}, \ldots\ \rangle\end{bmatrix}\end{bmatrix}\end{bmatrix} \\
\text{VAL} & \begin{bmatrix}
\text{SUBJ} & \left\langle \text{NP}\begin{bmatrix}\text{SYN} \mid \text{REL}\ \langle \boxed{x} \rangle \\ \text{SEM} \mid \text{KEY}\begin{bmatrix}\text{LBL}\ \boxed{l2} \\ \text{ARGS}\ \langle \ldots, \boxed{l3} \rangle\end{bmatrix}\end{bmatrix} \right\rangle \\
\text{COMPS} & \left\langle \text{NP}\begin{bmatrix}\text{SYN} \mid \text{REL}\ \langle \rangle \\ \text{SEM} \mid \text{KEY}\begin{bmatrix}\text{INDEX}\ \boxed{y} \\ \text{ARGS}\ \langle \ldots, \boxed{l12} \rangle\end{bmatrix}\end{bmatrix} \right\rangle
\end{bmatrix}
\end{bmatrix} \\
\text{SEM} & \begin{bmatrix}
\text{KEY}\ \boxed{k} & \\
\text{RELS} & \left\langle \begin{bmatrix}\text{LBL} & \boxed{l5} \\ \text{RELN} & \textit{pl-res} \\ \text{ARGS} & \langle \boxed{w}, \boxed{x}, \boxed{l6} \rangle\end{bmatrix}, \begin{bmatrix}\text{LBL} & \boxed{l7} \\ \text{RELN} & \textit{pl-res} \\ \text{ARGS} & \langle \boxed{k}, \boxed{y}, \boxed{l8} \rangle\end{bmatrix}, \boxed{k}\begin{bmatrix}\text{LBL} & \boxed{l9} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{l10} \rangle\end{bmatrix}, \begin{bmatrix}\text{LBL} & \boxed{l10} \\ \text{RELN} & \textit{hire} \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle \boxed{w}, \boxed{k} \rangle\end{bmatrix} \right\rangle \\
\text{CONS} & \left\langle \begin{bmatrix}\boxed{l5} \leq \boxed{l3}\end{bmatrix}, \begin{bmatrix}\boxed{l9} \leq \boxed{l6}\end{bmatrix}, \begin{bmatrix}\boxed{l7} \leq \boxed{l12}\end{bmatrix}, \begin{bmatrix}\boxed{l9} \leq \boxed{l8}\end{bmatrix} \right\rangle
\end{bmatrix}
\end{bmatrix}
$$

An example of a subject relative clause structure can be seen below. The VP combines with the subject NP as usual via the *h-subj-cx* rule, saturating the list SUBJ. The resulting S structure adjoins to the NP via the *h-mod-cx* rule and the feature MOD.

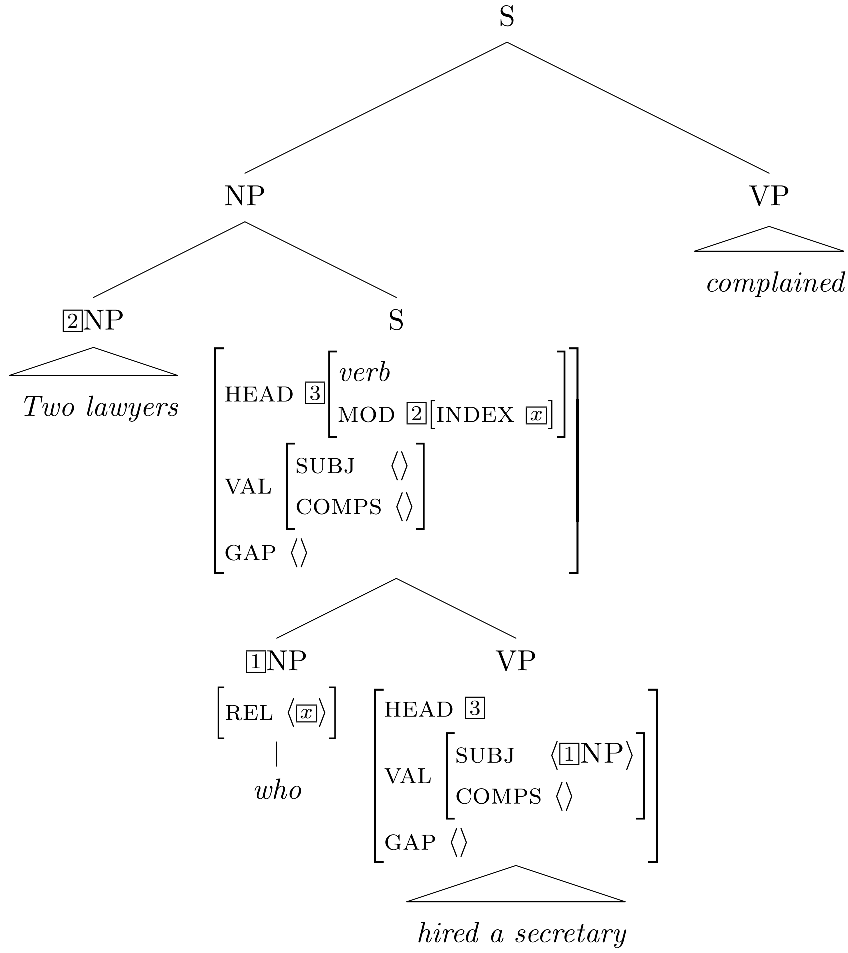


Figure 6.24: Syntax of an NP-adjoining subject relative clause

As usual, the semantics of a given phrasal node is defined in terms of the concatenation of the semantics of the daughters. Thus, one obtains the MRS depicted in Figure 6.25. The semantic representation that corresponds to the relative clause is enclosed in a box for perspicuity.

The only kind of semantic ambiguity that this example exhibits results from the plural subject and the embedded indefinite complement NP. Thus, if l_5 is resolved as a distribution relation D_a then the embedded indefinite NP l_{11} *a secretary* can have narrow or wide scope with regard to l_6. This MRS structure thus correctly captures the plural and scope ambiguities without changes to the grammar.

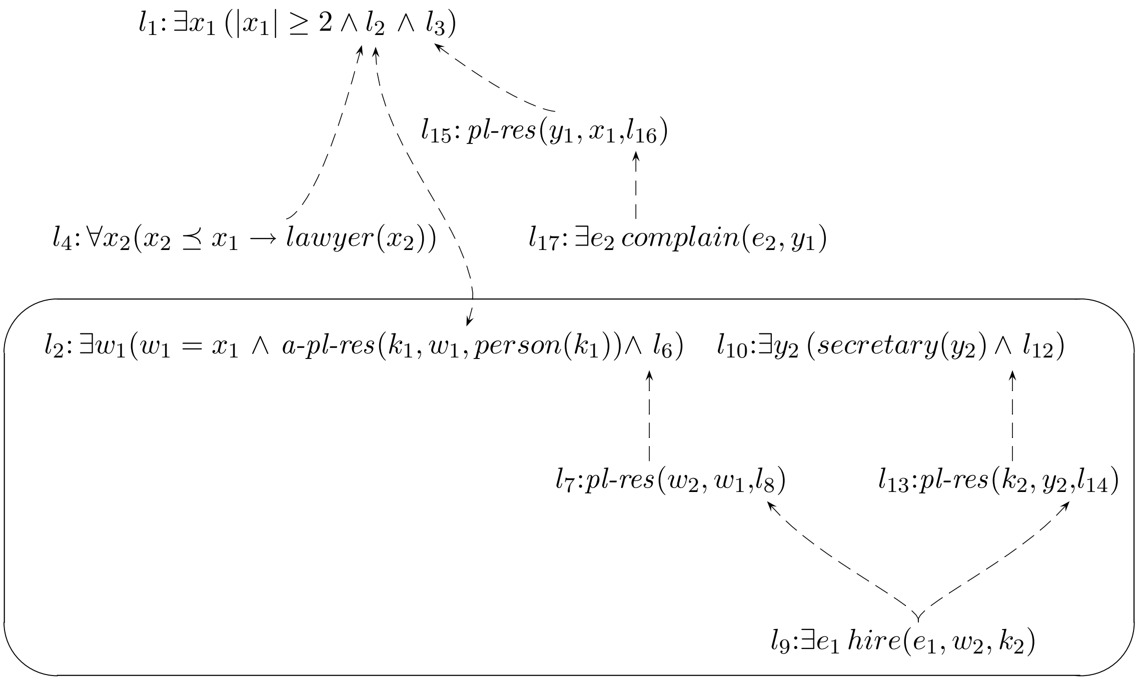


Figure 6.25: Underspecified semantic representation in Figure 6.24

Cases of NP coordination are handled in exactly the same way. The modified NP that the relative attaches to is a plurality formed with two conjuncts. All else works in exactly the same way because the relevant information is the index in KEY and the restrictor argument.

(135) [[Every man and every woman]$\boxed{2}^{x1}_{[\text{ARGS}\langle l_2,\ldots\rangle]}$ [who answered correctly to a technical question]$_{[\text{MOD}\boxed{2}]}$] were hired.

I am ignoring here the fact that the value of MOD must contain some extra constraints to prevent the relative clause from adjoining to pronouns and proper nouns. I will not attempt to characterize these constraints here and will merely note that this can be done via KEY|RELN, which provides access to the predication of the nominal.

Non-subject relative clauses are obtained by a second different lexical rule. Not all languages have non-subject relativization, and thus this lexical rule is not present in these languages. In languages like Turkish, the verb form in the output of this rule receives a *-DIK* suffix. For English it suffices that the rule takes an element from GAP and specifies that it is a relative argument. Recall that GAP contains the arguments that are involved in unbounded dependency constructions, such as topicalization structures. In the next chapter I will discuss how the feature GAP works, but for now it suffices to take into consideration that an argument of a verb can be located in GAP rather than in a valence list, and that the value of GAP is structure-shared between the mother and the daughter. Thus, it 'percolates' in the structure without in fact any movement or copying operation.

The relativization process is essentially the same as for subjects, except that it applies to the list of gapped elements rather than to the subject list. The lexical rule for obtaining verbs with a non-subject relativized argument is provided in (136).

(136) *pinfl-nonsubj-relativz-cx* ⇒

$$
\left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll} \text{FORM} & \textit{fin} \\ \text{MOD} & \text{NP}\left[\text{KEY} \left[\begin{array}{ll}\text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle \boxed{l1}, \ldots \rangle\end{array}\right]\right]\end{array}\right] \\
\text{VAL} & \boxed{2} \\
\text{GAP} & \boxed{3} \oplus \left\langle \left[\begin{array}{ll} \text{SYN} & \left[\begin{array}{ll}\text{HEAD} & \boxed{4}\\ \text{VAL} & \boxed{5} \\ \text{INHER} & \left[\begin{array}{ll}\text{GAP} & \langle\rangle \\ \text{REL} & \langle \boxed{x}\rangle\end{array}\right]\end{array}\right] \\ \text{SEM} & \boxed{5}\left[\text{KEY} \mid \text{LBL}\ \boxed{l1}\right]\end{array}\right]\right\rangle \oplus \boxed{7}
\end{array}\right] \\
\text{SEM} & \boxed{8} \\
\text{ARG-ST} & \boxed{9}
\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll} \text{FORM} & \textit{fin} \\ \text{MOD} & \textit{none}\end{array}\right] \\
\text{VAL} & \boxed{2} \\
\text{GAP} & \boxed{3}\textit{list}\Big(\left[\text{REL}\ \langle\rangle\right]\Big) \oplus \left\langle \left[\begin{array}{ll} \text{SYN} & \left[\begin{array}{ll}\text{HEAD} & \boxed{4}\\ \text{VAL} & \boxed{5} \\ \text{INHER} & \left[\begin{array}{ll}\text{GAP} & \langle\rangle \\ \text{REL} & \langle\rangle\end{array}\right]\end{array}\right] \\ \text{SEM} & \boxed{6}\end{array}\right]\right\rangle \oplus \boxed{7}\textit{list}\Big(\left[\text{REL}\ \langle\rangle\right]\Big)
\end{array}\right] \\
\text{SEM} & \boxed{8} \\
\text{ARG-ST} & \boxed{9}
\end{array}\right] \right\rangle
\end{array}\right]
$$

The input of the rule is a verb with at least one element in the gap list. The output of the rule is a relativized counterpart that allows for NP adjunction and which replaces the gap member with a relative constituent [REL ⟨$\boxed{x}$⟩]. The rule that saturates the GAP list here is the *h-filler-cx* rule, which more generally applies to topicalization structures. It basically allows a constituent to be identified with a gap that a S node contains. The intended structure is depicted below:

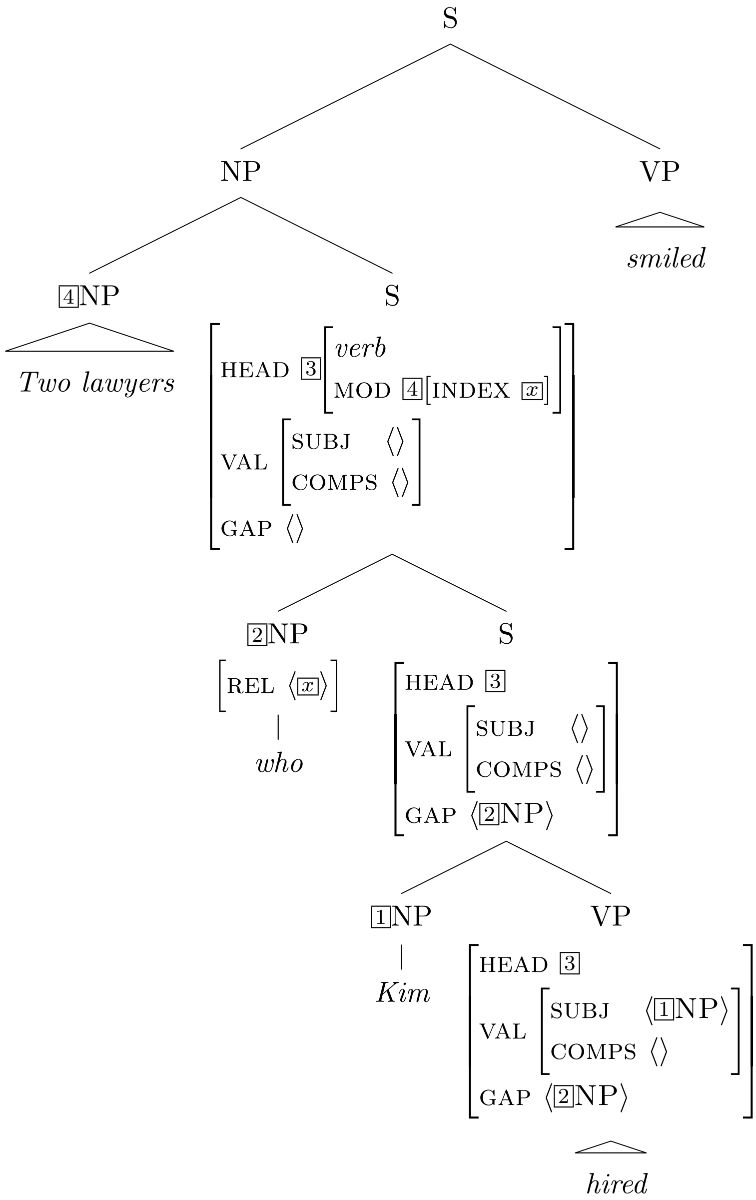


Figure 6.26: Syntax of a non-subject relative clause

The *h-filler-cx* rule is given below, which I will discuss in more detail in §7.1.1. It basically allows a S node that is gapped to saturate the gap with the sister node:

(137) HEAD-FILLER CONSTRUCTION

$$\textit{h-filler-cx} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{INHER} & \begin{bmatrix}\text{GAP} & \boxed{4} \\ \text{REL} & \boxed{5}\end{bmatrix}\end{bmatrix} \\ \text{SEM}\mid\text{KEY} & \boxed{k} \\ \text{DOM} & \langle\boxed{1}\rangle\oplus\boxed{3}\end{bmatrix} \\ \text{HD-DTR} & \boxed{2} \\ \text{DTRS} & \left\langle \boxed{1},\ \boxed{2}\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \boxed{0}\begin{bmatrix}\text{SUBJ} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle\end{bmatrix} \\ \text{INHER} & \begin{bmatrix}\text{GAP} & \langle\boxed{1}\rangle\bigcirc\boxed{4} \\ \text{REL} & \boxed{5}\end{bmatrix}\end{bmatrix} \\ \text{SEM}\mid\text{KEY} & \boxed{k} \\ \text{DOM} & \boxed{3}\end{bmatrix}\right\rangle \end{bmatrix}$$

An example of a verb with a relativized gap element is given in (138).

(138)

$$\begin{bmatrix} \text{MP}\mid\text{FORM}\ \langle\textit{hired}\rangle & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix}\text{FORM} & \textit{fin} \\ \text{MOD} & \text{NP}\begin{bmatrix}\text{KEY} & \begin{bmatrix}\text{INDEX} & \boxed{x} \\ \text{ARGS} & \langle\boxed{l1},\ldots\ \rangle\end{bmatrix}\end{bmatrix}\end{bmatrix} \\ \text{VAL} & \begin{bmatrix}\text{SUBJ} & \left\langle\boxed{1}\text{NP}\begin{bmatrix}\text{SYN}\mid\text{REL} & \langle\boxed{x}\rangle \\ \text{SEM}\mid\text{KEY} & \begin{bmatrix}\text{LBL} & \boxed{l1} \\ \text{ARGS} & \langle\ldots,\boxed{l3}\rangle\end{bmatrix}\end{bmatrix}\right\rangle \\ \text{COMPS} & \langle\rangle\end{bmatrix} \\ \text{INHER} & \begin{bmatrix}\text{GAP} & \left\langle\boxed{2}\text{NP}\begin{bmatrix}\text{SYN}\mid\text{REL} & \langle\rangle \\ \text{SEM}\mid\text{KEY} & \begin{bmatrix}\text{INDEX} & \boxed{y} \\ \text{ARGS} & \langle\ldots,\boxed{l12}\rangle\end{bmatrix}\end{bmatrix}\right\rangle \\ \text{REL} & \langle\rangle\end{bmatrix}\end{bmatrix} \\ \text{SEM}\ \ldots & \begin{bmatrix}\text{KEY} & \boxed{k} \\ \text{RELS} & \left\langle \begin{bmatrix}\text{LBL} & \boxed{l5} \\ \text{RELN} & \textit{pl-res} \\ \text{ARGS} & \langle\boxed{w},\boxed{x},\boxed{l6}\rangle\end{bmatrix}, \begin{bmatrix}\text{LBL} & \boxed{l7} \\ \text{RELN} & \textit{pl-res} \\ \text{ARGS} & \langle\boxed{z},\boxed{y},\boxed{l8}\rangle\end{bmatrix}, \boxed{k}\begin{bmatrix}\text{LBL} & \boxed{l9} \\ \text{RELN} & \exists \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle\boxed{l10}\rangle\end{bmatrix}, \begin{bmatrix}\text{LBL} & \boxed{l10} \\ \text{RELN} & \textit{hire} \\ \text{INDEX} & \boxed{e} \\ \text{ARGS} & \langle\boxed{w},\boxed{z}\rangle\end{bmatrix}\right\rangle \\ \text{CONS} & \left\langle\left[\boxed{l5}\leq\boxed{l3}\right], \left[\boxed{l9}\leq\boxed{l6}\right], \left[\boxed{l7}\leq\boxed{l12}\right], \left[\boxed{l9}\leq\boxed{l8}\right]\right\rangle\end{bmatrix} \end{bmatrix}$$

The verb selects a subject NP and with it forms a S node. However, this node contains a gapped element which is required to contain a relativized index (i.e. a constituent like *who*). The relative argument combines with S to saturate the gap list via the *head-filler-cx* rule. The result is a fully saturated constituent that can adjoin to NP in the usual way.

All the plural resolution constraints apply as usual. If the relativized verb is a collective predicate like *gather* then it requires a pluralic subject. All the core semantic aspects of the verb remain unchanged by the lexical rule, and thus both collective and intermediate group readings for relative clauses are obtained. If the relative adjoins to coordinate NP then exactly the same situation occurs as in the case of APs discussed above. From the point of view of semantic composition, the two cases are identical. The key index of the NP is bound, and the head of the relative is subordinated to the restrictor of the NP that the clause adjoins to. The same situation occurs with distributive predicates. Both plural and scope ambiguities are underspecified. For example, an indefinite complement NP embedded in a relative clause can have either narrow or wide scope over the determiner of the main NP.

For example, (139a) is preferentially interpreted with an intermediate group reading with respect to both the relative clause and the matrix predication. If the adjective *gay* is removed, than the preferential interpretation is a reciprocation over the set composed of men and women. As expected, the indefinite NP *a civil ceremony* can have a wide or a narrow scope reading with respect to the intermediate group distribution. In the wide scope reading, there is a joint ceremony wedding various gay couples, while in the narrow scope reading each gay couple married in a different ceremony.[12]

(139) a. Some of the gay men and some of the gay women who were able to marry in a civil ceremony were long-time partners.

b. The Egyptian workers and the Mayan workers who built pyramids never got to exchange ideas or technology.

In (139b) on the other hand, world knowledge leads us to presume that the Egyptians and the Mayans never met, and therefore that pyramid building obtains an intermediate group reading, and one in which different pyramids being built. In sum, the full array of readings exists, but the possibilities are not always equally prominent.

[12]Resorting to different data, Peres (1998, 354) claims that narrow scope readings are not possible. Given the data above I believe that the absence of such readings is a matter of lack of contextualization.

6.7 Summary

§6.1 In this section it is defined how constituents that are marked by coordinator markers are banned from entering various kinds of headed-constructions in general.

§6.2 An account of the formation of singular NPs is put forth, including several kinds of nominal modifiers. It is shown that the coordination rule can also deal with the coordination of adjectival and prepositional phrases in a uniform way.

§6.3 A general and systematic account of noun pluralization is proposed. It is argued that singular nouns denote atomic individuals but that pluralized nouns denote the full range of domain individuals, atomic and non-atomic. A lexical rule accounts for the pluralization process in both morphophonologic and in semantic terms.

§6.4 This section provides an account of how plural NPs are formed, and what is their semantic content. Various kinds of plural determiners are discussed, including bare existentials and pluralic quantifiers. Based in their distribution, agreement patterns, and meaning it is concluded that the latter range over non-atomic elements of the domain, unlike what is assumed in many formal semantics accounts. This constitutes a more uniform and parsimonious account that avoids various complications for the grammar of plurality, including the problematic assumption that the denotation of plural NPs is asystematic.

§6.5 The syntax-semantics interface proposed here describes how heads interact with arguments in general, and with pluralic arguments in particular. Various kinds of predication are discussed in some detail, including distributive, collective, and neutral predication. The result is an account where the very same lexical entry can take arbitrarily complex arguments, both singular or pluralic, in a fully uniform fashion. Plural and scope ambiguities are represented in a semantic underspecification setting in an independent way.

§6.6 This presents an account of structures where certain adnominal modifiers attach to NPs, and in particular, to pluralic NPs. These include certain adjectives, prepositional phrases, and relative clauses. The evidence suggest that the latter are allowed to attach to any kind of non-overtly quantified nominal expression. A lexicalist account of relative clause formation is put forth, extending the current grammar fragment to phenomena which are usually difficult to capture without stipulating complex and special-purpose covert operations. In the present account relative clauses simply attach to NPs, and the head of the relative structure is required to be semantically subordinated to the restrictor argument of the NP.

Chapter 7

Grammar Extensions

In this chapter I turn briefly to how the account can be scaled up to several other phenomena that pattern with coordinate constructions, or that exhibit a special behavior in the presence of coordination. A major case in point is extraction phenomena, which exhibits one kind of pattern in the presence of symmetric coordination and another in the presence of asymmetric coordination. Since both kinds of coordination are assumed to be based on essentially the same construction, some other grammatical aspect must be responsible for the different extraction patterns.

Another important case that I discuss concerns the matter extending the coordination rule so that agreement phenomena can be accounted for. I propose an account that is general enough to accommodate various kinds of agreement strategies, from different languages. This account is rather straightforward because various well-known recalcitrant cases are argued to be explained by independent factors, namely ellipsis and processing biases. More specifically, it is shown that languages like English and Portuguese do not have partial agreement, contrary to the claims in the literature.

This chapter also discusses how an account of the syntax, semantics, and pragmatics of correlative markers in English can be obtained, and sketches how correlative markers in other languages can be analyzed as well.

Note that all of these extensions are necessarily incomplete. There is much more to say about extraction phenomena, pragmatics, and agreement. However, a more in-depth discussion of these complex areas of research would lead us too far afield from the main topic of this dissertation.

7.1 On Extraction

This section presents an independently motivated theory of extraction and shows how this phenomenon interacts with coordination. As a result of this interaction, symmetric coordination exhibits the CSC and ATB effects without stipulation, and asymmetric coordination allows for non-ATB extraction.

The core of the account lies in the feature GAP. This feature records information about constituents which are not realized *in situ*. In this kind of non-transformational analysis, unbounded dependencies consist in the local structure-sharing of GAP values between mother and daughter. An unbounded dependency can be canceled off in certain constructions, including topicalization structures, wh-questions, non-subject relative clauses, *it*-clefts, pseudoclefts, purpose infinitives, *tough* 'movement', etc.. For illustration purposes, I focus on the topicalization construction, but in §6.6 an account of non-subject relative clauses is also provided.

The ensuing analysis of extraction phenomena is very similar to Ginzburg and Sag (2000, Ch.5), but there are also a number of simplifications. In Ginzburg and Sag's approach it is proposed that there are two kinds of signs – 'gap' signs and 'non-gap' signs – and that the determination of what arguments enter unbounded dependencies results from a number of non-trivial interactions between several grammar principles and rules.[1] The alternative put forth below boils down to one grammar rule that regulates what values the GAP feature can have, and to one grammar principle that controls how the GAP value of a given node relates to the GAP value of the mother node. Before fleshing out this account I will briefly review some of the main empirical facts about extraction phenomena (see for instance Pollard and Sag (1994, Ch.4) and Levine and Hukari (2006) for more discussion).

I begin by noting that both subjects and complements can be extracted:

(1) a. That actor, I would wage _ is no less that thirty years old.

b. That actor, I think I've never seen _ before.

Second, multiple extractions are possible. In the examples in (2) two different constituents i and j are extracted out of embedded sites:

[1] One rule states that gap-signs introduce a gap, a principle of canonicality requires that only non-gap signs can be realized *in situ*, an 'amalgamation' rule states that the gaps of a verb are (by default) identified with the gaps of the arguments, an Argument Realization Principle determines that some complements can be gaps, and finally a lexical rule allows for subject extraction.

(2) a. [A violin this well crafted]$_i$, even [the most difficult sonata]$_j$ [will be easy to play _$_j$ on _$_i$].

b. [Someone that stupid]$_i$, [how much time]$_j$ [do we really want to waste _$_j$ arguing with _$_i$]

It is also possible to have a unique filler that corresponds to multiple gaps:

(3) a. That was the rebel who$_i$ rivals of _$_i$ shot _$_i$.

b. Here's the guy$_i$ that I expected my pictures of _$_i$ to bother _$_i$.

The case of adjuncts is rather complex. In certain conditions the extraction may originate on the modifier phrase as illustrated in (4), while in other cases the modifier can only be gapped if the head is also gapped, as seen in (5).[2]

(4) a. Which of these reports did Kim go to lunch without reading _ ?

b. That's the symphony that Schubert died without reading _ .

c. A problem this important, I could never go home without solving _ first.

(5) a.*Which movie did you see Mary without paying for _ ?

b. Which movie did you see _ without paying for popcorn?

c. Which movie did you see _ without paying for _ ?

Postal (2001) considers a large body of syntactic phenomena and stresses how heterogeneous island phenomena are: specific constructions constitute islands for certain kinds of syntactic dependencies but not for others. A local and construction-based account such as the one currently adopted is compatible with this fact. Moreover, syntax is not the whole story either given that there are a number of factors that can ameliorate or degrade the same kind of unbounded extraction. A classical example is discussed by Fodor (1983), who notes an unbounded extraction that resists iteration:

(6) a. Who did you take a photograph of _ ?

b. *??Who did you take a photograph of a statue of _ ?

