Writing as Extended Mind: Recentering Cognition, Rethinking Tool Use

Recently, a new wave of materialist writing scholarship has sought to trace how technological change is impacting writing processes. This article suggests that such efforts can benefit from viewing writing as act of extended mind. Formulated by philosophers, but rooted in cognitive science, extended mind reconceives cognition as embodied action. Seen through such a lens, writing is spatially and temporally distributed, yet composed of discrete material elements. Tools emerge as more than items of mere use. After discussing what writing as extended mind holds and how it connects with (and challenges) current practice, I reinterpret data from two recent articles in Computers and Composition , showing how this provocative theoretical frame might supplement both writing research and pedagogy.

1. New Tools, New Processes

Over the past twenty years, digital writing tools and networked information access have come to dominate the writing landscape. With material change comes change in how people write. Indeed, some argue that writing's shifting material base has rendered previous process findings void (Stapleton, 2010). This possibility has sparked scholarly reorientation. As of 2003, Richard Fulkerson could wryly assert that rhetoric and composition scholars "no longer do research into writing processes" (p. 670). This is now not so. In recent years, a wide variety of studies have reengaged process, often seeking to trace how new writing tools and access options impact literacy practices (Bray, 2013; Ching, 2018; Kessler, 2020; Pigg, 2014; Takayoshi, 2015). These studies are often avowedly materialist in their theoretical commitments; they resist what Christina Hass (1996) calls the "myth of technological transparency," the idea that writing has an "essential nature unaffected by the mode of production and presentation" (p. 32). All told, we can say that the field's new wave of process scholarship is informed by a common belief that how writers write matters, how writers write is changing, and that to understand these hows, we must understand writing's "what withs" as Hannah Rule (2018) puts it (p. 403).

While earlier process research mainly drew on cognitive science, new-wave process research draws on sociocultural theory. Both the triumphs and failures of the former are well known: while making great strides in charting the complex, recursive nature of the writing act, the inward-directed focus of the process-era obscured social and material context (Prior, 2006). Contemporary sociocultural approaches such as posthumanism (e.g. Bray, 2013), actor-network theory (e.g. Ching, 2018) and activity theory (e.g. Kessler, 2020), seek to capture more contextual nuance. In broad terms, such approaches highlight the distributed and contingent nature of writing processes. They foreground the ways in which writing is mediated by shared technologies, whether physical (like pen or computer) or cognitive (like language or concept). In doing so, they productively expand the scope of writing research from individual acts of inscription to "literate activity" of all shapes and sizes (Prior, 2015).

Given the shifting material landscape, attention to tool use is essential; likewise sociocultural theory provides valuable insight into the nature of tool use. That said, recent process research betrays certain limitations which restrict our ability to trace the full impact of Scrivener and Grammarly and other writing apps, Google Scholar and Mendeley and other research tools, screens and ebooks and other reading devices, etc. Contemporary process research, I want to suggest, consistently neglects literacy activity at the operational or microscopic level. Collin Brooke and Thomas Rickert (2011) get at the core of the problem when they note a tendency in writing studies to center analysis on words rather than things (or things-in-use), thus obscuring the "radical alterity" of writing's material elements (p. 167). Using sociocultural theoretical frames, which strive to present writing as dispersed and distributed, and methods such as interviews or personal reflection which strive to capture dispersion and distribution, recent process studies tend to prioritize what writers think and say rather than the actual, non-discursive dynamics of tool use. The radically other, the unspoken and unknown, is thus elided. This is a problem when studying tool use because much of our engagement with writing tools, especially at the most local of levels, is habitual and reflexive, occurring beyond the bounds of consciousness and language. Too much focus on the conscious, intentional and ideational, in short, might leave us unable to capture the often-subtle ways in which a shifting material base is changing how people write.

In the following pages I take the first step towards developing a vocabulary to theorize writing processes at the operational or microscopic level. Combined with in-situ data-collection methods such as screen and workspace recording, this vocabulary, I believe, can help make visible what actually happens when writers use writing tools. It can thus productively supplement current sociocultural approaches. Like the thought of the earlier process era, the framework I propose is based in cognitive science. In particular, it is informed by and furthers what's known as the "extended mind thesis." This novel approach to human intelligence rejects the idea that the mind functions as a kind of "input-output sandwich" in which an inner executive applies logical rules to sensory data to build models and guide behavior (Clark, 2008, p. 70). Instead, cognition is understood as embodied action in physical space. The various motions by which humans manipulate and transform physical resources, including reading, writing and research tools, thus take center stage.

As I hope is clear, in rejecting internalism, writing as extended mind breaks with earlier cognitive approaches; in maintaining a tight focus on localized, embodied action, it also breaks with writing studies orthodoxy. This is not to deny the importance of the shared or social, of course. A writer is more like a bee tending a hive than a spider weaving a web; we always work with and within systems constructed by generations of cumulative activity.[1] That said, in addition to tracing how broad social practices shape individual action, I'd suggest we also need fine-grained analysis to reveal local idiosyncrasies, patterns and deviations. This sort of tight focus is what writing as extended mind offers.

