What Do Humans Do Best? Developing Communicative Humans in the Changing Socio-Cyborgian Landscape

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Our writing programs are a result of our pasts and a response to current pressures, needs, and opportunities, as explored in a number of the essays in this volume. The work of these programs, however, is addressed to the future—the ~~future~~ lives our students will live in their future worlds. Their careers may have them writing well past 2060, and if they are teachers, some of their students will be writing into the twenty-second century. This essay looks at current trends and dynamics to make judgments about what writing skills will be useful tomorrow and the day after tomorrow, as technology takes over many tasks, freeing us to do what humans do best.

Technology ever increasingly is taking over the work previously done by humans in the composition, distribution, storage, access, and use of communications, and is doing new tasks previously unimagined. What will the human half of the cyborg need to be able to do? Cyborgs fascinate us with technological extensions overcoming human limitations—powerful exoskeletons, infrared vision, and real-time data scans, but we forget the human half (see Bazerman, "WAC"). Every technological extension requires new training, orientations, sense making, and decisions by the living, educated, and purposeful legacy neuro-biomass—us and our students.

Until recently, legacy has been considered a valuable gift, associated power, explicit in the etymological root *legate.* To understand the legacy that humans bring as

we move forward, we must look backward to appreciate human value and power. Academic, professional, commercial, and personal writing have been from their beginnings sociocommunicative endeavors mediated by symbolic and material technologies. Humans created the richness of written language out of odd practices of making marks on clay. Using these marks, humans have created documents to coordinate meanings, knowledge, thoughts, plans, and activities. Humans have invented vocabularies, spelling systems, representational means, genres, forms of organization and persuasion, kinds of knowledge, channels of communication and distribution, procedures and locations for archiving and access, and all the other things skilled writers have to be aware of and make choices about.

Through much of history, the balance of the work of composing marks to convey meanings rested on individuals working alone or in small collaborative groups, even as text reproduction, distribution, and archiving extended networks of collaborators. Writers struggled with the changing language and expanding representational means, relying on the cultural inheritance from the work of previous humans—as resources and structuring frameworks for their current work. As we invent new technologies, new social arrangements and endeavors, new forms human-machine collaboration, new representational and distributional means, and new storage and analytic devices, the work equation is changing, shifting what each human or collaborative group of humans is expected to do and creatively add at any particular moment.

This changing distribution of work means that human skills also must change. While machines will come to do what machines do best, humans must reallocate their attention and skills to do what humans do best in these socio-cyborgian activity systems.

Further, humans need to develop new skills to understand, direct, and make choices about these complex networks. The teaching of academic, technical, and professional writing just a few decades ago focused on individuals producing fairly stable forms, but now the field has refocused on social participation and collaboration within organizations through changing genres and changing situations, incorporating new technologies for document production and distribution. Nonetheless, technical and professional writing has still focused on the individual text as a discrete utterance and the center of attention, even as the text has come to include hypertext and multimedia, and even as the work of production has included new possibilities of collaboration and distribution. If we are to address the needs of communicators entering careers that will span through the middle of the twenty-first century, we need to make further shifts in our perspective so that we can identify what humans can best contribute to social-individual human-machine complexes and then prepare our students to do those things better. Further, we must prepare our students to understand and maintain executive control of these rapidly evolving communicative systems.

The Transformation of Inscription Professions

To see what these shifts of the work equation might entail, let us look at a few related inscription professions that have been even more rapidly affected by digital technologies. In accounting, the traditional roles of keeping and then inspecting the financial records of individuals and enterprises have transformed as organizations grew, requiring ways to manage internal flows of material and labor resources, to minimize costs and maximize efficiencies. Records needed to be coordinated and aggregated across multiple sites, even as management became centralized in head offices. Communicative and informational

technologies, from the memo and form to the filing cabinet and graphic charts of business trends, created new tasks and roles for white-collar workers and managers. Massive records formed the neural infrastructure of corporate intelligence. While those at the top of the organizational pyramid gained more information in aggregated and often quantitative form to make creative managerial decisions, those lower down were often routinized through highly typified communications. Keeping records of clients and services as enterprises grew created new challenges to keep~~ing~~ order, make~~ing~~ sense, and predict~~ing~~ future business (Yates, *Control*). The insurance industry with its need for actuarial prediction and cost models that extended over decades, along with its many individualized consumers having individual contracts, payment, and expenditure records, was at the forefront of the accounting revolution and formed the clients for IBM, as insurers were inventing information technologies even before electronic computing (Yates, *Structuring*).<<Substitution of *insurers* for *they* okay? I wasn't sure what *they* referred to.>> Accounting was already turning into executive oversight and prediction based on cost and income models. Comparison of alternative ways of doing business, reflected in data representations, created the opportunity for higher-level choice making, leading to the Taylorist transformation of business.