[2]See Levine and Hukari (2006) for a critical overview of parasitic gaps in transformational syntax such as Cinque (1990). Therein is also noted that parasitic gaps in finite subject positions are legal, contrary to claimed in Chomsky (1982) and elsewhere (e.g. *Which people did you invite _ without thinking _ would actually come*?).

This is quite unexpected because this kind of extraction is unbounded (cf. *Who did you say that Mary wanted to take a photograph of _ ?*) and because (6a) clearly shows that extraction out of a picture-noun PP is legal. Instead of assuming that the competence grammar somehow counts and prescribes the number of embedded extractions, it is more natural to view these cases as processing effects, as Fodor argues.

More recently, Kluender (1998) shows that the manipulation of lexical content is sufficient to ameliorate extraction out of strong islands such as complex NPs. Compare the following syntactically identical examples:

(7) a. *??What do you need to find the professor [who can understand _]?
    b. Which article do you need to find someone [who can understand _]?

(8) a. *??What did [pictures of _] upset you?
    b. What were [pictures of _] seen around the world?

Furthermore, Kluender's experimental evidence from Event-related brain Potentials provides strong evidence for the existence of various processing loads that affect the processing of extraction phenomena, such as working memory limitations, lexical content, usage of finite tenses, lexical frequency, etc.. The experimental evidence collected in Sag et al. (2007) also indicates that there is differential processing difficulty in these phenomena which have to do with resources rather than grammar constraints. That said, I will keep the present account open to a psycholinguistic explanation for island effects other than purely syntactic accounts. The latter are stipulative in nature and are known since Ross (1967) to be prone to counterexamples. For instance, consider Ross's Complex NP Constraint (which precludes gaps in noun complements and relative clauses) or Chomsky's A-Over-A Constraint (which prevents extraction of constituents embedded in constituents of the same type) and the counterexamples below:

(9) a. That guy, they heard [a rumor that someone had beat _ to death].
    b. Who did you approve of [my visiting _]?

Again, the facts appear to hinge on lexical content and processing load rather than on structural syntactic conditions, since the presence of semantically less loaded intervening items ameliorates the purportedly illegal extractions:

(10) a. Fred, I don't know ANYONE who likes _ .

b. ??Fred, I don't know THE CLIENT who likes _ .

A final observation about extraction is that many languages signal the presence of an unbounded dependency in the sense that the structures intervening between the overt extracted element (the filler) and the extraction site (the gap) exhibit specific (morpho)syntactic phenomena. Consider for example the case of Irish, as reported in McCloskey (1979). The verb particle *goN* only occurs when there is no extraction, while every verbal particle that intervenes between the filler and the gap is required to alternate as *aL*:[3]

(11) a. Shíl mé goN mbeadh sé ann.
thought I VPART would-be he there
'I thought that he would be there'

b. An fear aL shíl mé aL bheadh _ ann.
[the man] VPART thought I VPART would-be there
'the man that I thought would be here'

Various other languages are known to exhibit similar extraction-sensitive phenomena, such as Chamorro (Chung 1998), Icelandic (Maling and Zaenen 1978), Kikuyu (Clements 1984), French (Kayne and Pollock 1978), Yiddish (Diesing 1990), and several others. What this kind of evidence indicates is that the information about the unbounded dependency is in some sense accessible to words that have no direct relation to the filler or the gap. As Bouma et al. (1998, 2001) note, in a lexicalist analysis where the extracted elements are recorded in a feature like GAP it makes sense to suggest that heads contain information not only about their extracted arguments but also about the extracted elements of their syntactic dependents. For example, in the case of Irish the generalization is that the verb particle *goN* selects only [GAP $\langle\rangle$] structures while *aL* selects [GAP $\langle [\ ], ... \rangle$] structures.

[3]In some analyses these particles are taken to be complementizers. The N orthographically indicates nasal mutation and L indicates lenition. I ignore the fact that these correspond to various surface forms which inflect for tense and negation.

7.1.1 An HPSG Account

I begin by departing from previous HPSG accounts and by assuming that the valency specifications of lexical items are given in full, instead of some flexibility being allowed by a ‘argument realization principle’. Below is depicted the inflected lexical item *likes*:[4]

(12)
$$\left[\begin{array}{l} \textit{inf-lex-it} \\ \text{MP} \mid \text{FORM} \ \langle \ \textit{likes} \ \rangle \\ \text{SYN} \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{l}\textit{verb}\\ \text{VFORM} \ \textit{fin}\end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \langle \ \boxed{1}\text{NP} \ \rangle \\ \text{COMPS} & \langle \ \boxed{2}\text{NP} \ \rangle\end{array}\right] \\ \text{INHER} & \left[\begin{array}{ll}\text{GAP} & \langle\rangle \\ \text{REL} & \langle\rangle\end{array}\right]\end{array}\right] \\ \text{ARG-ST} \ \langle\boxed{1},\boxed{2}\rangle \end{array}\right]$$

The ARG-ST feature contains the total of elements found in the valence lists, and it is usually used for stating binding theory constraints among other things.[5] Note that it is possible however to have mismatches between the syntactic argument position and semantic argument. One example is *Be-inversion*. Compare *Kim*$_i$ *is stealing it for himself*$_i$ with *Stealing it for himself*$_i$ *is Kim*$_i$. This pattern can be obtained via a lexical rule for copula verbs which switches the values of SUBJ and COMPS. The list ARG-ST can remain unchanged and the Binding Theory of Pollard and Sag (1994, Ch.6) can apply as usual: the reflexive pronoun is required to be bound by a preceding element in the ARG-ST list.

Another departure from standard HPSG is that there is a unique lexical rule in the grammar that outputs signs of type *word*. In that sense, this lexical rule becomes obligatory given all morphology involves lexical items of the type *inf-lex-it* (inflected) or of the type *ninf-lex-it* (noninflected). These lexical items cannot enter syntactic constructions because only items of type *word* or of type *phrase* are allowed in phrasal constructions, as defined in §5.1. The rule that yields items of the type *word* is also

[4] Some HEAD and SEM information is omitted for brevity, but is otherwise unchanged.

[5] The order of valents in this list records the fact that subjects have a more prominent grammatical status than complements. This may be relevant for various phenomena: if a language can relativize X, then it can relativize any element that precedes X in ARG-ST. No languages are known to relativize complements but not subjects. Similarly, if a language has words that show agreement with X then it also has words that show agreement with the elements that precedes X.

relevant for the grammar of extraction, given that it determines the possible values of GAP. For example, this lexical rule can take an item like (12) and produce various different outputs such as the ones depicted below:

(13) a.
$$\begin{bmatrix} \textit{word} & \\ \text{MP} \mid \text{FORM} & \langle \textit{ likes } \rangle \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \boxed{1}\text{NP} \rangle \\ \text{COMPS} & \langle \boxed{2}\text{NP} \rangle \end{bmatrix} \\ \text{INHER} & \begin{bmatrix} \text{GAP} & \langle\rangle \\ \text{REL} & \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \langle \boxed{1},\boxed{2} \rangle \end{bmatrix}$$

b.
$$\begin{bmatrix} \textit{word} & \\ \text{MP} \mid \text{FORM} & \langle \textit{ likes } \rangle \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \boxed{1}\text{NP} \rangle \\ \text{COMPS} & \langle \ \rangle \end{bmatrix} \\ \text{INHER} & \begin{bmatrix} \text{GAP} & \langle \boxed{2}\text{NP} \rangle \\ \text{REL} & \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} & \langle \boxed{1},\boxed{2} \rangle \end{bmatrix}$$

One realization of this verb requires the subcategorized items to be *in situ* while the other realization requires the complement to be locally unrealized. In languages that record the existence of an extraction morphologically, this lexical rule can also add the relevant morphemes to the MP value of words that have a non-empty GAP lists.

In order to flesh out this lexical rule some preliminary definitions are necessary. Since both valency and GAP features are list-valued we can put forth a single relation that non-deterministically combines gapped elements. This is necessary to allow a head to contain two gaps or to contain one gap coming from two different sources, as illustrated in (2) and in (3) above. I thus formalize a *list-union* operation that basically combines lists as if these were sets:

(14)
$$\mathsf{U}_{\oplus}(\langle\rangle) = \langle\rangle$$
$$\mathsf{U}_{\oplus}(\langle\boxed{1}|\boxed{2}\rangle) = \langle\boxed{1}|\mathsf{U}_{\oplus}(\boxed{2})\rangle$$
$$\mathsf{U}_{\oplus}(\langle\boxed{1}|\boxed{2}\rangle \oplus \langle\boxed{1}|\boxed{3}\rangle) = \mathsf{U}_{\oplus}(\langle\boxed{1}|\boxed{2}\rangle \oplus \boxed{3})$$

For example, a constraint like $\mathsf{U}_{\oplus}(\langle \boxed{a}, \boxed{b} \rangle)$ allows for two possible resolutions: $\langle \boxed{a}, \boxed{b} \rangle$ and $\langle \boxed{a} \rangle$ (where $\boxed{a}{=}\boxed{b}$). The goal is therefore to apply $\mathsf{U}_{\oplus}$ to the list of gaps that a certain head contains plus the list of gaps that its arguments contain. The latter gaps are collected via a second auxiliary relation G. This relation takes a list of signs and yields the concatenation of the GAP lists therein:

(15) $\mathsf{G}(\langle [\text{GAP}\boxed{1}], \ldots, [\text{GAP}\boxed{n}] \rangle) = \boxed{1} \oplus \ldots \oplus \boxed{n}$

These two relations allows us to state the intended generalization in a straightforward manner: the value of GAP of a given word corresponds to the list-union of the locally extracted arguments and the gaps found in the *in situ* arguments. The post-inflectional lexical rule that yields lexical items of the type *word* and allows for non-empty GAP specifications is provided in (16). It does all the work at once.

(16) WORD REALIZATION LEXICAL RULE:

$$
\textit{pi-word-real-cx} \Rightarrow
\left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{word}} \\
\text{MP} & \boxed{1} \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \boxed{2} \\
\text{VAL} & \left[\begin{array}{ll}
\text{SUBJ} & \boxed{3} \\
\text{COMPS} & \boxed{4}
\end{array}\right] \\
\text{INHER} & \left[\begin{array}{ll}
\text{GAP} & \mathsf{U}_{\oplus}(\boxed{5}\oplus\boxed{6}\oplus\mathsf{G}(\boxed{3}\oplus\boxed{4})) \\
\text{REL} & \boxed{7}
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \boxed{8} \\
\text{DOM} & \boxed{9} \\
\text{ARG-ST} & \boxed{10}
\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{infl-lex-it}} \\
\text{MP} & \boxed{1} \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \boxed{2} \\
\text{VAL} & \left[\begin{array}{ll}
\text{SUBJ} & \boxed{3} \bigcirc \boxed{5} \\
\text{COMPS} & \boxed{4} \bigcirc \boxed{6}
\end{array}\right] \\
\text{INHER} & \left[\begin{array}{ll}
\text{GAP} & \langle\rangle \\
\text{REL} & \boxed{7}
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \boxed{8} \\
\text{DOM} & \boxed{9} \\
\text{ARG-ST} & \boxed{10}
\end{array}\right] \right\rangle
\end{array}\right]
$$

Note that the extraction out of SUBJ and COMPS is optional, as nothing requires that the sub-lists $\boxed{5}$ and $\boxed{6}$ are non-empty. On the other hand, all of the gapped elements contained in the *in situ* valents are incorporated by the word. The function G takes the list $\boxed{3}\oplus\boxed{4}$ and places the gaps therein in the value of GAP.

The word illustrated in (13a) above corresponds to a resolution where the lists $\boxed{5}$ and $\boxed{6}$ are empty and where the signs in the lists $\boxed{3}$ and $\boxed{4}$ contain no gaps. Conversely, the word given in (13b) is obtained if $\boxed{6}$ is resolved as non-empty. Note that any verb that subcategorizes for the latter will incorporate the same unbounded dependency. Thus, in a sentence like *This car, I think that Kim likes* the main verb is required to incorporate the gap recorded in the complement clause as illustrated below:[6]

(17)
$$\begin{bmatrix} \textit{word} \\ \text{MP} \mid \text{FORM} \ \langle \ \textit{think} \ \rangle \\ \text{SYN} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{verb} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SUBJ} \ \langle \ \boxed{3}\text{NP} \ \rangle \\ \text{COMPS} \left\langle \boxed{4} \begin{bmatrix} \text{HEAD} \begin{bmatrix} \textit{verbal} \\ \text{VFORM } \textit{fin} \end{bmatrix} \\ \text{VAL} \begin{bmatrix} \text{SUBJ} \ \langle\rangle \\ \text{COMPS} \ \langle\rangle \end{bmatrix} \\ \text{GAP} \ \langle \ \boxed{2}\text{NP} \ \rangle \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{INHER} \begin{bmatrix} \text{GAP} \ \langle \ \boxed{2} \ \rangle \\ \text{REL} \ \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} \ \langle \boxed{3}, \boxed{4} \rangle \end{bmatrix}$$

The propagation of the value of GAP in syntax is governed by the NON-LOCAL INHERITANCE PRINCIPLE. Recall that this principle requires that the INHER value of the mother and the head daughter are identical. All headed constructions where arguments and functors are realized *in situ* are required to obey this principle, repeated below in (18):

[6]Note that this verb can take any finite clause of type *verbal*, a supertype of *verb* and *complementizer*. This means that the verb can take either a S of type *verb* like *Kim likes it* or a clause of type *comp* such as *that Kim likes it*. The complementizer *that* lexically selects for a finite S complement and selects no subjects. In languages like Portuguese the indirect discourse verb selects for *comp* clauses.

(18) NON-LOCAL INHERITANCE PRINCIPLE

$$\textit{h-local-cx} \Rightarrow \begin{bmatrix} \text{MTR}\,|\,\text{SYN}\,|\,\text{INHER} & \boxed{1} \\ \text{HD-DTR}\,|\,\text{SYN}\,|\,\text{INHER} & \boxed{1} \end{bmatrix}$$

To illustrate the account proposed so far, I follow Pollard and Sag (1994, 381) and Ginzburg and Sag (2000, 174) in general terms and adopt the grammar rule in (19) for topicalization. The *h-filler-cx* rule describes a structure with two daughters. One is the head daughter $\boxed{2}$, which is required to contain a non-empty GAP list. The remaining daughter is the non-head $\boxed{1}$, which is identified as the gap recorded in the GAP. The $\boxed{1}$ constituent thus functions as the filler for an unbounded dependency that started off at an arbitrarily embedded position inside $\boxed{2}$.

(19) HEAD-FILLER CONSTRUCTION

$$\textit{h-filler-cx} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{INHER} & \begin{bmatrix} \text{GAP} & \boxed{4} \\ \text{REL} & \boxed{5} \end{bmatrix} \end{bmatrix} \\ \text{SEM}\,|\,\text{KEY} & \boxed{k} \\ \text{DOM} & \langle\boxed{1}\rangle \oplus \boxed{3} \end{bmatrix} \\ \text{HD-DTR} & \boxed{2} \\ \text{DTRS} & \left\langle \boxed{1},\ \boxed{2}\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \boxed{0}\begin{bmatrix} \text{SUBJ} & \langle\ \rangle \\ \text{COMPS} & \langle\ \rangle \end{bmatrix} \\ \text{INHER} & \begin{bmatrix} \text{GAP} & \langle\boxed{1}\rangle \bigcirc \boxed{4} \\ \text{REL} & \boxed{5} \end{bmatrix} \end{bmatrix} \\ \text{SEM}\,|\,\text{KEY} & \boxed{k} \\ \text{DOM} & \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix}$$

All the semantic, case, agreement and syntactic constraints that are imposed on the gap $\boxed{1}$ must be satisfied by the filler daughter $\boxed{1}$, since the two constituents are now structure-shared.

To illustrate the workings of this rule, consider the sentence in (20). In this case there is only one gap listed in the head GAP list, which is identified with the leftmost constituent. The corresponding syntactic tree is depicted in Figure 7.1.

(20) [This car]$_{\boxed{1}}$ [I think Kim likes]$_{\text{GAP}\langle\boxed{1}\rangle}$

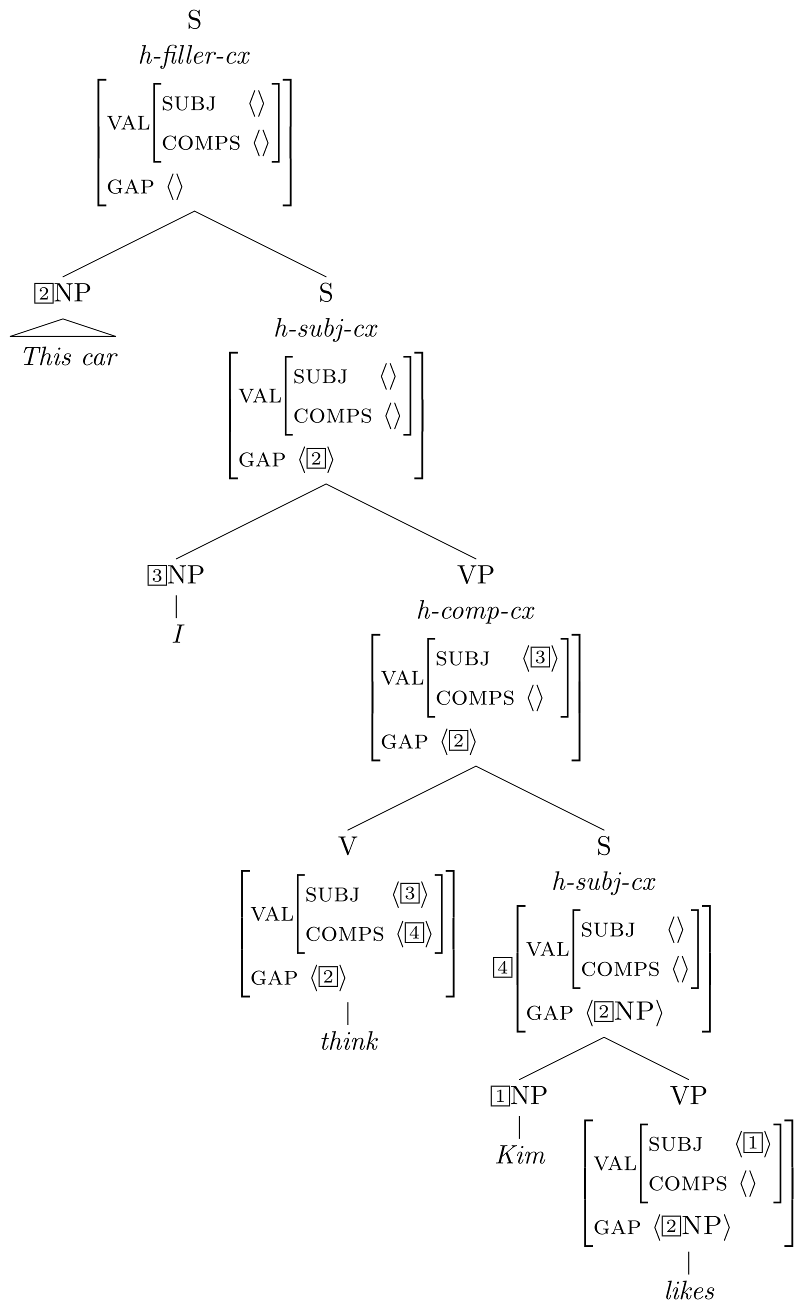


Figure 7.1: Unbounded filler-gap dependency

This parse is made possible via the lexical entry for *likes* in (13b), in which the complement is not present in COMPS, and is recorded in GAP instead. The indirect discourse verb *think* is required by the WORD REALIZATION LEXICAL RULE to absorb in GAP all the gaps in its arguments. Thus, the matrix verb in Figure 7.1 also contains the NP $\boxed{2}$ in the gap list.

As for the cases involving coordination, the fact that the SYN values of the daughters and the mother are required to be identical in all non-headed constructions has the effect that all conjuncts are required to contain exactly the same unbounded dependency specifications. As discussed in some detail in §5.2, this entails that either all conjuncts have the same extracted elements (bind the same referent and are subordinated to the same MRS label), or all conjuncts contain no extracted elements. As Bouma et al. (2001) point out, this predicts the CSC and the ATB effects without further stipulation while the conjunct constraint follows from the fact that there are no traces, and thus nothing to be coordinated.

Before concluding I will briefly discuss how the present account can capture parasitism in adjunction structures. One possibility is to allow the GAP value of the modifier to be list-unioned with the GAP value of the head. This has the desired consequences.

(21) HEAD-MODIFIER CONSTRUCTION (revised):

$$
\textit{h-mod-cx} \Rightarrow \begin{bmatrix}
\text{MTR} & \begin{bmatrix}
\text{SYN} & \boxed{1}\begin{bmatrix}\text{INHER} \mid \text{GAP} \ \cup_{\oplus}(\boxed{g1} \oplus \boxed{g2})\end{bmatrix} \\
\text{SEM} \mid \text{KEY} & \begin{bmatrix}\text{LBL} & \boxed{l} \\ \text{INDEX} & \boxed{4} \\ \text{RELN} & \boxed{5} \\ \text{ARGS} & \boxed{6}\end{bmatrix} \\
\text{DOM} & \langle \boxed{2} \rangle \bigcirc \boxed{B}
\end{bmatrix} \\
\text{HD-DTR} & \boxed{3} \\
\text{DTRS} & \left\langle \boxed{2}\begin{bmatrix}
\text{SYN} & \begin{bmatrix}\text{HEAD} \mid \text{MOD} & \boxed{3} \\ \text{INHER} \mid \text{GAP} & \boxed{g1}\end{bmatrix} \\
\text{SEM} \mid \text{KEY} \mid \text{LBL} & \boxed{l}
\end{bmatrix}, \boxed{3}\begin{bmatrix}
\text{SYN} & \boxed{1}\begin{bmatrix}\text{INHER} \mid \text{GAP} \ \boxed{g2}\end{bmatrix} \\
\text{SEM} \mid \text{KEY} & \begin{bmatrix}\text{INDEX} & \boxed{4} \\ \text{RELN} & \boxed{5} \\ \text{ARGS} & \boxed{6}\end{bmatrix} \\
\text{DOM} & \boxed{B}
\end{bmatrix} \right\rangle
\end{bmatrix}
$$

If the adjunct is not gapped (i.e. if the GAP list is empty) then the head may or may not contain gaps. If the adjunct is gapped then parasitism must ensue. To see why this is so, observe that the value of GAP of the mother node is required to be identical to the GAP value of the daughter: it cannot grow. This is also a property of all *h-local-cx* structures, due to the NON-LOCAL INHERITANCE PRINCIPLE. Thus, if the adjunct is gapped then both daughters and the mother must have the same gap.

The three cases are illustrated in more detail in Figure 7.2. Here, (a) depicts the simplest case where both the head and the daughter are ungapped. The resolution of the list-union constraint is trivial: $\mathsf{U}_{\oplus}(\langle\rangle \oplus \langle\rangle) = \langle\rangle$. This corresponds to cases like *I found a photo yesterday without looking for anything.* A parasitic case is shown in (b). Both daughters contain a gap and thus become one and the same since the GAP list of the mother is required to be identical to the gap list of the head. The only possible resolution is therefore $\mathsf{U}_{\oplus}(\langle\boxed{1}\rangle \oplus \langle\boxed{2}\rangle) = \langle\boxed{1}\rangle$, for $\boxed{1} = \boxed{2}$. This corresponds to cases like *That photo, I found _ yesterday without looking for _ .*

A regular extraction is shown in (c). The adjunct does not contain any gaps but the head is gapped. Again, because the mother and head are required to have the same gap value the only possible resolution for list-union is $\mathsf{U}_{\oplus}(\langle\boxed{1}\rangle \oplus \langle\rangle) = \langle\boxed{1}\rangle$. This corresponds to case like *To Kim, I can send flowers _ without asking for anyone's permission.*

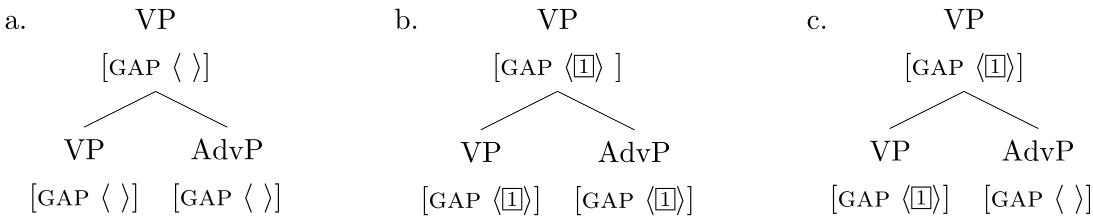


Figure 7.2: Legal list-unions in modification structures

Finally, in Figure 7.3 we can observe an ungrammatical case where the head is not gapped but the adjunct is. The mother is thus required to be [GAP $\langle\rangle$], which in turn makes it impossible to satisfy the list-union constraint: $\mathsf{U}_{\oplus}(\langle\rangle \oplus \langle\boxed{1}\rangle) \neq \langle\rangle$. This rules out cases like **That photo, I found a book yesterday without looking for _ .*

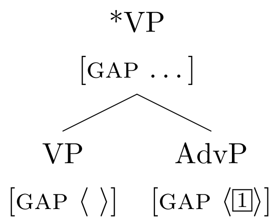


Figure 7.3: Illegal extraction and modification

In this account the cases where extraction out of adjuncts is not parasitic as in (4), repeated below in (22) remain a puzzle. It is unclear why certain cases of adjunction only allow parasitic gaps while others don't. One hypothesis is that there are two kinds of adjunction constructions: one that only licenses parasitism (given above) and another kind which allows the modifier to project its own unbounded dependencies. The latter requires various changes to the current grammar, but it does seem possible. However, the present account of ATB violations in asymmetric coordination structures may in fact obtain data like (22) as a prediction. This matter will be discussed in more detail in §7.1.3.[7]

(22) a. Which of these reports did Kim go to lunch without reading _ ?
  b. That's the symphony that Schubert died without reading _ .
  c. A problem this important, I could never go home without solving _ first.

7.1.2 Adjunct Extraction

Adjunct extraction would be an orthogonal topic to the present work if not for a coordination puzzle that arises in these structures. Let us start by noting that at least some adjuncts can enter long-distance dependencies:

(23) a. [On Monday], I think that [Kim went home very late _].
  b. [Yesterday], it seems that [Kim arrived home very early _].
  c. [How often] do you think that [Fred was late this week _]?

Nominal adjuncts do not exhibit this pattern, as noted by Pollard and Sag (1994, 388):

(24) a. *Red, I saw the _ ball.
  b. *Who shot the sheriff, I met the man _ .

Crucially, McCloskey (1979) notes that the extraction of adverbial constituents also triggers the complementizer alternation in Irish. This alternation occurs even with the extraction of canonical temporal adverbs, which provides strong evidence that such modifer constituents can indeed be extracted.

[7] It may be the case that extraction out of relatives is possible, as in ?*This book, I know* [*someone who would love to get their hands on* _]. Moreover, there may be cases of parasitic gaps as in *Which woman$_i$ do men who meet _ $_i$ usually ask _ $_i$ out?* (attributed to Elisabet Engdahl in Pollard and Sag (1994, 226)). If so, it may be necessary to assume that there are several sub-types of *h-mod-cx*, with different constraints on how GAP can propagate. Alternatively, there may be fewer grammatical constraints at work, and differential processing difficulty.

In order to account for adjunct extraction phenomena, Pollard and Sag (1994, 387) propose a lexical rule that applies to certain verbs and add adjuncts to the GAP list. This account has several known shortcomings, some of which are corrected in a more recent proposal put forth in Bouma et al. (2001). The latter assumes that post-verbal modifiers are in fact optional complements, and that a lexical rule adds any number of adverbs to the COMPS list of a verb. Since these modifiers are complements, adjunct extraction is handled in the same way as the extraction of canonical complements.

The analysis of adverbs as complements finds some cross-linguistic evidence in the literature, as noted in Bouma et al. (2001), but does not appear to be very intuitive. There is no semantic sense in which a verb can be said to select for an optional adverbial phrase. This objection is fairly weak but it gains importance when considering a puzzle presented by coordination structures. Adverbial extraction yields an unexpected kind of reading when coupled with a coordinate structure as noted in Levine (2003). In the datum in (25) the phrase *In how many seconds flat* obtains a collective reading over the three events denoted by the coordination, not over each conjunct.

(25) In how many seconds flat do you think that [Robin found a chair, sat down and took off her logging boots]?

