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“Digital Annotation: Bringing Affect to Active Reading”

In a discussion about using digital annotation tools to teach critical reading and writing, Sharona Levy explains that current technology can only go so far in illuminating how students process what they read. She encouraged her students to comment on texts, to make their understanding more transparent and explicit. Although digital annotation tools facilitate active reading practices, Levy points out that "there is no mechanism to open [our student's] heads and see which neurons are firing while they are reading" (5). In the 10 years that Levy ran her annotation experiments, however, educational technology has developed more incisive and sophisticated methods for visualizing student performance. Just a few months ago, primary schools in China are rolling out a "smart learning" program, where teachers track student learning through headbands that report on brain activity. The headbands are programmed to sense fluctuations of brain activity across different parts of the brain in class. They report these levels, which appears to correlate to student focus during a lesson. The results are then visualized and projected for the whole class to see:

The competition plays out in the form of a simulated rocket race on a screen at the front of the classroom. The headwear measures electric signals from neurons in the brain and translates that into an attention score using an algorithm. The more focused a student is, the higher the score gets, and the higher his or her rocket flies. If the score falls—meaning the student’s attention is waning—the rocket slows. Wang et al, "China’s Efforts"

Developments of "smart learning" in China are part of a general increase in surveillance technology, such as facial recognition technology. Although these developments are more pervasive and advanced in China than in the US (at least for the time being), China's example suggests a trajectory for Educational Technology (EdTech). These tools, which track and visualize student performance, ultimately aim for mass neuronal surveillance.

In the US, EdTech tends toward tracking and quantification. Educational platforms and tools increasingly offer "personalized solutions" for educators to measure and optimize student learning. In doing so, these technologies treat students as a site for data collection and analytics. Not only does tracking students make them vulnerable to those who would profit from them economically, it also reduces them to data points and labels, such as “cheat” or “at risk," according to Audrey Watters ("Ed Tech and Trump"). Watters explains that data collection and analytics simplifies the differences among learners and the complexity of the learning process. Learning then becomes less about cultivating individual critical thinking skills and more about acclimating students to certain mechanized processes for response and information retrieval. Watters concludes that, in purporting to create “personalized” learning experience, these programs actually standardize and automate education. Like Watters, Amelia Abreu is wary of the capitalist aims that drive quantification, and she explores the role of emotion in quantification. Abreau focuses on the "Quantified Self" movement, which encourages followers to track and measure daily activities, such as exercise and work, toward "the discovery and adoption of near-perfect, near-universal metrics" ("Quantify Everthing"). Quantified Self aims for this ideal measurement of the human body and human actions in order to improve them, making them more efficient and productive. Abreu points out that the drive toward human optimization, which "has been problematized since Rousseau," leaves out emotional or affective qualities that are more challenging to quantify. How do these tools measure the struggle that students undergo in solving a problem? The feelings of confusion, doubt, interest, and elation that accompany learning? The danger here, which Abreu points out, is that these emotional qualities and labors are not easily sensed or represented by quantitative methods.

One example of this difficulty is in EdTech solutions for Digital Annotation, often used to teach "active reading" skills in English classrooms. In English instruction, Digital Annotation makes reading practices more visible in order to improve critical thinking and literary analytical skills. It allows students to highlight and comment on electronic text, which can then be viewed and responded to by other students. Most implementations of Digital Annotation aim to cultivate active reading practices that engage directly with the ideas and language of the text, which are difficult to teach except by modelling and practice, as many English instructors know. Even this elusive work of active reading is not immune to the attempts of tracking and standardization. A variety of recent digital annotation tools now extend the basic "highlight" and "comment" functionality to offer additional options for responding, such as categorizing types of annotations, as well as tracking student reactions to reading. Some of these tools, which I explore in detail below, quantify and visualize student annotations to make assessment easier for instructors. In doing so, they run the risk of reducing the emotional labors of reading to arbitrary metrics like "annotation length." How might digital annotation address affect as part of active reading processes? How can instructors short circuit attempts at tracking to address more directly the emotional and instinctual reactions that occur during reading?

My project explores how digital annotation can side-step attempts at tracking by offering alternatives to verbalized response. It seeks to activate reading as an embodied practice, connecting more directly to knowledge as feeling and affect, rather than knowledge as information that exists purely in a textual form. Toward that end, I've modified my Hypothes.is[[1]](#footnote-1) annotation tool to include a multi-color highlighter, rather than just yellow. The option for multiple colors, I hope, will recuperate the role of the body in reading in ways that resist quantification and tracking, by prompting reactions that occur prior to fully articulated thought. In prioritizing nonverbal or preverbal responses, it recasts reading as an embodied activity, encouraging students to confront their more immediate responses, feelings, and gut reactions during the reading process.

