

Renaissance Dialogue: Humanities and Science

In his treatise on the origin of comets, *Il Saggiatore* (1623), Galileo used the form of a literary fable or folktale to describe a man's aptitude for the new scientific research.¹ This man, striving to observe and understand the device by which birds sing, went out in the world to research "new methods" ("nuovi modi") of producing sounds. He heard and studied the sounds of flutes, violins, organs, trumpets and fifes; the squeaking of door hinges; and the sounds made by wasps, mosquitoes, flies and crickets as they beat their wings or scraped their wings together. However, as the man's wonder grew, Galileo tells us, he felt more and more ignorant about how sounds were made. Finally, the man hoped to understand how a cicada sang, and manipulating or experimenting with one in his hand, the man accidentally killed the insect. Galileo ends his story, writing: "la difficoltà dell'intendere come si formi il canto della cicala, mentr'ella ci canta in mano, scusa di soverchio il non sapere come in tanta lontananza si generi la cometa" (Galileo e Saragat, 6: 281).² This essay is most interested in the experimenting (and writing) hands of this fable and explores how Renaissance texts might offer important resources for investigating the historicity of embodiment and the hand-brain connection.

Much neuro- and cognitive science research today is dedicated to the hand, the neural correlates of its capacity to point, grasp, connect, and understand, and its function in language processing, the sensorimotor system, and social interaction.³ I propose that our early modern texts make an important contribution to this research, enabling us to historicize the role of the hand in cognition and in constructing the social space of the researcher. Stepping back from questions of what words mean and focusing instead on representations of physical dimensions of handwriting, printing, and reading,⁴ we can document how historical shifts from handwriting to print, in particular, and changes in perception of the hand's activities and movements may have led to a depletion and impoverishment of an intersubjective research space, already sensed in Galileo's story of the hands, the cicada, and comets, and investigated today across the disciplines in research on embodiment, identity, and empathy. If, as Sklar and Foster have argued, representations of historical hands conserve a memory of movement and momentum,⁵ then such representations surely activate a sense of sociality and intersubjectivity with "the past," also contributing, from a humanistic perspective, to the definition of what Vittorio Gallese, in his

neuroscientific study of empathy, has termed “a new conceptual tool: the shared manifold of intersubjectivity” (“Roots of Empathy” 171).

1. Hands as the measure of social, commercial and spatial relations

In the mercantile culture of 15th century Florence, the writing activities of the hand in account books, memoirs, and chronicles were understood to be at the center, indeed constitutive, of social, cognitive and spatial relations. In Book III of his dialogue, *I libri della famiglia*—set around 1421 (but composed between 1435 and 1444)—Leon Battista Alberti’s character Giannozzo, identifying the manual dimension of commercial intercourse, tells us he would relate to his administrators (“fattori”) by always reviewing even the smallest details so that “errors could not grow old in his hands” (“non potrebbero gli errori invecchiarmi tra le mani”; 250). Giannozzo cited the practice of his ancestor Benedetto Alberti (c. 1320-1388) who used to say that in order to avoid deceit, a merchant “should always have his hands stained with ink” (“egli stava così bene al mercatante sempre avere le mani tinte d’inchostro”; 251). And he extended this advice to suggest that it was the duty of the merchant to conduct all relations with a pen in hand:

Dimonstrava essere officio del mercatante e d’ogni mestiere, quale abbia a tramare con più persone, sempre scrivere ogni cosa, ogni contratto, ogni entrata e uscita fuori di bottega, e così spesso tutto rivedendo quasi sempre avere la penna in mano.⁶

This mercantile precept—to keep the hand at the center of business relations—represented an artisanal relationship to writing, a relationship that, blurring the boundary between the hand and the recording of commercial transactions, insured the integrity of business relations. Moreover, we might extend the pertinence of Berenson’s concept of “tactile values”—i.e., the experience of motor sensations in the spectator that gave a multi-dimensional depth to Renaissance painting⁷—to include, as well, these mercantile relations of writing that organized the relational space, the movements, and the thinking or *ragione* of the merchant (Jed, *Chaste Thinking* 97-114; Cicchetti and Mordenti).

Juxtaposing the representation of hands in the pages of merchant books or *ricordi* to Galileo’s portrayal of the hands that accidentally killed the cicada, we might also observe that the merchants’ perceptions of their hands’ activities and movements were unproblematically central to their ways of knowing and to the production and organization of their

intersubjective space. Knowledge of business was, indeed, unequivocally acquired by movement in space, through the grasping of the pen, the moving touch of that pen on paper, the “annulling” of a distance, through touch and movement, between merchants and the letters and numbers they write (Refskou and Thomassen 39).⁸ What, then, might the representation of the hand in the merchant books contribute to neuroscientific investigations today?

According to neuroscientists who study the distribution of spatial attention, if we are viewing a book, say, at a desk and grasping our pens, we are more likely to prioritize the space near the hand for the upcoming action of writing. Bimodal neurons, specific to the region of the brain corresponding to the hand and its environs, begin to coordinate visual and tactile-motor systems that enable us to interact efficiently with the book if it is placed correctly in our peripersonal space (Reed et al. 236-43). Or, in the case of the merchant account books and *ricordi*, the sensorimotor input of the pen strokes on the page were geared to specific habits of movement and meant to recruit in the writer’s hands and brains a particular kind of exertion or practice of forming letters that would lead to a particular configuration of social relations and intersubjective space, one that protected the integrity of relations and precluded the detachment of such relations from the merchant’s sensorimotor activities. This representation of a felt connection to the hand as engaged in meaningful movements and the production of intersubjective space might serve as a historical baseline against which to measure and interpret hand action in brain experiments today.⁹

2. Stilling the hand

Representations of literacy in early modern European texts often included reference to the ability to know the letters of a particular handwriting style. In Act 1, Scene 2 of *Romeo and Juliet*, for example, Romeo’s servant asked Romeo: “can you read anything you see?” And Romeo responded: “Ay, if I know the letters and the language” (lines 60-61). Shakespeare was reminding his audience that in order to be able to decipher the various types of handwriting practiced in different social settings—various secretary hands, humanistic hands, chancery hands, etc.—some prior physical training of the hand was required.