This sentence is a question about the total time occupied by the serial occurrence of the three events. This suggests that the topicalized constituent is not a complement of anything in the sentence. If it were, then it would be predicating each of the conjuncts separately, not the whole plural eventuality associated with the coordination structure.

Sag (2005) presents a solution to this problem by revising the account in Bouma et al. (2001). The former resorts to MRS subordination constraints and assumes that the extracted adjunct *in how many seconds flat* is scopal. The adjunct is required to embed the verb that selects it via a MRS subordination constraint and the fact that coordinate structures are unheaded causes the extracted PP to be required to simultaneously outscope each of the verbs heading the conjuncts. Thus, the PP gains wide scope over the MRS representation of the coordination.

Levine and Hukari (2006, 177–181) raise some concerns about the details of the MRS proposal, but the general take of Sag's analysis yields the intended results as far as extraction is concerned. The main problem of this account, in my view, is that there is no evidence that the modifier *in X seconds* is scopal. Consider the examples in (26). The intersective modifiers in (26a) do not give rise to scope ambiguities, while the scopal modifiers in (26b) trigger an ambiguity with respect to the wide or narrow scope interpretation of the indefinite subject:

(26) a. A spy photographed the documents $\left\{\begin{array}{l}\text{in twelve seconds.}\\ \text{yesterday.}\end{array}\right\}$

b. A spy $\left\{\begin{array}{l}\text{probably}\\ \text{usually}\end{array}\right\}$ photographed the documents.

Sag (2005) also notes that the adverbs-as-complements analysis requires further assumptions in order to account for cases that would otherwise be taken care as standard VP adjunction, such as (27).

(27) Nobody can [[drink four beers and eat two hotdogs] [in fifteen seconds]].

An ellipsis analysis is unavailable because the PP is understood as modifying the entire VP coordination. Some extra mechanism is required, which Sag (2005) suggests may be a form of rightward extraction.[8] A more parsimonious account of (25) would scale to both intersective and scopal modifiers in a uniform way. I will advance a simple approach inspired in the lexical rule originally proposed in Pollard and Sag (1994, 387), which will capture cases like (23) and (25) as essentially the same kind of phenomenon, without resorting to the adverbs-as-complements account nor to rightward extraction.

The rule that is proposed for this purpose is essentially a unary-branching head-adjunction phrasal construction that allows adjuncts to modify a VP by entering the tree structure as a member of GAP rather than as a tree node:

[8] Levine and Hukari (2006, 177–181) strongly oppose a rightward extraction analysis since they assume that this is synonymous with Right-Node Raising. It is well-taken that there are good reasons for not analyzing RNR as extraction, but Sag's proposal does not endorse such an analysis. One possibility is extraposition, as in *I have wanted to know for many years exactly what happened with Rosa Luxemburg.* See Kim and Sag (2005) for a rightward extraction account of extraposition.

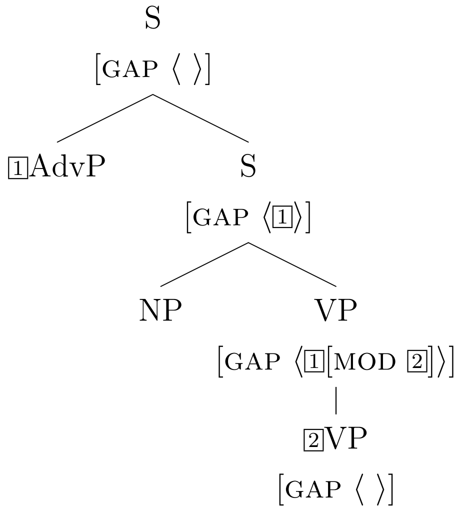


Figure 7.4: A modifier adjoining into GAP

This allows the grammar to detect the 'extracted' adjunct, because of the non-empty GAP value. I assume that this new rule is a sub-type of *headed-cx*, and formalize it as follows:

(28) ADJUNCT EXTRACTION CONSTRUCTION:

$$
\textit{adj-extr-cx} \Rightarrow
\begin{bmatrix}
\text{MTR} & \begin{bmatrix}
\text{SYN} & \begin{bmatrix}
\text{HEAD} & \boxed{1} \\
\text{VAL} & \boxed{2} \\
\text{INHER} & \begin{bmatrix}
\text{GAP} & \boxed{3} \oplus \left\langle \text{XP}\begin{bmatrix}\text{MOD} & \boxed{4}\end{bmatrix} \right\rangle \\
\text{REL} & \boxed{5}
\end{bmatrix}
\end{bmatrix} \\
\text{SEM} \mid \text{KEY} & \boxed{k}
\end{bmatrix} \\
\text{DTRS} & \left\langle \boxed{4} \begin{bmatrix}
\text{SYN} & \begin{bmatrix}
\text{HEAD} & \boxed{1}\,\textit{verb} \\
\text{VAL} & \boxed{2} \begin{bmatrix}
\text{SUBJ} & \langle [\ ] \rangle \\
\text{COMPS} & \langle \rangle
\end{bmatrix} \\
\text{INHER} & \begin{bmatrix}
\text{GAP} & \boxed{3} \\
\text{REL} & \boxed{5}
\end{bmatrix}
\end{bmatrix} \\
\text{SEM} \mid \text{KEY} & \boxed{k}
\end{bmatrix} \right\rangle
\end{bmatrix}
$$

Consider now how this proposal interacts with VP coordination. In the case of a VP coordination the rule cannot apply to just one conjunct. Oddness ensues because the other VPs do not contain different gap values and all non-headed constructions are required to have identical gap specifications.

If on the other hand the rule applies to each of the VP conjuncts instead of applying to the coordinate VP mother, then the resulting MRS is ill-formed for it does not describe a tree structure. Recall that the adverb is intersectively combined with the VP it modifies. More precisely, it is plugged in the argument of the existential quantifier associated with the respective verbal constituent. If each conjunct has such an adverb in the GAP list, then at the coordination level this is required to be one and the same adverb because of SYN identity. The extracted adverbial phrase thus has the same MRS label and binds the same eventuality. But this also means that the label of the adverb is intersectively combined *simultaneously* with the argument of the existential quantifier associated with each verbal head. This yields an ill-formed MRS structure which cannot be scopally resolved, as illustrated in the partial representation below (only the semantics of the verbal conjuncts and the adjunct are depicted for brevity):

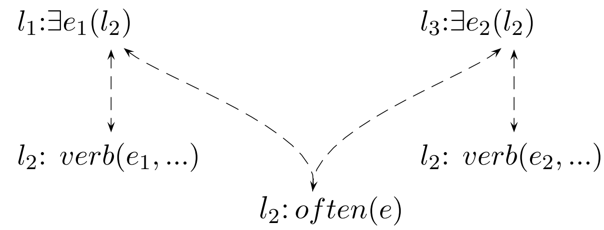


Figure 7.5: Illegal MRS representation (partial)

With scopal adjuncts no such ill-formedness arises because the extracted phrase is lexically required to outscope the verbal predicate it modifies. The end result in this case is very similar to Sag's analysis, but without viewing post-verbal adverbs as complements in English, being forced to assume anything about rightward extraction, or running into MRS-specific problems discussed in Levine and Hukari (2006).

7.1.3 Asymmetric Coordination

Let us briefly review the main observations made in §2.1.3 about asymmetric coordination. It was concluded that there exists no evidence that asymmetric coordination structures are anything other than coordination structures, and that these should therefore be accounted for by the same coordination rule. Asymmetry is only possible with verbal conjuncts and is accompanied by extra semantic import, possibly pragmatic in nature, that consists in relations that hold between the conjuncts. These relations can be of various kinds, such as time-precedence, causality, unexpectedness, and others, and can be paraphrased as *and then*, *and so*, *and still*. In asymmetric coordination it is often the case that some of the conjuncts are backgrounded, as their meaning is taken to be of minor relevance for the discourse and is possibly already presupposed. Crucially, extraction phenomena is optional for the backgrounded conjuncts.

One important aspect of the non-ATB extraction cases is that even though an asymmetrical relation like time-precedence holds between the conjuncts, either one can be gapped. For example, going to the store always precedes temporally the act of buying the whiskey and the presupposition that this is where it was bought:

(29) a. This is the store that I went to _ and bought a bottle of whiskey for $15.

b. This is the bottle of whiskey that I went to the store and bought _ for $15.

This means that the asymmetric relation that holds between the conjuncts does not correlate with the extraction pattern. On the other hand, backgrounding does correlate: the conjunct that conveys common ground information can remain ungapped. Note also that in extraction-less cases or ATB extraction cases it is unclear if there is any backgrounded conjunct at all:

(30) a. I went to the store and bought a bottle of whiskey for $15.

b. This is the hotel that I went to _ and bought _ for $65 million.

The proposal that follows will pursue the idea that the asymmetric relation is pragmatic in nature and that it is independent from the particular extraction phenomena that this kind of structure allows. Also pragmatic in nature is the backgrounding effect with correlates with asymmetric extraction. I will first account for the extraction phenomena and only then discuss the asymmetric relational import.

Backgrounding will be modeled by a coercion process that targets verbal phrases. The result of this process is a novel verbal constituent with extra pragmatic content and with different syntactic properties. In particular, some head information is altered by this coercion rule, as well as the value of the feature GAP. The changes in the latter will be responsible for allowing non-ATB extraction. For this purpose I will adopt the BACKGROUND feature, first discussed in Pollard and Sag (1994), which I assume is appropriate for signs and takes as value a list of semantic representations:

(31) $$\begin{bmatrix} \textit{sign} \\ \ldots \\ \textsc{background}\ \ \textit{list}(\textit{pred}) \end{bmatrix}$$

The feature BACKGROUND is intended to contain pragmatic information, although theories differ greatly with respect to what exactly should be considered pragmatics and how to best represent it. Pollard and Sag (1994, 332–337) already are aware of some of the shortcomings of their proposal, some of which are amended in a more elaborate theory put forth in Ginzburg and Sag (2000). But since providing a theory of pragmatics is well beyond the scope of this work, I will make a minimal set of assumptions about the feature BACKGROUND. First, I assume that it can contain semantic content that is presupposed to be given, and shared between speakers. This content is secondary and not topical. Extra mechanisms can be adopted to make a finer-grained distinction, perhaps also incorporating aspects of information structure. Second, I assume that in headed structures the BACKGROUND value of a mother is defined as the concatenation of the values of the daughters, similarly to what occurs in the SEMANTIC INHERITANCE PRINCIPLE. Such principle is called PRINCIPLE OF CONTEXTUAL CONSISTENCY in Pollard and Sag (1994, 333). Finally, I assume that MRS representations are built by taking into consideration the information in BACKGROUND as well as the information in SEM.

The backgrounding coercion process is modeled by a *backgr(ounding)-coer(cion)-cx* rule, along with other coercion rules proposed so far:

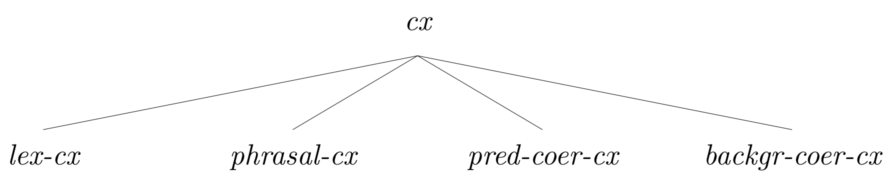


Figure 7.6: Type Hierarchy of constructions (extended)

The backgrounding construction alters the pragmatic import of a verbal structure by placing it in BACKGROUND, and yields a structure with different syntactic properties. In particular, the value of GAP becomes underspecified. The intended effect of the *backgr-coer-cx* rule is illustrated in the tree seen below, as it applies to a leftmost VP conjunct:

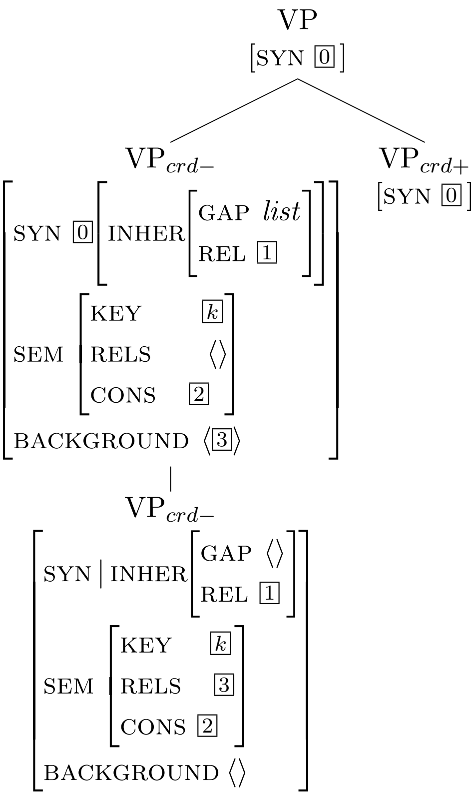


Figure 7.7: VP conjunct coercion in asymmetric coordination

The backgrounding process boils down to transferring the semantics of the VP into the BACKGROUND feature. Alternatively, one could simply embed the semantics in a special relation that encodes the fact that this semantic material is assumed to be common ground in the discourse, but no major linguistic issue appears to hinge on choosing either methodology.

Let us observe in more detail the effect of altering the value of GAP as indicated above. A crucial thing to keep in mind is that the coordination structure is the same as usual and as a non-headed construction, it is required that conjuncts have identical SYN information. If the uncoerced VP daughter is specified as [GAP $\boxed{1}\langle\rangle$] then the coerced counterpart becomes [GAP *list*]. Thus if the remaining VP$_{crd+}$ conjunct is also specified as [GAP $\langle\rangle$] then the SYN values are trivially compatible because *list* can be resolved as $\langle\rangle$. This case allows for no extraction as illustrated below:

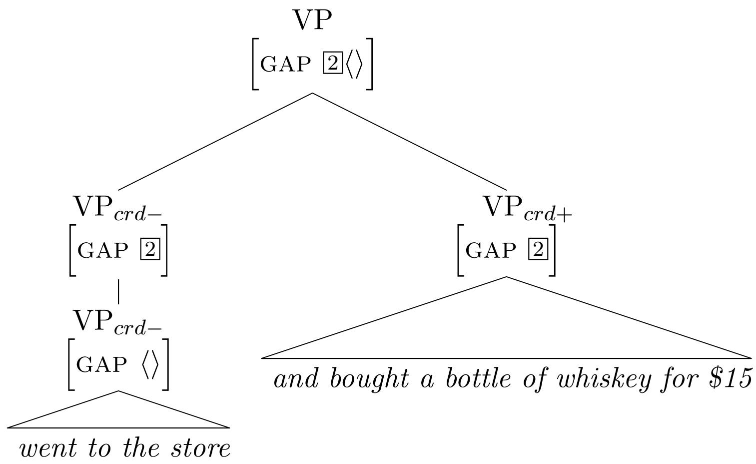


Figure 7.8: Extraction-less asymmetric coordination

However, if the remaining VP$_{crd+}$ conjunct contains a gap [GAP ⟨XP⟩] then the SYN values are again compatible because *list* can be further instantiated as ⟨XP⟩. Even though there was no extraction in the backgrounded conjunct, the coordinated VP allows for non-ATB extraction:

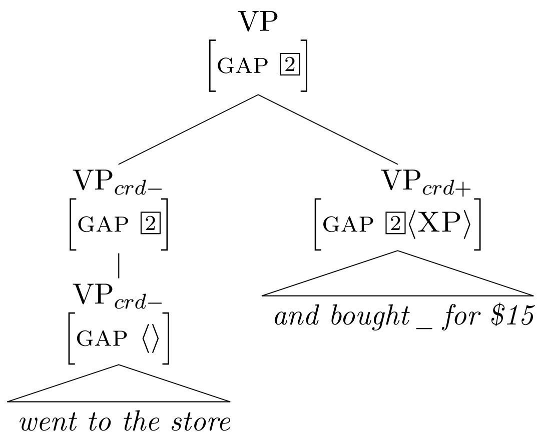


Figure 7.9: Non-ATB extraction in asymmetric coordination

It should be observed that nothing in the coercion rule forces any particular conjunct to be targeted, so any number of conjuncts can be backgrounded. The case where all of the conjuncts are coerced should be prevented, perhaps on pragmatic grounds. This could be achieved in various ways. For example, one can require that every phrase specified as [CRD *crd-*] and as [MODE ¬*none*] must contain at least one unbackgrounded conjunct in SEM.

The coercion process can also occur in non-coordinate contexts, which brings us to the puzzling cases of extraction out of adjuncts, as in (4). The present approach predicts that adjuncts on the account that if the VP being adjoined to is backgrounded, then it should be possible for the modifier phrase to be gapped. These cases are illustrated in the following examples:

(32) a. Which of these reports did Kim [go to lunch]$_{GAP\langle\boxed{1}\rangle}$ [without reading]$_{GAP\langle\boxed{1}\rangle}$?

b. Someone this famous, I couldn't [go home]$_{GAP\langle\boxed{1}\rangle}$ [without talking to]$_{GAP\langle\boxed{1}\rangle}$.

It remains to flesh out a theory of pragmatics that can shed more light on this issue and ideally add further independent motivation for this kind of analysis. As for the coercion rule sketched above, it can be formalized as follows:

(33)

$$
\textit{backr-coer-cx} \Rightarrow
\left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN } \boxed{2} & \left[\begin{array}{ll}
\text{HEAD} & \textit{verb} \\
\text{VAL} & \boxed{0} \\
\text{INHER} & \left[\begin{array}{ll}
\text{GAP} & \textit{list} \\
\text{REL} & \boxed{4}
\end{array}\right]
\end{array}\right] \\
\text{SEM } \boxed{3} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \langle\rangle \\
\text{CONS} & \boxed{5}
\end{array}\right] \\
\text{DOM} & \left\langle \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN} & \boxed{2} \\
\text{SEM} & \boxed{3}
\end{array}\right] \right\rangle \\
\text{BACKGROUND} & \langle \boxed{6} \rangle
\end{array}\right] \\
\text{DTRS} & \left\langle \left[\begin{array}{ll}
\text{MP} & \boxed{1} \\
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \textit{verb} \\
\text{VAL } \boxed{0} & \left[\text{COMPS } \langle\rangle\right] \\
\text{INHER} & \left[\begin{array}{ll}
\text{GAP} & \langle\rangle \\
\text{REL} & \boxed{4}
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \boxed{6} \\
\text{CONS} & \boxed{5}
\end{array}\right] \\
\text{BACKGROUND} & \langle\rangle
\end{array}\right] \right\rangle
\end{array}\right]
$$

Note also that certain head features are left unspecified, the behavior and consequences of which require further study. One reason behind this kind of move, however, is to allow for a backgrounded non-inverted clause [INV−] to be compatible with an inverted conjunct [INV+], as illustrated in asymmetric structures like the ones below:

(34) a. Did Fred enter the room and I didn't wake up?

b. Did you ever wake up and your hand is still asleep?

I now turn to the extra semantic content which is present in asymmetric coordination structures. This is taken to be pragmatic import that can optionally be introduced in a coordinate verbal phrase. Coordination structures will be allowed to add, for example, a time-precedence '$\leqslant_t$' condition or a causative relation '$\rightsquigarrow$' that holds between the events denoted by the two conjuncts. This is achieved by the rule in (35), using an ancillary relation R. The purpose of the latter is to capture the combinatorics in a compact way bearing in mind the fact that conjunction and disjunction allow for different asymmetrical relations.

(35)

$$\textit{coord-cx} \Rightarrow \begin{bmatrix} \text{MTR} \begin{bmatrix} \text{BACKGROUND } \mathrm{R}(\boxed{1},\boxed{\alpha},\boxed{\beta},\boxed{A},\boxed{B}) \end{bmatrix} \\ \text{DTRS} \left\langle \begin{bmatrix} \text{SEM} \mid \text{INDEX } \boxed{\alpha} \\ \text{BACKGROUND } \boxed{A} \end{bmatrix}, \begin{bmatrix} \text{SEM} \mid \text{INDEX } \boxed{\beta} \\ \text{CRD} \mid \text{MODE } \boxed{1} \\ \text{BACKGROUND } \boxed{B} \end{bmatrix} \right\rangle \end{bmatrix}$$

Coordination structures can therefore obtain extra pragmatic content, depending not only on the semantic type of the conjuncts but also on the coordination type. In the simplest case considered below, the BACKGROUND value of the mother is $\langle\rangle$ because none of the daughters is backgrounded. This obtains the symmetric reading for coordination. Asymmetric readings arise via the remaining cases, for these add a relation between the conjuncts:

(36)

$\langle\ \boxed{1},\ \boxed{\alpha},\ \boxed{\beta},\ \boxed{A},\ \boxed{B}\ \rangle$	$\mathrm{R}(\boxed{1},\boxed{\alpha},\boxed{\beta},\boxed{A},\boxed{B})$
$\langle\ \boxed{1},\ \boxed{\alpha},\ \boxed{\beta},\ \langle\rangle,\ \langle\rangle\ \rangle$	$\langle\,\rangle$
$\langle\ \in,\ \textit{evt},\ \boxed{\beta},\ \boxed{A},\ \boxed{B}\ \rangle$	$\langle[\boxed{\alpha} \leqslant_t \boxed{\beta}]\rangle \oplus \boxed{A} \oplus \boxed{B}$
$\langle\ \in,\ \textit{evt},\ \boxed{\beta},\ \boxed{A},\ \boxed{B}\ \rangle$	$\langle[\boxed{\alpha} \rightsquigarrow \boxed{\beta}]\rangle \oplus \boxed{A} \oplus \boxed{B}$
...	...

The first case thus concerns conjuncts that are symmetric, regardless of their category and regardless of the coordination type. No pragmatic relations are inserted.

Generally, speaking one can observe that the BACKGROUND values of the daughters are concatenated in the mother node. This is in accordance with the PRINCIPLE OF CONTEXTUAL CONSISTENCY from Pollard and Sag (1994, 333).[9]

Asymmetric relations are only introduced if conjuncts are eventualities, and their insertion appears to be relatively free. For example, all of the sentences in (37) are equivalent even though time-precedence or causality holds between the same two conjuncts. The demise of the parrot always precedes or leads to the burial and never the other way around, while the meteorological conjunct can interleave or precede either conjunct. Each of these sentences is an adequate answer to the question *why are your clothes all wet?*

(37) a. It was snowing, the parrot died, and we buried it in the yard.
b. The parrot died, it was snowing, and we buried it in the yard.
c. The parrot died, we buried it in the yard, and it was snowing.

The kind of process that (35) aims to model should perhaps be generalized to sequences of verbal structures in context, rather than just applying to coordinate structures. If so, this would be a discourse property rather than a syntactic-dependent property. I leave this reformulation for further research.

The other properties of asymmetric coordination will be obtained as predictions of independently motivated constraints. The impossibility of Left-Peripheral Ellipsis will be explainable as following from the fact that this kind of ellipsis requires a certain kind of semantic identity. This will be discussed in Chapter 8, but for now it suffices to note that the semantic structure of a coerced VP conjunct is very different from the structure of other non-coerced conjuncts. Since the meaning of a backgrounded conjunct is absent from SEM, there is no semantic content for the semantic identity conditions to apply to. Thus, LPE is systematically ruled out when in the presence of backgrounded conjuncts.

The fact that some correlative markers are not compatible with asymmetrical readings is also likely to be semantic in nature. For example, [*both* VP *and* VP] requires that the situations described by the two conjuncts are independent. But the causal or temporal reading that coercion introduces states otherwise. These semantic dependencies contradict the expectation introduced by *both*. This matter will be discussed in more detail below.

[9]Compare also with the generalized version in Ginzburg and Sag (2000, 211).

7.2 Correlative Markers

In §2.2.1 it was argued that English correlative markers are emphatic expressions rather than true coordination lexemes. These expressions make a pragmatic contribution and bias the interpretation of the coordinate structures that they attach to. For example, NP conjunction yields a plurality that can be interpreted distributively or collectively, but the presence of *both* emphasizes the distributive reading. Similarly, disjunction can be interpreted with an inclusive or with an exclusive implicature but the presence of *either* biases towards the latter .

One of the basic syntactic aspects of *both* and *either* is that they only attach to certain kinds of coordinate structure. In the case of *both* it only co-occurs with non-intersective conjunction and in the case of *either* it only occurs with disjunction. Neither of these correlatives occurs with adversative *but* or with intersective conjunction, as noted in §3.3. This means that the grammar must distinguish between these four kinds of coordination modes. I will therefore assume that the type hierarchy of *coord-mode* is extended as follows:

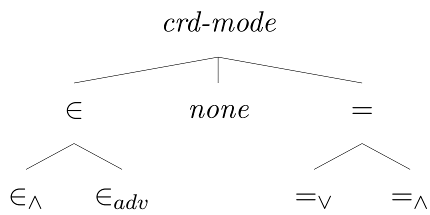


Figure 7.10: Type hierarchy of coordination mode (revised)

The non-intersective conjunction lexeme *and* is now assumed to be lexically specified as [MODE $\in_{\wedge}$], the lexeme *but* is specified as [MODE $\in_{adv}$], the disjunction lexeme *or* is specified as [MODE $=_{\vee}$], and finally, the intersective conjunction *and* is specified as [MODE $=_{\wedge}$]. All the remaining aspects of the proposal for coordination discussed so far remain the same. One can now state that *both* attaches to [MODE $\in_{\wedge}$] constituents and that *either* attaches to constituents [MODE $=_{\vee}$].

7.2.1 *Both*

The correlative marker *both* has no mobility in modern English and only attaches to structures that denote a doubleton plurality (an individual or an eventuality) as discussed in §3.2. Some examples are repeated to illustrate this point:

(38) a. Both the boy and the girl.

b. He had both every reason and every opportunity to be a close observer.

c. Both men and women were measured and medicated.

(39) a. Kim is both strong and agile.

b. Fred can both sing and dance.

c. She works both quickly and efficiently.

d. Sue is both the director and the editor.

e. Tom is both a conductor and a composer.

f. I am both on the board and on the administrative committee.

All the above coordinations are due to the same lexical entry *and* and to the same syntactic rule *coord-cx*. The distribution of the correlative can be likewise accounted for by a single lexical entry such as (40). The correlative selects a *crd-* constituent that is $[\text{MODE } \in_{\wedge}]$, and not quantificationally defective.

(40)
$$
\left[\begin{array}{ll}
\text{MP}\,|\,\text{FORM} & \langle\ \textit{both}\ \rangle \\
\text{SYN}\ |\ \text{HEAD} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{coord}} \\
\text{SPEC} & \left[\begin{array}{ll}
\text{SYN} & \left[\text{HEAD}\ \neg\textit{verbal}\right] \vee \left[\text{VAL}\,|\,\text{SUBJ}\ \langle[\,]\rangle\right] \\
\text{SEM}\,|\,\text{KEY}\ \boxed{k} & \left[\begin{array}{ll} \text{LABEL} & \boxed{l2} \\ \text{RELN} & \textit{quant} \\ \text{INDEX} & \boxed{\alpha} \end{array}\right] \\
\text{CRD} & \left[\begin{array}{l} \textit{crd-} \\ \text{MODE}\ \in_{\wedge} \end{array}\right]
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{KEY} & \boxed{k} \\
\text{RELS} & \left\langle \left[\begin{array}{ll} \text{LBL} & \boxed{l2} \\ \text{RELN} & \textit{cardinal} \\ \text{ARGS} & \langle \boxed{\alpha}, 2 \rangle \end{array}\right] \right\rangle \\
\text{CONS} & \langle\rangle
\end{array}\right] \\
\text{CRD} & \left[\begin{array}{l} \textit{crd-} \\ \text{MODE}\ \textit{none} \end{array}\right]
\end{array}\right]
$$

The disjunction on the value of SYN requires that the marked constituent be either non-verbal or unsaturated for subject valence. This prevents *both* from attaching to clauses, as in **Both Tom smiled and Mia laughed.* The [SPEC|CRD *crd-*] constraint prevents the correlative from attaching to marked conjuncts, e.g. **both and Fred.* The constraint [MODE $\in_\wedge$] ensures that the correlative only attaches to non-intersective conjunction, thus ruling out cases of disjunction **I saw both Fred or Tim* as well as cases of intersective conjunction **Both the editor and the owner is a member of the club.* The cardinality constraint guarantees that the plurality contains only two members, which may themselves be plurals of course, as in *Both the boys and the girls complained about the game.* Note also that the value of MODE of this lexeme is different from the one that it attaches to. This has the correct consequence that recursive markings are ruled out as ungrammatical: **both both Fred and Mia.*

The lexical entry can also be extended to require that the constituent that the correlative attaches to does not contain any backgrounded content, in the sense discussed for asymmetric coordination (i.e. [BACKGROUND $\langle\rangle$]). This would guarantee that the correlative never attaches to asymmetric coordination structures.