In pressing my case, I will first discuss sociocultural theory and the various levels or scales on which sociocultural theorists may approach human activity. Via analysis of Tim Lockridge and Derek Van Ittersum's recent work on "workflows," I provide support for my claim that contemporary, tool-centric process research, while of great value, consistently neglects activity at the most local of scales. Next, I present a vision of writing as act of extended mind. The writer in such a scheme consists of a biological core— "the ancient biological skinbag," as Andy Clark (2008) writes—manipulating (more or less skillfully) a suite of external resources (p. 138). Seen in this way, cognition as enacted in environmental manipulations becomes a prime object of inquiry. The externalization of cognition is not new to our field, of course. I argue, though, that its implications have been neither fully articulated nor felt, especially in regard to tool use. Through reinterpretation of data from a recent process study, I show how writing as extended mind can help chart writing activity that typically goes unnoticed, providing new insights into how extant and emerging reading, writing and research technologies actually function. To show the practical value of examining tool use through the lens of extended mind, I then tackle a timely pedagogical problem: why is it seemingly so hard for student writers to read, understand and use digital texts? Again I take a second look at data from a recent process study. Understanding writing as act of extended mind, I argue, allows us to see digital reading in a new light, thus suggesting new pedagogical paths.

2. Sociocultural Theory & the Problem of Scale

Writing in 2006, Paul Prior noted that sociocultural theory represents "the dominant paradigm for writing research" (p. 54). The same holds true today. In fact, for many writing researchers, sociocultural tenets may seem like commonsense. "Sociocultural theory," Prior writes, "rejects the notion that human action is governed by some Neoplatonic realm of rules," whether linguistic, social or cognitive (p. 55). Instead, human behavior, including writing, is improvised locally, situated in concrete interactions and mediated by shared technologies. As the notion of mediation suggests, in the sociocultural mode, writing events are not viewed as autonomous or self-contained. Instead, acts of inscription are understood as inherently connected with and informed by a diverse array of elements and processes operating at different temporal and spatial scales. For the sociocultural researcher, any writing event implicates a variety of literacy activity "temporally and spatially dispersed and distributed across multiple persons, artifacts, and sites" (Prior, 2015, p. 189). All told, sociocultural approaches aim to account for both individual actions, and the broader networks and systems which inform them. Charting the relationship between varied spatial and temporal scales thus emerges as a key challenge (Cole, 1996; Prior, 2015).

Within writing studies, Clay Spinuzzi (2002) provides the most in-depth account of how various levels of scale might be modeled. Surveying the sociocultural canon, he claims that any specific literacy event can be approached via three mutually defining levels. The broadest level is *macroscopic*, implicating "the ways in which entire communities understand, structure, collaborate on, and execute their evolving cooperative enterprises" (Spinuzzi, 2002, p. 7). Within the macroscopic sits the *mesoscopic*, which implicates goal-directed action—the discrete tasks which constitute literate life. Finally, at the most local level is the *microscopic*, implicating "moment-by-moment operations… the minute practices, reflexes, and habits on which users automatically draw as they perform [goal-directed] actions" (Spinuzzi, 2002, p. 10).

Sociocultural canon further holds that the varying levels of scale are *coconstitutive*, meaning that none can be considered foundational (Russell, 1997; Spinuzzi, 2002). Mesoscopic goals, for instance, may spur microscopic actions, but the relationship always runs in two directions, with the reality of the microscopic working to transform the mesoscopic and vice versa. Also, in practice, the various levels are not fixed or stable; what activities are slotted where depends on the needs of the analyst. Consider a student writing a research paper. The macroscopic may be the nation or university or course. The mesoscopic may be the assignment or the sub-task of writing a literature review. The microscopic may be the process of entering search terms in a database or the movement of hands on a keyboard. What's important, we might say, is not specific labels, but the recognition of the nested and coconstitutive nature of literacy activity. To understand any writing event, all three levels should be considered, and considered in light of their unique properties and features.

Reviewing our field's recent wave of tool-centric process research, we see little explicit distinction between levels of activity. This body of work also tends to neglect activity at the microscopic level. Indeed, there seems to be an innate tendency among sociocultural writing researchers to overlook minute moves and operations. Hannah Rule suggests that this tendency arose as a reaction to the overly narrow focus of the process-era. With the expansion of writing research's scope post-process, Rule (2018) writes, came general neglect of writing at the "radically local" level (p. 402). If we view the different scales of literacy activity as coconstitutive, with each shaping and informing the others, this neglect becomes quite a problem.

Tim Lockridge and Derek Van Ittersum's discussion of "writing workflows" is representative of recent process trends. Lockridge and Van Ittersum (2020) present a number of concepts related to workflows with the laudable goal of turning "personal and local computing practices into a form of disciplinary knowledge" (p. 40). Given the shifting nature of writing's material base, and its inevitable impact on writing processes and products, this is important work. If we are to understand the relationship between writing and extant and emerging technologies, description and analysis of the ways in which "specific pieces of software and hardware mediate writing in practice" (p. 39) is much needed. The idea of "workflows" provides a useful frame to accomplish such work.

Like other recent process studies, Lockridge and Van Ittersum's efforts to trace tool use are informed by sociocultural tenets. Their research foregrounds the evolution of writing processes and the connection between practice and historical and cultural contexts. It also considers what Paul Prior and Jody Shipka (2003) call "environmental selecting and structuring practices," or the ways in which writers manipulate their physical environment for intellectual and affective purposes. These emphases evidence the sociocultural aim of grappling with writing as "an increasingly complex semiotic phenomenon dispersed across widening spatiotemporal networks of activity" as Paul Prior (2006, p. 64) puts it. In terms of methodology, Lockridge and Van Ittersum rely on interviews; specifically, they interview a small group of experienced writers accustomed to experimentation with different writing tools about their writing behaviors. All told, viewing these writers' experiences in terms of workflow results in a rich and informative account of the role tools can play in the modern writing life.