Much later, Galileo, again in *Il Saggiatore*, also referred to this cognitive training with respect to the learning of mathematical characters. “La filosofia,” he wrote,

è scritta in questo grandissimo libro che continuamente ci sta aperto innanzi agli occhi (io dico l'universo), ma non si può intendere, se prima non s'impara a intender la lingua, e *conoscer i caratteri* ne' quali è scritto. Egli è scritto in lingua matematica, e *i caratteri son triangoli, cerchi ed altre figure geometriche, senza i quali mezzi è impossibile intenderne umanamente parola*; senza questi è un aggirarsi vanamente per un oscuro laberinto." (Galileo e Saragat 6: 232, emphasis mine)¹⁰

Again, Galileo's metaphor pointed to training in the cognition of written symbols as a necessary foundation for all other learning and knowing. To appreciate what Shakespeare's and Galileo's texts tell us about the dynamics and consequences of this cognitive training based on the movement-rich making and reading of linguistic and mathematical characters, we might look at the figure of Ludovico Vicentino degli Arrighi and his printed handwriting manual, *Operina* (1523-24), that, preceding Shakespeare's and Galileo's texts by several decades, affords an opportunity to understand the cognitive shift in the perception of the hand with the advent of printing. Indeed, we can observe in this work, in contrast to Alberti's representation of a felt connection to the hand as engaged in meaningful movements, Arrighi's representation of efforts to still the hand's movements.

Arrighi's *Operina* might be read in relation to the new bureaucratic relations of writing emerging in the early sixteenth century.¹¹ Moreover, the metaphors through which Arrighi represented the stilling of the hand and the transference of attention from the hands of writers to the letters on the page open up a vista on the historical processes through which handwriting came to be felt as disconnected from the sensorimotor system. It is precisely this new representation of disconnection that might make Arrighi's *Operina* of importance for current research in such topics as neural specialization, sensorimotor experience, visual processing, spatial attention, embodied cognition, affordances, and cortical hand motor activation. Indeed, a case might be made for the consideration of handwriting teachers like Arrighi, Palatino, and Tagliente, etc. as proto-scientific thinkers who, through their practices of handwriting, were attuned to the ways in which the sensorimotor system was engaged in processes of embodied cognition. At the same time, ironically, one might argue that works like Arrighi's *Operina*, contributing as they did to the construction of a new "professional formation of secretaries, editors, chancellors needed for public administration and by the dominant social classes" (Petrucci,

“Pouvoir de l’écriture” 839), were also instrumental in severing a felt connection between the writing hand and its acts of knowing.

In his dedication to the reader, Arrighi suggests that “even though the printing press cannot completely reproduce the living hand” ‘Conciosia che la stampa non possa in tutto ripresentarte la viva mano’ (3), his readers might still learn to write chancery letters by imitating the letters they find on the pages of his little work. Surprisingly, he referred to his work as a memento or record—“il mio ricordo” (3)—using a term that, as we have seen, tied the *Operina* to mercantile writing practice and grounded it in the hand-centered social world of registering and remembering transactions, contracts, loans, and events—both historic and personal—via acts of writing in merchant books. As we saw in the case of Alberti’s text, the merchants’ hands were represented as agents in the construction of their hybrid worlds of business, family relations, history, politics, and culture. It was, for example, the merchant’s hand that produced the event of a death in the act of registering it in the family *ricordi*. And it was the merchant’s hand that settled a loan or a debt with a diagonal stroke of a pen in the account book. The work of the mercantile hand was here-and-now work engaged in the present time of writing. How might Arrighi have conceived of the physical work of the hand in his professional formation of secretaries, editors, chancellors whose hands would be interpellated by the necessities and ideologies of local and imperial bureaucracies?

Near the beginning of his *Operina*, Arrighi presents two strokes of the pen that form the foundation of all chancery letters: “one is horizontal” and thick, the other is diagonal and thin as we are able to see marked *here* – ‘ – ‘ –’ ‘l’uno é piano et grosso, l’altro é acuto et sottile come *qui* tu puoi vedere notato’ (4). Arrighi’s deictic marker “here”—“come *qui* tu puoi vedere notato”—directs our attention to the marks on the page. Although printing created a distance between marks on the page and the *now* dimension of the writing teacher’s work, for the reader or writing student, there was still here-and-now work to be done. Here on the page were letters to be imitated now by the writing student. Embedded in this direction of our attention, then, were also instructions about the positions of the writers’ hands (and bodies) in relation to upcoming actions (Reed et al. 236-37, 243).

With respect to the hands, Arrighi advised writers both to strengthen their hands through movement and practice and to steady their hands in the making of such movements, so that there would be no trembling or wavering in the lines produced. Arrighi’s phrase *firmar la mano* thus referred both to the movements of the hands and the stilling

of the hands. These contradictory meanings, I would like to suggest, had concrete consequences for the felt connection between the writer's hand and activities of knowing.