It is unclear what kind of semantic or pragmatic contribution should be made by this lexeme. It is tempting to assume that when the correlative attaches to a nominal constituent it introduces a distribution like $\forall x(x \in y \rightarrow \ldots)$. But the problem with this view is that there is no sense in which such a distribution is in effect in non-nominal conjunction like (39). There is nothing to be distributed over. Let us aim for a uniform account, instead of postulating two independent correlative markers.

The presence of *both* can be viewed as requiring that the plurality is composed of independent entities (individuals or events). In other words, that the plurality is not involved in any collective predication. I will therefore introduce a condition consisting in a second-order predicate *independent*($\boxed{\alpha}$, $l_\top$). The α is the referential argument of the constituent that the correlative attaches to, and $l_\top$ is the global top label of the MRS representation. This condition ensures that the individual members of $\boxed{\alpha}$ are not involved in any collective predications in the MRS representation in $l_\top$. In other words, it requires that no predication in the formula labeled by $l_\top$ directly applies to α.

7.2.2 *Either*

Let us now turn to the case of *either.* The present formalization differs from Hofmeister (2005) in several ways, but the linearization aspects of account are very similar. Recall that this correlative marker can attach to any kind of disjunction, and biases the interpretation to the 'exclusive-or' entailment. Along the lines of Hendriks (1995) and others I will assume that this usage of *either* is an adverbial expression that attaches to a verbal structures. Since the correlative is viewed as an adverbial, the *h-mod-cx* rule will allow *either* to shuffle with the linearization domains of the coordinate structure. The lexical entry of *either* is as follows:

(41)
$$\begin{bmatrix} \text{MP} \,|\, \text{FORM} \ \langle \ \textit{either} \ \rangle \\ \text{SYN} \ | \ \text{HEAD} \begin{bmatrix} \textit{adv} \\ \text{MOD} \begin{bmatrix} \text{SEM} \,|\, \text{KEY} \ \boxed{k} \begin{bmatrix} \text{RELN} & \textit{quant} \\ \text{INDEX} & \boxed{\alpha} \end{bmatrix} \\ \text{CRD} \begin{bmatrix} \textit{crd-} \\ \text{MODE} \ =_{\vee} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY} & \boxed{k} \\ \text{RELS} & \langle\rangle \\ \text{CONS} & \langle\rangle \end{bmatrix} \\ \text{CRD} \begin{bmatrix} \textit{crd-} \\ \text{MODE} \ \textit{none} \end{bmatrix} \\ \text{BACKGROUND} \left\langle \textit{unique}(\boxed{\alpha}, \, l_{\top}) \right\rangle \end{bmatrix}$$

The correlative expression introduces a condition stating that there is only one referent $\boxed{\alpha}$ that satisfies the semantic conditions associated with the clause MRS representation: $\textit{unique}(\boxed{\alpha}, l_{\top})$, where α is the referential argument of the constituent that the correlative attaches to and $l_{\top}$ is the global top label. This condition should basically require that only one of the disjuncts equated to α can allow the formula to be true in the model.

One final matter concerns the surface realization of the correlative. It is allowed to interleave with the constituent that is attaches to, but as proposed by den Dikken (2006), it should be sensitive to the presence of interpretive focus. For example, in the cases below the interpretive contrast is always placed on the NP *a joint*, and as a consequence either can be placed in any position:

(42) a. Either Fred handed someone $\underline{\text{a joint}}$ or he handed something even worse.

b. Fred either handed someone $\underline{\text{a joint}}$ or he handed something even worse.

c. Fred handed either $\underline{\text{SOMEONE a joint}}$ or he handed something even worse.

d. Fred handed someone either $\underline{\text{A JOINT}}$ or he handed something even worse.

Compare with a case where the interpretive contrast is located in the entire conjunct:

(43) <Either> Fred handed Kim <*either> something or Jones took it from him.

I will follow Hofmeister (2005) in assuming that an information-structure feature [CONTR(ASTED) *bool*] indicates whether a given sign is interpreted contrastively or not, and that the correlative must precede the interpretive focused element in the conjunct. This is captured in the linear precedence rule in (44) requiring that the correlative precedes the contrasted element.

(44) $$\begin{bmatrix} \text{MP} \mid \text{FORM } \langle \textit{ either } \rangle \\ \text{SYN} \mid \text{HEAD} \mid \textit{adv} \end{bmatrix} \;<\; \text{X[CONTR+]}$$

I also assume that each disjunct must contain at least one interpretively contrasted element. This can be ensured by a rule stating that each of the daughters of a coordinate structure specified as [MODE $=_\vee$] must contain at least one one [CONTR +] element in the DOM list:

(45) $$\begin{bmatrix} \textit{coord-cx} \\ \text{MTR} \begin{bmatrix} \text{CRD} \begin{bmatrix} \text{MODE} =_\vee \end{bmatrix} \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{DTRS} \left\langle \begin{bmatrix} \text{DOM} \left\langle \text{[CONTR +]} \right\rangle \bigcirc \textit{list} \end{bmatrix}, \begin{bmatrix} \text{DOM} \left\langle \text{[CONTR +]} \right\rangle \bigcirc \textit{list} \end{bmatrix} \right\rangle \end{bmatrix}$$

Hofmeister (2005) provides arguments against the movement analysis of den Dikken (2006) and shows how some of den Dikken's data follows from the fact that *either* is an adverbial expression, without further stipulations. One case in point is that *either* cannot appear after negation, as in **John didn't eat either rice or he didn't eat beans.* This follows from a more general fact that modal and evaluative adverbs cannot follow negation, aspectual auxiliaries, or subject-oriented adverbs. As Hofmeister points out, *either* mirrors this behavior.

(46) *Jules didn't either remove his shoes or Fred didn't take off his boots.

Hofmeister (2005) also notes that ellipsis can explain seemingly unbalanced prepositional phrase disjunctions, such as those in (47). Recall that complements get compacted by the *h-comp-cx* rule. Thus, in PP coordination the preposition is not compacted with the NP complement. Thus, the ⟨ [*either*] ⟩ domain list can shuffle with the domain list ⟨ P, NP ⟩ associated with the PP:

(47) You may choose to subscribe [to either DirectTV or to the Dish Network].

This is illustrated in the *h-mod-cx* structure seen below, with the domain shuffling constraint ⟨[*either*]⟩$\bigcirc$⟨[*to*], [*DirectTV*], [*or*], [*to*], [*the Dish Network*]⟩ being resolved as ⟨[*to*], [*either*], [*DirectTV*], [*or*], [*to*], [*the Dish Network*]⟩:

PP

[DOM ⟨[*to*], [*either*], [*DirectTV*], [*or*], [*to*], [*the Dish Network*]⟩]

[DOM ⟨[*either*]⟩] [DOM ⟨[*to*], [*DirectTV*], [*or*], [*to*], [*the Dish Network*]⟩]

Figure 7.11: Illustration of *either* interleaving

Examples in which *either* appears to float to the left follow from Left-Peripheral Ellipsis as illustrated in (48a). Hofmeister (2005) also points out that there are elliptical cases where the correlative simultaneously floats to the right as seen (48b). Here, the correlative adjoins to the leftmost edge as usual, is allowed to interleave to the right as usual, and Left-Periphery Ellipsis omits part of the second disjunct (below, brackets indicate the conjuncts, not the linearization domains):

(48) a. Either [John ate rice] or [~~John ate~~ beans].

b. [Congress will either pass the legislation] or [~~Congress will~~ lose our confidence].

Finally, I note that *either* is unable to shuffle into NPs as in *[*The either boy or the girl*] or with APs *[*easy either to please or easy to satisfy*] by virtue of the linear precedence rule defined in §6.2 that requires adverbs to precede the modified nominal/adjectival head. The relevant linear precedence rule is repeated below in (49).

(49) $$\left[\text{SYN}\,|\,\text{HEAD}\begin{bmatrix} \textit{adj} \lor \textit{adv} \\ \text{MOD}\ \boxed{1} \end{bmatrix}\right] < \boxed{1}\left[\text{SYN}\,|\,\text{HEAD}\ \textit{adj} \lor \textit{noun}\right]$$

7.2.3 Beyond English

I conclude by briefly sketching how the correlative marking patterns that Romance and other languages exhibit can be accounted for in the current grammar. For example, for a disjunction pattern like Portuguese [*ou* ... *ou* ...] ('or ... or ...'). I will assume that there are two coordination lexemes *ou*. One is a standard disjunction like *or* in English, and the second is a correlative marker that attaches to each conjunct in a correlative coordination structure. The latter are specified as [CORREL+] and as *crd-*. For languages like Romance I thus assume the following hierarchy of constructions:

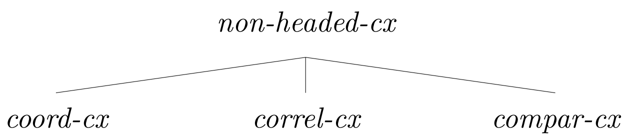


Figure 7.12: A type-hierarchy of coordinate constructions for Romance

The constraints imposed by the type *non-headed-cx* and on the type *coord-cx* are the same as in English.

The new *correl-cx* rule requires that both the left daughter and the right daughter are marked by correlative expressions, and that the same mode of coordination is present in each conjunct. Thus, if the first conjunct contains a disjunctive marker then so must the second conjunct. Note that the value of CRD makes it impossible to add non-correlative conjuncts.

(50)

$$\textit{correl-crd} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{CRD} \begin{bmatrix} \textit{crd-} \\ \text{MODE } \boxed{1} \end{bmatrix} \end{bmatrix} \\ \text{DRS} & \left\langle \begin{bmatrix} \text{CRD} & \begin{bmatrix} \textit{crd-} \\ \text{MODE } \boxed{1} \\ \text{CORREL}+ \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \text{CRD} & \begin{bmatrix} \textit{crd-} \\ \text{MODE } \boxed{1} \\ \text{CORREL}+ \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

In fact, since this construction makes no direct appeal to coordination markers, it may be the case that it can also be generalized to account for other correlative patterns, such as correlative comparatives (e.g. *the more you eat, the fatter you get*). I will not explore this possibility here however.

7.3 Agreement in Coordination

The grammar discussed so far remains silent about how agreement phenomena are captured in NP coordination. Languages exhibit various different strategies for the determination of agreement in coordination structures. Some, like English and Romance, employ *principled resolution* while others like Frisian and Arabic employ *partial agreement.*[10] In the former strategy the agreement features of the NP are derived from the agreement features of all of the conjuncts and in the latter agreement results from one particular conjunct. English is a principled resolution language with regard to person and number. For example, in the presence of 1*st* person the resolution is always 1*st*, and non-intersective conjunction always yields plural agreement. This observation is illustrated by the sentences in (51), where the plural reflexive pronoun is used to indicate the person of the coordinate subject:

(51) a. You and I may perjure ourselves.

b. You and Kerry have perjured yourselves.

In disjunction for example, one can argue that there is a tendency for requiring that both NPs have identical number specifications, while person agreement is again resolved as in conjunction. In the example below, due to Pullum and Zwicky (1986, 753), oddness arises because there is no way to satisfy these principled resolution conditions:

(52) a. Either they or I {*are / *am / *is} going to have to go.

b. Either this boy or that girl {?*are / *am / is} going to have to go.

In (52a) the verb *are* requires a third person plural subject and *am* requires a first person singular subject, but the disjunction cannot be resolved in such a way as to be compatible with those requirements. However, Pullum and Zwicky (1986) note that if the verb does not impose number or person agreement then the acceptability improves.

(53) Either they or I will get back to you.

A simple account of the latter is that (53) is an instance of Right-Periphery Ellipsis: *Either they ~~sing better than he does~~ or I sing better than he does.* This is consistent with a marginal oddness that this kind of example sometimes receives, and with the minor prosodic break that is usually placed after each pronoun, a trademark of this

[10]This terminology follows Corbett (1991).

kind of ellipsis. Crucially, no such account is available for (52a), e.g. **Either they ~~are going to go~~ or I are going to go.*

RPE can also explain puzzling cases like the one below, noted in Hoeksema (1988):

(54) a. Every day and every night were spent in bed.

b. Every day and every night was spent in bed.

The plural verb agreement in (54a) indicates that this is a standard NP non-intersective conjunction. Conversely, the singular agreement in (54b) can be seen as resulting from a clausal coordination with RPE of the VP: *Every day ~~was spent in bed~~ and every night was spent in bed.* The latter analysis also makes clear semantic predictions. If cases like (54b) do not contain instances of NP coordinations then it follows that collective predications are impossible. This prediction is borne out in the oddness of examples like the ones below:[11]

(55) a. *Every boy and every girl is kissing.

b. *Every man and every woman has been compared.

Thus, instead of having to resort to special machinery in order to get these facts, ellipsis actually obtains these for free. The same facts hold for Portuguese, for instance:

(56) a. Cada minuto e cada segundo foram contabilizados.
each minute$_{sg}$ and each second$_{sg}$ were accounted$_{pl}$

b. Cada minuto e cada segundo foi contabilizado.
each minute$_{sg}$ and each second$_{sg}$ was accounted$_{sg}$

Next we must consider why is it that other cases are not acceptable with singular verb agreement. Consider the data in (57). The RPE analysis predicts that all of these are grammatical, and yet the singular verb in (57b) is odd:

(57) a. Every boy and every girl were / was happy.

b. A boy and a girl were / *was happy.

[11]Of course, these are grammatical if parsed as instances of null complement ellipsis: *Every boy and every girl is kissing* (*someone*). What is at stake here is the intransitive usage of the verb.

This paradox can be explained as a matter of frequency and of preferential processing strategies. This is similar to the absence/presence of garden-path effects in Pearlmutter and MacDonald (1979), briefly discussed in Chapter 1 as well as in §3.4. First, note that the coordination of universally quantified NPs is very rare, while the coordination of non-quantificational NPs is extremely common. A search in the British National Corpus shows a very strong tendency for avoiding conjoining quantificational NPs, shown in Figure 7.13. There are various reasons why this may be so. The coordination of quantificational conjuncts involves more complex semantic interactions, as discussed in Chapter 3. There are various kinds of scopal interactions that can arise between conjuncts, with consequences on the truth conditions.

Det	BNC absolute frequencies
each	36
every	74
a	4,682
the	28,952

Figure 7.13: Occurrence of $[Det\ \ldots_n\ and\ Det]$ $(1 < n < 4)$

The fact that non-quantificational conjuncts are extremely frequent suggests that an NP coordination parse may be so preferential that the ellipsis parse (where the VP is elided) becomes impossible to obtain. This is consistent with what occurs in garden-path sentences. MacDonald et al. (1994) show that the garden-path effect is worsened if the first verb is more frequently a finite form than a passive participle. I thus propose that the oddness caused by the singular verb in (57b) is due to the fact that the NP coordination is so preferential, and that the oddness that it leads to is so disruptive, that the alternative elliptical clausal coordination parse is inhibited and not attempted by the parser.

On the other hand, the coordination of quantificational NPs is rather infrequent and thus not so preferential as to overwhelm the parser. It is easier to reconsider the parse once an unexpected singular verb is encountered, and thus the clausal coordination alternative is available for sentences like (57a).

Ellipsis thus allows us to deal with puzzling phenomena that would otherwise imply a complex number of stipulations. Rather, we have a basic ellipsis operation that is independently motivated and that can help explain a number of challenging cases. Ellipsis may also account for many other problematic data that have been noted elsewhere. For example, it is claimed by Munn (1993, 91–95) that languages like English, Brazilian Portuguese and others exhibit partial agreement in inverted structures like the ones in (58). The claim is endorsed by Colaço (1999) for European Portuguese.

(58) a. There is a man and three women in the garden.

b. Telefonaram / (?)Telefonou a Maria e os teus irmãos
phoned$_{pl}$ phoned$_{sg}$ the Maria e the your brothers
'Maria and your brothers called'

The datum in (58a) is less than grammatical for the English informants I have consulted (some speakers only accept the sentence if the verb is contracted), and (58b) may indeed be slightly degraded for some Portuguese speakers, specially if given out of the blue.

The claim that English and Portuguese have one kind of agreement in inverted structures, but another in non-inverted ones is most suspect. Not only the above data are somewhat degraded, but European Portuguese is rather strict with regard to agreement. A principled resolution strategy typically enforces plural agreement for NP conjunction as illustrated in the non-inverted counterpart in (59). Why would there be two different agreement strategies for the same language, some structures exhibiting resolution while others exhibiting partial agreement? A simpler explanation is in order.

(59) Um homem e uma mulher telefonaram / *telefonou
a man and a woman called$_{pl}$ / called$_{sg}$
'A man and a woman called'

Further evidence that closest conjunct agreement in Portuguese is a suspect notion is provided by examples like the following, which informants usually rate as slightly degraded:

(60) ? Foram editadas duas brochuras e dois livros.
were edited$_{pl.fem}$ two brochures$_{fem}$ and two books$_{mas}$

This kind of oddity becomes unremarkable in an ellipsis/processing account. In this view, sentences in (58) with a singular verb are regular S coordination structures with Left-periphery Ellipsis: *Telefonou a Maria e ~~telefonaram~~ os teus irmãos.* The fact that the singular form is more likely to be degraded, and that (60) is very degraded follow from the fact that the impossible NP coordination parse is overwhelmingly preferential from a processing point of view. It is much more frequent and simpler than the elliptical parse, and since the singular verb agreement mismatch yields ungrammaticality, the parse may crash without the elliptical alternative being considered. As a result, the data often sound less than perfect.

This account predicts that the acceptability of the singular form improves once the ellipsis analysis is forced and the NP coordination parse is made impossible. This prediction is borne out in the example below, where the sequence of constituents [NP] and [PP] in each conjunct does not form a constituent:

(61) Telefonou um homem na Terça e ~~telefonaram~~ duas senhoras na Quinta
phoned$_{sg}$ a man on Tuesday and phoned$_{pl}$ two women on Thursday

This kind of analysis is possible because Left Periphery Ellipsis does not require phonological identity, as noted in Chaves (2006). This is also true for English:

(62) a. There were two guards when I arrived, and only one guard when I left.
b. There was one fatality yesterday, and two others on the day before.
c. Is the bridge too tall or the waters too shallow?

Thus, *There is a man and three women in the garden* can be seen as involving left-periphery ellipsis and right-periphery ellipsis simultaneously: *There is a man ~~in the garden~~ and ~~there are~~ three women in the garden.* The fact that such examples involve two kinds of ellipsis may also explain why the sentence is less than grammatical for many speakers. Consider, for example, other cases where both kinds of ellipsis apply to the same sentence:

(63) Fred [confessed to the police that he BUYS], and [to his lawyer that he sometimes even SELLS] marijuana seeds.

Finally, this account also readily explains why (64) is ungrammatical: neither the ellipsis nor the inversion parse are available because the verb is in the singular and in both cases it would have to be plural. No additional stipulations required.

(64) *Telefonou os teus irmãos e a Maria
phoned$_{sg}$ the your brothers and the Maria

I therefore conclude that principled resolution languages such as Portuguese and English do not exhibit partial agreement phenomena in certain constructions only, as the apparent exceptions follow from the existence of an independently motivated peripheral ellipsis operation. Presumably, other languages have been misdiagnosed as allowing both partial agreement only when the verbal head is in a clause-peripheral position. This allows for more parsimonious theories of agreement, of semantic composition, and of syntax.

A general property of principled resolution is that it depends on the coordination mode. For instance, in intersective conjunction and in disjunction the number agreement is the same as the conjuncts, and in non-intersective conjunction plural agreement always obtains:

(65) a. [The owner or the editor of the newspaper]$_{=\vee}$ is a member of the club.

b. [The owner and the editor of the newspaper]$_{=\wedge}$ is a member of the club.

c. [The owner and the editor of the newspaper]$_{\in\wedge}$ are members of the club.

Other agreement patterns emerge from other coordination modes. Consider 'packaging conjunction' as discussed in Sag et al. (1985, 154,ft.22). Here, a singular NP can be obtained from plural NP conjuncts:

(66) Two ham rolls and two glasses of milk was more than she wanted.

But while number agreement may be associated with semantic import, person and gender agreement seem to be a different matter. In Romance for example, masculine gender obtains if there is at least one conjunct with masculine gender and a similar effect is seen in person agreement. A fairly general mechanism is necessary in order to account for cross-linguistic agreement patterns in coordination. This should make sure that the agreement value of the mother node depends on the agreement values of the conjunct daughters and the coordination type. I turn to this matter below.

7.3.1 Formalization

Agreement phenomena in coordination will be processed by a general agreement function F_{AGR} that evokes a number of language-specific functions responsible for establishing the particular agreement patterns in coordination. Thus, F_{gen} is a function mapping gender values from the conjuncts to the gender value of the mother, F_{num} is a similar function for computing number agreement, and F_{per} computer person agreement. The function F_{AGR} takes as input the agreement specifications of two conjuncts and the coordination mode, and outputs the agreement specifications for the local mother:

(67)
$$F_{AGR}\left(\begin{bmatrix}\text{AGR}\begin{bmatrix}\text{GEN} & \boxed{g1}\\ \text{NUM} & \boxed{n1}\\ \text{PER} & \boxed{p1}\end{bmatrix}\end{bmatrix}, \begin{bmatrix}\text{AGR}\begin{bmatrix}\text{GEN} & \boxed{g2}\\ \text{NUM} & \boxed{n2}\\ \text{PER} & \boxed{p2}\end{bmatrix}\end{bmatrix}, \boxed{c}\right) = \begin{bmatrix}\text{AGR}\begin{bmatrix}\text{GEN} & F_{gen}(\boxed{g1}, \boxed{g2}, \boxed{c})\\ \text{NUM} & F_{num}(\boxed{n1}, \boxed{n2}, \boxed{c})\\ \text{PER} & F_{per}(\boxed{p1}, \boxed{p2}, \boxed{c})\end{bmatrix}\end{bmatrix}$$

Thus, in principled resolution languages the agreement functions take into consideration all the conjuncts while in partial agreement languages only one of the conjuncts is taken into consideration by the agreement functions. F_{AGR} is applied locally, at the level of a coordination construction, as informally illustrated below:

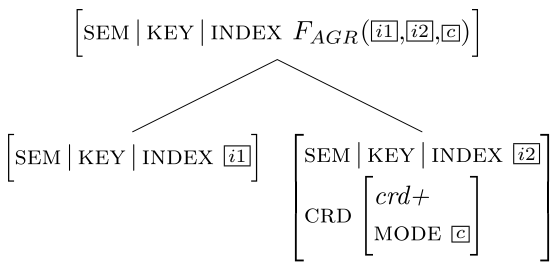


Figure 7.14: Agreement processing in coordination (preliminary)

In a principled resolution language like English or Portuguese, number agreement can be computed by F_{num} as follows: in the presence of non-intersective conjunction '$\in_\wedge$', plural agreement is obtained regardless of the agreement of the conjuncts. If however the conjunction mode is '=' (i.e. disjunction or intersective conjunction) then the conjuncts and the mother are required to have the same number agreement. This is illustrated in the definitions for F_{num} given below:

(68)

$\langle \boxed{n_1}, \boxed{n_2}, \boxed{c} \rangle$	$F_{num}(\boxed{n_1},\boxed{n_2},\boxed{c})$
$\langle \boxed{n_1}, \boxed{n_2}, \in_\wedge \rangle$	*pl*
$\langle \boxed{n_1}, \boxed{n_1}, = \rangle$	$\boxed{n_1}$
...	...

I will not formalize the agreement processing functions exhaustively here, and will assume that their workings are intuitive. For example, in non-intersective conjunction

F_{gen} yields masculine agreement if any of the two daughters is masculine and yields feminine otherwise. Similarly, F_{per} yields first person if any of the two daughters is first person, otherwise it yields second person if any of the daughters is second person, and finally it yields third person if all of the conjuncts are third person. In what follows I will focus on how the function F_{agr} is to be incorporated in a consistent manner with the current grammar of coordination.

In order for this analysis to work, each node of the coordination structure requires an application of F_{AGR}. Thus, the agreement values can potentially change along the coordination structure tree. This creates a technical difficulty. Recall that in coordinate constructions the KEY value corresponds to the one introduced by the coordination lexeme. But since INDEX introduces both the semantic variable and the agreement information, there is no way to percolate one without percolating the other:

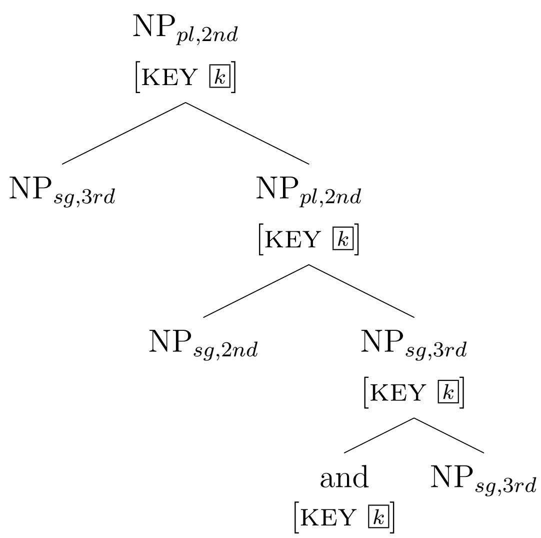


Figure 7.15: Semantic index percolation vs. Agreement processing

The intended behavior is that the variable associated with a coordination structure must always correspond to the variable introduced by the coordination lexeme, while the agreement specification of the coordination structure is a function of the agreement specifications of the local daughters. To solve this problem, I will make explicit the introduction of the MRS variable with a new feature VAR. The grammar as a whole will remain basically the same, the main difference being that the information about the variable is now decoupled from the agreement information:

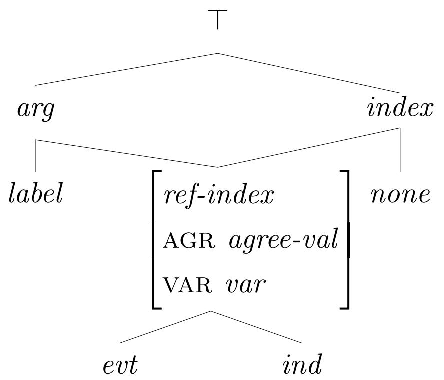


Figure 7.16: Type hierarchy of argument and index types

Where the *agree-val* type is defined as follows:

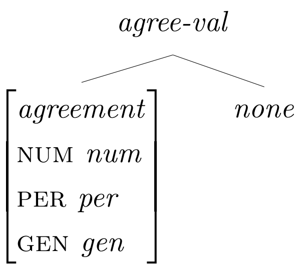


Figure 7.17: Type hierarchy of agreement types

I assume that only *ind* indices can contain agreement. Accordingly, the AGR value of eventuality indices is typed as *none*, as enforced by the following well-formedness conditions:

(69) a. *ind* ⇒ [AGR *agreement*]

b. *evt* ⇒ [AGR *none*]

The function F_{AGR} is assumed to yield [AGR *none*] if the conjuncts are [AGR *none*], as is the case of non-nominal coordination. This can be done straightforwardly by adding the following case to the definition given in (67) above.

(70) F_{AGR}([AGR *none*], [AGR *none*], *crd-mode*) = [AGR *none*]

The account starts by assuming that coordination lexemes incorporate the agreement specifications of the conjunct that they attach to. This can be done in a straightforward manner by stating that the coordinator's value of AGR is the same as the conjunct that it attaches to. Thus, I assume that the lexical entries for *and*, *or*, and *but* are extended in such a way. The constraint is illustrated in (71), in the lexical entry for non-intersective conjunction.