<<Insertion of paragraph break here okay?>>When digital technologies, and in particular the VisiCalc and Excel spreadsheet programs came along in the late 1970s and early 1980s (Ceruzzi and Grad), accounting underwent a further transformation. The traditional skills of fine handwriting, orderly columns, and accurate and rapid calculation were displaced by the technology. Accountants and managers now needed to be able to use and understand the operations carried out by the software, so as to make choices of

how to represent items within the spreadsheet and which calculations and re-representations they wanted the spreadsheet to carry out. Human energy was freed to compare alternative scenarios under different assumptions ~~and choices or to consider~~ or with different ways of representing costs and assets. The work of accounting and management became ever more one of manipulating numbers and alternatives to maximize profits. The world of financial markets became more complex and intense, with rapid decisions made on massive data projecting shorter time periods, relying on rapid calculations done by machine, and with actions often triggered by machines (though according to human-set parameters). At the same time, the data reported and calculated on became more abstracted and distanced from actual material properties, labor, and other assets, as all were transformed into numbers and calculations buried within machine operations. This often led to sleight-of-hand vanishing of information necessary for accurate concrete evaluation, as notoriously happened with credit default swaps and other manipulations of the financial crisis. Even without deceptive manipulation, evaluation and decision-making~~s~~ about assets require special skills and tools.

Additionally, as billing and financial-transfer work becomes distributed through various electronic means, new authentication, security, and oversight challenges require the design of new accounting systems and inspection of transactions. Not only have internal calculation and oversight of transactions been taken over by machines but so has the production of final reports in standardized formats. Here is a simple example that exhibits some of the changes that have occurred. Many years ago, when I first used a tax accountant, what impressed me were his neat handwriting, precise columns, and rapid

calculation, along with his knowledge of tax law and IRS procedures. My current tax accountant still knows the law and IRS procedures, but he hardly writes any numbers by hand and makes few calculations. He does, however, understand the tax software installed on his computer, and he knows how to test the consequences of reporting income and expenses under one category or another. Much of our meeting time is devoted to trying out different scenarios, ~~either~~ reporting the information under various categories and adopting different assumptions and parameters. Then the machine calculates and prints out the completed forms and a cover letter telling me exactly what I owe, how to mail it, when and how much I should pay in estimated taxes for the next year, and so on. The machine speaks to me in intelligible boilerplate including the specifics of my own finances and obligations. But once I approve and sign these documents, the relevant data (and not the whole form) are submitted to the IRS electronically through an authenticated system.

I could continue with many other examples. In the European Union, where the increasing cooperation across borders has amplified the need for government and business documents to appear in multiple languages, various forms of machine translations, specialized real-corpus concordance tools, and other databases have transformed the work of translators, who are as likely to spend their time overseeing and making choices about options offered by their digital tools as they are seeking words and phrases in their mind to express meanings presented in the original language and then transcribing them (Alcina). Literary translation has not yet been as influenced by technological changes, but the world of gaming, with its highly typified language use, does allow people to participate through multiple languages. So the work of linguists and

translators moves to another level, designing systems to aid translation and creating interactive environments within which language and interactions are structured to allow multiple-language equivalents. The translator steps out of the individual interaction to the level of systems design or inspection and correction of machine-produced alternatives, with particular attention paid to pragmatics, idiom, and interaction.

The Technologizing of Writing

So let's now think about writing: What work involved in writing is being off-loaded onto technology, and what tasks remain for humans? In some ways writing is a clunky technology, requiring many years to become reasonably competent at and often consuming much time to compose individual texts. Written texts are frequently cognitively demanding for the reader, inviting interpretation, approximation, and imprecision of meaning, even misunderstanding. Further, the effectiveness of communication through writing relies on a state of trust and receptivity between writer and reader, for the reader must be willing to mentally construct meaning initiated by another mind (Bazerman, *Rhetoric*).