In one definition of the phrase *firmary la mano*, we can understand that the purpose of Arrighi's handwriting manual was to teach his readers to strengthen their hands through active movement. Having completed the training of the writer's hand in the formation of lower case letters, Arrighi suggested, towards the end of his "little work," that writing would require less effort with continued practice. Using the expression "firmary la mano" to mean "to strengthen the hand," he intended *firmary* in its sense of *rendere saldo*, *assicurare*, or *rafforzare*: "Grave fatica non ti sia ad imparar fare le littere Maiuscole, quando nelle piccole harai firmato bene la mano" 'Once you have really strengthened your hand with the practice of writing lowercase letters, it won't take such serious exertion to learn to make the uppercase letters . . .' (21). This experience of continued efforts and exertions over time that lead a person to be able to do something with less effort and exertion is a commonplace of all arts that require practice. In the case of Arrighi's understanding of practice, the strengthening of the hand through practice did not mean that the hand movements would decrease or that writing would become less motocentric. Yet, he suggested, as writing became more automatic with diminished efforts and exertions, attentive thoughts to hand movements would also diminish in the writer's awareness.¹²

Indeed, the goal of those who, learning to write in the sixteenth century, would become secretaries, diplomats, and clerks in chanceries and other offices, was precisely to subsume their hand movements to administrative and bureaucratic tasks and ideologies of recording (Petrucci, "Pouvoir de l'écriture" 841). In contrast with the merchant writers who, as we have seen, projected the historicity and logic of their lives and bodies on to the pages of their *ricordi*, these new professional writers who emerged from the teaching of writing masters like Arrighi, Tagliente, Palatino, etc. were trained to detach from the exertions of their hands and wholly transfer their attention to the letters on the page. Arrighi may have subtly encouraged this detachment, when he instructed his students to "make a little head at the top" of certain letters, so that they might "have their own rationality" 'et per fare che habbiano la ragione sua li farai in cima quella testolina un poco piu grosseta che la linea' (8). Or when he instructed his students to give "corpi" to their letters (10 and 13) and referred to letters as having their own "panza" (10), and "gambe" (13), he may have been diverting attention from the

embodied, intersubjective, multidimensional activity of writing to the flatness of the page that contained the disconnected “bodies” of letters.

Considering his other definition of the phrase “firmar la mano” ‘to still the hand,’ we might observe how Arrighi similarly led attention away from hand’s activities to the area of the page by referring to the process of developing, through the practice of writing, an unwavering and steady hand. Arrighi wrote of the making of uppercase letters: “I want your uppercase letters to be always upright with your strokes *steady and solid* and without any shaking inside” ‘Voglio che le tue maiuscole sempre siano tirate drite et con li suoi tracti *fermi et saldi* senza tremoli per dentro’ (18, emphasis mine). Not only would shaky letters have “little gracefulness” ‘non haveriano Gratia alcuna’ (18), as Arrighi was quick to point out; but shaky letters could also divert attention from the bodies of the letters on the page back to the hand of the writer. By practicing handwriting with the intention of stilling the hand, writers would effectively separate their letters from the efforts required to make them. This historical stilling of the hand, in my view, could make an important contribution to current research today on motor cortex involvement in writing and social interaction.¹³

On the last pages of his *Operina*, Arrighi provided, with his “Exempli per firmar la mano,” opportunities for his readers and students to steady or still their hands through the development of a consistent writing practice. It was fitting that the first *sententia* or aphorism to be copied would motivate the writer to practice stilling the hand by sustaining focus on the page: “There is no glory in starting but in continuing [the practice]. This is where true honor is born and perfected. What value is there in entering the field, if we flee soon after?” ‘Non é Gloria il principio, ma il seguire. De qui nasce l’honor vero et perfecto: Che vale in campo intrare, et poi fuggire?’ (23) As sixteenth-century students of writing practiced copying these words, they would also attain honor by diverting their attention from their bodies to the page understood as a battlefield. In this space of the page, intended for accruing honor for bureaucracies, governors, and princes, writers might best serve by steadying or stilling their hands to the point that they would no longer occupy their attention.

Neuroscientists today who have studied the development of a neural specialization for letters have indeed confirmed what Arrighi noted almost 500 years ago, and that is, the importance of manual motor associations in strengthening neural systems for other types of learning (James). Once these manual motor associations become hardwired (so to speak), attention may be diverted from the head and hand of the writer

to the head, body, and rationality of the letters (and knowledge) represented on the page. But as the manual motor activities are subordinated to higher-order operations (prepared for by these same activities), an important neural connection between the movements of the hand and the page is also subordinated to a sense of stillness that is commonly associated with writing and study.

3. *Quieting the intellect*

I turn now to a dialogue that may have plausibly taken place in sixteenth century Florence and that captured this shift from the embodied movements required in writing to a sense of stillness associated with study. It is well documented that in the first decades of the 16th century, men of letters and politics, including such notables as Machiavelli, Zanobi Buondelmonte, and Francesco Vettori met regularly in the Rucellai gardens to share their ideas and writing (Cantimori). We know that Machiavelli shared the chapter of his *Discorsi* on conspiracies in the gardens. And, indeed, he set his dialogue, *The Art of War*, in these gardens giving a taste of how, when the “convivial pleasures” ‘i conviviali piaceri’ were finished and the tables cleared, the friends would move to the “most secluded and shady part of the garden” ‘la più segreta e ombrosa parte del giardino’ to discuss their studies and ideas. One less well-known participant in these conversations, Antonio Brucioli—an anti-Medici philosopher and scholar who was ultimately exiled from Florence—may have based his volumes of dialogues on some of the topics actually covered. He included, in his writings, dialogues on the senses, on memory, tyranny, poverty, friendship, exile, comets, galaxies, and a dialogue between Letters and Arms that illustrates how the sense of stillness associated with writing and study, eclipsing an awareness of writing movements, became consolidated in sixteenth-century thinking.