(71) NON-INTERSECTIVE CONJUNCTION LEXEME

$$\begin{bmatrix} \textit{word} \\ \text{MP}\,|\,\text{FORM}\ \langle\ \textit{and}\ \rangle \\ \text{SYN}\,|\,\text{HEAD} \begin{bmatrix} \textit{coord} \\ \text{SPEC} \begin{bmatrix} \text{SEM}\,|\,\text{KEY} \begin{bmatrix} \text{RELN}\ \textit{quant} \\ \text{INDEX}\ \boxed{\beta}\begin{bmatrix}\text{AGR}\ \boxed{1}\end{bmatrix} \\ \text{ARGS}\ \langle \ldots\boxed{l7}\rangle \end{bmatrix} \\ \text{CRD}\ \textit{crd-} \end{bmatrix} \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{KEY}\ \boxed{k} \\ \text{RELS} \left\langle \boxed{k} \begin{bmatrix} \text{RELN}\ \exists \\ \text{INDEX}\ \boxed{\alpha}\begin{bmatrix}\text{AGR}\ \boxed{1}\end{bmatrix} \\ \text{ARGS}\ \langle \boxed{l2}\ldots \rangle\end{bmatrix}, \begin{bmatrix}\text{LBL}\ \boxed{l4} \\ \text{RELN}\ \in_\wedge \\ \text{ARGS}\ \langle\boxed{\alpha},\boxed{\beta}\rangle\end{bmatrix}\right\rangle \\ \text{CONS} \left\langle \begin{bmatrix}\boxed{l4} \le \boxed{l2}\end{bmatrix}, \begin{bmatrix}\boxed{l4}\le\boxed{l7}\end{bmatrix}\right\rangle \end{bmatrix} \\ \text{CRD} \begin{bmatrix} \textit{crd+} \\ \text{MODE}\ \in_\wedge \end{bmatrix} \end{bmatrix}$$

Note that the new feature VAR does not have consequences for the overall grammar. Predicates still apply to INDEX and not to VAR precisely because the former feature contains information about the type of index and about agreement. Thus, in the computation of anaphora it suffices to state that the binder and the bindee have the same INDEX value. The agreement information located in INDEX ensures that the anaphoric linkage preserves agreement:[12]

(72) a. [Fred and Sue]$_{NP[\text{INDEX}\boxed{1}]}$ love [themselves]$_{NP[\text{INDEX}\boxed{1}]}$

b. Mary$_{NP[\text{INDEX}\boxed{1}]}$ saw [herself]$_{NP[\text{INDEX}\boxed{1}]}$

The next step is to extend the coordination rule so that F_{AGR} is applied and agreement specifications are computed, while the VAR value is shared between the coordination lexeme and the mother node. This is formalized in (73):

[12] Binding principles are specified in terms of the ARG-ST list, as in Pollard and Sag (1994, Ch.6).

(73) COORDINATION CONSTRUCTION (augmented with F_{AGR}):

coord-cx $\Rightarrow$

$$
\left[\begin{array}{ll}
\textsc{mtr} & \left[\begin{array}{ll}
\textsc{sem}\mid\textsc{key} & \left[\begin{array}{ll}
\textsc{lbl} & \boxed{l} \\
\textsc{reln} & \boxed{6} \\
\textsc{index} & \left[\begin{array}{ll}
\textsc{agr} & F_{AGR}(\boxed{\delta},\boxed{\alpha},\boxed{1}) \\
\textsc{var} & \boxed{4}
\end{array}\right] \\
\textsc{args} & \boxed{7}
\end{array}\right] \\
\textsc{crd}\mid\textsc{mode} & \boxed{1}
\end{array}\right] \\
\textsc{cx-sem} & \left[\begin{array}{ll}
\textsc{c-rels} & \left\langle \left[\begin{array}{ll}
\textsc{lbl} & \boxed{l9} \\
\textsc{reln} & \boxed{1} \\
\textsc{args} & \langle \boxed{\delta}, \boxed{\alpha} \rangle
\end{array}\right] \right\rangle \\
\textsc{c-cons} & \left\langle \left[\boxed{l9} \leq \boxed{l12}\right], \left[\boxed{l9} \leq \boxed{l2}\right] \right\rangle
\end{array}\right] \\
\textsc{dtrs} & \left\langle \left[\begin{array}{ll}
\textsc{sem}\mid\textsc{key} & \left[\begin{array}{ll}
\textsc{reln} & \mathit{quant} \\
\textsc{index} & \boxed{\delta} \\
\textsc{args} & \langle \ldots \boxed{l12} \rangle
\end{array}\right] \\
\textsc{crd} & \mathit{crd-}
\end{array}\right], \left[\begin{array}{ll}
\textsc{sem}\mid\textsc{key} & \left[\begin{array}{ll}
\textsc{lbl} & \boxed{l} \\
\textsc{reln} & \boxed{6} \\
\textsc{index} & \boxed{\alpha}\left[\textsc{var}\ \boxed{4}\right] \\
\textsc{args} & \boxed{7}\langle \boxed{l2} \ldots \rangle
\end{array}\right] \\
\textsc{crd} & \left[\begin{array}{l}
\mathit{crd+} \\
\textsc{mode}\ \boxed{1}
\end{array}\right]
\end{array}\right] \right\rangle
\end{array}\right]
$$

The only revision to the original coordination rule concerns the percolation of KEY information. The agreement in the mother node is a function of the agreement information specified by each conjunct but the semantic variable $\boxed{4}$ associated with the mother is always the same, throughout the coordination structure.

All other aspects of the grammar discussed so far remain the same. The value of INDEX is still the relevant value for semantic predication, variable binding, anaphora, etc.. The only difference resides in that upon translation to FOL, it is the structure-sharing observed in VAR that indicates multiples occurrences of the same MRS variable.

7.3.2 Case Mismatches

As discussed in §5.2, conjuncts are usually required to have the same case marking:

(74) a. *I saw [her$_{acc}$ and he$_{nom}$].

b. *He likes [she$_{nom}$ and me$_{acc}$].

c. *Kim gave a book to [him$_{acc}$ and I$_{nom}$].

But English is also known to exhibit some exceptions in this regard. There are certain grammatical cases where conjuncts have different case markings, and exhibit a certain linear order. Even though there is considerable variation between speakers, many find the following examples acceptable:

(75) a. She and him went to the store.

b. This is between him and I.

There are some attempts in the literature to make sense of the data, such as Emonds (1986) and Sobin (1997) who argue that the facts are the emergent result of a naturally acquired grammar (in which coordinated pronouns are universally accusative) pitted against an explicitly learned system (in which coordinated pronouns are prescribed to be nominative in syntactic environments where a non-coordinated pronoun would be nominative).

There are several phenomena that conspire to make this a difficult problem and which should be teased apart. One is the linear order of person, and the other is case assignment. The ordering tendency typically reflects a deictic hierarchy as in *you and your sister* (2nd precedes 3rd). However, in the case of the personal nominative pronoun this is overridden:

(76) a. My sister and I/me went swimming.

b. ??I and my sister went swimming.

c. Me and my sister went swimming.

Observe that (76a) reverses the hierarchy (with 3rd person before 1st) and that (76b) – which follows the hierarchy – is actually *worse* than (76a,c). This suggests that not all pronouns are required to follow the hierarchy. For instance, nominative 1st person pronouns are required to follow the hierarchy but not accusative 1st person pronouns.

A corpus study in Grano (2006) shows that there is a clear preference for [*X and I*] over [*I and X*] and for [*s/he and X*] over [*X and s/he*]. Moreover, with ordering tendencies factored out, the corpus data reveal that there is a higher percentage of nominative forms for *1sg* as compared to *3sg*:

	1sg nominative	*3sg* nominative
subject position	82% (n = 624)	57% (n = 184)
object position	34% (n= 125)	06% (n = 78)

Figure 7.18: Corpus study results: *1sg* versus *3sg*

Grano argues that this effect results from the fact that n is much higher for subject-position 1sg than for subject-position 3sg. I this view, since the former is more salient for prescriptive pressure, it follows that it is also more likely to be corrected into nominative.

However, it remains unclear how exactly these data are to be accounted for: at the level of human processing of grammatical constraints (where these cases are ungrammatical but somehow the parser does not crash) or at the grammar proper (where these are in fact a part of modern English grammar). This may even be a case where both processing and grammar constraints interact and allow for acceptable (and yet somewhat marked or degraded) case mismatches. Ungrammaticality is certainly a gradient effect caused by collection of syntactic, semantic, processing and contextual factors, rather than an 'all-or-nothing' property of grammar.

I note that the theory proposed in this chapter is in principle capable of modeling the above phenomena as a form of principled resolution in coordination structures. First, the CASE feature can be made an INDEX feature rather than a HEAD feature. Second, a new function F_{case} can require that conjuncts have the same case, except in the presence of 1st person pronouns, for certain orders of conjuncts. For illustration, consider two possible case resolutions in (77). In (77a) the case of the second conjunct is ignored for processing of case resolution, but in (77b) the case of the conjuncts cannot be ignored and the function F_{case} fails:

(77) a. *her and I*:

$$F_{case}([3rd, acc], [1st, nom]) = [1st, acc]$$

b.**she and me*:

$$F_{case}([3rd, nom], [1st, acc]) = \perp$$

Note that F_{case} must also take as input person information of each of the two conjuncts, which is necessary to capture the linear order asymmetries between *I* and *me* for instance. Of course, this account rules out **I saw she* on the basis that the verb requires a *s-acc* complement and the object NP is in fact *nom*. The function F_{case} is not active in these cases because it is only evoked in coordination structures.

This approach requires minimal changes to the feature geometry, but it also requires that the kind of co-indexing that Binding Theory establishes is defined as co-indexing AGR and VAR, not INDEX values. This is of course because binders and bindees bear different case specifications. I will not make the respective reformulations to the grammar here, even though these are fairly minor, essentially because it is unclear what exactly are the grammatical combinations in pronoun coordination, given the speaker variability and gradient acceptability.

7.4 Summary

§7.1 A theory of extraction is provided to account for how unbounded dependencies are recorded and propagated in the syntactic tree. The proposal interacts with symmetric coordination in the intended way to obtain the CSC and ATB phenomena as discussed in Chapter 5. An analysis of asymmetric coordination is proposed, which is based on the coercion of the backgrounded conjuncts. The latter conjuncts are underspecified for a number of information and as a result, the non-ATB extraction patterns are allowed.

It is also suggested that this coercion has wider implications, as it also enables the grammar to account for cases of (non-parasitic) extraction out of adjunct phrases. Finally, it is also shown how challenging extraction phenomena involving coordination and extracted modifier phrases can be dealt with without major stipulations.

§7.2 The syntax, semantics and pragmatics of correlative markers in English is discussed within the present framework and various phenomena are accounted for. This includes the linear order flexibility of *either* when attaching to verbal coordinates, which essentially follows as a consequence of the linearization constraints that are in place for adverbial expressions in adjunction. It is also briefly discussed how the grammar may capture correlative coordination patterns in other languages.

§7.3 The coordination rule is extended with a general agreement function that computes how number, gender and person agreement is determined in coordination structures. In the case of languages like English this function triggers a principled resolution of gender and person agreement information.

It is also shown how apparent exceptions for agreement resolution in English and in Portuguese can be seen as predictions of the same peripheral ellipsis phenomenon. Semantic arguments are provided to show that the agreement phenomena are rather uniform, and no closest conjunct agreement phenomena actually exists. Various recalcitrant cases are shown to arise from processing preferences rather than from grammar proper. This allows us to explain the agreement asymmetries observed in various data without further theoretical complications.

Finally, it is also shown how the grammar fragment can be scaled to deal with exceptions in pronominal case marking in English, these are taken up as instances of principled resolution.

Chapter 8
On Peripheral Ellipsis

This chapter concerns two elliptical phenomena that are very common in coordination structures: Right Periphery Ellipsis (RPE) and Left Periphery Ellipsis (LPE). These are of great relevance for achieving a leaner and more parsimonious account of coordination, as argued in previous chapters. In what follows I will show that both LPE and RPE are best analyzed as deletion. The empirical evidence show that these two kinds of ellipsis operate under very different syntactic, semantic, and morphophonological conditions. The account is based on previous research, put forth in Chaves (2005a), Chaves (2006), Chaves (2007), and Chaves and Sag (2007).

There are several important contributions made here. On the one hand, it is shown that the RPE data go well beyond coordination structures, unlike what is usually assumed in the literature where RPE is seen as a phenomenon that is particular to coordination. Another fundamental aspect of this study is that it shows that RPE and LPE apply in a uniform way not only to phrasal and clausal structures, but also to lexical structures. The existence of the latter is an often overlooked aspect of ellipsis, but the data clearly indicate that both the sub- and supra-lexical ellipsis phenomena exhibit the same syntactic, semantic, and morphophonological conditions. As such, these instances should be accounted for in a uniform way, not as the result of separate kinds of operations as is often argued.

This chapter thus provides independent accounts for RPE and LPE phenomena, that encompass various kinds of constructions and make a number of predictions that are usually dealt with via stipulations.

8.1 Right-Periphery Ellipsis

Under certain conditions, right-peripheral elements can be omitted in each of the daughters except for the last one. Characteristically, the rightmost element is separated from the rest of the structure by a prosodic break:

(1) a. [Kim likes] [and Mia hates] [chocolate bagels].

b. Tracy is [on the cover of] [and featured in] [the July 2001 issue].

c. There seem to be [strong arguments in favor of] and [little to be said against], [extending your idea to other domains of application].

d. The difference between [an interesting] and [a tedious teacher] is this.

One of the trademarks of RPE is that the longer the strings in the brackets are, the more contrastive prosody tends to be placed in the periphery of the conjuncts. Thus, a significant amount of prosodic contrast must be placed on *favor of* and *against* in (1c), while a minor contrast suffices for *likes* and *hates* in (1a). Ideally, a proper account of RPE ought to predict this fact. Some accounts like Hartmann (2000) hinge on the idea that the ellipsis site is adjacent to the focused element, by proposing that the focus causes the ellipsis. But ever since Postal (1974) that it is known that the focused element need not be adjacent to the ellipsis site:

(2) [I find it *easy* to believe] [but Joan finds it *hard* to believe] [that Tom is a dishonest person].

One crucial and well-known property of RPE is that it can target arbitrarily embedded structures, and exhibit no sensitivity to island constraints:[1]

(3) a. [John thought Mary was trying to sell] [and Mary thought John was trying to donate], [his 1974 Cadillac].

b. [One police officer said that he liked] [and another even boasted that he defended] [vigilante justice].

(4) a. [John wonders when Bob Dylan wrote], [and Mary wants to know when he recorded], [his great song about the death of Emmet Till].

[1]This includes *wh*-islands, the Complex NP Constraint, or the Right Roof Constraint. See Neijt (1979) and Wexler and Culicover (1980, 299) for example.

b. [I know a man who sells], [and you know a person who buys], [pictures of Elvis Presley].

c. Who$_i$ does [Mary buy], and [Bill sell] [pictures of $\_\ _i$]?

Some authors like Hartmann (2000, 141) claim that conjuncts must exhibit an identical syntactic structure, but this is also known to be incorrect. Wexler and Culicover (1980, 299) and Goodall (1987, 97), already have pointed out that no syntactic parallelism is required in RPE. Consider the examples in (5):

(5) a. [John flew], [and Tom planned to drive], [to the south of Italy].

b. [John bought], [and Mary put in the fridge], [two bottles of wine].

c. [Joan sells], [and Fred knows a man who repairs], [washing machines].

Furthermore, RPE only targets peripheral elements in the domain of application. Thus, in S coordination only S final elements can be omitted:[2]

(6) *Mike may have talked to t_i about love and certainly talked to t_i about marriage [the tall woman in the black dress]$_i$.

(Levine 2001, 163)

Napoli (1983), McCawley (1988, 282), Hendriks (1995, 54) and many others assume that RPE only arises in coordination structures. But this is known to be problematic at least since Bresnan (1974) and Hudson (1976b), where it is noted examples involving subordination structures:[3]

(7) a. It seemed likely to me, though it seemed unlikely to everyone else, that he would be impeached.

b. It doesn't matter to you, though it matters very much to me, whether my theory is correct.

Moreover, not only RPE occurs in comparatives as shown in (8), it also occurs in virtually any kind of construction as shown below, from (9) to (12).

[2]Postal (1998) argues that (6) is grammatical. I have found no speaker that shares this intuition, and will consider this example ungrammatical.

[3]But see also Goodall (1987, 97) and Williams (1990).

(8) a. I know [more women who admire] [than men who detest] [paintings by Picasso].

b. We would be better off [in a situation with] [than in a situation without] [trade regulations].

(9) a. Of the people questioned, those who liked outnumbered by two to one those who disliked the way in which the devaluation of the pound had been handled.

b. It's interesting to compare the people who like with the people who dislike the power of the big unions.

(Hudson 1976b, 550)

Postal (1994) offers more examples of RPE between a subject and a complement:

(10) a. Politicians who fought for, may well snub those who have fought *against* chimpanzee rights.

b. Spies who learn *when* can be more valuable than those able to learn *where* major troop movements are going to occur.

I provide various other instances of RPE non-coordinate structures below:

(11) a. The institution directed the interns who already *had*, to companies that *didn't have* a great deal experience with micro-industrial management.

b. The people who *supported* are in fact not very different from the people who *didn't support* George W. Bush.

c. Welcome to my *first* which will probably also be my *last* freelance production gig.

d. Tom claimed that he *liked* simply because he knows that Dana absolutely *hates* the president's handling of the economy.

e. If Tom says he liked then I can only assume that you *didn't like* the new Victoria Secret catalog.

(12) a. We tried to compare *small* with *large* firms.

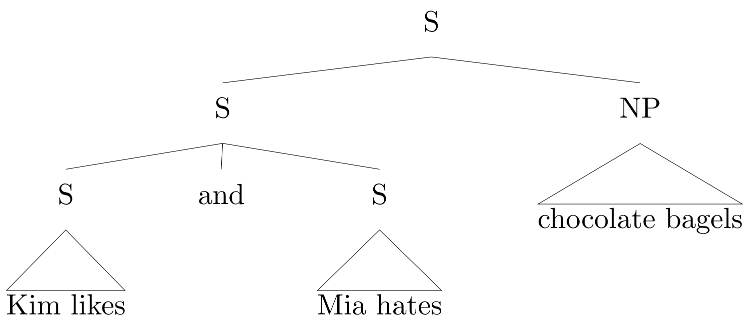
b. The system can be programmed to discriminate *small* from *big* gas molecules.

This already poses a problem for most accounts of RPE, given that these typically assume that the phenomena are restricted to coordination. I briefly discuss these accounts below.

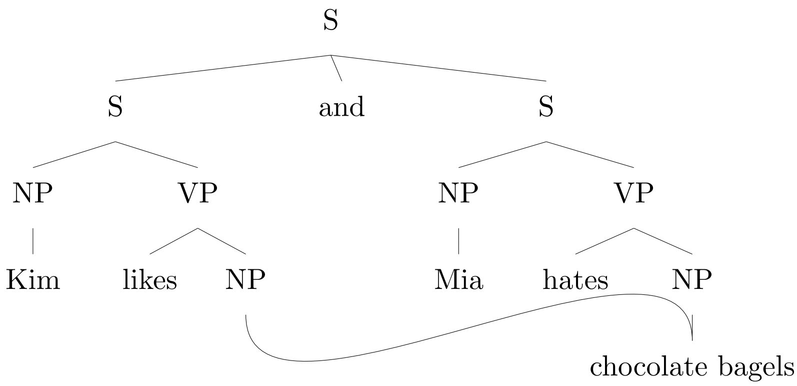
8.1.1 Three Kinds of Accounts

Before going further in the characterization of the phenomenon, I will point out that there are three main avenues for the analysis of RPE:

- **Displacement** (extraction or movement): the peripheral material is moved or extracted to the right. This ranges from transformational accounts like Ross (1967, 99) and much subsequent work like Sabbagh (2007) to Categorial Grammar accounts such as Gazdar (1981) and Steedman (2001).[4]



- **Multidominance**: the syntactic representation is no longer a tree, as the rightmost node is the daughter of several mothers simultaneously. This is advocated in McCawley (1982), Radford (1988), Johannessen (1998), and Wilder (1999).



[4]The account in Steedman (2001) is lacking in uniformity. In Steedman (2001, 41,62), a sentence like [*Anna met, and might marry, Manny*] requires the operation of forward composition $>\mathsf{B}$, but [*I shall buy today, and cook tomorrow, the mushrooms you bought*] requires backward crossed composition $<\mathsf{B}_\times$. Moreover, [*Tom likes, and I adore, beans*] requires subject type raising $>\mathsf{T}$ followed by $>\mathsf{B}$. In my account all three cases are captured by one and the same operation.

- **Deletion**: peripheral strings are deleted from non-final conjuncts. Traditional accounts proposed deletion of syntactic structure, such as Wexler and Culicover (1980, 298) or van Oirsouw (1987), while more recent proposals consist in deletion of linearized elements such as Swingle (1995), Blevins and Sag (1996), Wilder (1997), Hartmann (2000), Yatabe (2002), Beavers and Sag (2004) and others.

Postal (1998, 98–108) points out that the exact nature of the multidominance accounts is most unclear. It is never made clear under what conditions multidominance can or cannot occur, and what consequences it has for other aspects of the grammar.[5] But even if these accounts were well-defined, they would still miss an important generalization. All of the above resort to operations that only apply to coordination structures. This point is noted in Goodall (1987, 98), who argues that RPE cannot be treated in terms of his account of union of reduced phrase markers because the data go beyond coordination.

The displacement and multidominance accounts also run into major problems. For example, even though RPE can apply to arbitrarily embedded structures, there is no independent evidence for unbounded rightward extraction:

(13) a. I know a man who *likes* and you said that Mia knows someone who *adores* the house on Carrol Street.

b.*A man who *likes* called me on the phone the house on Carrol Street.

Barring unmotivated stipulations, there is no reason to assume that rightwards displacement only occurs in the presence of a coordination. In fact, given the non-coordination data previously discussed, this kind of assumption is untenable.

Another problem concerns co-referentiality. If the rightmost element is one and the same than this predicts that there is only one predication. This is too strong as it wrongly predicts that in (14) there is one and the same valentine card:

(14) a. Fred mailed *Mary* and Tim actually handed *to Sue* a valentine card.

b. Sue thought of *writing* and Tom actually *wrote* a valentine card.

Another problem stems from the fact that the shared rightmost element can have a completely different semantic function in each conjunct:

[5]For example, Johannessen (1998) defines node *Merging* as 'unifiable material in the same syntactic position can be merged'. It is left to the reader to consider what counts as the same syntactic position, what makes elements (non)unifiable, and how massive overgeneration due to free *Merging* is prevented.

(15) Did you say that Tom *pushed* or that Tom was *pushed by* his older brother?

Yet another semantic problem for displacement and multidominance accounts is the existence of both strict and sloppy readings as shown in 16. Only the strict reading is expected if there is only one realization of the rightmost NP:

(16) Chris likes and Bill loves his friend.

Note that a phonological deletion account has none of the above problems. Both strict and sloppy readings are predicted, no co-referentiality is enforced, and no unbounded rightward extraction is postulated.

But there are more well-known reasons why deletion offers a superior account of RPE. This was first noted in Levine (1985) and McCawley (1987), and concerns the fact that anaphoric linkages are the same as in the corresponding non-elided counterparts. This fact is unexpected if the pronoun is realized in a higher node:

(17) Mary$_i$ liked and I thought she$_i$ hated that picture of her$_i$.

More evidence against multidominance and displacement comes from the fact that RPE allows p-stranding to occur in languages that do not allow p-stranding, as noted by McCloskey (1986). These include Irish, Polish, and several Romance languages such as Portuguese:

(18) a. Isto é válido para processos iniciados em, ou a partir de, Janeiro de 2003.
this is valid for processes initiated in or starting from January of 2003

b.*Janeiro de 2003, isto é válido para processos iniciados em _ .

I also note a final, albeit crucial, problem for displacement and multidominance accounts. This is the fact that RPE can also operate on lexical items as shown in (19). Note that the semantics of the elided examples is the same as in the non-elided counterpart, as expected in a deletion account:

(19) a. You prefer the heart- or the flower-shaped bead box?

b. The difference between a five- and a ten-minute therapy session

c. You can choose between a single- and a double-digit number.

d. Did you order the hard- or the soft-cover edition?

e. This is either a second- or a third-hand copy of the tape.

(20) a. These events took place in pre- or in post-war Germany?

b. We can use either un- or completely oversalted dough.

This is a fundamental problem because there is no independent evidence for rightward movement/extraction of word parts: *[*We can use un-_ to cook the bread*] [*-salted dough*], nor for some form of discourse anaphora analysis: *[*The difference between a five-minute therapy session and a ten-*].[6]

The data in (21) show that Portuguese is similar. None of the strings *a bio* and *o pré* are well-formed NPs in isolation, but in this case they are grammatical and understood as it they were realized as *a biotecnologia* and *o pré-processamento*:[7]

(21) a. A bio- e a nanotecnologia são importantes áreas de investigação
the bio and the nanotechnology are important areas of research

b. O pré- e o pós-processamento dos dados está concluído
the pre and the post-processing of-the data is concluded

Below I offer some 'long-distance' cases of word-part RPE in English. Bear in mind that given the length of the conjuncts a fair amount of contrastive focus is necessary:[8]

(22) a. We ordered the HARD- but they got us the SOFT-cover edition.

b. Fred majored in NEURO- while Mia majored in SOCIO-linguistics.

The most parsimonious account of these data would resort to a unique RPE operation, rather than assuming that there are two kinds of ellipsis operations at work. Further evidence for this comes from the fact that RPE can target both word-parts and phrases simultaneously. Consider (23) from Dutch, due to Booij (1985, 147):

(23) ... dat [Jan appel~~sap~~ ~~dronk~~]$_S$ en [Piet druivesap dronk]$_S$
... that [Jan apple juice drank]$_S$ and [Piet grape juice drank]$_S$

[6]Furthermore, allowing sublexical items to move out into syntactic structure goes against the idea that words are closed off from syntax, cf. Lexical Integrity (Chomsky 1970), The Generalized Lexical Hypothesis (Lapointe 1979,22), and the Word Structure Autonomy Condition (Selkirk 1982,70)

[7]This makes it very hard to accept Vigário and Frota (2002), where it is claimed word-part ellipsis in Portuguese is limited to lexical coordination, and that phrasal ellipsis is a different process altogether.

[8]Wilder (1997, 83) also offers the example (?) *Your theory* under- *while my theory* over*generates.*

The above evidence calls for a uniform account of phrasal and word-part ellipsis where the sub-lexical and phrasal phenomena are the result of the same underlying mechanism. Further evidence for this is provided by Booij (1985) who noted that there are cases in which one daughter undergoes word-part ellipsis while the other undergoes phrasal ellipsis. This process is more common in morphologically more productive languages such as German and Dutch, but I also provide some examples from English in (25). Note that in the example that Booij provides the expression *ijsberen* is a compound but *bruine beren* is not:

(24) [[[ijs]$_{N}$ [~~beren~~]$_{N}$]$_{N}$]$_{NP}$ en [[bruine]$_{A}$ [beren]$_{N}$]]$_{NP}$
polar- and brown bears

(25) a. It is neither un~~patriotic~~ nor overly patriotic to tread that path.

b. The ex-~~smokers~~ or current smokers had a higher blood pressure.

c. Please list all publications of which you were the sole ~~author~~ or co-author.[9]

This also means that non-standard accounts of RPE such as the axiomatic-based approach in Milward (1990) are also in trouble. Therein, RPE is licensed in terms of proofs that span an initial category '*s*' and the rightmost shared constituent. If all conjuncts can have a proof starting from the same initial category and reaching the same final category, then the coordination is valid. But not only Milward (1990) wrongly assumes that RPE is limited to coordination, but in (25) the final categories are completely different: one is phrasal while the other is sub-lexical.

Indeed most research does not recognize that sub-lexical and phrasal RPE are due to one and the same RPE operation. For instance, Di Sciullo and Williams (1987) argue that word parts are also independent words. However, this raises more problems than it solves because it fails to explain why a 'NP' *a four-* is interpreted as *a four-star luxury hotel* or why **Describe the behavior of a pre-* is impossible.

If sub-lexical and phrasal RPE is due to the same mechanism then one would also expect to find word-part ellipsis in various kinds of non-coordinate constructions. This prediction is borne out in data below, from Alsina (1990), Wiese (1996), Wilder (1997):

(26) a. How to distinguish neuro- from psycholinguistic claims.

b. The report compares a four- with a five-star luxury hotel.

[9]Attested example taken from Huddleston et al. (2002, 1325, ft. 44). Another candidate is *They sell new and second-hand books*, also from Huddleston et al. (2002, 1283).

c. I am more interested in pre- than in post-World War II.

Below I offer some other examples, adapted from naturally occurring data:

(27) a. Explain how signals move from a pre- to a post-synaptic neuron.

b. The passage from a pre- to a post-Vatican Council is imminent.