The inscription of letters or characters is the first clunkiness that people learning to write encounter, whether with a stylus forming cuneiform on clay, a brush forming ideographic characters on scrolls, or a pencil forming alphabetic letters in school notebooks. Much of writing education over millennia has been devoted to teaching fine motor control and visual discrimination, manipulation of writing instruments, form and decipherment of characters, spelling, arrangement of symbols on the medium, and so on. In every child's life, five or more years are devoted to gaining reasonable competence in transcribing words and sentences. Technology has been long easing those burdens,

replacing stylus and brush with pens and pencils of increasing ease and reliability, and simplifying letterforms and scripts. Over the last century and a half, the easier motor task of pressing keys has been displacing burdensome handwriting. Electronic devices have further eased neat and accurate transcription by preformatted page layouts and spell checkers. Variable sizing of fonts and displays eases development of visual discrimination. Voice recognition and transcription from voice to text and text to voice are also becoming increasingly common—especially for those with disabilities that interfere with transcription and visual recognition. But we still teach versions of hand-transcription skills and spelling along with keyboarding because they are still necessary in many circumstances and because they appear to be useful for becoming familiar and skillful with written language (James and Engelhardt). Even as we off-load tasks to machines, we still need understanding and skills to make choices, to oversee processes, and to monitor results so that we retain ultimate responsibility for the production.

Word choice, grammar, syntax, and text organization similarly require long training, extending through secondary and higher education, to create texts that are intelligible to others and indicate the education and thoughtfulness of the writer—and thus the reliability of the meanings evoked by the texts. While we have become used to employing digitally implemented prostheses that help guide and correct us, from online dictionaries and thesauruses to grammar checkers and document templates, these have longer print histories that still require us to make choices about their suggestions.

Revision as well has been a burdensome task requiring use of expensive material and time resources, hard-to-decipher text markups, repeated copying of versions, and production of clean copies. The introduction of computers and visual displays was

immediately recognized as a great boon to revision, decreasing the amount of manual labor and cost in making revisions and trying alternative formulations (Hawisher). Nonetheless we remain responsible for the final choices. Reproduction and distribution of texts have also become increasingly easy and inexpensive, aided by the evolution of the printing press, paper technology, rail and motor transport, and now desktop publishing and internet distribution and cloud storage in multiple formats and synchronicities. Yet we are still faced with choices about privacy and distribution in various networks.

Bibliographic technologies from library catalogues and journal indexes to Google and citation searches have also aided the amassing of intertextual resources and positioning our writing intertextually. Distant reading now helps us assess large corpora of texts to discover patterns and aggregate tendencies, aiding us in our own new statements in relation to the intertexts of interest (Moretti). Even cutting and pasting have made quotation (and plagiarism) easier, and automated summarizing may soon be coming to your desktop (Lehmam). Even the existence of Wikipedia as a ready source indicates how technologically assisted crowdsourcing diminishes the work of individuals in locating and elaborating information, even while increasing the challenges of choice making (Silva). Certainly such large-corpus crowd-based strategies have made machine translation more intelligible and less comic. Already some kinds of reports that are highly typified and need only specific data are regularly produced. Even the first press-release reports of earthquakes and volcanic events are machine produced in order to speed distribution of the information (Oremus).

Monitoring and Higher-Level Decision-Making

As changing supportive technologies have sped the process and decreased the burden of communication, the work of writers has moved from basic transcription and word memory to determining larger purposes, making design choices, selecting content, adopting analytic perspectives, hybridizing options, and monitoring and refining results to match our intention and the needs of the communicative situation. The lower-level tasks that continue to be taken over by machines have each been considered at various times the very definition of writing and the focus of writing education—starting with letter or character inscription; then continuing with spelling, syntactical, and grammatical correctness; and most recently focusing on text organization, content location and selection, and intertextual context and positioning. These latter (which are currently only partially supported technologically) are still central to contemporary writing pedagogy. Further, all of them, even transcription, require some continuing instruction for the purposes of understanding, monitoring, correcting, and refining machine choices. Yet we writers are also increasingly freed from their more burdensome aspects to engage in higher levels of understanding, decision, and control—previously either the work of specialized experts or unimagined. Typographic and page design was until recently the work of only a few print and book design specialists. While syntactic and grammatical correctness still remains an educational obsession, the expectations for compact, efficient, and pointed sentences continue to rise among educated writers. That is, the specialized work of identifying and tightening good jokes and tight lines is extending beyond the work of professional comics and poets. Even the technological constraints of Twitter inspire some to epigrammatic and allusive elegance.