Personifying Letters and Arms as the interlocutors of the dialogue, Brucioli took the opportunity to level a harsh critique against language and its tendency to get humans into “atrocious” battles and “cruel” polemics.¹⁴ First, according to Arms, there was the problem that literary study was void of activity: “il troppo studio delle Lettere, parte gli huomini dalle civili attioni, et da tutte le altre operationi . . . le quali piu presto commuovono, et dispongono à operare, rendendogli pronti, et arditi à ogni genere di laudabile fatto.”¹⁵ Moreover, too much still and isolated activity has only produced misunderstandings, so that, according to Arms, humans have had to develop: 1) grammar in order to remediate isolation; 2) dialectic because so many disparate opinions tend to lead

people to war; and 3) rhetoric, so that isolated people are able to persuade others that there is an enemy and therefore, a just reason to go to war.¹⁶ Indeed, because so much violence has ensued from the still and quiet practice of letters, humans need, according to Arms, to start their development from the movements of martial training. Only great soldiers (not men of letters) are, according to Arms, able to develop positive language skills, because of their martial exercise. While proficiency in Letters was perceived to require no physical training, physical training in Arms enabled Scipio to become, “a kind listener, an eloquent speaker, and just as remarkable at reconciling adversaries.”¹⁷

As the stilling of the hand and the loss of a felt connection to the movements of the hand became a value to be aspired to, so did the quieting of the intellect with its detachment from bodily exercise. Indeed, the argument that Arms made from the beginning about why they should be considered as “preeminent” or superior to Letters was one that corralled Letters within the immaterial region of the soul. Completely disconnecting Letters from the source of their production in the body, Arms was able to boast that they, alone, integrated both physical and metaphysical aspects:

noi non siamo strumenti bellici solamente, ma forze dell’animo, et del corpo, conciosia cosa che nella militia l’uno, et l’altro sia necessario . . . per la qual cosa noi Armi saremo da essere numerate fra i beni dell’animo, et del corpo, dove voi lettere, fra quegli dell’animo solamente.¹⁸

With the production of Letters dematerialized or disembodied, it neatly followed that men of Letters, from the perspective of Arms, would want to avoid any causes of anxiety or fear that would remind them of their bodies. Only Arms, though bodily exercise, could protect Letters against anxiety and fear (and connection to their bodies), providing some guarantee of security and, especially, the benefit of quiet (and stillness):

per noi Armi s’acquistano le gran ricchezze, per lequali, oltre alla fortitudine, et magnanimita si conseguono tante mirabili virtu, quanto voi potete comprendere, senza che per esse ricchezze, dalla virtù, et valore nostro acquistate, possono anchora venire gli huomini studiosi, et litterati et negli alti studij felicemente quietare l’intelletto . . .¹⁹

Although books and pens continued to be grasped by the same human hands as swords and firearms, and, indeed, even words for books and weapons, like *manuale*, *enchyridion*, and *pugnale*, were understood to have a direct connection to the hands of those who used them,²⁰ nonetheless, the exercise of the hands of men of Letters came to be perceived as detached from physical exercise. All the while profiting from the physical exercise of men of Arms, men of Letters could only be happy if they—and their intellects—were still and quiet.

In the process, then, of representing writing and study as motionlessly separate from and dependent upon the physical activity of Arms, Brucioli replicated Arrighi's thinking about stilling the hand that suppressed the felt connection (so important in the case of mercantile writing) between the hand's activities and social cognition. From the perspective of embodied cognition, however, it becomes possible to unpack this fiction of intellectual stillness, rediscovering the perceptual memories of hand positions, movements, and momentum that have been stored in historical representations and revising the research field between humanities and science to center on these memories.

4. Recovering the momentum

In her book, *Choreographing Empathy*, Susan Foster turns her attention to movement patterns as embodied ways of knowing in particular cultural contexts. Examining practices of cartography, she discusses, in particular, how Portolan and chorographic maps represented “the labor of the map-maker, as someone en route” (92), someone in motion, while the Mercator projection “stilled” its viewers (85, 86), separated them from their sense of body, and “removed [them] to an omniscient and all-encompassing vantage point” (89). Also the author of a textbook on handwriting (Osley, “Calligraphy”) and almost contemporary to Arrighi, Mercator's impulse to still his viewers may have come from his practice of stilling his hand in the formation of letters. In both map-making and in the formation of letters, as we have seen, a fiction of a still hand was produced; new professional writers in bureaucratic offices aspired, with the exercise of writing, to still their hands in the service of paper rationalities and ruling ideologies. But if “corporeal, emotional, and conceptual memories” were stored within the movement patterns of even a very still hand, as Foster encourages us to consider (8), then we might investigate those movement patterns that were “stilled” within offices and on the pages of books and documents, in order to rewrite and

reorganize the intersubjective space that once depended on a felt connection to the hand used to write.