Though things are developing dramatically in the world of EdTech, Levy's claim—that you cannot open up a student's brain to see which neurons are firing during reading—still stands. Although we cannot (yet) visualize how a student processes a text, looking at what happens in the brain and body during reading reveals the role of affect in opening up how we understand learning. By "affect," I refer to the cogntive and embodied processes of perception that guide emotional reactions to text. In reading the body back into active reading, Digital Annotation becomes the site where conversations about educational technology intersect with conversations about theories of embodied cognition. Therefore, for the rest of this paper, I approach educational technology side by side with discussions on embodied cognition, searching for parallels across the technical and neurological. Exploring how emotion functions in the body enhances my critique of the pedagogical value of certain annotation tools and offers alternative methods for assessing student performance. As the example with China's "smart learning" headbands demonstrates, if we do not engage thoughtfully with the processes of embodied learning, EdTech will provide its own "solutions."

Throughout my examination of technology and embodiment, I also interweave a narrative of my work on the annotation tool that I'm developing for my English classroom. Here, I insert excerpts and images from my "development notes," a record of my progress throughout the tool's technical and theoretical development. These notes portray the confusion, contradictions, and suspensions of knoweldge that are part of working with technology. I hope that these notes will show readers who are not familiar with coding that, regardless of proficiency, all technological projects contain obstacles and challenges. By making the coding work more visible, I gesture toward the inherent opacity of digital methods and tools, indicating to the nontechnical reader some of the suspensions of knowledge that are part of immersing yourself within a technical project.

*3.1.19: Day One at the New Media Lab.*

*Today Joe and I tried following the Client development instructions on the H docs. There were a bunch of issues, mostly to do with NPM. From what I can gather, Node requires you to install it globally, rather than just locally. As a result, every time we ran the local version of NPM we encountered a bunch of errors.*

*It took us (mostly Joe) about an hour and a half attempting to install the client and browser-extension this sloooow way before we finally doubled back and started over with a non-problematic installation of node. This involved deleting the repos from Github and starting over, installing the dependencies (node) via the NVM (node version manager) rather than NPM. The instructions are below:*

A screenshot of a cell phone

Description automatically generated

The attempts by EdTech to turn human bodies into sites of data collection benefit from a general disagreement about how learning works in the brain and body. Neuroscientists have long argued about seemingly simple questions like where consciousness is located, not to mention how learning functions on a neuronal level. This uncertainty leaves a space for cognition to be co-opted into discourses about productivity and management. For example, Catherine Malabou points out the common assumption in "neuronal ideology" that brains should be made to conform and adapt to social and economic needs. Malabou finds a troubling parallel between discourses on "brain plasticity," which posit a flexible, developing brain, and capital's need for docile, networked, and adaptable workers. In resisting this understanding of "brain plasticity," she explores another valence of the word plastic that is based off the French term plastique, meaning "explosive." Rather than approach plastic as flexible, something that can be molded to fit economic needs, plastic can be an agent for annihilation and creativity. Plasticity in this sense offers a means of refusal to submit to the managerial model, to resist complicity to capitalism. Malabou insists that affect—particularly anger—is a tool for refusing expectations for docility and complicity: "Perhaps we ought to relearn how to enrage ourselves, to explode against a certain culture of docility, of amenity, of the effacement of all conflict even as we live in a state of permanent war" (79). Her exhortation to "enrage" ourselves points to a way that people can use emotion to subvert pressures to be managed or conform to standards of productivity.

Malabou's invocation to anger as a means of resisting the pressures of productivity opens up the way we understand digital annotation. How can tracking student reading can serve ends that are not exploitative, but creative, approaching students as sites of data production rather than data collection? In what follows, I examine a variety of Digital Annotation tools (alongside my own) for how they scaffold student responses to reading. Here, I'm interested in whether Digital Annotation facilitates what I call prescriptive or provocative approaches to reading. Prescriptive approaches encourage a standardized method for responding to text, where certain options pre-empt or prompt students to react in specific ways. Provocative approaches open the text up to new insights, bringing students to imagine new relations and reactions to what they read. How do certain features, such as color-coding, categories, or tags, for example, actually create a confining structure for response? Do additional options limit the kinds of responses students might have without these prompts? Specifically, I wonder how such features might engage emotional struggle and insight, rather than measurable “learning outcomes.”

*5.2.19: adder.html*

*This is the short html file for the buttons, both the "Annotate" and "Highlight" button that pop up together once you make a text selection./ /I am able to make additional buttons (which don't actually work when pressed) on the toolbar by duplicating the html within the file. It is important to note that on its own, my work in this file doesn't affect functionality. In order for the buttons to work, I have to modify some javascript files that save and pass the data from the user’s click.*

*The image shows two files on top of each other. In the background, there’s an image of my final modifications to the adder, with an additional drop down menu for colors under the “Highlight” button. In the foreground, there’s an image of the original HTML file that configured the adder.*