In sum, displacement and multidominance accounts raise many problems that require a non-trivial number of stipulations. A phonological deletion account on the other hand is compatible with all of the above phenomena, without the need for further assumptions. RPE is best viewed as the deletion or right-peripheral phonologic items (phrasal or lexical) and that can occur in virtually any kind of construction. To my knowledge no previous account can claim this kind of uniformity and degree of generalization. For example, Wilder (1997) is aware of many of the facts discussed above but avoids the problem of characterizing what exactly are the syntactic (and lexical) domains that can undergo RPE, and focuses mainly on phrasal coordinate structures. Below I explore the nature of this deletion process in more detail.

8.1.2 On Morphophonological Deletion

One important aspect of the deletion analysis is that phonological identity is necessary. This is borne out in the data shown in (28):[10]

(28) a.*John *loves* and Mary *hates* herself/himself.

b.*I said that *the birds* but you claimed that *the cat* was ill.

c.*Tom said that *I* and Ann claimed that *she* is the best swimmer.

However, semantics also plays an important role in this kind of deletion phenomenon. The ungrammatical examples in (29) show that RPE requires more than just phonological identity:

(29) a. *Sue had to *erase* and Tom was asked *to join* the board.

b. *I put the *money* while Roger left the *boat* in the bank.

c. *Robin *swung* and Leslie *tamed* an unusual bat.[11]

[10]There are however some special cases in English, discussed in §8.1.3 in more detail.

[11]Example taken from Levine and Hukari (2006, 156).

In (29b) one verb preferentially selects a financial institution, while the second verb selects a geographical location. As expected, this shows up in word-part ellipsis also:[12]

(30) a. *We need new black~~boards~~ and floorboards.

b. *There stood a one~~-armed~~ and well-armed man.

c. *Did you find a fire~~trap~~ or a mousetrap?

In (30b) the noun *boards* is forced to refer both to a wide flat surface designed for writing and to a wood section. The above data show that the relevant identity conditions for peripheral ellipsis are not only phonological but that they also involve some semantics.

Note however that sense identity is not so strong as to prevent RPE of polysemous word senses. Consider the data in (31):

(31) a. It is rumored that the president himself *painted* and that Gandhi actually *walked through* this very door.

b. Beethoven *composed* but never *listened to* the 9th Symphony.

In (31b) the verb *compose* can only apply to the information sense of music, not to the physical sense of sound (e.g. #*Fred composed a loud song*). Conversely, *listen* can only apply to sound and not to the abstract, symbolic sense of sound representations (cf. #*Fred listened to the tablature*). This in turn suggests that RPE is sensitive to the core meaning of the morpheme, rather than to semantics proper. The hypothesis that the relevant kind of identity is morphophonological means that cases like (32) can be captured without the need to assume that RPE requires *part-of-speech* identity or some kind of syntactic identity.

(32) *Mary *saw* and John *has been* flying planes.

There also are some important prosodic aspects associated with RPE. Hankamer (1973) and Bresnan (1974) note that unstressed pronouns cannot be omitted:

(33) a. *Alice *composed* and Tim *performed* it.

b. *He tried *to persuade* but he couldn't *convince* them.

[12]Example taken from Artstein (2005). Bauer (1998) makes a similar observation, but both authors do not view the phrasal and lexical RPE data as being the same phenomenon.

Unstressed pronouns are prosodically weak, and as such are unable to occur in environments that require prosodic independence. Conversely, heavily stressed pronouns gain prosodic independence and can be elided as shown in (34).

(34) He tried *to persuade* but he couldn't *convince* THEM.

McCawley (1988) and Swingle (1995) propose that both remnants and elided items must be Phonological Phrases and Intonational Phrases, respectively. This is too strong as it glosses out cases like the prefixoid '*pre-*' which can function as a remnant in *Pre- and post-revolutionary France*, but which is unable to project Phonological or Intonational Phrases. A more general view is order. One that does not stipulate the kind of prosodic constituent that is necessary for RPE. This can be achieved by abandoning the assumption that RPE is a PF interface operation: RPE is a morphophonological deletion process that can only apply to prosodically independent elements in the local domain of application. Put in more precise terms, a given node can be partially deleted if it consists of four sequences A, B, C and D of prosodic constituents c, such that B and D are morphophonologically identical. This is illustrated in the unary branching tree in Figure 8.1.

$$\begin{array}{c}
\underbrace{c_1 \dots c_n}_{A}\underbrace{c'_1 \dots c'_k}_{C}\underbrace{c'_{k+1} \dots c'_{k+m}}_{D} \\
| \\
\underbrace{c_1 \dots c_n}_{A}\underbrace{c_{n+1} \dots c_{n+m}}_{B}\underbrace{c'_1 \dots c'_k}_{C}\underbrace{c'_{k+1} \dots c'_{k+m}}_{D}
\end{array}$$

Figure 8.1: Schematic view of RPE of sequences of independent prosodic constituents

A unstressed pronoun is unable to project an independent prosodic constituent c and therefore is not visible to the RPE operation. If sufficiently stressed however, it projects an independent prosodic constituent and thus becomes eligible for RPE. We can also observe this effect on the remnants of RPE. McCawley (1988) points out that cliticized verbs, (unstressed) determiners, and coordination particles cannot be stranded:

(35) a.*I think that I'd and I know that John'll buy one of those portraits of Elvis.

b.*Tom has always wanted a so I've given him my coffee grinder.

This is as expected, since these elements are required for independent prosodic reasons to prosodify with the adjacent prosodic constituents. The situation is remarkably similar in word part ellipsis. Looking only at word-part ellipsis phenomena, Booij (1985) proposes that ellipsis results from a phonological process which requires remnants to be able to receive phonological word status. This explains why the unrestricted ellipsis of phonetically identical strings is impossible:

(36) a. *Fred is both a alco~~holic~~ and a workaholic.

b. *He was both a reaction~~ary~~ and a visionary.

c. *They were sing~~ing~~ and dancing.

But as I have shown above, morphology also plays a role. For example, Müller (1990) and Smith (2000) note that less grammaticalized prefixoids are more easily elided than grammaticalized ones, and that verbal prefixes are more easily elided than nominal ones. This accounts for cases like the ones in (37) for instance, which involve ungrammatical deletion of phonological words in fully lexicalized compounds:[13]

(37) a. *I caught butter~~flies~~ and fireflies.

b. *We bought an hour~~glass~~ and a looking-glass.

c. *We need more floor~~boards~~ and cupboards.

From the standpoint of RPE the generalization seems to be as follows: this kind of deletion applies to right-peripheral morphophonological strings that are prosodically independent, regardless of the node being phrasal or lexical. The prosodic constituency is determined by an independent theory of phonology and prosody, but the interaction between RPE and prosodic constituency yields the above contrasts.

This view not only offers a general and uniform account of the data, but it also makes predictions. For example, in a lexical coordination structure the elided constituents may turn out to be phonological words. In a VP structure that undergoes RPE the elided constituents may instead be Phonological Phrases. In clausal instances of RPE the constituents may be Intonational Phrases and so on. This predicts that in longer structures the amount of contrastive stress must also be stronger, since only stressed material can claim prosodic independence. Without prosodic independence there is

[13]These have idiosyncratic meaning and no productivity, cf. **butterbee*, **staring-glass*, **bowlboard*.

nothing for RPE to apply to. This prediction is borne out if RPE applies locally, and not as a post-processing stage or interface level like in Wilder (1997).

Further support for RPE being a local operation is provided by examples like (38a). Here the relevant notion of 'right periphery' is embedded in the clause. Only the noun *inequity* is elided, not the subsequent modifier phrase.

(38) a. [Another important factor is the faith in, or at least the *comprehension* of, inequity], [whether such inequity truly exists or not].

b. The people [[of whom and to whom] George speaks] are specially selected.

c. It tells the story of Will Hunting, a troubled prodigy (...) who works as a janitor, despite the fact that [[his knowledge of and facility with, higher mathematics], far outstrips that of anyone in the school, if not the country].[14]

I follow Inkelas and Zec (1990a) who for independent reasons, argue for a bidirectional relation between syntax and phonology, articulated in a model in which two grammar components are simultaneously construed and locally available. HPSG is an ideal framework to state these constraints since all the syntactic, semantic and morphophonologic information is locally available. In order to state the account of RPE in more precise terms it is necessary to state what kinds of prosodic constituents are assumed to exist. It should be stressed however that nothing in the account I am about to present hinges on a particular flavor of prosodic constituency. The core claim is quite general: RPE is a local ellipsis phenomenon which targets right-peripheral, prosodically independent morphophonological units. Contrastive focus plays an important, albeit independent, role given that it is able to create junctures where usually none can exist. Regardless of how many kinds of prosodic constituents are postulated, the constituent boundaries predict the locations where RPE can in principle apply, provided that morphophonological identity is satisfied.

I will assume a layered hierarchical structure, the *prosodic hierarchy*, advocated by Selkirk (1978, 1980), Nespor and Vogel (1982, 1986), Beckman and Pierrehumbert (1986), and Hayes (1989, 1990), *Phonology Yearbook 4*, Inkelas and Zec (1990b), and many others. Consider the example below, taken from Hayes (1990):

[14] `http://en.wikipedia.org/wiki/Good_Will_Hunting` [22 January 2007]

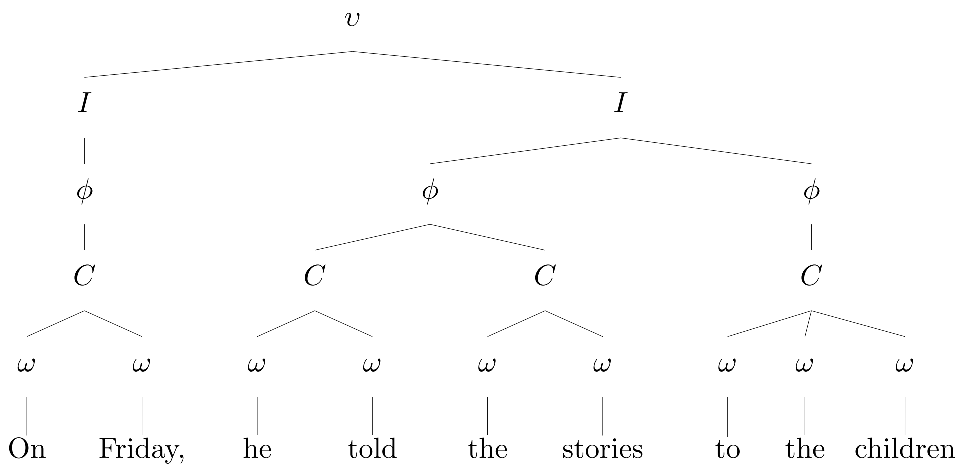


Figure 8.2: Example of phonological phrasing

The phonological word (ω) is the category that immediately dominates the foot. In general, a stem will correspond to a ω, which may also include other elements morphologically associated with the stem. Next, the clitic group (C), is composed of a sequence of ω's and usually contain a content word. This constituent groups elements that are tightly connected, such as (unstressed) clitics and other function words. For English it has been argued that C is the domain of v-Deletion (cf. [*please*]$_C$, [*lea~~ve~~ me*]$_C$ [*alone*]$_C$ with *[*please*]$_C$, [*lea~~ve~~*]$_C$ [*Mia*]$_C$ [*alone*]$_C$), as well as of s, z-Palatization.

Next, we have the phonological phrase (ϕ), which groups together one or more Cs. The former is a domain for the assignment of stress and intonational patterns. Some authors propose to split this category in other phrases (e.g. intermediate, major and accentual phrases), but we shall simplify here, and adopt the traditional ϕ. This constituent contains a pitch accent and its boundaries are characterized by a H-/L- Phrase tone and a minor juncture. A ϕ-boundary marks the location where parenthetical interruptions can occur, and often coincides with syntactic boundaries. In turn, ϕ's can be grouped in a Intonational Phrase (I). This constituent is delimited by either a high boundary tone (H%) or a low boundary tone (L%), in which the initial tone is optional and a final boundary tone is obligatory. Certain constructions systematically project an I of their own, such as vocatives, appositives, parentheticals, topicalized constituents, nonrestrictive relative clauses, tag questions, etc.. Finally, an Utterance (υ) consists of one or more I's and may extend beyond the sentence.

Theories differ on what kind of syntactic information is relevant the formation of prosodic constituents. Many authors have argued that prosody is sensitive to syntactic boundaries, category membership, headship, (directionality of) branching, and grammatical relations, in various languages (see for instance Inkelas and Zec (1990b)). The main theoretical approaches are relation-based mapping (Nespor and Vogel 1982; Nespor and Vogel 1986; Hayes 1989), end-based mapping (Selkirk 1986; Chen 1987; Selkirk and Shen 1990), and arboreal mapping (Inkelas and Zec 1990a). There are also less syntactic oriented accounts, such as Ghini (1993), in which phonological phrasing is for the most part determined by heuristics on rhythmical balance and symmetry. Although I am very sympathetic to the latter account, I will not go into the details of a theory of phonology in this work, and I will assume that an independent theory is formulated via the function F_{MP}. I will basically assume that lexical and phrasal environments can trigger the construction of clitic groups (C) and of phonological phrases (ϕ), clauses and extracted phrases trigger the construction of intonational phrases (I), and cross-sentential discourse environments trigger the construction of utterances (υ).

Below I formalize the type system for a basic encoding of prosodic constituents. I start by stating that the value of MP is a list of *morphphon* items, which in turn are pairs of phonological representations and morphological word forms:

(39) $$\begin{bmatrix} \text{MP} & \textit{list}\left(\begin{bmatrix} \textit{morphphon} & \\ \text{PHON} & \begin{bmatrix} \textit{phon} \\ \text{UNITS} \; \textit{list(phon)} \end{bmatrix} \\ \text{FORM} & \textit{list(form)} \end{bmatrix}\right) \end{bmatrix}$$

The type *phon* subsumes the types of the possible phonological units, such as σ (syllables), ε (feet), ω (phonological words), C (clitic groups), ϕ (phonological phrases), I (intonational phrases), and U (utterances):

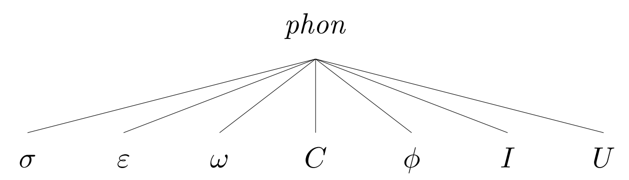


Figure 8.3: A type hierarchy of phonological layers

The phonological content of signs can now be described in more detail. Consider the verb '*to like*' (syntax and semantics features omitted for brevity):[15]

(40)
$$\begin{bmatrix} \textit{word} & \\ \textsc{mp} & \left\langle \begin{bmatrix} \textit{morphon} & \\ \textsc{phon} & \begin{bmatrix} \omega & \\ \textsc{units} & \left\langle \begin{bmatrix} \varepsilon & \\ \textsc{units} & \left\langle \begin{bmatrix} \sigma & \\ \textsc{units} & \langle \text{laɪk} \rangle \end{bmatrix} \right\rangle \end{bmatrix} \right\rangle \end{bmatrix} \\ \textsc{form} & \langle\ \textit{like}\ \rangle \end{bmatrix} \right\rangle \\ \textsc{syn} & \ldots \\ \textsc{sem} & \ldots \end{bmatrix}$$

As discussed in §5.1, phonological representations are combined according to an independent theory of phonology, articulated by the function F_{MP}. This function operates on every construction licensed by the grammar, and is responsible for incrementally assembling and aligning linearized phonological representations according to general principles. The LINEARIZATION PRINCIPLE proposed in §5.1 is therefore revised so that it includes F_{MP}:

(41)
$$cx \Rightarrow \begin{bmatrix} \textsc{mtr} & \begin{bmatrix} \textsc{mp} & F_{MP}(\boxed{1} \oplus \ldots \oplus \boxed{n}) \\ \textsc{dom} & \left\langle \begin{bmatrix} \textsc{mp} & \boxed{1} \end{bmatrix} \oplus \ldots \oplus \begin{bmatrix} \textsc{mp} & \boxed{n} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

The MP information conveyed in the mother thus corresponds to linearized MP values in DOM. For illustration, consider the sentence in (42a). There are many different ways for this sentence to be realized (depending on word stress, rhythm, speech rate, speaker differences, style, pragmatics, etc.) but two possible realizations are depicted below, in (42b) in (42c). In the latter the verb is stressed:

(42) a. Pat hates books.

b.
$$\begin{bmatrix} \textsc{mp} & \left\langle \begin{bmatrix} \textsc{ph} & [{}^{I}\text{pæt heɪts bʊks}] \\ \textsc{fm} & \langle \textit{pat, hates, books} \rangle \end{bmatrix} \right\rangle \\ \textsc{dom} & \left\langle \begin{bmatrix} \textsc{ph} & [{}^{\phi}\text{pæt}] \\ \textsc{fm} & \langle \textit{pat} \rangle \end{bmatrix}, \begin{bmatrix} \textsc{ph} & [{}^{\phi}\text{heɪts}] \\ \textsc{fm} & \langle \textit{hates} \rangle \end{bmatrix}, \begin{bmatrix} \textsc{ph} & [{}^{\phi}\text{bʊks}] \\ \textsc{fm} & \langle \textit{books} \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

[15] Henceforth, I will abbreviate the PHON value with the top phonological layer, as in [${}^{\omega}$laɪk].

$$\text{c.}\ \left[\begin{array}{ll} \text{MP} & \left\langle \left[\begin{array}{ll}\text{PH} & [^{I}\text{pæt heɪts}]\\ \text{FM} & \langle \textit{pat, hates}\rangle\end{array}\right], \left[\begin{array}{ll}\text{PH} & [^{I}\text{bʊks}]\\ \text{FM} & \langle \textit{books}\rangle\end{array}\right]\right\rangle \\ \text{DOM} & \left\langle \left[\begin{array}{ll}\text{PH} & [^{\phi}\text{pæt}]\\ \text{FM} & \langle \textit{pat}\rangle\end{array}\right], \left[\begin{array}{ll}\text{PH} & [^{\phi}\text{heɪts}]\\ \text{FM} & \langle \textit{hates}\rangle\end{array}\right], \left[\begin{array}{ll}\text{PH} & [^{\phi}\text{bʊks}]\\ \text{FM} & \langle \textit{books}\rangle\end{array}\right]\right\rangle \end{array}\right]$$

A well-known fact is that the elements that follow a stressed word are usually de-accented and separated by a break or pause. If the standard prosodic constituency conditions are met, the elements following the stressed verb *hates* in (42c) reside in an independent phonological constituent as depicted above.

Now consider the case where (42c) is conjoined with another sentence that also has an independent ϕ *books*:

(43) a. We like books, but Pat hates books.

$$\text{b.}\ \left[\text{MP}\ \left\langle \left[\begin{array}{ll}\text{PH} & [^{I}\text{wɪ laɪk}]\\ \text{FM} & \langle \textit{we, like}\rangle\end{array}\right], \left[\begin{array}{ll}\text{PH} & [^{I}\text{bʊks}]\\ \text{FM} & \langle \textit{books}\rangle\end{array}\right], \left[\begin{array}{ll}\text{PH} & [^{I}\text{bʌt pæt heɪts}]\\ \text{FM} & \langle \textit{but, pat, hates}\rangle\end{array}\right], \left[\begin{array}{ll}\text{PH} & [^{I}\text{bʊks}]\\ \text{FM} & \langle \textit{books}\rangle\end{array}\right]\right\rangle\right]$$

In this case the function F_{MP} has just concatenated the two morphophonological representations. This utterance can be realized as it is, or be targeted by RPE via the ellipsis of the independent prosodic constituent *books*. The RPE schema depicted in Figure 8.1 is formalized in HPSG with the *rnr-cx* rule provided in (44).

(44)

$$\textit{rnr-cx} \Rightarrow \left[\begin{array}{ll} \text{MTR} & \left[\text{DOM}\ \left\langle \left[\begin{array}{ll}\text{MP} & \boxed{A}\oplus\boxed{B}\oplus\boxed{R}\\ \text{SYN} & \boxed{1}\\ \text{SEM} & \boxed{2}\\ \text{DOM} & \boxed{3}\end{array}\right]\right\rangle\right] \\ \text{DTRS} & \left\langle \left[\begin{array}{ll}\text{MP} & \boxed{A}_{ne-list}\oplus\boxed{R}_{ne-list}\oplus\boxed{B}_{ne-list}\oplus\boxed{R}\\ \text{SYN} & \boxed{1}\\ \text{SEM} & \boxed{2}\\ \text{DOM} & \boxed{3}\end{array}\right]\right\rangle \end{array}\right]$$

This rule divides the MP list into four non-empty sub-lists. The sub-list $\boxed{R}$ is required to occur (at least) twice in the daughter, and the mother node is required to contain a single domain element with the same syntactic and semantic information, but without the non-peripheral $\boxed{R}$ sub-list. The principle in (41) can thus apply and compute the MP value of the mother sign.

For illustration, consider the application of the *rnr-cx* to the node in (43b). The output is an elided counterpart in which the noun is missing from the non-rightmost position:

$$\begin{array}{c}
\left[\textsc{dom}\left\langle\left[\textsc{mp}\left\langle\begin{bmatrix}\textsc{ph} & [^{I}\text{wɪ laɪk}]\\ \textsc{fm} & \langle\textit{we, like}\rangle\end{bmatrix},\begin{bmatrix}\textsc{ph} & [^{I}\text{bʌt pæt heɪts}]\\ \textsc{fm} & \langle\textit{but, pat, hates}\rangle\end{bmatrix}\right\rangle\oplus\boxed{R}\left\langle\begin{bmatrix}\textsc{ph} & [^{I}\text{bʊks}]\\ \textsc{fm} & \langle\textit{books}\rangle\end{bmatrix}\right\rangle\right]\right\rangle\right]\\
|\\
\left[\textsc{mp}\left\langle\begin{bmatrix}\textsc{ph} & [^{I}\text{wɪ laɪk}]\\ \textsc{fm} & \langle\textit{we, like}\rangle\end{bmatrix}\right\rangle\oplus\boxed{R}\oplus\left\langle\begin{bmatrix}\textsc{ph} & [^{I}\text{bʌt pæt heɪts}]\\ \textsc{fm} & \langle\textit{but, pat, hates}\rangle\end{bmatrix}\right\rangle\oplus\boxed{R}\right]
\end{array}$$

Figure 8.4: Right Periphery Ellipsis of '*books*'

This account can also accommodate word-part RPE phenomena. Observe for instance the contrast between a level 2 prefix '*un-*', and the level 1 prefix '*in-*'. The former prefix can be stressed and is known to not fuse phonologically with the stem, while the latter necessarily fuses. This is made evident by various well-known assimilation phenomena observed in *in-* prefixation: [m] before a labial (e.g. *immature*), [ ] before a velar (as in *incorrect*), [r] before /r/ (e.g. *irrelevant*), and [l] before /l/ (as in *illegal*). As a result of this contrast the current, my account predicts that only *un-* can be a remnant in RPE provided it receives sufficient stress:

(45) a. It wasn't un- or anti-American to criticize Bill Clinton.

b. These measures will minimize both un- and over-employment.

(46) *The company cannot afford to be im- nor overproductive.

The stressed prefix can thus project an independent prosodic constituent, such as a prosodic word. This is illustrated in the lexical entry in (47):

(47) $$\begin{bmatrix}\textit{word} & \\ \textsc{mp} & \left\langle\boxed{1}\begin{bmatrix}\textsc{ph} & [\omega\ \textsf{\textit{un}}]\\ \textsc{fm} & \langle\textit{un}\rangle\end{bmatrix},\ \boxed{2}\begin{bmatrix}\textsc{ph} & [\omega\ \textsf{stable}\rangle]\\ \textsc{fm} & \langle\textit{stable}\rangle\end{bmatrix}\right\rangle\\ \textsc{syn}\,|\,\textsc{head} & \textit{adj}\end{bmatrix}$$

This also means that the range of RPE phenomena that affixes allow for is limited. Since affixes cannot in general project I or even ϕ, this correctly predicts that long-distance cases of RPE are very difficult to obtain:

(48) ?*We tend to study un- while they tend to examine over-employment.

I further illustrate this point with the adverbial suffix *-mente* from Portuguese. This suffix has a phonological word status, as shown by Vigário (2003), and can can undergo RPE in adverbial coordination. However, it resists RPE in VP or in S coordination:

(49) a. O advogado agiu rápida~~mente~~ e eficientemente?
the$_{mas}$ lawyer$_{mas}$ acted rapid and efficiently

b. *O homem agiu rápida~~mente~~ ou agiu lentamente?
the$_{mas}$ man$_{mas}$ acted rapid or acted slowly

The suffix cannot be elided because the phonological structure would have to be [$^{\phi}$ *agiu educada*] [$^{\phi}$ *mente*]. But this structure is not possible for independent reasons: affixes cannot project an independent phonological phrase.

8.1.3 Semantic Integration

Vergnaud (1974), Abbott (1976, ft.3), and Jackendoff (1977) noted a phenomenon that arises in English, and that remains recalcitrant for virtually all accounts of Right-Periphery Ellipsis. Consider the examples in (50):

(50) a. Peter sings, and Mary whistles, a similar tune.

b. John defeated, and Mary lost to, very different opponents.

c. Fred spent, and Mia lost, a total of $10.000.

In these cases the rightmost elements cannot be realized in situ with the same semantic interpretation. For instance, in (50b) John may have lost to a given opponent and Mary to another, while the rightmost NP refers to both individuals. It seems that in these examples there is some kind of *semantic integration* process at work, so that the right-peripheral elements are either equated as a unique entity as in (50a) or grouped into a plural description (50b,c).

But to assume that the shared element in the right periphery is realized *in situ* also runs into several problems already discussed above, as well as the problem seen in (51). These data show that the rightmost element must – in some sense – still be compatible with each conjunct separately:

(51) a. *John loves, and Mary hates, themselves / each other.

b. *Tom seems, and Mary probably is, neighbours/friends.

It is unclear whether these data are the result of processing effect or part of the grammar. Beavers and Sag (2004) suggest that this is a form of *semantic integration*, whereby the two 'shared' elements are semantically linked during processing. For example, consider the sentence in (50c). Suppose that the speaker does not know how much money Fred spent nor how much money Mia lost, but that the total amount is known. To convey this information, the speaker is thus apparently forced to use a sentence like *Fred spent some money and Mia spent some money* plus some continuation like *and the total of that amount was $10.000.* Moreover, since the strings *some money* are peripheral then RPE can apply. The fact that only one occurrence of this string is realized may cause the speaker to substitute the indefinite description by a definite one. In other words, the phonological string that is 'RNRaised' is superseded by a more informative one. From the speaker's point of view, the meaning of the sentence remains the same. It is only that the background information about the total amount of money has become an explicit part of the utterance. I will not go any further in discussing how this kind of analysis may be formalized, but point out that the necessary machinery may already be available in the work of Yatabe (2002), and that such machinery can be adopted in the present account.

8.2 Left-Periphery Ellipsis

At first sight, LPE appears to be a mirror-image of RPE. Consider the data in (52).

(52) a. John gave a book to Mary, and a rose to Sue.

b. I gave to Mary a coloring book, and new roller skates to her sister.

c. I sent a postcard to your brother on Monday and to your sister on Tuesday.

A movement or an extraction account makes no sense here, for lack on independent evidence attesting that kind of phenomena in other constructions. There have been proposed two main kinds of analysis: Deletion and Base-Generation. In the former, the left periphery of the non-initial conjuncts is deleted as proposed in various accounts such as Ross (1967, 99), Sag (1976), Neijt (1979), van Oirsouw (1987), as well as more recent accounts such as Blevins and Sag (1996), Johannessen (1998), Yatabe (2002), Crysmann (2003), Beavers and Sag (2004), and others. In the Base-generation approach the notion of constituency is relaxed so that sequences of co-arguments are also taken to be constituents. This avenue of research has been pursued in Dowty (1988), Steedman (1989), Cho (1996), and Mouret (2006), among others.[16]

There are various reasons supporting that LPE is an instance of deletion rather than base-generation. First, there is no independent evidence that the sequence of objects [*a rose*] [*to Sue*] forms a constituent:

(53) a. [That rose], I think that Kim gave _ to my younger sister.

b.*[That rose to my younger sister], I think that Kim gave _ .

(54) [That rose (*to my younger sister)]$_{NP}$ is beautiful.