In his Preface to the Mercator-Hondius *Atlas* of 1636, Henry Hexham, over a hundred years after Arrighi and Mercator, represented an almost contemporary version of financial capitalist stillness, suggesting that the users of the *Atlas*—especially princes, noblemen, and merchants—would have an opportunity to move about the world without leaving the still and quiet spaces of their cabinets, “clossets,” and counting-houses; they needed only to transfer their full attention to the pages of the book (today, we might substitute a computer screen or a virtual reality headset for the pages of the *Atlas* to appreciate the import of Hexham’s insights):

if [Princes] be in hostility with their neighbour [they] may peepe upon those places, townes and Forts, which lye most advantagious & commodious to satisfie their ambition . . . Here [inside the covers of the *Atlas*] the Noble-man and Gentle-man by speculations in his closset, may travell through every Province of the whole world. Here the Marchant sitting in his counting-house, may know what marchandises every Countrie affordeth, what commodities it wanteth, and whither he may transport, and vent those which are most vendible, to return gaine and profite into his purse. (*Mercator* iv)

Like the pages of Arrighi’s *Operina* with its little heads, bellies and legs, and the rationality of its letters, the pages of the *Atlas* could also be host to “places, townes and Forts,” “marchandises” and commodities, all with their own rationality and equally disconnected from “the Marchant sitting in his counting-house.” According to this representation of a particular moment in the history of thinking and knowing and capitalist acquiring, the very pages of the *Atlas* would provide a quiet space in which its readers might, while sitting “still,” engage in activities of knowing, travel, conquest, speculation and exploitation of the world and its markets.

However, as researchers investigating the momentum and activities stored in these representations of the merchant “sitting in his counting-house,” we need not acquiesce to this fiction of “stillness.” Though even the *atlas* itself appears “inert”—no longer connected to the hands that produced it and unable to feel the physical momentum of merchants traveling and conquering the world—the very physicality of the *Atlas*’s binding, its pages and the ordering of its maps tell a story

which objectifies the physical momentum that goes into sitting still. There is, in other words, a sense of physical momentum that, while producing a fiction of stillness, also stores a story of peeping, speculating, traveling, knowing, transporting, selling, and profiting. Here, sitting safely in the cabinet, closset, or counting-house and inside the covers of the Atlas, there is a story of movement that might provide another control against which to measure and interpret hand action today in neuroscience research; against which to revise those research habits that attend more readily to “the formal rules structuring a solipsistic [and quiet] mind” (Gallese, “Roots of Empathy” 172) than to the intersubjective identifications with larger communities that may be initiated with motor cortex involvement in the production and perception of handwritten letters (Gallese, “Roots of Empathy” 172, 177; and Heimann, Umiltà, and Gallese 2834).

5. Revising the paradigm of the isolated scholar

The concept of literary *otium*, deriving from the Roman ideal of solitary leisure for virtuous activity, has been operative at least since the 14th century as a resource for the rich productivity of isolated scholars (Jed, *Wings for Our Courage* 47). As we have seen, Brucioli made use of this propensity of scholars to work in isolation to represent the reading and writing of scholars as disconnected from physical activities and movements. And Machiavelli, in his famous letter to Vettori (10 December 1513), consolidated this image of the dematerialized scholar who, from the solitude of his study, was uniquely able to “transfer himself completely” away from his own body—that was full of weariness, fears, and mud (from the day’s activities)—and onto the pages of the ancient authors, suppressing in this process a feeling of connection to the writing activities through which he asked the ancient authors “the ragione of their actions” and discharged himself of “every anxiety” (Jed, *Chaste Thinking* 117). And yet, at the same time, this solitude was never perceived as a feeling of being alone. Indeed, Machiavelli constructed a ritual practice of physically dressing for and entering into “the courts of ancient men” and “feasting” on their words/food. And later, in the *New Atlantis*, Bacon imagined isolated scholars who would similarly make community across generations and physically “pass through the vast seas of time, and make ages so distant to participate of the wisdom, illuminations and inventions, the one to the other” (Jed, *Wings for Our Courage* 47). Pointing to the page as a physical space in which the hands of different generations might

assemble, the Royal Society even provided the physical space of a register in which fellows from different places and times might unite their individual research experiences through practices of writing (Jed, *Wings for Our Courage* 47). These examples of physical practices of collaborative research might afford a lens through which to revise our paradigms of individualistic research for the virtual age. Indeed, if we examine historical images of solitary, individualistic research activity through this lens of interactive hands, we might be compelled to observe an entirely different story connecting our own movements to those we research.

In 1657, an early cognitive scientist, John Comenius, published the *Orbis Sensualium Pictus* (*The Visible Sensory World*) to introduce the things and experiences of the world to the sensorimotor system of young readers. His purpose was to “stir up the Attention, which [was] to be fastened upon things, and even to be sharpened more and more” (xv). And his method for training the attention of young minds was to supply visual input for the mind and the hands that was “*Full, Clear, and Solid . . .*” “It will be *full*,” he wrote, “if the mind be polished for wisdom, the tongue for eloquence, and the hands for a neat way of living. . . . It will be *clear*, . . . and *solid*, if whatever is taught and learned, be . . . apparent, distinct, and articulate, as the fingers on the hands” (xiii). For Comenius, the hand clearly played a central role in the development of the brain.



Comenius, *Orbis Pictus*, Ch. 39, The Head and the Hand (47-48)

Comenius developed this interconnection between hand and mind in his work by providing, among other things, images of objects and spaces of learning: books, bookbinders and booksellers, paper, writing, printing, and school. Of particular interest is Comenius's representation of the peripersonal space of the scholar—the scholar's study—or, we might also think, of the space of a researcher's lab.