It must be noted, though, that Lockridge and Van Ittersum's account operates almost solely on the macroscopic and mesoscopic levels. Both theoretical and methodological choices work to obscure more intimate forms of activity. First, there's the sociocultural mandate to stretch the bounds of the writing scene. Unless explicitly counteracted, attention to such distant foci as "the history of word processor development" (p. 83), for instance, can divert attention from more local study. Second, Lockridge and Van Ittersum's chosen methodology—interviews about writing practices—while a powerful research tool, falters when probing literacy activity at the operational level. As Spinuzzi (2002) makes clear, while operations typically start out as conscious and goal-directed, they quickly fade from conscious awareness. Most hands-on engagement with mature writing technologies, even for the most self-aware of writers, is habitual and reflexive, and thus invisible to retrospective accounts of writing behavior. Studies which rely solely on such accounts—such as Lockridge and Van Ittersum's discussion of workflows—will inevitably miss the operational details of tool use.

Earlier, I accused new-wave process research, despite materialist commitments, of continuing to prioritize words over things-in-use. We center narratives about tools and processes and sideline material dynamics. This discursive focus manifests in neglect of the microscopic or operational level of writing activity. As I've tried to show, both theory and method are implicated. To capture writing processes in their full complexity, writing researchers need to acknowledge the coconstitutive, multi-leveled nature of writing activity and deploy methodologies that can chart each level in light of its unique characteristics. That said, acknowledging diverse scales and implementing new methodologies aren't alone sufficient to unlock writing processes at the operational level. Making sense of hands-on tool use is notoriously difficult. Even when in-situ data collection methods are used researchers may have trouble understanding what a particular action means or how it relates to other operations. As Cheryl Geisler and Shaun Slattery (2013) explain, at the operational level, data can become "so fine-grained it becomes impossible to tell what is

going on" (p. 199). For this reason, new theoretical insights are required. In short, we need a framework to help organize operational data collection and analysis. Enter extended mind.

3. A (New) Cognitive Process Theory of Writing

In its simplest formulation, extended mind holds that elements other than the human brain and its internal processes play an active role in cognition. Bodies, behaviors, spaces and tools are viewed as constitutive elements of intellectual activity. This claim may feel familiar to writing scholars. Indeed, Kristopher Lotier (2016) argues that the idea that "environmental features… are constitutive elements of one's mental systems" has informed writing studies for over thirty years (p. 366). Among the various strains of externalism, though, extended mind stands out as being particularly useful for theorizing the material dynamics of tool use. As far back as 2011, Brooke and Rickert suggested that extended mind offers writing scholars a way to talk about technology "while granting it its radical material alterity" (p. 167). The key, as they see it, is that within the extended paradigm tools are not relegated to mere conduits of human desire. Instead, as cognitive philosophers Andy Clark and David Chalmers (1998) put it in their foundational essay, "The Extended Mind," when merged in "coupled systems" of human and non-human, external resources are just as "casually relevant" as body and brain (p. 9).

In presenting the non-human as agentive, extended mind parallels actor-network theory, posthumanism and other "new materialist" forms of sociocultural thought. That said, extended mind also challenges current understandings. First, despite paying great attention to external objects, extended mind is fundamentally a theory of human cognition. It is thus primarily concerned with acts of *information processing*, defined as a cognizing entity engaging its environment to perceive, remember, reason, and ultimately, act. In the theory's defining thought experiment, for instance, Otto, a man with Alzheimer's disease, navigates to a museum using information he's written in a notebook. This external memory supplement is shown to be equivalent, on a functional level, to an internalized, brain-based belief. Otto's mind has thus been extended (Clark & Chalmers, 1998).

As the example of Otto indicates, an act of "information processing" can involve reading, inscription and indeed, literacy activity of all sorts. To conceive writing in such terms thus helps fulfill the sociocultural mandate to capture writing's multi-faceted, distributed nature. At the same time, though, extended mind also respects biological reality. The paradigm is rooted in recent empirical work in cognitive science. Thus, as Andy Clark (2008) writes, it follows convention in that field by positing a "persisting common biological core" at the center of the cognizing act (p. 117). Mark Rowlands (2010) further explains that to be considered "cognitive," a process must be owned by an agent. It must help that agent detect changes in its environment and modify its behavior in turn (Rowlands, 2010, p. 147). Although an agent

in this sense could be a group or non-human animal, the version of extended mind I wish to forward focuses primarily on individual human animals. These animals are "profoundly embodied" creatures, who are "promiscuously body-and-world exploiting… forever testing and exploring" new possibilities for environmental manipulation and device incorporation (Clark, 2008, p. 42). Writing as extended mind, in short, is the study of the resulting bio-centric assemblages.

With its empirical bent and emphasis on local acts of information processing, extended mind naturally evokes the cognitive science-informed writing research of the original process era. As noted, the complaints leveled against the work of Linda Flower, John Hayes and other cognitivists are well known. In their efforts to create generalized models of the writing process, these scholars failed to sufficiently account for social and material context. Fortunately, writing as extended mind can sidestep many of the complaints lodged against earlier cognitivist theory. It can thus help displace a set of old, frankly outdated ideas about cognition which continue to shape writing scholarship.

As noted, extended mind posits a biological core equipped with a set of evolutionarily informed "recruitment processes." Cognizers deploy these processes at varying temporal and spatial scales to "bootstrap into existence" complex cognitive systems (Clark, 2008, p. 138). Cognizers tend to "recruit, on the spot, whatever mix of problem-solving resources will yield an acceptable result with a minimum of effort," Clark writes (2008, p. 13). Though the construction process is underpinned by shared biological tendencies, each cognitive system is context dependent: its nature and dynamics determined by the specific problem presented and specific resources available to be recruited. Resources include shared creations such as constructed spaces, languages, ideas and tools. And, of course, embodied habits and patterns of integration are themselves learned, social practices. Seen in this way, social and material context lies at the very heart of the extended mind program.