Even skills now considered higher order are getting technological support. Idea-mapping software helps aggregate and organize ideas, resources, and bibliography, bringing the challenging tasks of complex text organization to higher levels of coherence and creativity. While basic PowerPoint at first seemed to pull us back to traditional outlining and five-paragraph speeches that some of us worked hard to get beyond, it has in practice facilitated the use of graphics, illustrations, videos, and sound files (along with sidelong comments) into the linearity of our arguments. Further, visual displays can carry audiences through more subtle forms of organization, making the steps of reasoning, focal points, memorable slogans, and stances more transparent. Other less linear presentation software, such as Prezi, offers new ways of displaying coherence and movement through ideas by graphic means. So even while we still need to monitor the neatness, spelling, and phrasing of the texts we insert, we are able to develop whole new sets of skills to make more complex and higher-order decisions. So this monitoring and higher-level decision-making is the first thing we already do (and we already support in our teaching), but we will need to do it more, with greater scope for incorporating, organizing, and monitoring the products of nonhuman entities.

Collaboration and Collective Production

The second thing we already do well, but will be called on to do in more complex ways facilitated by technology, is collaboration, as we move more fully into a distributed and crowdsourced world with new temporalities, interactivity, and social arrangements. It has long been known that books are collaborative, a collaboration that Martha Woodmansee recovered from a 1753 German book about the economic lexicon:<<The following quote is more than forty words long, so I set it off in a block, per MLA.—Wayne Larsen>>

> Many people work on this ware [the book] before it is complete and becomes an actual book in this sense. The scholar and writer, the papermaker, the type founder, the typesetter and the printer, the proofreader, the publisher, the book-binder, sometimes even the gilder and the brass-worker, etc. Thus many mouths are fed by this branch of manufacture. (15–16)

Scientific publication has required increasingly large numbers of participants (Clarke), and this tendency is growing throughout academic writing. Collaboration has been facilitated by technology, and it is not uncommon for small groups of collaborators distributed around the world to work on texts together, even simultaneously, and reports of organizations can move from one department and one work group to another with immense speed and around the clock. The text and work space can exist in the cloud with participants visiting and interacting without even having to hand the documents back and forth. Software facilitates group revision, tracking who makes what changes when, who approves, and what the current state of the document is.

The complex collaborations facilitated by technology require ever-greater project management skills to keep people coordinated and on task and to maintain textual coherence and purpose. Maintaining timely advance of the work and managing the synchronicities and asynchronicities, attention, and timely input and decision-making by participants out of physical reach—all require special skills that we need to develop (Orlikowski and Yates).

The distributed writing supported by recent technologies, however, goes far beyond the enhanced management and negotiation of traditional collaboration in order to engage crowdsourced negotiation of knowledge among large numbers of strangers and large collections of knowledge from many sources. Sometimes these projects seem to

grow on their own, with viral creativity. Yet there is always some organizing intelligence in the initial concept and the design and maintenance of the platform. Somebody or somebodies have to have the idea that Twitters or Vines or Tumblrs would be a good idea; to design a workable platform that allows the activity to flourish; to monitor the products to make improvements; and to publicize and instigate use. Almost all require medium-to-large companies to keep them going, comply with government regulation, and make them financially viable ~~or profitable~~. Wikipedia, perhaps the ultimate crowdsourced project, has had to create many technologically supported layers of peer and accredited-expert monitoring and editing.

Here is an example of the complexity of skills that go into ~~the~~ writing ~~for~~ such a project, though we might not traditionally think of these as writing skills. I have recently contributed to the *Naming What We Know* project organized by Linda Adler-Kassner and Elizabeth Wardle. In order to gain the collective view of the field, Linda and Liz instigated crowdsourcing, interaction, and negotiation by a group of field leaders to identify key threshold concepts. They invited almost fifty scholars in the field to participate in a wiki. Once the participants were aligned to the goals of the project and the idea of threshold concepts, they each entered, on a wiki, brief paragraph descriptions of up to three candidate threshold concepts of composition. As the descriptions appeared, participants were asked to comment on each other's offerings. Debate ensued about what was meant, how the concepts might be better formulated, what was the relationship to others' proposals, whether these were true threshold concepts or just ideas about writing, and so on. In order to keep the scholars' attention and engagement, the schedule was

tight, with only about a month for the initial gathering and then another month for discussion.