Comenius, *Orbis Pictus*, Ch. 99, The Study (Museum) (120-121)

Museum, 1.
 est locus ubi Studiosus, 2.
 secretus ab Hominibus,
 sedet solus
 deditus *Studiis*,
 dum lectitat *Libros*, 3.
 quos penes se
 & exponit super *Pluteum*, 4.
 & excerptit optima quæque
 ex illis
 in *Manuale* suum, 5.
 notat in illis
Liturâ, 6.
 vel *Asterisco*, 7.
 ad *Margiem*.

The Study, 1.
 is a place where a Student, 2.
 apart from Men,
 sitteth alone,
 addicted to his *Studies*,
 whilst he readeth *Books*, 3.
 which being within his reach
 he layeth open upon a *Desk*, 4.
 and picketh all the best things
 out of them
 into his own *Manual*, 5.
 or marketh them in them
 with a *Dash*, 6.
 or a *little Star*, 7.
 in the *Margent*.

In his chapter on the study, Comenius represented the student or researcher as “alone” and “addicted to his Studies, whilst he readeth Books” (120). Indeed, we might recognize ourselves in this image, filling in from the tradition the story of a solitary scholar sitting “still.” And yet, Comenius tells us, this scholar or researcher is performing significant and meaningful movements: he grasps, handles, and manipulates books, writing implements, paper, etc. that are within his reach or in his peripersonal space.²¹ Indeed, the hands and body of this student are in active relationship with these objects that are in his space, occupying his attention. The way he moves his hands, for example, to reach for his books and lay them open may extend “the distribution of [his] spatial attention” (Reed et al. 236-38) to the movements of those who wrote and produced the books he is handling. And his experience of using his pen to make marks, and copy those passages that seem important into his own manual may connect him to upcoming actions like reaching for and opening other books, including, in the field of neuroscience, those books that study the hand and the objects in perihand space to address “how our bodies help shape the distribution of attention in space and how visual events are processed as a result” (Reed et al. 236). Seen from the perspective of current neuroscience research, the representation of meaningful movements stored in this image of a solitary scholar, purportedly sitting “still,” may also provide important data about intersubjective learning. For as we investigate these movements, we discover that this scholar is not alone.

Perceiving the researcher as “alone in his study” (as Comenius describes him), we may merely be replicating the rules we have been taught for stilling the hand and quieting the intellect. However, from the perspective of neuroscience, we might also perceive that the image of this researcher activates the regions of our brains in charge of grasping, handling, manipulating, and marking objects in our peripersonal space. As we view this researcher engaging with the objects around him, according to Gallese, our brain’s mirror neurons simulate the scholar’s movements and “instantiate a multimodal representation of organism-organism relations. They map this multimodal representation across different [historical] spaces inhabited by different actors. These spaces are blended within a unified common intersubjective space, which paradoxically does not segregate any subject. This space is we-centric” (Gallese, “Roots of Empathy” 175).

This researcher, therefore, is not alone at all, because he is neurally connected to us who view him. We are not physically using our hands to

connect to this image—unless, of course, we are reaching for and holding Comenius’s book—and yet, it is through the agency of our hands that an intersubjective identity is created at the neural level. This intersubjective identity through the agency of our hands may also lead in the search for a cross-disciplinary or we-centric method for exploring terms we share between the humanities and the cognitive and neurosciences.

6. Conclusion: The Humanities and Breakthrough Scientific Research

In their collaborative work on scientific creativity, J. Rogers Hollingsworth, Ellen Jane Hollingsworth and David M. Gear have identified those institutional qualities that have historically facilitated the promotion and nurture of breakthrough discoveries.²² They cite, for example, the case of the Cavendish laboratory, which, under the leadership of William Lawrence Bragg, organized well-attended courses in literature, history, and music, affording researchers opportunities to make “unexpected connections from disparate fields.” As Hollingsworth suggests, it was these “unexpected connections” that led researchers to “qualitatively different styles of doing science” and exceptional scientific achievement (Hollingsworth 141-44).²³ Although we cannot draw a causal relation between these courses, the dialogues that ensued, and the extraordinary achievements of the scientists doing research at the Cavendish, it is my thought/hope that the connections I have explored here might lead to new models of collaboration between humanities and science.²⁴

From the perspective of today, we might look back at the seventeenth century development of scientific method as a watershed moment in western history, a decisive fork in the road that definitively severed the scientific paradigm of knowing based on quantifiable results from a felt connection to the intersubjective work of the hand.²⁵ Indeed, from the perspective of the history we have traced here, we might say that an increasingly perceived disconnection between the movements of the hand and the sensorimotor system may have even contributed to the development of scientific method; as secretarial hands were perceptually stilled to serve the dominant social classes in the writing offices and as intellects became quiet in order to serve the public administration of imperial interests, new instruments of measurement helped scientists to move past the limits of perception and scientific hands came to doubt their ability to know how the cicada sang or how comets were formed. But once the human body and its perceptual affordances were removed from the field of research, we were left with language alone.²⁶ No matter

if this was/is a verbal language or mathematical language—figures, shapes, numbers, algorithms, etc.; in either case, research results that are disconnected from the bodies that produce them cannot by themselves activate a relationship to an intersubjective world they purport to decipher and represent. Indeed, our research creativity may depend upon our abilities to reconnect our hands and bodies to research results in our intersubjective world, examining the neural correlates of historical hand movements (or, as Petrucci has so importantly designated them, “relations of writing,” in his essay “La scrittura del testo”) in relation to embodied language research and engaging in meaningful dialogues between humanities and science.