Extended mind also calls into question the generalized behavioral models which defined the earlier process era. Rather than stable, hardwired connections, in most cases, Clark writes, the extended mind theorist confronts "only soft-assembled, temporary medleys of info-processing resources" (2008, p. 116). Within these medleys, relations are "highly complex, nested and nonlinear" (Clark, 2008, p. 116). To theorize writing through such a lens requires abandoning generalized models. Instead, writing researchers need to view each writing act as a singular whole, a unique assemblage of human and non-human. From the study of multiple writing events, patterns of engagement might emerge, but any descriptive claim will be generalizable only within a specific social and technological milieu. In other words, writing as extended mind can provide insight into how certain writers use their tools. It might even provide guidance as to how we might use our tools better. It is unlikely, though, to provide a generalizable theory of the writing process.

In breaking with cognitivist tradition, extended mind tracks broader trends regarding the nature of thought and intelligence. As noted, extended mind, like much work in contemporary cognitive science, deemphasizes the role of rule-based model building in the thinking process. Instead, emphasis is placed on "epistemic action," that is, environmental engagements which work to supplement, or even replace, conventional brainbound thought. Otto writing in his notebook is one example of epistemic action. Another example can be found at your local bar. A bartender might assign each drink a specific type of glass. When it comes time for another round, rather than having to maintain and recall an internal representation of who ordered what, she simply notes the type of glass. Through this simple environmental manipulation the bartender has turned the glasses themselves into representations, thus off-loading some of the work of cognition. She has transformed the physical world from a problem space to a problem-solving resource, as Andy Clark might say. The idea at the heart of the extended program is that such manipulations are more common, and more important, than previously acknowledged.

A devaluation of internal models marks a break not just with earlier cognitivist approaches but also with current thought in writing studies. While scholars of computers and writing have long argued for more attention to materiality, the idea that internal representations of writing and the writing process are of great import, and that the construction of elaborate representations should be a primary pedagogical aim, remain central to our field's identity.[2] Extended mind challenges these ideas. To shift to an extended rather than brainbound understanding of cognition means paying less attention to what writers think (or say) and more attention to what they do. Fully extended, "cognitive writing studies" comes to signify the study of cognition as enacted in environmental manipulations. The material dynamics of tool use, spatial arrangement and embodied performance are prime objects of inquiry. Given the omnipresence of digital writing tools and networked information access, how writers engage these resources would be central to any such program. How do writers-as-cognizers work with (and against) computer and network interfaces? How do they personalize digital tools and spaces to turn the world itself into a problem-solving resource? Such questions would guide writing as extended mind in a digital and networked age.

Of course, recognizing the often-extended nature of cognition doesn't mean denying that conscious ideation influences the construction of texts. Nor does it mean denying the power of abstract social and cultural forces. It does mean, though, steadily foregrounding the contribution of concrete local action—marks on a PDF document, the arrangement of windows on a computer screen, etc. Such actions often go unnoticed, existing below the level of consciousness. Writing as extended mind both draws attention to and helps make sense of them.

4. Writing as Extended Mind

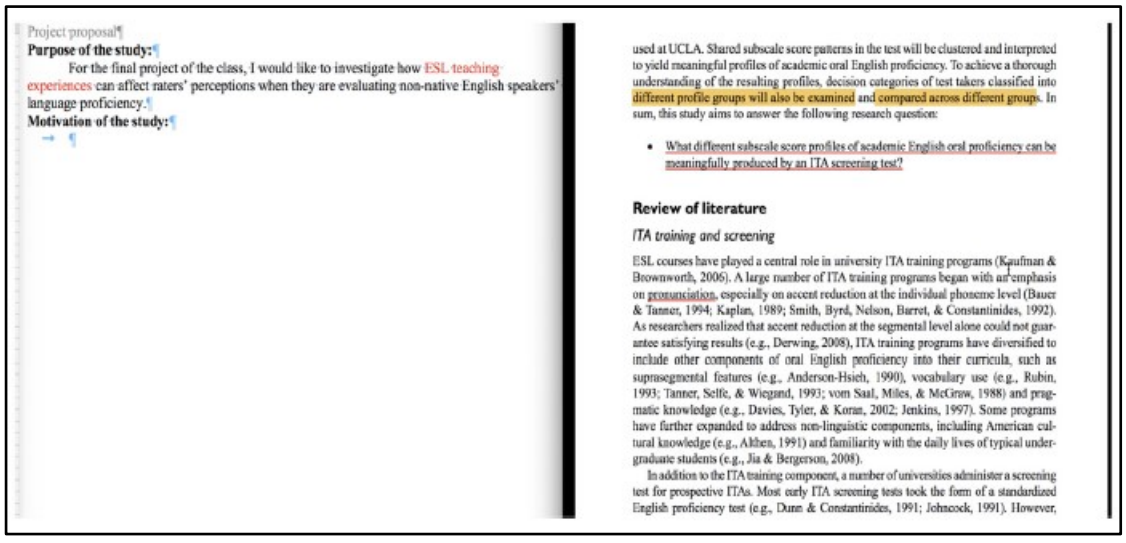
So how does one theorize writing as act of extended mind? What principles inform the construction of bio-centric information-processing assemblages? And what role might extant and emerging technologies play within? A good place to start is with what extended mind theorists say about written language. Writing, Richard Menary (2007) argues, is "thinking in action," a complex dance that involves "the coordination of neural, bodily and environmental processes" (p. 622). Menary, like other extended mind theorists, starts from the premise that discursive forms (sentences, genres, etc.) are best conceived not "as abstractions, but as material vehicles" (629). As material vehicles, shared forms have generative power. When writing a poem, for instance, it is often the material properties of the words used, such as their structure and cadence, that help determine the poem's content. Other elements within writing ecologies are similarly generative. Seen in this way, the content of a text is an emergent property of work in physical space. More specifically, writing is a process of integration and supplementation. Brain, text and tools all have different material affordances. Writing is the act of marshaling these disparate resources (and many others) to achieve wholes bigger than the sum of the parts.