While the editors hoped that a few of the concepts would rapidly rise as obvious choices, in fact the editors needed to sort through the ideas, as not every one was presented in an appropriate form, many overlapped, the discussion did not resolve the boundaries and contradictions, and a number of other incoherencies obscured clarity. So the editors, communicating with each other by email phone and Dropbox, reformulated, combined, and reorganized the candidate proposals, while trying to stay true to the original expressions. The editors then posted the new hierarchically organized list on the wiki and asked for further discussion and comments.

The editors then commissioned participants, based on their interests in the previous discussion, to write more extended discussions of the concepts. Again, the deadline for production of the chapters was quick in coming, about two months. As chapters emerged, issues of consistency of audience, tone, stance, level of handling the subject, and citation density had to be worked out—through peer commentary and revision comments from the editors. A second wiki was established for the emerging full text, to provide space for peer commentary, revision, boundary definition, and cross-referencing. This process of mutual adjustment and alignment continued on the new wiki and through email correspondence between editors and authors as well as between authors of different chapters At this stage comments from authors about topics that were not fully handled led to some new topics and rearrangement of sections, and last-minute authorships were assigned. At this point the editing of this section of the book became

more like conventional editing of a reference work, with the editors corresponding with the authors about final revisions.

Some of the skills exhibited by the editors, such as controlling attention, urgency, and temporality in asynchronous virtual exchanges or creating negotiations among stakeholders to come to shared statements, have been discussed in the literature, but I don't think we have yet gotten a good conceptual grasp on the skills exhibited here of identifying untapped energies and providing them a shape, managing hybrid crowdsourced projects, knowing when to give participants a long leash and when to rein them in, and knowing when to take charge. The more we can articulate and reflect on these skills, the better the already skilled will become at them, the more widely shared the skills will be, and the better we can prepare our students for writing in distributed, asynchronous, knowledge- and project-building networks. While technology can aid this work, it is the human understanding of how to bring humans together for complex collaborations that directs the use of technologies to facilitate shared writing.

Audience and Empathy

The third thing humans are already good at is knowing audiences and forming positive relations with them. This is hardly news to teachers of writing, informed by wisdom going back to Aristotle and almost every rhetoric and rhetorician since then. So here I will add only a few comments on technological approaches to audience. Appealing to audiences is a subtle skill, and mechanistic demographic approaches soon become transparent and alienating. Just think about how we react to the personalized selection of ads we get based on the data gathered from our Google searches and web visits. As Plato knew, speaking to someone else's soul requires an intimate sense of the other person,

gained most easily and fully in face-to-face dialog, requiring a spontaneity, authenticity, and intuitive sense of the other that leads to surprise and poignant intervention in individuals' thinking and action. Demographic approaches to audience used by current technologies rely on our most visible characteristics and behavior, and do not empathetically reconstruct our ways of feeling and thinking. Rather, they are in constant danger of evoking audience responses of feeling stereotyped or pigeonholed in ways that do not understand who the persons addressed perceive themselves to be or how they feel.

In writing we have to enact that relationship at a distance of time and space, an act that requires even greater human understanding and intuition. Writing to audiences is an act of imagination facilitated by knowledge of genres and activity systems but still one requiring a particularity in the specific communication (Bazerman, *Rhetoric* and *Theory*). If imagining oneself into the place and relations of writing in the paper-and-ink world is an imaginative challenge, the affordances of technology for distribution and access make the imaginative challenges of the digital world even greater. The kinds of disasters that people regularly get into by wayward emails or retweets going viral are only the spectacular tip of the much deeper set of challenges that await us.

The human potential for intuitive alignment with each other (a potential possibly shared with other higher forms of life) may have to do with mirror neurons. Mirror neurons were discovered about twenty-five years ago in monkeys (di Pellegrino et al.) and then in humans (Keysers and Gazzola). They are thought to allow one organism to interpret or sense the observed behavior of another organism as though it were enacted within the observer's own neural system, so, for example, when we watch another human (or even a horse) racing, our own adrenaline starts to pump. These mirror neurons, whose

function and consequences are still controversial, may be crucial to such phenomena as understanding intentions, motor mimicry, vocal imitation, acting, empathy, self-awareness, and even language (Keysers).<<Insertion of *vocal* okay? Otherwise, *imitation* seems equivalent to *mimicry* and thus perhaps redundant.>> Mirror neurons may be central to how humans reenact meaning and affect from texts as well as project anticipated reactions of readers. If mirror neurons are crucial in anticipating audience relation and response, then the human ability to address audiences is unlikely to be matched by technology for the foreseeable future. Even if somehow technology were to simulate mirror neurons, the receiving entity would still have to have a rich set of humanlike experiences and a humanlike capacity for sense making in order to reverberate in alignment with the anticipated audiences.