Second, the sentences in (52) describe two events rather than one. For example, even though there is only one verb and one postcard one interprets (52c) as conveying that there were two sending events and two postcards. Both the syntax and the semantic of the data above can be straightforwardly accounted for as standard VP coordination structures in which the left-periphery is omitted:

(55) a. John [gave a book to Mary, ~~gave~~ and a rose to Sue].

b. I [sent a postcard to your brother on Monday and ~~sent a postcard~~ to your sister on Tuesday].

Beavers and Sag (2004) point out that given the proper context, LPE is may target an entire clausal coordination. This is illustrated in the data below:

(56) a. Three men died in Baghdad on Tuesday, and in Tikrit on Friday night.

b. Several trees were planted by me in 1982, and by my wife in 1993.

In (56a), due to Beavers and Sag, the human parser is forced to abandon the VP coordination parse because of plausibility considerations: people do not usually die twice. The alternative is to consider the S coordination parse, which consists in *Three men died in Baghdad on Tuesday, and three men died in Tikrit on Friday night.* This does not force the subject NP to be co-referential, and obtains the correct results. The same goes for (56b) because presumably the same tree cannot be planted twice. The effect is reversed if a verb like *study* is used instead of *plant*, because the same trees can be studies several times over.

[16] A third kind of approach is Wilder (1997), which assumes that there is a base-generation of empty items. I will discuss this account in more detail in §8.2.2 below.

These readings are made preferential because of world-knowledge and lexical semantics rather than by grammatical rules. The same reasons are behind the fact that the PP coordination parse of (57) is not the preferential one. The more likely parse is one where the sentence is seen as an elliptical VP coordination:

(57) I found a coin in the kitchen and in the garden.

The PP coordination structure gives rise to a reading that is hard to contextualize in a plausible way: the same coin was found and lost several times over in a small period of time. The preferential parse in the elliptical VP coordination allows for two different coins and two distinct coin finding situations. Even though the latter is more complex to obtain because it involves a ellipsis operation, context and world knowledge make the simpler parse less plausible.

Further supporting evidence comes from examples such as (58) which can be felicitously interpreted without contradiction. It is the elliptical VP coordination parse that allows for such a reading: [*can drink and ~~can~~ drive*].

(58) Every person can drink and drive, but not at the same time.

Many authors have also noted that the existence of a deletion operation acting on the left-periphery predicts the so-called 'coordination of unlikes' phenomena, which now become unremarkable:

(59) a. We left the hotel frightened and in a hurry.
b. Fred became wealthy and a Republican.
c. Sue is healthy and in good shape.
d. That was a rude remark and in very bad taste.
e. He emphasized the danger involved, and that the wiring had to be replaced.

LPE can also target NP coordination structures, thus offering a rather straightforward account of the meaning of the following examples:[17]

[17]Some authors like Koutsoudas (1971), Neijt (1979), Russell (1983), van Oirsouw (1987), Wilder (1997), and Johannessen (1998) propose that LPE and Gapping are due to the same mechanism. This is unlikely because Gapping cannot apply to NP coordination, compare *[*You should accept* (*both*) [*all the good and all ~~the~~ bad*]] with [*You should accept* [*all the good and ~~all the~~ bad*]]. It is also now widely recognized that so-called 'N-Gapping' (Jackendoff 1971) as seen in *I have one shirt with yellow stripes and two with blue stripes* is a different phenomenon. It exhibits the traits of discourse anaphora (Hankamer and Sag 1976): may be arbitrarily embedded, also occurs in any kind of subordination structure, may be backwards elided, and is recoverable from non-linguistic context.

(60) a. [That boy and ~~that~~ girl] are really no different from each other.

b. [Every logician and ~~every~~ philosopher] agreed on this matter.

c. Both [the soloist and ~~the~~ recitalist] were late.

d. [A flight to Venice on Monday or ~~a flight~~ to Crete on Tuesday] would be equally expensive.

e. We're missing [a bag with no handles and ~~a bag~~ that has a red name tag].

f. [The boy's uncle and ~~the boy's~~ aunt] were kissing.[18]

Finally, LPE also seems to apply to word-parts as shown in the examples below.[19]

(61) a. Elemental mercury is used in gold-mining and -refining.

b. According to the law of intestate succession, half-brothers and -sisters are considered the same as full brothers and sisters.

(62) a. Most anti-wrinkle and -aging creams have Vitamin C and Retinol.

b. This company disencorages self-aggrandizement or -promotion.

c. She has considerable experience in planning, forecasting, and analyzing multimillion or -billion dollar mergers.

These cases are often somewhat difficult to process because they can also obtain a non-elliptical parse, albeit a semantically odd one.

However, the similarities that LPE has with RPE end here. The first major difference is that LPE only occurs in non-headed constructions, that is, coordinate and comparative constructions:

(63) a. We ship more games to Japan than hardware to our clients here in Europe.

b. I met more White Sox fans yesterday than Yankee fans last year.

(64) a. *John gave a book to Mary although a rose to Sue.

b. *I try to not make noise when (to) sneak in late at night.

c. *If Tom gave a rose to Mary, then a tulip to Sue.

[18] Example taken from Ross (1967, 128).

[19] See Booij (1985) and Toman (1985) for examples in Dutch and German.

Another major difference is that LPE exhibits some island effects. For instance, the left periphery of a subject NP cannot be elided in clausal coordination:

(65) a. *The best swimmer lost and runner won.

b. *The shop that sells fossils is open and souvenirs is closed.

c. *A portrait of Turing was on the desk, and of Gödel was hanging on the wall.

Moreover, LPE does not require phonological identity as noted in Chaves (2006). Verbs with different agreement marking can be omitted from the left periphery of non-initial conjuncts:

(66) a. There were two guards when I arrived, and only one guard when I left.

b. There was one fatality yesterday, and two others on the day before.

c. Is the bridge too tall or the waters too shallow?

d. Was the message easy to find, and the instructions easy to follow?

e. Why is the TV on full volume, and all the doors left wide open?

The same is true for various Romance languages, including Italian and Portuguese:

(67) a. Sono arrivate due amiche veneredì ed
are arrived$_{pl\,fem}$ two$_{pl\,fem}$ friends$_{pl\,fem}$ Friday and

~~è arrivato~~ un amico lunedì.
is arrived$_{sg\,masc}$ one$_{sg\,masc}$ friend$_{sg\,masc}$ Monday.
'Two female friends arrived Friday, and one male friend arrived Monday'

b. Chegou um pacote na terça-feira e ~~chegaram~~ duas cartas na sexta.
arrived$_{sg}$ one package on Tuesday and arrived$_{pl}$ two letters on Friday
'One package arrived on Tuesday and two letters arrived Friday'

Further evidence comes from NP coordination in Romance languages such as Portuguese, where determiners exhibit gender agreement. In the example below the masculine definite determiner *o* is omitted even though it is usually obligatory:

(68) a. *(O) valor é desconhecido
the$_{sg.mas}$ value$_{sg.mas}$ is unknown$_{sg.mas}$

b. A data e ~~o~~ valor são desconhecidos
the$_{sg.fem}$ date$_{sg.fem}$ and the$_{sg.mas}$ value$_{sg.mas}$ are unknown$_{pl.mas}$
'the date and the value are unknown'

The above cross-linguistic evidence indicates that the relevant identity conditions for LPE do not involve PHON information. The question now is what kind of semantic conditions does LPE impose, if any. As it turns out LPE requires the exact same word sense as shown in the data below:

(69) *I want another beer and to have a good time.
(Pullum and Zwicky 1986).

(70) a. *I like to play songs and chess.
b. *Mia went home and to get a bottle-opener.
c. *Fred tried the shrimp and being humorous about it.
d. *Tom began the talk and pacing back and forth.
e. *God loves us and to see us happy.

This is a much stronger semantic identity requirement than the one obverved in RPE, which tolerates different polysemous word senses as seen in (31). As expected, examples of LPE with simple homonymy and different word meanings are also ungrammatical:

(71) a. *I [can tuna and be contacted by phone].
b. *George [fired his advisors and a gun in the oval office].

Let us take stock of the properties of LPE just discussed. With regard to semantic interpretation, the phenomenon is compatible with a deletion account. LPE can occur in coordinate and comparative structure, and apply to phrasal and lexical daughters alike. A deletion account also explains a host of other phenomena, including 'coordination of unlikes', challenging cases with regard to the semantics of nominal coordination as discussed above and in Chapter 3, as well as 'closest conjunct' agreement as discussed in §7.3. Finally, LPE is very different from RPE. On the one hand, LPE requires sense identity rather than morphophonological identity, and on the other, LPE cannot apply to arbitrarily embedded structures.

One final peculiar aspect is the fact that the deletion operation is not hampered by the presence of the coordination lexeme. That is, only the conjunct's left periphery is relevant for LPE, not the coordinator:

(72) I [gave a book to Mary] [~~gave~~ a rose to Sue] [and ~~gave~~ a tulip to Mia].

This raises the question as to what other kinds of items may be left-peripheral remnants in LPE. Comparative markers are definitely included in this set, given that they are also allowed to be peripheral remnants in LPE:

(73) More people sent gift cards to Bill than ~~sent~~ books to George.

I will turn to this matter next, and consider a wider range of expressions that are not considered by the LPE deletion phenomenon.

8.2.1 On Peripheral Remnants

Consider the example in (74) below. This sentence has two readings, both of which can be explained via LPE. In one of the readings *not* adjoins to the NP, yielding an interpretation in which Sandy will offer Lee not even a single book. This reading can be straightforwardly obtained by the ellipsis of *offer* (i.e. *and ~~offer~~ not a book to Lee*).

(74) Sandy will offer a record to Chris, and not a book to Lee.

The second reading is corresponds to a situation where Lee will not be receiving books from John, but may receive something else. This interpretation can be obtained if adverbs are allowed to be left-peripheral remnants of ACC:[20]

(75) Sandy will offer a record to Chris, and not ~~offer~~ a book to Jean.

Further evidence for this comes from examples in which both overt and elliptical realizations are ungrammatical. Since the overt counterpart (76a) is ungrammatical, then LPE cannot apply to obtain (76b):

(76) a. *Tom handed me a flower, and not handed her a postcard.

b. *Tom handed me a flower, and not her a postcard.

[20]There are other cases like '*I'm talking, not you*', '*I tried that, but not today*', or '*He gave MY dog a bone yesterday, not YOUR dog*'. These are instances of discourse anaphora rather than of ACC, because 1) they require contrastive focus, 2) the elision cannot be reconstructed (cf. **I'm talking, not you're talking*), and 3) the target of the anaphora may be embedded and precede the controller: *Not you, but I think that someone here is lying.*

The particle *not* isn't the only element which may be a peripheral remnant in LPE. Below I provide more cases in which preverbal modifiers survive LPE:

(77) a. We took a train to Grenoble on Monday and then a bus to the resort on Tuesday.

b. It killed two of his friends last night, and nearly him as well this morning.

c. In the case of fire, always use the stairs and never the elevator.

d. Fred was knocked down in the first round, and almost again in the 11th.

e. I've worked for MI6 as an operative, but never for the KGB as a double agent.

f. I am not objecting to his morals, but rather to his manners.

In order for the above examples to receive the intended interpretations, the modifiers must be in a preverbal position. In the case of (77d) and (77e) for instance, this is the only possible syntactic distribution:

(78) a. *I've worked never for the CIA as an informant.

b. *Tom was knocked down almost again in the 11th round.

In sum, various kinds of expressions, ranging from coordination lexemes, comparative expressions, and adverbs can be peripheral remnants in LPE.

8.2.2 A Linearization-based Account

Since the phenomena only target the non-headed constructions it is natural that the account of LPE should be stated in terms of the Non-Headed Structure Principle from §5.1. This principle is repeated here in (79) for perspicuity.

(79) Non-Headed Structure Principle:

$$\textit{non-headed-cx} \Rightarrow \begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{SYN} & \boxed{1} \\ \text{DOM} & \boxed{A} \oplus \boxed{B} \end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{SYN} & \boxed{1} \\ \text{DOM} & \boxed{A} \end{bmatrix}, \begin{bmatrix} \text{SYN} & \boxed{1} \\ \text{DOM} & \boxed{B} \end{bmatrix} \right\rangle \end{bmatrix}$$

The principle states that the list $\boxed{A}$ of linearized elements contributed by one daughter is simply concatenated with the list $\boxed{B}$ of linearized elements contributed by the other daughter. What is necessary however, is something along the lines of the proposals in Yatabe (2002), Crysmann (2003) or Beavers and Sag (2004). In these approaches the left periphery of the linearization lists is allowed to be partially shared with the mother node. In essence, these are deletion accounts where the phenomena are captured in terms of structure-sharing constraints, rather than a special operation that actually deletes linguistic information.[21] The fact that these structure-sharing constraints are non-deterministic captures the fact that LPE is optional. Another positive aspect of these accounts, as we shall see, is that the LPE 'island' effects come out as a prediction: since the constraints that obtain LPE are stated in terms of the members of the linearization domains in DOM, compacted domain elements cannot be partially elided.

However, linearization-based accounts wrongly assume that the relevant identity constraints are phonologic, or in some cases, morphemic. What is needed is sense-identity, as I have shown above. I thus reformulate (79) so that the identity conditions imposed by LPE consist in structure-sharing the value of RELN in the linearized domains. The idea is to allow the left periphery of $\boxed{A}$ and $\boxed{B}$ to have identical predications (up to predicate name identity). This is informally depicted in Figure 8.5 ($k \geq 0$):

$$[\textsc{dom}\ \boxed{L} \oplus \boxed{A} \oplus \langle [and] \rangle \oplus \boxed{B}\ ]$$

$$[\textsc{dom}\ \boxed{L}\langle R_0(...) \ldots R_k(...)\rangle \oplus \boxed{A}\ ] \qquad [\textsc{dom}\ \langle [and], R_0(...) \ldots R_k(...)\rangle \oplus \boxed{B}\ ]$$

Figure 8.5: LPE as omission of domains under sense identity (simplified)

Observe that each daughter is split in two sublists. The first sub-list of each daughter is required to contain, by that order, a number of predications composed of the same relation symbol R. In other words, the relation R_0 is present in both daughters, the relation R_1 is also present in both daughters and so on. Note that nothing is said about the arguments of the R relations, which thus are not identical. This achieves the intended sense-identity effect.

[21] In fact, even the relation '$\oplus$' is not a primitive: it can also be cast in terms of structure-sharing of feature values by using a 'difference-list' representation of lists.

Next, note that the mother node does not contain the first sublist of the second conjunct: the only items from the second daughter that occur in the mother are the conjunction and those in $\boxed{B}$. This is what obtains deletion: the peripheral domain elements preceding $\boxed{B}$ are not present in the mother node.

The workings of this account are illustrated below with more detail in AVM format. Consider a VP coordination in which the left conjunct has [DOM ⟨[*gave*], [*a book*], [*to Mary*]⟩] and the right conjunct has [DOM ⟨[*and*], [*gave*], [*a rose*], [*to Sue*]⟩]. The ellipsis of the verb element is obtained by omission of the domain element after the conjunction:

$$\begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{DOM} & \boxed{L}\oplus\boxed{A}\oplus\left\langle\begin{bmatrix}\textit{and}\end{bmatrix}\right\rangle\oplus\boxed{B} \\ \text{SYN} & \text{VP}\end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{DOM} & \boxed{L}\left\langle\begin{bmatrix}\text{RELS}\ \left\langle[\text{RELN}\ \boxed{1}\textit{gave}]\right\rangle\end{bmatrix}\right\rangle\oplus\boxed{A} \\ \text{CRD}- & \end{bmatrix}, \begin{bmatrix} \text{DOM} & \left\langle\begin{bmatrix}\textit{and}\end{bmatrix}\right\rangle\oplus\left\langle\begin{bmatrix}\text{RELS}\ \left\langle[\text{RELN}\ \boxed{1}]\right\rangle\end{bmatrix}\right\rangle\oplus\boxed{B} \\ \text{CRD}+ & \end{bmatrix}\right\rangle \end{bmatrix}$$

Figure 8.6: Example: [*gave a book to Mary and ~~gave~~ a rose to Sue*]

Put in informal terms, the list $\boxed{L}$ is resolved as ⟨[*gave*]⟩, the list $\boxed{A}$ is resolved as ⟨[*a book*], [*to Mary*]⟩, and the list $\boxed{B}$ is resolved as ⟨[*gave*], [*a rose*], [*to Sue*]⟩. In this case $k = 1$ but the schema in Figure 8.5 also allows for the case in which $k = 0$. In this alternative resolution for the constraints the list $\boxed{L}$ is empty, no elements are missing in the mother node, and thus no ellipsis occurs:

$$\begin{bmatrix} \text{MTR} & \begin{bmatrix} \text{DOM} & \boxed{L}\langle\,\rangle\oplus\boxed{B} \\ \text{SYN} & \text{VP}\end{bmatrix} \\ \text{DTRS} & \left\langle \begin{bmatrix} \text{DOM} & \boxed{L}\langle\,\rangle\oplus\boxed{A} \\ \text{CRD}- & \end{bmatrix}, \begin{bmatrix} \text{DOM} & \left\langle\begin{bmatrix}\textit{and}\end{bmatrix}\right\rangle\oplus\boxed{B} \\ \text{CRD}+ & \end{bmatrix}\right\rangle \end{bmatrix}$$

Figure 8.7: Example: [*gave a book to Mary and gave a rose to Sue*]

The lists $\boxed{A}$ and $\boxed{B}$ that survive the deletion must be typed as non-empty lists. The reason for this is that ellipsis must not be allowed to delete an entire conjunct:

(80) *Should I just send the papers to him or ~~should I just send the papers?~~

In order to reformulate (79) so that the constraints depicted in Figure 8.5 are accommodated it is necessary to generalize over the relations in every peripheral domain element: a daughter can have many domain elements, and each domain element may have many predications. For LPE to occur all of the latter must be identical to the ones in the remaining conjunct.

A second generalization concerns the peripheral remnant, which can be a coordinator, a comparative expression, an adverb or none at all. In coordinations with more than two conjuncts only the rightmost will typically have a coordination lexeme, and yet LPE can target all of the non-initial conjuncts likewise. See for instance the second conjunct in (73) above. The constraint $\textit{list}([\text{HEAD } \textit{conj} \vee \textit{compar} \vee \textit{adv}])$ states that the peripheral remnants can be a list which can either be empty or contain coordination lexemes, comparative expressions, adverbs, or any combination of these. I thus reformulate the NON-HEADED STRUCTURE PRINCIPLE as follows:

(81) NON-HEADED STRUCTURE PRINCIPLE (revised):

$$
\textit{non-headed-cx} \Rightarrow
$$

$$
\left[\begin{array}{ll}
\text{MTR} & \left[\begin{array}{l}\text{DOM } \boxed{L} \oplus \boxed{A}_{ne-list} \oplus \boxed{C}\,\textit{list}\Big([\textit{conj} \vee \textit{compar} \vee \textit{adv}]\Big) \oplus \boxed{B}_{ne-list} \\ \text{SYN } \boxed{1}\end{array}\right] \\
\text{DTRS} & \left\langle \begin{array}{l}
\left[\begin{array}{l} \text{DOM } \boxed{L} \left\langle \begin{array}{c} \left[\text{SEM} \mid \text{RELS} \left\langle \left[\text{RELN } \boxed{R_{00}}\right], \ldots, \left[\text{RELN } \boxed{R_{0n}}\right]\right\rangle\right] \\ ,\ldots, \\ \left[\text{SEM} \mid \text{RELS} \left\langle \left[\text{RELN } \boxed{R_{m0}}\right], \ldots, \left[\text{RELN } \boxed{R_{mk}}\right]\right\rangle\right] \end{array}\right\rangle \oplus \boxed{A} \\ \text{SYN } \boxed{1}\end{array}\right], \\
\left[\begin{array}{l} \text{DOM } \boxed{C} \oplus \left\langle \begin{array}{c} \left[\text{SEM} \mid \text{RELS} \left\langle \left[\text{RELN } \boxed{R_{00}}\right], \ldots, \left[\text{RELN } \boxed{R_{0n}}\right]\right\rangle\right] \\ ,\ldots, \\ \left[\text{SEM} \mid \text{RELNS} \left\langle \left[\text{RELN } \boxed{R_{m0}}\right], \ldots, \left[\text{RELN } \boxed{R_{mk}}\right]\right\rangle\right] \end{array}\right\rangle \oplus \boxed{B} \\ \text{SYN } \boxed{1}\end{array}\right]
\end{array} \right\rangle
\end{array}\right]
$$

for $n, m, k \geq 0$

Note that one can simplify this constraint by using *list*([HEAD *lpe-remnant*]) instead of the disjunction. The type *lpe-remnant* would be a supertype of *conj*, *compar* and *adv*. However, this is basically pushing the disjunction to the type-hierarchy, and does not really offer a superior explanation for the phenomena.

Since LPE is formulated in terms of domain elements, the account also obtains island effects without further stipulation. The sublists that can undergo LPE are computed with the relation '$\oplus$'. This relation concatenates lists, not elements inside lists. For example, if $\boxed{1} = \langle [abc], [def] \rangle$ then $\boxed{1} = \boxed{2} \oplus \boxed{3}$ can be resolved in one of three ways (as before, square brackets identify domain elements):

1. $\boxed{2} = \langle \rangle$ & $\boxed{3} = \langle [abc], [def] \rangle$
2. $\boxed{2} = \langle [abc] \rangle$ & $\boxed{3} = \langle [def] \rangle$
3. $\boxed{2} = \langle [abc], [def] \rangle$ & $\boxed{3} = \langle \rangle$

No other solutions exist. Thus, a domain element cannot be split apart (e.g. ssay splitting *ab* from *c*. Domain compaction prevents LPE from deleting arbitrary strings. Now, recall from §5.1 and from §7.2 that subject and complement NPs are compacted for linearization reasons. Such a constraint prevents LPE from partially deleting an NP subject domain in sentential coordination. Thus the examples in (82) are ruled out because NPs have been compacted:

(82) a. *[The best swimmer] [lost] and [~~the best~~ runner] [won].

b. *[Some of them] [were] [in favor] [and] [~~some of~~ us] [were] [against].

c. *[The shop that sells fossils] [is] [open] [and] [~~the shop that sells~~ souvenirs] [is] [closed].

This account also makes important predictions and captures several intricate phenomena first noted in Dowty (1988, 173). Recall from §6.3 that plural determiners are the ones that introduce cardinality constraints, not pluralized nouns. The latter can range over both atomic and non-atomic elements in the domain. This fact interacts with my account of LPE so that the following data are predicted:

(83) a. $\left\{ \begin{array}{l} \text{This} \\ \text{*These} \end{array} \right\}$ man and woman $\left\{ \begin{array}{l} \text{*was} \\ \text{were} \end{array} \right\}$ squatting in a castle.

b. This man and $\left\{ \begin{array}{l} \text{woman} \\ \text{*women} \end{array} \right\}$ were squatting in a castle.

c. These men and $\left\{ \begin{array}{l} \text{women} \\ \text{*woman} \end{array} \right\}$ were squatting in a castle.

The NP *this man and woman* in (83a) surely denotes a plurality, as the main verb is plural. Our account can capture this by analyzing (83a) as an instance of NP coordination and LPE: [*this man and ~~this~~ woman*]$_{NP}$. On the other hand, the NP [*these* [*man and woman*]$_{N'}$]$_{NP}$ is ungrammatical because the coordination of singular N' phrases does not yield a plurality, e.g. **two boy and girl*. Finally, cases like *[*these men and ~~this~~ woman*]$_{NP}$ are ruled out because the plural determiner introduces extra semantic relations about cardinality constraints which prevent ellipsis under RELN identity from occurring.

Another consequence of this theory is that LPE cannot occur in asymmetric coordination structures. Recall from §7.1.3 that asymmetric conjuncts are the result of a coercion process. More specifically, the *backr-coer-cx* allows the semantic content of a verbal constituent to be perceived as 'given' information, by locating it in BACKGROUND instead of in SEM. Consequently, LPE cannot apply because the required identity conditions cannot be satisfied: the brackgrounded conjunct does not have any semantic content in RELS.

Finally, note that my account can also capture word-part LPE. Consider (84):

(84) House-cleaning and -repairing is an ongoing process for many people.

This instance of LPE will follow from the theory proposed so far if compound words are allowed to contain one domain object per word, as illustrated in the lexical representation of *house-cleaning*:

(85) $$\begin{bmatrix} \textit{word} \\ \text{MP} \left\langle \boxed{1}\begin{bmatrix}\text{FM } \langle \textit{house} \rangle\end{bmatrix}, \boxed{2}\begin{bmatrix}\text{FM } \langle \textit{cleaning} \rangle\end{bmatrix} \right\rangle \\ \text{DOM} \left\langle \begin{bmatrix} \text{MP } \langle \boxed{1} \rangle \\ \text{SEM} \begin{bmatrix} \text{RELS} \left\langle \begin{bmatrix} \text{RELN } \textit{house} \\ \text{INDEX } \boxed{x} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \text{MP } \langle \boxed{2} \rangle \\ \text{SEM} \begin{bmatrix} \text{RELS} \left\langle \begin{bmatrix} \text{RELN } \textit{clean} \\ \text{ARGS } \langle \boxed{x} \rangle \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

The idea of allowing lexical items to contain non-atomic linearization domains has been proposed before the literature. For instance, in Nunberg et al. (1994:513) for dealing with idiom parts that allow for some degree of discontinuity, and in Kathol (1995) for capturing the distribution of separable verbal prefixes in German. If one assumes that the compounding lexical rule for English does not compact the lexical domain lists, then not only word-part LPE as in (84) is obtained in a uniform way via the *non-headed-cx* rule in (81), but also subject and object NP compaction predicts that long-distance LPE of word-parts is impossible:

(86) *[House-cleaning] [is] [a good business], [but] [~~house-~~repairing] [is] [better].

In other words, the lexical rule for the formation of compound words in English should concatenate the domain lists of the daughters, not compact them. A different pattern is observed in derivation and in inflection. Affixes should in general be compacted with their stems. My making this move, all of the examples given below can be correctly ruled out:

(87) a. *John outran Bill or -swam Patrick?

b. *Outdancing and -singing me this year won't be easy.

(88) a. *The cut will heal quicker or ~~quick~~ly?

b. *This is completely unjust and ~~un~~acceptable.

c. *The child is awake or ~~a~~sleep?

For perspicuity, the lexical entry of the adverb *quickly* is depicted in (89). Note that it contains a single domain element:

(89)
$$\begin{bmatrix} \textit{word} \\ \text{MP} \left\langle \begin{bmatrix}\text{FORM } \langle \textit{quick} + \textit{ly}\rangle\end{bmatrix} \right\rangle \\ \text{SYN } [\text{HEAD } \textit{adv}] \\ \text{DOM} \left\langle \begin{bmatrix} \text{SEM} \begin{bmatrix} \text{RELS} \left\langle \begin{bmatrix} \text{RELN } \textit{quick} \\ \text{INDEX } \boxed{e}\end{bmatrix}, \begin{bmatrix}\text{RELN } \textit{manner} \\ \text{ARGS } \langle \boxed{e} \rangle \end{bmatrix} \right\rangle \end{bmatrix}\end{bmatrix} \right\rangle \end{bmatrix}$$

I will not provide the lexical rule for deriving adverbs here but it should be clear how this rule would work. Given an adjectival lexical item, a suffix *-ly* is added to the MP value and a semantic condition is added to the RELS. The mother node of the lexical rule consists in an adverb with extended MP and RELS values, and with a single domain element.

The theory of LPE that I have proposed offers a uniform account of both word-part and phrasal ellipsis. No actual deletion operations are employed. Rather, the omission of leftwards elements are captured locally, in terms of structure-sharing of linearization domains. Now consider for instance the PF-based account of Wilder (1997). Here it is argued that LPE is best captured at LF, and proposed that the structures are base-generated with empty elements. Not only this already requires a stipulation about empty categories, but Wilder (1997) notes that this approach is not compatible with the Minimalist model. Therein, the standard assumption is that syntactic structure must be projected from lexical material at the start of derivation. Wilder thus conjectures that there are special variants of ordinary lexical items, containing syntactic and semantic features, but lacking phonological content of their overt counterparts. Alternatively, it is also hypothesized that the insertion of phonological forms could be turned into a post-S-structure operation, where the forward gaps would correspond to items that for some reason fail form insertion.[22]

Setting aside these various complications, let us consider the proposal in Wilder (1997) for LPE in more detail. This account consists in four structural conditions that require non-trivial tree-structure traversals for the identification of triggering configurations: *Head-Condition*, *Context-identity*, *Content-identity*, and *Major Constituent Condition*. The Head-Condition states that an ellipsis site may not be c-commanded by an overt head inside its domain. This is introduced in order to prevent material to be elided to the right of an overt head. It does not however, prevent ellipsis of an entire conjunct as in (80).