To show how theorizing the writing process as integration and supplementation can help us better understand tool use, it's best to engage a concrete example. A suitable example can be found in Matt Kessler's article, "Technology-Mediated Writing: Exploring Incoming Graduate Students' L2 Writing Strategies with Activity Theory," published in this journal in 2020. Here, Kessler deploys activity theory to chart how writers use digital technology. Kessler's interests are very much in line with my own. He believes that with technological change writing processes are changing and that we need process-scale research to understand these changes. Towards this end, Kessler (2020) collects and analyzes a range of data pertaining to the efforts of two graduate students to complete a graduate-level writing task. The wide variety of data collected, which includes written artifacts, screen recordings and interview transcripts, allows Kessler to present a comprehensive picture of these writers' processes.

As noted, to make sense of his data, Kessler turns to activity theory. This framework, he writes, emphasizes "the social, interconnected dimensions" of tool use, thus allowing for important insights (p. 3). I agree. His subjects' conscious evaluation of Wikipedia, for instance, why they use it and who taught them to do so, is essential information. That said, without a conceptual vocabulary to describe unconscious material dynamics as well as conscious social dynamics key aspects of tool use remain invisible. It is here that extended mind provides a useful supplement. In particular, I want to focus on a writer named Rebecca and her use of a computer application called "Shift-It" which allows her to customize the size and position of windows on her computer screen. I will argue that when Rebecca's writing process is viewed as act of extended mind, Shift-It emerges as a constitutive cognitive element. Through a process of integration and

supplementation, its unique affordances are combined with those of a wide array of other resources, allowing for acts of inscription that would otherwise be impossible.

Turning to the data, we find that Rebecca engages in extensive manipulation of her writing environment.[3] Figure 1 depicts a screenshot from her computer. Here Shift-It is used to divide her screen between a Microsoft Word document in which she takes notes and a PDF journal article. Screen-recording data further indicates frequent shifts between the screen depicted and Wikipedia. Kessler labels these behaviors "tool-mediated strategies of content development." Within the PDF, Rebecca uses a variety of novel annotation techniques and textual manipulations, including highlighting, underlining and changing the color of certain text. Kessler labels this behavior a "multimodal strategy." Through stimulated recall, he elicits Rebecca's motivation for and understanding of these unique literacy behaviors (mesoscopic analysis), as well as their roots in past educational experience (macroscopic analysis). Drawing on this information, as well as screen-recording data, he concludes that Rebecca's use of Shift-It, "made it easier to scan back-and-forth between her writing and the source she was referring to/pulling from" (p. 9). Wikipedia allowed her to access "basic, background information" as to help understand the topic at hand (p. 9). While her multimodal strategies helped her "quickly [find] relevant information," which could then be "summarized/integrated into her document" (p. 9).


Project proposal¶

Purpose of the study:¶

For the final project of the class, I would like to investigate how ESL teaching experiences can affect raters' perceptions when they are evaluating non-native English speakers' language proficiency.¶

Motivation of the study:¶

→ ¶

used at UCLA. Shared subscale score patterns in the test will be clustered and interpreted to yield meaningful profiles of academic oral English proficiency. To achieve a thorough understanding of the resulting profiles, decision categories of test takers classified into different profile groups will also be examined and compared across different groups. In sum, this study aims to answer the following research question:

- What different subscale score profiles of academic English oral proficiency can be meaningfully produced by an ITA screening test?

Review of literature

ITA training and screening

ESL courses have played a central role in university ITA training programs (Kaufman & Brownworth, 2006). A large number of ITA training programs began with an emphasis on pronunciation, especially on accent reduction at the individual phoneme level (Bauer & Tanner, 1994; Kaplan, 1989; Smith, Byrd, Nelson, Barret, & Constantinides, 1992). As researchers realized that accent reduction at the segmental level alone could not guarantee satisfying results (e.g., Derwing, 2008), ITA training programs have diversified to include other components of oral English proficiency into their curricula, such as suprasegmental features (e.g., Anderson-Hsieh, 1990), vocabulary use (e.g., Rubin, 1993; Tanner, Selfe, & Wiegand, 1993; vom Saal, Miles, & McGraw, 1988) and pragmatic knowledge (e.g., Davies, Tyler, & Koran, 2002; Jenkins, 1997). Some programs have further expanded to address non-linguistic components, including American cultural knowledge (e.g., Althen, 1991) and familiarity with the daily lives of typical undergraduate students (e.g., Jia & Bergerson, 2008).

In addition to the ITA training component, a number of universities administer a screening test for prospective ITAs. Most early ITA screening tests took the form of a standardized English proficiency test (e.g., Dunn & Constantinides, 1991; Johnsock, 1991). However,

Figure 1: Screenshot showing Rebecca's writing process (Kessler, 2020, p. 9)

So, how does writing as extended mind supplement Kessler's analysis? In short, it provides a set of tools to chart the specific material dynamics captured in his data. In performing such work, we move beyond *what* Rebecca thinks or knows. Instead, we engage *how* she thinks, how she knows, doing so, of course, via close attention to how she writes.