Intuition and Emergent Cultural Consciousness

The final human capacity I want to explore has also to do with intuitive response to our social situation and the role of imagination, inspiration, or the muse—how fresh thoughts come to our mind. At one level, seeding imagination is a familiar part of our pedagogy as well as part of our personal tricks for invoking the muse by creating good environments for work and concentration, by engaging in stimulating discussions and brainstorming, by using such practices as freewriting and meditation. Early in my career as a writer and teacher I encountered the words of one of the great chess masters, which I remember as something like “study the position, calculate some alternatives but then sit quietly until one of the moves arises in your mind with conviction.” When I am writing, that is what I try to do: set the conditions, set my goals, understand the direction and probable end point of my argument, consider some alternatives about the next phrase or sentence or

paragraph or section, or even the theme and title of an essay—and then I wait until the right words arise in my mind. I take the risk of following my intuition, buffered by the knowledge that I can always revise, go back to a false turn, erase an aberration. But the more experience I have, the less often I find I have to retrace or erase my steps. That intuitive assessment of where next to go seems to factor in all I know about the subject, situation, and emerging text. I have come to recognize and calibrate the rising certainty within me and follow it.

When words and ideas flow, I am sometimes surprised by what emerges, but not shocked, because in retrospect this is where my understanding of the situation was leading me, and the words that appear suggest a way to go through the opening that was prepared before. As writing teachers, we repeat to students quotations about not knowing what you think until you write it. Most writing teachers also diminish the risk of trusting intuitions, through techniques like brainstorming, freewriting, or discovery drafts.

What might this curious role of intuition in writing mean about humans and how we operate? Of course we can always invoke a spark from the gods or muses or genius. But cognitive neuroscience may give us some clues about what is going on. When I first heard thirty years ago about neural networks and connectionism, they seemed to provide a mechanism for the way our minds make complex intuitive judgments and assessments below the level of conscious calculation, through the weight of experience, perception, disposition, and goals. Then, in the 1990s, work by Damasio and others identified emotions as overall assessments of situations that are central to the process of making judgments and shaping actions—not in ways that were inimical to reason, but at the very core of reason. Damasio's more recent work gives further speculative insight into the

nature of consciousness and its relation to more primitive, emotive parts of the brain. I need to confess, though, that I have a very limited window into the world of neural science, working primarily from Damasio's popularizing books: *Descartes' Error*, *The Feeling of What Happens*, *In Search of Spinoza*, and *Self Comes to Mind.* Further, although his work depends on the work of many others, I know that work largely through his representations, and not all of his colleagues are likely to agree with his syntheses and assessments.

Damasio presents a view of consciousness as a mapping and awareness of one's situation and a calculation of alternatives, which rests on nonconscious mappings and also lags behind knowledge, calculation, and assessment. Damasio points out that, in the most basic of animals, the neural system records sensations from the external senses, and the creature uses those neural representations to locate itself and move in the environment without necessitating consciousness. As organisms become more complex, they record and map information from internal sources as well to regulate their internal state and operations, such as with peristalsis, heartbeat, and balance. Again, these do not require consciousness. As organisms become neurologically even more complex, however, they map their neurological system's operations and responses, forming the bases of an emergent consciousness. A creature's mapping of its neurological state forms a sense of a protoself, which gives rise to an awareness of a self that is having sensations and emotions and moving or acting in response—what Damasio calls an autobiographical self. Yet conscious feeling or awareness lags behind the initiating emotions and more basic neurological responses. One begins to smile before one recognizes one is smiling; one begins releasing the fight or flight chemicals before one recognizes feeling fearful or

threatened. Nonetheless, the conscious awareness allows one to monitor oneself and change one's action in relation to other things one notices or feels. One can consciously suppress the smile or choose to ignore a pain in order to finish a race, and one can proceed observantly and intentionally without fleeing or fighting when in a threatening situation. Thus, in neurologically complex creatures, there are multiple levels of mapping one's perceived external and internal environment, one's responses to the states of the environment, one's self-directed goals that require monitoring multiple impulses, and ultimately one's choice-making processes.<<Is my edit to the sentence above okay?>> While higher-order parts of the frontal cortex are involved in this mapping of the self, the more anterior regions of the brainstem where emotions emanate take a central role in integrating information and setting the orientation and directions of consciousness. With the emergence of an autobiographical self that feels and acts and is aware of feelings and actions over time, one's experiences accumulate and modify one's internal state, influencing future feelings and actions.