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NOTES

I am grateful for opportunities I have had to organize this ongoing research for talks at UCR, UCSD’s Center for Research in Language, the 2014 RSA meeting, University of Oregon, and University of San Diego; and for the feedback I received on those occasions. I am especially pleased to be able to contribute to this volume of *NeMLA Italian Studies* and very much appreciate the feedback of anonymous readers and the meticulous editorial care of Daniel Armenti in helping to bring this essay to its final version. I would like to express my deepest appreciation to the following colleagues who had an important part in the development of this essay: Peter Devine, Roger Gallegos, Gloria Chacón, Jinkyung Lee, Margaret Loose, Sarah Nicolazzo, Ben van Overmeire, and Robert Westman.

¹ Given his formation in literature, philosophy, and music and his self-identification as a natural philosopher, it was not unusual for Galileo to represent the aptitude for scientific research and exploration in the form of a fable. For an understanding of a hierarchy of the disciplines in sixteenth- and seventeenth-century Europe, see Winkler and Van Helden 198, 205, 211-15; Westman, “Astronomer’s Role”; Westman, “The Copernicans” 78. On the importance of historicizing the self-designation of philosophers, mathematicians, etc., see Westman, “Copernican Question” 30-32. For a reading of Galileo’s literary hermeneutics in *Il Saggiatore*, see Wojciehowski, “Against Persuasion” 63ff.

² “The difficulty of comprehending how the cicada forms its song even when we have it singing to us right in our hands ought to be more than enough to excuse us for not knowing how comets are formed at such immense distances.” All translations, unless otherwise noted, are my own. Cf. Drake’s translation of this “fable” in Galilei, *Discoveries and Opinions* 256-58.

³ See Bergen and Wheeler; Gallese; Gallese and Lakoff; Glenberg and Gallese; Marghetis, Nuñez, and Bergen; Reed, Betz, Garza, and Roberts; Wheeler and Bergen.

⁴ I am indebted in this essay (as in all of my research questions) to Petrucci’s brilliantly inventive locution “rapporti di scrittura” or “relations of writing” and to the way his scholarship opens up the enormously fruitful possibility to examine those ways in which

language can refer to social activities of reading and writing that are taking place not out “in the world,” but on the page itself.

⁵ Part of the larger inspiration for the ideas of this essay comes from Foster. See Sklar (12, 14), cited by Foster: “Movement embodies socially constructed cultural knowledge in which corporeality, emotion, and abstraction are intertwined”; and “The medium of embodied knowledge is not words but sensations in which are stored intertwined corporeal, emotional, and conceptual memories” (8).

⁶ “He asserted that it was the duty of the merchant and of every tradesman who had business relations with people to write down everything, every contract, every item of income and of expenses paid, and to review everything often, always with a pen in hand” (Alberti 251). Cf. Jed, *Chaste Thinking* 92-93; and Grafton 159-60.

⁷ See Brown for her illuminating analysis of the development of this concept in Berenson’s work. Cf. reference to “tactile values” in Pallasmaa 102.

⁸ Cf. the description of drawing in Pallasmaa 89, 95.

⁹ Another important historical baseline against which to measure and interpret hand action would be representations of hands explicit and implicit in the work of Leonardo da Vinci. In his celebrated drawing, Vitruvian Man, we see that the palm of the hand is the central measure of humans and their buildings: “24 palms make 1 human and these measures are in his buildings” ‘24 palmi fa 1 homo ecquestre misure son ne’ sua edifiti’ and “The whole hand should be a tenth of man’s size” ‘tucta la mano fia la decima parte dell’omo’ (Leonardo e Torrini 17). Leonardo was also educated as an artisan, learning to write in *mercantesca*—the mercantile handwriting that was taught to merchants and artisans. And his gifts and genius in mathematics and engineering were not recognized among the branches of learning of the liberal arts, but were considered to belong to the lesser crafts and mechanical arts centered on the work of the hand. Still, he grounded his contributions to advancements in knowledge in the work of the hand, the basic unit and tool for thinking on paper and for measuring and exploring weight, gravity, proportion, and intersubjective space.

¹⁰ “[Natural] philosophy is written in this very large book (I mean the universe) that is continuously open before our eyes, but we can’t understand it, if we don’t first learn to understand its language and the characters in which it is written. It is written in a mathematical language, and the characters are triangles, circles and other geometric shapes; without knowing these characters, it is humanly impossible to understand the words; without knowing these characters, science would just be wandering around in a dark labyrinth.” Although Galileo perceived mathematics as a discipline of lesser status than philosophy, he nonetheless acknowledged it as a foundation for deciphering the more abstract secrets of science or natural philosophy. Cf. Wojciehowski, “Against Persuasion” 79 and Winkler and Van Helden 198-99, 214. Cf. also n. 1.

¹¹ I am at the beginning of my studies of this pivotal cultural figure about whom the bibliography is extensive. See in particular Casamassima; Osley *Luminario*; and Petrucci “Insegnare a scrivere.”

¹² Cf. Sennett’s description of Erin O’Connor’s glassblowing practice: “she was no longer conscious of her hands, she no longer thought about what they were doing . . . ingrained hand motions became part of the act of seeing ahead” (176).

¹³ See Heimann, Umiltà, and Gallese; Longcamp, Tanskanen, and Hari; Longcamp et al.