As noted, writing as extended mind takes as its starting point the physical entity of the writer, an entity which displays certain biological tendencies, abilities and constraints, as well as learned behavioral patterns. The writing act itself is an act of problem-solving, in the simple sense that it is sparked by a desire to move from present to intended state. To make this move, the writer must process information, an activity that involves a recursive, and not necessarily linear mix of perceiving, remembering, reasoning, and acting. At any stage, external resources may be incorporated into the writer's information-processing regime.

The limited capacity of human working memory is undoubtedly one of the most important biological constraints a writer faces (see McCutchen, 2000). Indeed, Ronald Kellogg (2008) goes as far as to say that working memory capacity is "the primary constraint" on the development of writing skill (2). Given this situation, behavior which works to offload cognitive function is of great value to a writer. It should therefore be a central concern of writing scholars. In particular, in light of writing's shifting material base, we might look for ways in which emerging technologies allow for increasingly sophisticated acts of cognitive offloading.

In Rebecca's case, we see evidence of such activity. An extended mind approach, attending to action at the microscopic or operational level, allows us to chart its dynamics. One of the most common forms of offloading, extended mind tells us, involves the use of external information stores. Rather than converting and storing data in rich, cognitively intensive internal models, empirical evidence indicates that during complex cognitive activity, cognizers often use optical scanning and other forms of sensory activity to dip into external information resources on a "just-in-time" basis (Kirsh & Maglio, 1994; McBeath, Shaffer & Kaiser, 1995). As Clark explains, sensing, in such situations, "acts as a constantly available channel that productively couples agent and environment" (2008, p. 15). In other words, through sensory engagement, cognizers effectively merge internal and external, combining the affordances of the human brain (E.G. dynamic processing capacity) and external objects (E.G. static storage capacity).

As noted, Kessler determines that Rebecca uses Shift-It "to scan back-and-forth between her writing and the source she was referring to/pulling from" (p. 9). This is an accurate claim. Writing as extended mind, though, suggests that what Kessler reads simply as "scanning" is likely the surface manifestation of an intricate act of information processing. The evidence indicates that Rebecca is likely using the annotated PDF document as an external information store. Deploying Shift-It's unique affordances, she has positioned herself as a link or node between an external information resource (the PDF document) and the site of inscription (the Word document). This positioning allows her to process information from the former without having to maintain that information within working memory. As a result, additional brainbound resources can be devoted to language generation, textual planning and other concerns, increasing Rebecca's overall writing proficiency. In short, this writer has integrated data store, computer app, inscription tool and human mind, using the unique affordances of each to supplement one

another. In doing so, she has created an extended cognitive system—an "extended mind"—capable of acts of textual construction which would otherwise be impossible.

To clarify my intervention, it is important to note what is *not* happening here. My claim is not that Rebecca is simply reading the annotated PDF, internalizing information and using it to inform inscription (such activity would do little to reduce cognitive load). Instead, her brainbound cognitive processes are drawing from the annotated text in the same way they would an internal memory store. In essence, she is skipping a step (internalization). Seen in this way, her tools, artifacts and workspace are functionally part of her cognitive architecture. Their design thus intimately informs both Rebecca's thinking and her text.

The above analysis indicates how even the most basic of writing tools can take on great import through the process of integration and supplementation. In Rebecca's case, seemingly humble Shift-It emerges as the lynchpin in a system carefully, though perhaps unconsciously, designed to maximize Rebecca's ability to produce complex academic texts. Of course, though, no tool can be understood in isolation. No matter how potent, a tool's affordances can only be exploited as part of an ecology of other tools and patterns of tool use. If we expand the temporal scope of our analysis, we see that this is indeed the case with Rebecca's use of Shift-It.

As mentioned, writing as extended mind foregrounds the ways in which writers physically manipulate their environments in order to combine disparate resources and thus increase their cognitive capacities. One common form of environmental manipulation involves work upon what Mark Rowlands labels "information bearing structures." The general idea of the "manipulation thesis" is that structures external to a cognizer will often carry information relevant to a cognitive task. Integrally, in its default state, this information may be present, but not available, as in able to be incorporated into an active cognitive ecology. First, the cognizer must act upon the information-bearing structure. They must manipulate it as to "unlock" the information within. Once worked upon, the information can be integrated with brainbound resources—it can be accessed and exploited the same as if committed to onboard memory.

As she inscribes, Rebecca successfully incorporates information from an academic text. Prior to inscription she engages in a complex series of highlighting and other textual manipulations, what Kessler deems "multimodal strategies" (p. 9). The manipulation thesis allows us to better understand these strategies and how they relate to other elements of Rebecca's writing process. First off, the academic journal article clearly contains information deemed relevant to Rebecca's writing task. Initially, though, this information is inaccessible to the writer and her inscription process. The conventional way to make it accessible would be simply to read and memorize the relevant portions. Information would then be stored in Rebecca's memory and drawn upon during the act of inscription. This cognitively intensive process is not what Rebecca appears to be doing, though. Instead, she uses environmental structuring and manipulation to unlock the information within the document and prepare it for future use, thus allowing

easy access during inscription. Her multimodal strategies represent one stage in this process, as she works with the target text to highlight and otherwise make available key segments. Her use of Shift-It to position the manipulated source document represents another stage.