The Context-identity condition requires that the antecedent of the elided element must stand in the same hierarchical relation to its conjunct. This condition enforces some syntactic parallelism, and requires non-trivial traversals in the tree structure. Wilder (1997) does not actually define what this condition consists of and thus a more objective evaluation is not possible. The Content-identity condition requires that the target and the source of LPE must end up having the same linguistic content at LF. This seems to enforce something akin to our sense identity, but because no actual LF

[22]Nothing is said about how the combinatorial explosion of possible ellipsis sites (created by the base-insertion of null forms) can be avoided. As it stands, this account would cause the 'minimalist' computational system to be extremely inefficient and redundant.

representations are provided it remains unclear what kind of identity is actually being alluded to and what are the predictions of the account. Finally, the Major Constituent Condition, due to Neijt (1979), is essentially a stipulation about islands and deletion.

In sum, the account in Wilder (1997) makes a number of assumptions about empty categories and base-generation, and postulates various conditions that have to perform non-trivial searches on the syntactic tree. Moreover, it is stipulated which constituents form islands. I my account both phrasal and lexical instances of LPE are accounted for, and the phenomena are obtained locally, via structure-sharing constraints stated over linearization domains.

8.2.3 Semantic Integration

For completeness, I note that a kind of semantic integration may also occur in LPE. Consider languages in which adjective have overt agreement and can be realized post-nominally as is the case of Portuguese. The data in (90) appear to have conjunctions of *singular* adjectives modifying a *plural* nominal head:

(90) a. Os valores são claros nos [pontos [máximo e mínimo]]
the$_{pl}$ values are clear$_{pl}$ in-the$_{pl}$ points maximum$_{sg}$ and minimum$_{sg}$
'The values are clear in the maximum point and in the minimum point'

b. Os [chás [preto, verde e chinês]] são obtidos da mesma planta
the$_{pl}$ teas black$_{sg}$ green$_{sg}$ and Chinese$_{sg}$ are obtained$_{pl}$ of-the same plant
'The black, green, and Chinese teas are obtained from the same plant'

Note that the conjunction of adjectival phrases does not yield plural agreement. That kind of agreement pattern is impossible in a copula structure for instance:

(91) a. *Os pontos cujos valores são mais claros são máximo e mínimo.
the points which values are more clear are maximum and minimum

b. *Os chás são preto, verde e chinês.
the teas are black green and Chinese

The data above show that the phenomenon has to do with adjunction rather than with adjectival coordination. I have no account for these cases, but conjecture that this may be an effect similar to the one observed in RPE: the speaker plans to talk about three kinds of tea and instead of uttering a rather repetitive coordination of three singular NPs: *o chá preto, o chá verde e o chá chinês*, the left periphery *o chá* is omitted for economy. The fact that there is a plurality involved may then lead the speaker to optionally pluralize the determiner and the noun. If this analysis is correct then the same account suggested for integration in RPE can be adopted for LPE.

8.3 Summary

§8.1 The basic syntactic, semantic, morphologic, and phonologic properties of Right Periphery Ellipsis are characterized and empirically motivated. All previous accounts assume that the phenomena are restricted to coordination structures, but counterexamples have been noted in the literature, suggesting that this is not the case. Novel evidence is provided to show that RPE applies to essentially any kind of construction.

It is concluded that displacement accounts (e.g. movement or extraction) have many problems and that a deletion account is better suited to deal with the full range of phenomena. The data provided shows that a single and uniform deletion operation applies in phrasal, lexical, and mixed environments.

Right Periphery Ellipsis is argued to be a local operation on morphophonological items rather than a post-processing PF interface phenomenon. This operation is quite general and amounts to the deletion of peripheral items that are prosodically independent, under morphophonological identity. The fact that RPE hinges on phonological constituency has a number of predictions, in particular, the fact that RPE correlates with prosodic contrast. Without such contrast the peripheral items are not prosodically independent and thus no ellipsis can arise.

§8.2 The syntactic and semantic properties of Left Periphery Ellipsis are characterized and the various alternative accounts are discussed. This phenomenon is best seen as a deletion operation rather than base-generation (either by relaxing constituency or by stipulating the existence of empty categories). LPE is shown to apply both in phrasal and lexical domains, in non-headed constructions. Left Periphery Ellipsis is thus argued to be a local deletion operation that elides linearized elements under sense identity rather than under phonologic or morphologic identity, and that there are various kinds of elements that can be peripheral remnants, immune to LPE. This account attains a wide linguistic coverage and makes several correct predictions without resorting to complex non-local tree-searching machinery.

Chapter 9

From Theory to Implementation

Grammar implementation can play an important role in testing and evaluating a formal theory, and as such assist in the process of technical and theoretical investigation. Implementations allow to readily detect certain kinds of errors and inconsistencies automatically, and to compare and evaluate competing theoretical assumptions. However, the grammar implementation issues and techniques should not directly interfere with the process of linguistic theorization. The latter should be guided strictly by empirical considerations.

The implemented grammar consists in a fragment of the theory provided in this dissertation, but it covers the main aspects of the grammar of coordination, and the source code is available in http://www.clul.ul.pt/clg/gram.html. There are various challenges to implementing this kind of grammar. In this chapter I discuss the three main problems that the Prolog grammar fragment had to deal with. These issues concern the implementation of a linearization-based parser, infinite recursion due to partial rule instantiation, and the processing of deletion phenomena.

9.1 Grammar Fragment Implementation

9.1.1 Linearization-based Parsing

Curry (1961) makes a distinction between the *phenogrammatical* level (surface realization) and the *tectogrammatical* level (syntax proper). In this view, the yield of a syntactic tree is no longer read from the terminal nodes. Instead, there is a 'surface realization domain' where strings can shuffle and permute according to language-specific linear precedence rules. In this view the various degrees of word order freedom are mainly taken as a matter of language specific linearization constraints instead of one of syntactic structure. Thus, the composition of syntax and of semantics in languages with different degrees of word order freedom is essentially identical. For example, all the word orders in (1) are valid for Russian, with the same basic meaning:

(1) a. Vse znayut kogo-to.
everyone$_{nom}$ knows someone$_{acc}$

b. Kogo-to znayut vse.

c. Vse kogo-to znayut.

d. Kogo-to vse znayut.

e. Znayut vse kogo-to.

f. Znayut kogo-to vse.

In linearization-based account, the syntactic structure of these sentences is always the same, but the order of word realization may vary. The tree structure below captures this intuition. The same syntactic tree (and same semantic composition process) is in place, but the '◯' operator can be used to allow for any of the orders in (1):

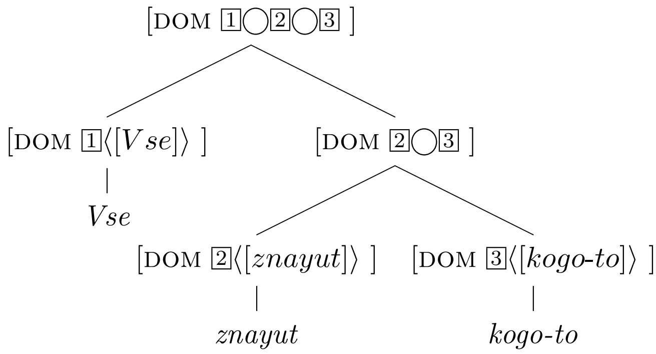


Figure 9.1: One syntactic tree *vs.* six possible realizations

Using standard parsing techniques for this kind of syntactic structure raises several challenges. First, if one gives a set of words to the parser, then the order by which these are given is not relevant. The goal of the parser is to find a way in which these words can be combined to yield a tree. The level of DOM is a different matter. The order in that list must follow the grammar constraints and the order observed in the input given to the parser. A number of grammar implementations have been developed for parsing in linearization-based HPSG that I overview briefly.

Müller (1996) describes Babel, a Prolog system for the implementation of HPSG grammars which can handle discontinuous constituents indirectly: in general, each grammar rule with n items on the DTRS list is compiled into $n!$ rules, each with a different permutation of items in the right-hand side. The parser can then handle these rules in the usual way. The approach in Müller (1996) blurs the distinction between pheno- and tectogrammar made by the grammatical theory, because word order is encoded in DOM and not the RHS of ID schemata.

Penn and Haji-Abdolhosseini (2003) propose a parsing system for linearization domains that uses a mixed bottom-up/top-down processing strategy operating over two parallel grammars: one which uses bottom-up *pheno-rules* and a second which uses top-down *tecto-prediction* rules. Here, the phenogrammatical level also yields a parse tree and the chart must distinguish the two levels by keeping track of *pheno-edges* and active/passive/frozen *tecto-edges*. In my implementation I will not resort to a secondary pheno-grammar.

Daniels and Meurers (2004) propose GIDLP, a special grammar format for the direct encoding of linearization-based HPSG theories. More specifically, the formalism parses discontinuous trees and linearization domains, rather than tectogrammatics. To use this implementation formalism the grammar engineer may have to rewrite the grammar constraints if the linguistic specification adopted for a given linearization theory does not match the particular format supported by GIDLP.

In my view, a parsing strategy should not impose restrictions on the linguistic specification, nor require time-consuming grammar rewriting. Following Pollard and Sag (1994), I view a HPSG grammar as a set of declarative linguistic constraints. In the proposal that follows the parsing system uses the grammar rules to guide parsing in an efficient way, yet without requiring any specific formatting over the grammar.

9.1.2 A Key-driven Linearization-based Chart Parser

The parser is a modified bottom-up Earley parser. I follow standard practice in taking the grammar rules of the grammar as phrase structure rules. This involves no grammar rewriting and basically amounts to viewing grammar rules as follows:

$$h\text{-}subj\text{-}cx \Rightarrow \begin{bmatrix} \text{MTR} & \text{X} \\ \text{DTRS} & \langle \text{Y}\,,\text{Z}\rangle \end{bmatrix} \quad \equiv \quad \text{X} \rightarrow \text{Y Z}$$

Figure 9.2: The head-subject rule viewed as a phrase structure rule

As a convention, the first element in DTRS corresponds to the *key daughter*. The key daughter is the element that imposes selectional restrictions on the sister node. This allows for a more efficient prediction of sister nodes than with a naive left-corner prediction or even with a head-driven strategy (van Noord 1997; Oepen and Carroll 2000b, Daniels and Meurers 2004). This convention has no impact on the linguistic specification, since the order in DTRS has no true linguistic relevance in general. In head-complement and in head-subject constructions the head daughter is the key because it is the daughter that imposes constraints in the sisters (via COMPS and SUBJ respectively), but in head-modifier and head-specifier constructions the key daughter is the non-head daughter. It is the modifier and the specifier that impose constraints on the sister node, via MOD and SPEC, respectively. In coordination, the *crd+* daughter is the key.

Second, seeding the parser involves labeling each input word with a number. The parser will be allowed to try to merge any two nodes as long as their spans do not overlap (and the resulting structure satisfies the grammar principles, of course). For a more efficient representation of edge spans (and more efficient computation of span merging), I follow Reape (1991), Johnson (1995), Ramsay (1999), and others in encoding spans as bit vectors.[1] Thus I use a generalized fundamental rule of the form:

(2) $\langle i, A \rightarrow w_1 \bullet Bw_2\rangle + \langle j, B \rightarrow w_3 \bullet\rangle \mapsto \langle k, A \rightarrow w_1 B \bullet w_2\rangle$

The spans i and j are non-overlapping bit vectors and k is computed via bitwise-or. The Prolog implementation makes edge search more efficient by using bit masks (see Müller (2004, 237) and Daniels and Meurers (2004)). That is, instead of blindly searching for edges that may or not overlap, one can directly search over non-overlapping edges only. For example, if the edge in question is $[1, 0, 1, 1, 0]$ then a Prolog bit mask $[0, X, 0, 0, Y]$ is generated and searched for. Because of Prolog's first argument indexing, only edges that begin with '0' will be considered.[2]

Parsing starts by first seeding the chart with lexical items and then building a tectogrammatical tree bottom-up. The grammar is used as a repository of constraints

[1] In fact, reversed bit vectors, for these are easier to assemble from the input string.

[2] There are other techniques that could be adopted for improved efficiency, such as *ambiguity*

that the parser consults to validate a candidate edge. In order to admit a given candidate edge in the agenda, the parser also imposes a filtering condition: the linear order observed in the phenogrammatical level of the candidate edge must be consistent with the linear order observed in the input string. More specifically, if a token α precedes β in the surface string then the corresponding α' must also precede β' in DOM.[3] This constraint is implemented as a grammar principle (`surface_consistency`/1), and is computed by attaching the bit vector to the word form. This way the order in DOM is identical to the order in the input string. The algorithm for the parser is given in Figure 9.3 (the *bit*-$\vee$ function computes the bit-or of two input spans). As standard practice, the parser can directly process valid candidate edges as soon as the these are found by the parser, without resorting to an Agenda.

Seed Agenda with scanned input lexical items.
<u>*While*</u> *Agenda is non-empty* <u>*do*</u>*:*

  Remove edge E_i from the top of Agenda;

  <u>*If*</u> *E_i not already in Chart* <u>*then*</u>*:*

    <u>*If*</u> *E_i is passive (i.e. of the form $\langle i, B \rightarrow w_1 \bullet \rangle$),* <u>*then*</u>*:*
      Fundamental rule: obtain new candidate edges $\langle k, A \rightarrow B \bullet w_2 \rangle$ from existing chart edges of the form $\langle j, A \rightarrow \bullet B w_2 \rangle$, where k:= bit-$\vee$(j,i);
      Prediction: obtain more candidate edges of the form $\langle i, C \rightarrow B \bullet w_3 \rangle$, where the B category in E_i is the key daughter;

    <u>*If*</u> *E_i is active (i.e. of the form $\langle i, w_1 \rightarrow w_2 \bullet B \rangle$)* <u>*then*</u>*:*
      Fundamental rule: obtain new candidate edges $\langle k, A \rightarrow B \bullet w_2 \rangle$ from existing chart edges $\langle j, B \rightarrow w_3 \bullet \rangle$, where k:=i <u>*if*</u> *i=j and k:= bit-$\vee$(j,i)* <u>*otherwise*</u>*;*

    Add all remaining candidate edges to the Agenda.

Figure 9.3: A Bottom-up Key-driven Linearization-based Chart Parser

packing. See for example Oepen and Carroll (2000a) for more on the application of packing in large-scale HPSG implementations. The adoption of linearization bounds may also speed up parsing, as reported in Müller (1999)

[3]This condition may also be recast as a set of implicit LP constraints derived from the input string.

There are various sophisticated HPSG-based grammar implementation platforms, such as ALE (Carpenter and Penn 1999) (and a more recent extension, TRALE), and the LKB Copestake (2002) but none of these currently implements linearization domains and already come with a built-in parser. In order to implement this system I used ProFIT (Erbach 1994), a Prolog extension that allows one to compile typed feature structure descriptions into Prolog terms.

As an illustration, I provide the SEMANTIC INHERITANCE PRINCIPLE and the NON-LOCAL INHERITANCE PRINCIPLE. Below, the first argument of the principle is the mother and the second argument is a list of signs (the daughters).

```
semantic_inher_principle( mtr!sem!(rels ! RelsMtr &
                                   cons ! ConsMtr) &
                          cx_sem! (c_rels! C_Rels &
                                   c_cons! C_Conds) ,
                        [sem!(rels! RL1 &
                              cons! CL1),
                         sem!(rels! RL2 &
                              cons! CL2)]):-
   append(RL1,RL2,RelsMtr_t),
   append(CL1,CL2,ConsMtr_t),
   append(RelsMtr_t,C_Rels,RelsMtr),
   append(ConsMtr_t,C_Conds,ConsMtr).
```

In the case of the NON-LOCAL INHERITANCE PRINCIPLE, it need only apply to constructions of the type *h-local-cx* and access the value of HD-DTR. This is implemented as a conditional predicate:

```
 non_local_inher_principle(M):-
  (M = <h_local_cx) ->  (M = (mtr!syn!inher!I &
                              hd_dtr!syn!inher! I)) ; true.
```

The complete set of principles that the grammar implements are the following:

```
principles(Mother,Dtrs):-
   headed_struc_principle(Mother),
   linearization_principle(Mother,Dtrs),
   non_local_inher_principle(Mother),
   semantic_inher_principle(Mother,Dtrs),
   surface_consistency(Mother).
```

9.1.3 Delayed Constraint Satisfaction

One of the major problems is that when predicting new edges and applying the grammar principles, the key daughter often imposes very little constraints on the sister node. This causes the constraints to apply to uninstantiated lists and result in memory overflow. Fortunately Prolog offers a straightforward solution. One can deal with this kind of issue via the predicate `freeze`/2. This allows a call to be delayed until a certain variable is instantiated. I illustrate this with the *h-subj-cx* rule:

```
rule(M& <h_subj_cx&
         mtr!(<phrase& syn! (val! (subj ![] &
                                   comps![])) &
                       sem!key!K &
                       dom ! [S|DL1]) &
         hd_dtr!H ,
         Dtrs&[H&(syn! (val! (subj![S] &
                             comps![])) &
                  sem!key!K &
                  dom! DL1),
               S& dom!DL]):-
    freeze(DL,principles(M,Dtrs)).
```

Thus, the grammar principles are only applied when the domain list `DL` of the sister node is instantiated. Delayed constraints are particularly important with regard to the coordination rule. The list of domains can only be appended when the list of the left conjunct is known. Moreover, parsing is more efficient if the scopal argument of the quantifier is accessed when it is known if it is a one-place or a two place quantifier (implemented by `last_member`/2), and similarly for the requirement that the index types of the conjuncts be the same (either *ind* or *evt*).

```
rule(M& <coord_cx&
         mtr!(syn! S &
              sem! key! K &
              crd! c_mode! Mode &
              dom! DL3) &
         cx_sem ! (c_rels! [ <non_q_pred & lbl! L1 &
                                           reln! Mode  &
                                           args! [Y,X] ] &
                   c_cons! [leq(L1,L3), leq(L1,L2)]) ,
         Dtrs& [ (syn! S &
                  sem! key! (K & (index! X &
                                  args! [L2|_])) &
                  crd! (<crd_plus & c_mode!Mode) &
```

```
                 dom! DL2),
                (syn! S &
                 sem!key! (reln! <quant &
                          index! Y &
                          args ! Alist) &
                 crd! <crd_minus &
                 dom! DL1) ]):-
 freeze(DL1, (append(DL1,DL2,DL3),
             last_member(AList,L3),
             principles(M,Dtrs),
             same_type(X,Y)) ).
```

9.2 Parsing and Deletion

The account of deletion that is proposed in this thesis can be implemented without major problems. However, it raises important questions as to how parsing should work. Recall that deletion is seen as an economy mechanism that speakers use in order to avoid repeating identical strings. In general, a bottom-up parsing strategy is at odds with these data. Any linguistic account that includes deletion will have a problem when it comes to bottom-up parsing. The full input string can be given and the right output can be obtained, but the problem is that in parsing one typically intends to give as input the string that is observed in text or in spoken input, not the set of leafs that are associated to the syntactic tree.

In linearization-based HPSG, bottom-up parsing makes more sense if one is doing generation: start with a semantic representation and obtain possible surface realizations. For recognition something else is necessary. The problem with top-down parsing is the combinatorial explosion of nodes (specially with regard to recursive rules such as the coordination rule). There are ways to circumvent termination issues, but there are major memory overflow problems that cannot be handled via delayed constraints because these constraints are needed to guide parsing in the descending search.

If the deletion account and the linearization approach adopted in this dissertation are correct, than this suggests that the parsing problem must be solved via an *incremental*, left-to-right, pheogramatically-driven parsing strategy. Incrementality is well-motivated with respect to cognitive experimentation. For decades there is substantial evidence showing that humans process language in an incremental fashion and recently various models of human parsing have been proposed such as Konieczny and Hemforth (1994) which draw from psycholinguistic research, computational linguistic approaches, and statistical models, blending cognitively and computationally motivated parsing approaches.[4] This is based not only on the idea that words are processed one at a time, but on the idea that linguistic structure is also built in this fashion, incrementally.

9.3 Summary

§9.1 This section discusses various computational approaches that can be adopted in order to parse with linearization domains. A modified bottom-up key-driven Earley-based chart parser is proposed, which is capable of directly parsing tectogrammatical trees for grammars supporting linearization domains. The consistency between the surface and the pheno/tectogrammar levels is regulated by a linear precedence *pheno-surface constraint*. The parser thus imposes no format limitations on the linguistic grammar specification of linearization constraints. The grammar is taken to be nothing but a set of declarative constraints independent from the parsing strategy of choice.

§9.2 Deletion phenomena and linearization-based theories of word order are shown to be at odds with standard parsing technology, and it is suggested that the recent resurgence in interest and in technology with regard to incremental parsing methods may just provide an adequate linguistic (and cognitively motivated) solution to this problem.

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[4] See also the *Incremental Parsing: Bringing Engineering and Cognition Together* Workshop held at ACL-2004.

Chapter 10

Conclusions

This dissertation provides novel empirical observations and new lines of research for a more parsimonious understanding of coordination, agreement, extraction phenomena, and ellipsis. It explores the syntactic and semantic underpinnings of coordination, and in particular, of conjunction. A central claim is that coordination structures are uniform with regard to their syntax-semantics interface. A wide range of phenomena result from a unique syntactic construction and a unique semantic composition process. Moreover, the ambiguities that arise in the presence of pluralic arguments are argued to result from lexical constraints introduced by subcategorizing heads, and not from the arguments. The latter are claimed to be non-ambiguous. It is also argued that conjunction can systematically form pluralities with any category that it conjoins, nominal or non-nominal alike. The grammar fragment that is proposed and formalized in HPSG goes well beyond coordination and shows how coordinate structures can interact with other constructions in a systematic fashion.

10.1 Summary of Contributions

This dissertation makes several claims that I summarize below.

1. Coordination is a non-headed construction.
2. Comparative structures are not coordination structures, and do not exhibit the same extraction phenomena.

3. Conjuncts must have identical categorial specifications. From this property, a wealth of correct predictions follow.

4. The phenomenon of coordination of unlike categories follows as a prediction of an independently motivated ellipsis operation.

5. Nominal agreement asymmetries follow as a prediction of an independently motivated ellipsis operation and of frequency- and context-dependent preferential processing biases.

6. Asymmetric readings in coordination structures are due to a pragmatic process, not to an underlying subordination structure.

7. Conjunction can form a plurality with any conjoinable category.

8. Cases of nominal coordination which are usually seen as recalcitrant and require special semantic operations, are explained by independently motivated ellipsis phenomena.

9. Distributive, collective, and cumulative readings of pluralic arguments (plural nominal structures or conjoined structures of any complexity) result from the lexical meaning of subcategorizing predicates, in a uniform way.

10. Right-Periphery Ellipsis is a deletion phenomenon that can apply locally, to any construction (phrasal or lexical), and that omits prosodically independent morphophonological constituents.

11. Left-Periphery Ellipsis is a deletion phenomenon that can only apply to non-headed constructions, to omit linearized structures under sense identity, either phrasal and lexical structures.

10.2 Future Research

There are various well-known instances of coordination that have not been addressed in this dissertation, but which the theory proposed here may be able to accommodate without major changes. Some of these other instances of coordination result from the interaction with other phenomena that more generally occur throughout the grammar. Consider for example cases in which only the marked conjunct is realized:

(1) a. And I thought *you* were in a foul mood!
[denial elaboration]

b. And to think that I knew you when you were still in diapers...
[*amazement* VP[to] reading, marked prosody]

There are two main aspects to cases such as these. First, the initial conjunct is recovered from context and second, the structure has a particular kind of meaning. The former aspect may be an instance of discourse anaphora, which in HPSG terms can be accounted for as in Ginzburg and Sag (2000, Ch.8) for example. The peculiar meaning observed in the coordination can either be accounted by a new lexical entry for the conjunction (with a different MODE relation), or by the constructional feature CX-SEM. This choice hinges on whether the peculiar semantic import of such cases is associated to the overt conjunct or to the coordination marker.

Let us consider some other cases. Various kinds of constituents can have a parenthetical realization and coordination structures are no exception. In (2) is provided an example that may perhaps be a mixed case of a parenthetical usage and discourse anaphora.

(2) Mary – and I don't think she is making it up – said he was naked in the kitchen.

Other instances may resort to a different kind of ellipsis phenomena, such as the case in (3). The simplest possible account would have it that *and* is here homonymous with the word *to*.

(3) Let me try and answer to all your questions.
[*and*=*to* reading]

But there appears to be no independent evidence for this move. An alternative analysis that may be worth exploring is one in which the first conjunct has an instance of VP ellipsis. Observe that this analysis is independently motivated by the acceptability of *Let me try* and *Anyone foolish enough to try would get themselves killed.* This cannot be all there is to it however, for the elided VP must be required to be cataphorically identified with the one in the following conjunct. Cataphoric VP ellipsis is independently motivated by examples like *If you think you are brave enough to try, then I'd love for you* [*to teach the course backwards*].

Culicover and Jackendoff (1997) argue that the construction exemplified in (4) – in which the first daughter has a rising (quasi-interrogative) contour while the second daughter as a descending contour – has the syntax of a coordinate structure but a subordinate-like semantics.

(4) Mary listens to the Grateful Dead↑ and she gets depressed↓.
[If/When Mary listens to the Grateful Dead, she gets depressed.]

I note however that this prosodic contour is not obligatory for the asymmetrical readings. In my account no major syntax-semantics mismatch need to be assumed. The semantic facts can in principle be accounted in the same way as the extra pragmatic import of asymmetrical coordination is captured, via extra semantic relations added to BACKGROUND.

A similar account might be extendable to other examples like the one in (5). Here, the conditional import is only insertable in BACKGROUND if the antecedent eventuality has an imperative mode.

(5) (Give) one more step and I'm afraid I'll have to shoot you.
[*One more X and Y* idiomatic conditional]

It may be that in some cases there are reasons to introducing extra lexical entries for conjunction – on top of the other existing lexicon for non-intersective conjunction, intersective, packaging, numeral, and arithmetical conjunctions – but the syntax-semantics mismatch that Culicover and Jackendoff (1997) argue for does not need to occur.

There are also a number of more idiomatic usages for coordination, which impose more restrictions on the conjuncts. For example, these are required to be phonologically identical (except for the cases where the second conjunct must be negated): Some of these cases are typically binary, but others need not be.

(6) a. The sound became louder and louder / He spent years and years in exile
[*X and X* intensification]

b. There are teachers and (there are) teachers.
[*There are X and there are X* idiomatic frame, 'good-and-bad' reading]

c. He's all brawn and no brain / all bark and no bite
[*all X and no X* idiomatic frame]

d. Iraq war or no Iraq war.
[*X or no X* idiomatic frame, 'with or without' reading]

It is unclear how to best account for these cases. It may be that these require an additional kind of coordination construction and/or additional lexical entries for conjunction, similarly to correlative coordination as discussed in §7.2.3.

Finally, there are also structures like the ones in (7), where either all non-initial conjuncts are marked by a coordination lexeme or none of the conjuncts is marked. These typically require an enumerative prosody, and do not allow for intermediate group readings.[1] For example, either sentence below can only mean that each person was hired individually, or that they were hired collectively.

(7) a. I hired Fred, Sue, Tim, Kim ...

b. I hired Fred, and Sue, and Tim, and Kim.

As such it is unlikely that the extra conjunction lexemes in (7b) have a meaning contribution. These may correspond to another kind of lexical entry for *and* which do not actually introduce a novel pluralic referent. In this view only the last conjunction lexeme is a true conjunction in the sense that it introduces a pluralic referent, but all remaining conjunction lexemes are semantically vacuous. The latter would entail that no intermediate group readings would arise. Their pragmatic content and prosodic realization is marked however, and thus some kind of non-semantic contribution is in order. In the case of (7a), one could propose a unary branching rule that coerces the rightmost conjunct into being marked as *crd+*.

[1]Compare the intermediate group reading observed in cases like *I hired* [*Tom and Fred*] *and* [*Mia and Sue*], in which there are two team hirings.

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