Yet this knowledge and personal development are locked within one's neural system and, without communication, die when the neural system dies. Means of communication, particularly language, however, allow one to share one's perception of the world, one's internal states, and one's choices and actions, to the degree that one can formulate and represent them. With language, knowledge becomes shared, and the loneliness of the separate neural system begins to be breached. One's idiosyncratic representations, perceptions, and knowledge can also be compared with those of others, and one's errors or bad judgments can be modified with goals and choices changed on the basis of the shared communal mappings or knowledge. We can speculate beyond the

scope of Damasio's examination of the internal state and consciousness to characterize language itself as facilitating a communal mapping of the world and coordinating the internal states of the people sharing language, plans, and procedures—thereby forming community knowledge. This community knowledge then changes the perceptions, action environment, and goals for each of the individuals, as humans perceive the world in relation to and as part of the social collective. Language, as many have noted, embodies the collective unconscious, embodying motives, perceptions, dispositions, and orientations that are not yet brought into explicit collective consciousness. Community elders, seers, poets and other creative writers, essayists, philosophers, and other visionaries can serve to articulate those underlying social impulses and emotions as part of an emerging collective consciousness. Again, each new level of consciousness lags behind the emergent representations, orientations, and actions of individuals and the collective. Yet each new level of emergent representation and eventual consciousness embodies and is built on the mappings of prior states of knowledge and awareness.

Literacy and inscribed knowledge creates a new level of more enduring and more widely spread representations, more widely testable against broader experience, and even explicitly tested against probes into the environing world as well as the internal states and actions of oneself and one's fellow creatures. Each extension of the formation and diffusion helps advance the sophistication and reliability of the communally shared representation, in the manner in which Eisenstein identifies the impact of the printing press in the formation of science (Eisenstein). Yet even with all the sophistication of the literate mappings and communal knowledge, which form the basis of our posing the problems of living and all the subproblems of inquiry and action choices, calculative

awareness lags behind the internal intuitive assessment that directs our action and sense of where answers and actions lie. We only become aware of these sensed solutions as they arise to consciousness, even while they embody all the prior layers of conscious learning and sharing of knowledge. So even as we are puzzling through the conflicting representations of multiple works of philosophy and science, based on our lifetime of experience, reading, debate, and writing, we gravitate toward our solutions only partly aware of where we are headed and what formulations will make sense to us. We are like the reptile wandering toward the warmth of the sun and rocks but only recognizing where we are as we get there. We work best when we do not fight those inarticulate emotions arising into feelings of where we are headed and then honoring them by bringing them into consciousness. Humans are really good at intuition, and it is going to be a long time, if ever, before machines will beat us at this game. Computers now can beat us at chess, but only because they can calculate all the alternatives much faster in this closed domain with discrete moves conducive to calculation. Even within this realm, some humans, with far less calculative power but lots of intuitive understanding and access to the collective experience of play embodied in the extensive literature on chess, can still do pretty well. Most of what we write about is far less bound and far less conducive to a limited set of calculations than chess. In those more open domains of life, human intuition, emotions, and subconscious calculation still are powerful guides to statements we articulate for our conscious recognition and to contend for a place within communal consciousness.

Conclusion

Writing and knowledge technologies offer us a wealth of cyborgian extensions. Yet as we and our students learn to take advantage of them, we also need to learn to take more

explicit advantage of our human capacities within the cyborgian partnership. Here I have proposed some things that humans do well, and might need to do even better, to use our technology to best advantage: monitoring production and making high-level choices; coordinating complex distributed collaborative projects; understanding audiences empathically and forming communicative relations; and, finally, sensing where we are and where we are headed in complex social-informative-knowledge worlds. Or we could say in a more familiar way: revision, rhetoric, collaboration, inspiration.

A wag once said the future will be much the same, only different. Or perhaps the future will be different, but much the same. The conditions and situations of writing will be different, but we will continue to do well what we do well, while technology does what it does even better.

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