Rebecca's multimodal and positional strategies are supplemented by additional acts of environmental manipulation. Kessler notes, remember, that when engaging the PDF document, Rebecca makes frequent trips to Wikipedia to access "basic, background information" to help her understand the topic at hand (p. 9). During her trips to this website, she enters search terms, clicks on links, and scrolls through pages—all forms of physical manipulation meant to identify and unlock relevant information. Once made available, this information can be combined with brainbound resources to reason and guide behavior; it can help her identify what sections in the PDF document to highlight, for instance. All told, viewed in light of the manipulation thesis, Rebecca's writing process looks something like a set of Russian dolls—a nested sequence of similarly structured information-processing behaviors. At each stage in the process we might say that Rebecca operates as a relay or node, combining disparate resources, and a conductor, physically manipulating resources to facilitate subsequent acts of combination. Integrally, skill at one stage would mean little without skill in the others. In order to exploit the unique positional affordances of Shift-It, for instance, Rebecca must be able to annotate, which requires facility with Wikipedia, and so on. All told, it appears that Rebecca's literacy behaviors, like the tools on which they depend, obey the logic of supplementation: without skillful design activity at any one stage, her writing ecology would be rendered inert.

As noted, it is now common to claim that writing processes are multifaceted and distributed. The application of extended mind to the above data shows how this is true even at the most local of scales. Writing at the microscopic level is shown to be distributed spatially and temporally, yet composed of discrete, concrete elements and actions. Reading, writing and research are shown to be intimately intertwined. Extended mind also helps us move beyond commonplaces, though. In providing a framework to understand how different literacy resources might be made to work together, it makes visible previously invisible connections. In the complex, non-linear relationship between Shift-It and Wikipedia, for instance, we see how the full affordances of one tool may remain unavailable without skillful use of another. It is widely acknowledged that digital and networked technologies are changing writing processes. By providing insight into how technological affordances build on and supplement both each other and biological affordances, microscopic analysis via extended mind helps provide a more complete picture of how such tools actually function.

5. Digital Reading as Act of Extended Mind

In the above pages I've sought to show how extended mind can help writing scholars better understand the impact of emerging technologies on writing processes. As we've seen, extended mind provides a theoretical framework to study writing at the microscopic or operational level, the level of tools-in-use. In particular, it suggests we pay attention to how writers combine various technological resources to offload, and thus enhance, cognitive function. In this final section, I'd like to turn to the classroom. How might an extended mind approach change how we teach writing? To answer this question, I will center a timely pedagogical concern: our students' digital reading practices.

Recent years have, of course, been marked by changes in the material base of reading as well as writing. As digital texts pervade the writing classroom, a growing body of work has sought to understand and shape student engagement with such texts (Carillo, 2019; Craig, 2017; Overstreet, 2021; Rodrigue, 2017a). Unfortunately, there is agreement among writing teachers that students' digital reading skills are often lacking. Students often find digital texts—whether web-native or PDF—difficult to read, with some students needing to print out digital texts in order to achieve comprehension (Rodrigue, 2017a). Web-native texts are a particular area of concern. Even at top American universities, Ellen Carrillo (2019) writes, students often fail "to read in ways that allow them to understand and discern the credibility of what they encounter online" (p. 137).

Tanya Rodrigue (2017b), writing in this journal, has recently sought to better understand students' digital reading practices. Rodrigue monitored undergraduate students as they drew on digital texts to draft a research-based argumentative essay. Her research reveals something of a mystery. On one hand, examination of student texts suggests shallow engagement with sources. The student writing in Rodrigue's study displayed little summary or other high-level moves, instead engaging sources only on a sentence or even word level. On the other hand, talk-aloud data from the same study revealed rather sophisticated reading behavior. Participants questioned what they read, engaged in summary and hinted about how they might use certain ideas in their own texts. For whatever reason, though, this "sophisticated reading invention work," as Rodrigue puts it, somehow got lost in the space between reading and writing (p. 5).

As I will discuss below, Rodrigue (2017b) provides several possible explanations for the disconnect between her participants' reading and writing practices. She then suggests potential pedagogical interventions. While not discounting Rodrigue's conclusions, extended mind, I want to suggest, helps us see the mystery at the heart of her research in a new light. An extended approach also provides alternative guidance as to how we might teach digital reading.

Earlier, I suggested that much writing scholarship, even if not cognitivist in name, still operates per conventional cognitivist principles. Internal representations of knowledge are still seen as the driving force

behind the production of texts, often to the exclusion of material factors. In Rodrigue's work we see evidence of this tendency. Citing Peter Elbow, she first suggests that study participants might have failed to capitalize on their invention work because they didn't sufficiently appreciate the value of everyday speech. Alternatively, they might have misconceived the role of audience. Both of these explanations foreground what writers know in a direct, articulatable and internalized sense. Next, Rodrigue considers whether a lack of effective strategies "to capture pre-writing ideas" is at fault (p. 15). Unlike her first two points, this explanation foregrounds material practice. That said, even here, writing skill is interpreted through an internalist lens. To help students develop effective pre-writing strategies, Rodrigue suggests, we need to teach "the relationship between reading and writing" (p. 17). In other words, we need to help students develop more elaborate internal representations, brainbound conceptual models they can draw on during the writing process.

So, in short, Rodrigue's analysis displays a conventional internalist orientation. Thus, though some of her pedagogical recommendations implicate tool use and epistemic action, such as annotation and note-taking, these material practices remain tangential. An extended mind approach, not surprisingly, inverts this dynamic. Looking through the lens of extended mind, we see the failure of the writers in Rodrigue's study to successfully incorporate outside information not as a failure to develop or deploy certain concepts, but as a failure of environmental structuring and manipulation. To help these writers, we need to teach these physical practices. This means teaching tool use.