¹⁴ “Guardate di poi la Dialettica con la Philosophia insieme, à quello che gli huomini habbino recato, et vedrete che col Tomista pugna lo Scotista, col Reale il Nominale, et bene sovente di cose minime atrocissimamente combattono, infino che il furore del le disputationi da gli argomenti al dire male, et dal dire male alle zuffe incrudelisce” (38v). (In this and all subsequent citations of Brucioli, I have conserved spelling, punctuation, and accents from the 1538 edition.) In this critique of language, Brucioli anticipates the 17th critique of language by philosophers such as Bacon, Locke, and Leibniz. See de Grazia.

¹⁵ “too much literary study divides humans from civic actions and from all those activities . . . that quickly move people and lead them to act, making them courageous and prepared for every kind of praiseworthy deed” (35r).

¹⁶ “à que tempi tranquilli della età de l’oro, che voi tanto celebrate, non era la Grammatica, essendo una et la medesima lingua in tutti, non si parlando, in modo che l’uno non intendessi l’altro, non la Dialettica, quando nessuno dispare di oppinioni era fra loro . . . Guardate di poi questa degna vostra Rettorica, quello che di male non persuada. Questa tutto il giorno nelle gran corti appresso de Principi, va con sua versutie persuadendo che à questo et à quello si debba muovere guerra” (38r).

¹⁷ “Scipione solamente, pel grande studio delle Armi, divenne benigno nell’udire, facundo nel rispondere, et non manco egregio nel conciliare gli huomini” (35r). Looking through the eyes of Arms, who claims that “ogni virtù per le armi difesa viene,” it would be important to investigate neuroscientifically: what strengths are developed in the making of letters and what virtues are conserved by this strength?

¹⁸ “we [Arms] are not just implements of war, but forces of the soul and the body, since both are necessary in warfare . . . for which reason we, Arms, should be included among the assets of the soul and the body, while you, Letters, among those of the soul alone.” (33r).

¹⁹ “great riches are acquired through us Arms and, besides strength and nobility of spirit, as many amazing virtues as you can imagine. And without those riches that you gain from our virtue and courage, scholarly men of letters cannot come *to quiet their intellects* happily in lofty studies” (33v, emphasis mine).

²⁰ Cf. James Sanford, *The Manuell of Epictetus*, 1567 (cited in Sherman 47-48): “This booke (gentle Reader) is entituled a Manuell, which is deriued of the Latin word *Manuale*, and in Greeke is called *Enchyridion*, because he may be contained εν χειρι that is, in the hand. It is a diminutiue of *Manus*, as it were a storehouse, & which ought always to be had in hand, as the handle in the sword.” See also Rowe; and Sherman et al.

²¹ Cf. the self-representation of Roland Barthes who wrote in 1973: “I’m content to read the text in question, in a rather fetishistic way: writing down certain passages, moments, even words that have the power to move me. As I go along, I use my cards to write down quotations, or ideas that come to me, and . . . from then on, I’m plunged into a kind of frenzied state. I know that everything I read will somehow find its inevitable way into my work” (181).

²² See Hollingsworth; Hollingsworth and Gear; Hollingsworth and Hollingsworth.

²³ I first learned of these courses held at the Cavendish Laboratory at a 2013 seminar organized by the Arthur C. Clarke Center for Human Imagination at UCSD at which Professor Hollingsworth spoke. I am grateful to one of his collaborators David Matthew Gear who followed up in personal correspondence to indicate the published resources for knowing about these courses. See Hunter 185, n. 704; and Crowther 285. In his final

report for the year 1952-53, William Lawrence Bragg mentioned the arts and humanities lectures at the outset. These, according to Crowther, had been organized “to widen the outlook of the physicists, and had continued most successfully, with an average audience of 200. One subject had been ‘The novel, from Conrad to Virginia Woolf,’ and another ‘Science and the Modern Novel,’ the latter being delivered by D. Daiches. Another subject was ‘The History of North America.’ In previous years there had been courses on ‘Economic and Social Development since the Middle Ages,’ ‘Music’ and ‘Man and his environment’” (320). Cf. Crowther: “Bragg had an artistic conception of research and discovery; he approached them in the spirit of a poet, and his genius and creation in an artistic manner. It was on this aspect of science that he was at his strongest” (277).

²⁴ For two exemplary collaborations between neuroscientists and humanists, see Jenson and Iacoboni; and Wojciechowski and Gallese.

²⁵ For a seminal account of this watershed moment, see Ginzburg and Davin.

²⁶ Cf. Galileo in this humorous passage from *Il Saggiatore* (Galileo e Saragat 6: 350) about the interdependent relations between language and the human body: “per eccitare in noi i sapori, gli odori, e i suoni, si richiegga altro che grandezze, figure, moltitudini e movimenti tardi o veloci, io non lo credo; e stimo che, tolti via gli orecchi, le lingue e i nasi, restino bene le figure, i numeri e i moti, ma non già gli odori né i sapori né i suoni, li quali fuor dell’animal vivente non credo che sieno altro che nomi, come appunto altro che nome non è il solletico e la titillazione, rimosse l’ascelle e la pelle intorno al naso,” (“In order to excite in us tastes, odors, and sounds, only quantities, shapes, numbers and movements are required. I predict that if we take away our ears, tongues, and noses, the shapes, numbers, and movements will remain, but not the odors, tastes, and sounds. Once the living animal is removed from the picture, odors, tastes, and sounds become nothing more than nouns, just as tickling is nothing more than a noun, once you remove our armpits from the picture”).

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