As we've seen, extended mind emphasizes the temporally and spatially distributed, yet concrete, nature of writing processes. In doing so, it evidences the importance of environmental manipulations such as the preparation, population and arrangement of writing spaces. Rather than being tangential to writing processes, these physical practices represent powerful cognitive supplements. Reviewing Rodrigue's study through such a lens, one can't help but feel that the participants were destined to fail. They were asked to "write a researched argumentative essay," but there is no evidence of sustained pre-writing activities (2017b, p. 6). Perhaps as a result, in Rodrigue's data we see very little evidence of manipulation of the sort that would make information contained in digital texts available for cognitive processing. When reading webpages, for instance, students temporarily highlight certain words on the computer screen, but do not engage in digital annotation. Likewise, only one student is shown to take extensive notes. These notes are on paper, begging the question as to how or even if this student eventually incorporated the information into her own digitally native text.

All told, the participants in Rodrigue's study engage in reading and writing as purely internalized mind work, E.G. they attempt to consume information in a digital text, process it, then re-externalize it in altered form at a later time. Extended mind suggests that this is a very difficult, very cognitively demanding task. Indeed, my analysis of Kessler's study of graduate students (2020) suggests that this is not at all how

experienced writers operate. Seen in this way, it is not surprising that these writers were unable to successfully incorporate information from digital sources into their own work. Because of a failure to engage in the necessary environmental manipulations, the information in the target texts remained "locked," thus off-limits to the writing process.

I would like to imagine that the above analysis suggests flaws in Rodrigue's research methodology. I don't think it does, though. The evidence indicates that Rodrigue's work effectively captures her participants' writing life. That being the case, extended mind suggests a number of pedagogical interventions. They center around helping students supplement their brainbound cognitive routines via environmental structuring. In practical terms, given the digital and networked nature of contemporary writing environments, this means explicit instruction in the use of digital reading, writing and research tools, and integrally, how such tools might be made to work together.

In her own pedagogical suggestions, Rodrigue correctly notes the importance of introducing students to digital reading technology, as well as "digital text specific reading strategies" (p. 9). Extended mind builds on this advice, suggesting that to be optimally effective, strategies will likely need to involve a variety of different tools deployed in combination. As we've seen, analysis via extended mind indicates that broad integration of resources (and their generative potential) is how sophisticated literacy activity gets accomplished. We can imagine that like Kessler's Rebecca, successful writers tend to operate within complex cognitive ecologies, combining diverse resources in synergistic fashion. The ability to employ resources in combination arises from practice, for sure, but can be cultivated by helping novices learn to build and work within complex ecologies. For instance, to help students better understand and utilize web-native digital texts, they might first be shown how to install and use a browser extension which allows readers to highlight and annotate webpages.[4] They might be shown how to use Google to find sources and Wikipedia and Scimago to research those sources. They might then be asked to use these tools to create summaries of high-quality sources in a Google Doc using a research log template. Finally, they might draw on these summaries to create a final product. A pedagogy such as this would give students hands-on experience managing and manipulating key writing, reading and research technologies. It would encourage them to prepare, populate and work within a complex cognitive ecology, the sort of "extended mind" that will allow them to unlock the information contained within digital texts.

In arguing that to teach writing as extended mind is to explicitly teach tool use, I'm not suggesting that writing instruction become mere technical training. The endpoint of the activity described above is not mastery of any specific reading or writing technology. Instead, as noted, the activity simply seeks to give students the experience of working within a more complex, more distributed cognitive ecology than they would otherwise. Ultimately, of course, writers need to learn to build their own complex thinking systems. Introducing students to new tools and environmental manipulation techniques is one way to facilitate the

construction process. Instructors might also ask students to consider their current cognitive ecologies.[5] What resources are involved? How are their varied affordances integrated? How can they be integrated more effectively? More broadly, to teach writing as extended mind means to take seriously the grounded, material nature of the writing process. This means treating course readings and other documents as objects to be worked upon rather than abstractions to be memorized. It means treating each piece of student writing as a physical construction, the result of specific resource combinations in physical space. As instructors adopt this orientation, I believe that students will follow. They will reimagine their writing environments and begin to develop their own methods of integration and supplementation.

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In the above pages, I've attempted to use ideas from contemporary cognitive science to rethink the role digital and networked technologies play within writing processes. It is commonly agreed that with technological change, processes are changing. I've argued that to understand these changes, writing scholars need to study tool use at the operational or microscopic level, and that the extended mind program can help us do so. As I see it, writing as extended mind recenters cognition in our field's disciplinary vocabulary, but shifts the site of cognition from inside the head to physical space. It presents writing as a distributed, material process and urges attention to how writers combine disparate resources within personalized ecologies. Of course, the resources combined are very often digital and networked technologies. Writing as extended mind suggests we pay particular attention to how writers use these technologies to offload and distribute cognitive function. I've offered integration and supplementation and the manipulation thesis as concepts key to understanding this work. By providing insight into how technological affordances build on and supplement both each other and biological affordances, extended mind helps paint a more complete picture of how writers actually use their tools. It can thus help us better understand and teach writing in a digital and networked age.

Notes

[1] This wonderful metaphor is adapted from Kirchhoff & Kiverstein (2019).

[2] Consider, for instance, Douglas Downs and Elizabeth Wardle's writing about writing paradigm, one of the field's most influential pedagogical interventions of recent years. The core of writing about writing, Downs and Wardle (2007) state, is to teach students "realistic and useful conceptions of writing" (p. 557). Sophisticated pedagogues, Downs and Wardle are wary of "merely banking information" (p. 561), but the ultimate goal of their approach is clear: to help students develop more elaborate internal representations of writing and the writing process.

[3] The available data only pertains to Rebecca's digital manipulations. Of course, there are certainly important acts of environmental structuring occurring beyond the screen.

[4] I use Weave Highlighter, a free and simple extension for the Chrome browser.

[5] Lockridge and Van Ittersum's concept of "workflow mapping" could provide a framework to conduct such analysis.

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