*![A screenshot of a cell phone

Description automatically generated]()*

The annotation tool most compelling for my purposes is “Ponder”, created by a private tech company, Parlor Labs. Like Hypothes.is, Ponder is a browser add-on tool that can be activated on any webpage. The company describes it as a “micro-response tool”, that purports to “give teachers a view into the ‘invisible’ process of learning through higher-order critical thinking” (“About”). The tool shares a basic functionality with Hypothes.is, which is highlighting text and responding through a written annotation. But it has some additional features, including options for different “reactions”, called “sentiment tags”, and options for choosing from a list of “themes," compiled and customized by the teacher. The “sentiment tags” are particularly interesting, because they allow students to color-code their responses according to the categories “clarification," "analysis" or "emotion." Carl Byth explains that goal of this "microresponse" strategy is to condense student responses into a simple expression that others can most easily engage with:

To encourage students to “read each other,” Ponder limits responses to short phrases called sentiments that fall into three categories: comments about text comprehension (e.g., “I don’t get this”), critiques of the text (e.g., “This smells like hyperbole”), and emotional responses to the text (e.g., “Tsk, I disapprove.”) Blyth 209

These pithy annotations encourage readers to categorize their responses as cognitive, analytic, or emotional, and they allow interpretations to be shared and recognized among readers. These “microresponses” function analogously to emoticons or emojis, which are more exaggerated methods of condensing feeling into a expression that’s easily shared across social media.

Despite the obvious social benefits of this tool, this prefabrication of responses could be constraining. By forcing the reader to choose between “clarification”, “analysis” or “emotion”, is the tool determining what kind of reaction someone might have? Or do these three tagging options function as an “enabling constraint”, that is, as a productive scaffolding that guides students toward thinking more deeply about their reading? Keeping these questions in mind, I now turn to another tool that functions similarly to Ponder.

This other example of digital annotation comes from a project called “Lacuna Stories," developed by the Poetic Media Lab at Stanford, where it is deployed as a Learning Management System. As such, it is used by schools as a central organizing space for a course, like Blackboard or Canvas, and provides a reading and writing interface for engaging with course materials. To make an annotation, the reader highlights a section of the text, and has the option of making a comment. Then, the reader is prompted by options for different types of responses. Like Ponder, there are pre-set categories for responding, which are also color-coded: here, the categories are “Comment”, “Question”, “Analyse”, “Connect”. According to Stanford instructors Amir Eshel and Brian Johnsrud, one of the tool’s main benefits is how it visualizes their students' solitary responses to reading in a way that directs classroom discussion about the text.

A screenshot of a social media post

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Lacuna Interface

A screenshot of a cell phone

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Lacuna Dashboard

Despite the benefits, there are drawbacks that come with increased access to student annotations. Making annotations visible necessarily prescribes certain patterns of response and textual interpretations over others. The instructors admit that Lacuna creates a trade-off between what they call "guidance and discovery," that is, "a tension that must be negotiated between the desire to allow students the space for intellectual discovery and the desire to guide their learning along a pre-specified path” (“Making Reading Visible”). In other words, annotation primes students toward more fixed interpretations of the text before they even enter into the classroom.

Another drawback is the way that Lacuna Stories tracks and visualizes student activity across the platform. Lacuna contains an “Annotation Dashboard” that is only visible to instructors so that they might access data about their students' annotations. On this dashboard, student data such as the number and length of annotations is quantified and visualized in a series of graphs and charts. Here, annotations "serve as an accountability mechanism for completing assigned reading in a timely fashion, because instructors will see students’ activity on the text and students will know that instructors can see this activity” (Schneider et al). For example, in “Filter by Time," instructors can view the raw number of annotations made on any given day of the course, getting a sense of individual participation. In “Annotation Details”, a series of pie charts indicate the relative amount of annotations by category and the length for each annotation. Finally, the “Network” section connects students to the texts they have annotated, where the links between them are weighted according to the amount of annotations each student made on each text. By directly visualizing quantitative information about student annotations, the Annotation Dashboard potentially engages in the reductive effects of certain EdTech tools that Audrey Watters warns about. How is tracking the distribution, amount, of length of annotations an effective assessment criterion?

*July 17, 2019: Label-less Icons*

*After much difficulty, I've decided to forgo the color labels on the drop down, and have the highlighter icon on its own, in the relevant color. When playing around with different sizes for the icon, its simiplicity started to appeal to me. This decision also accords with what I've said before regarding Jon Udell's script to "tag" annotations with color. My project is moving away from using verbal cues and engaging in verbal reactions. So having the color itself be the selection on the interface makes sense, because the person engages directly with that color.*

*The problem is that coloring the icons proved extremely time consuming. I wanted each icon to display the color indicated in the colors label. First, I spent a lot of time trying to find the source of the icon to change the color, ended up going on icomoon, where I still couldn't figure out how to do it. I also tried a bunch of different CSS solutions, coloring the h-icon-highlight image to red, for example. This worked, but it made all the icons red. There's no way for me to do this just to one icon. I finally ended up by using in inline CSS rule in adder.html to color the entire button. This is less elegant than I hoped, but at this point I need to move on. I'm going to leave it as is and start thinking about functionality.*

*The first iteration: a boring menu*

**A screenshot of a cell phone

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*The second iteration: a busy style*

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*The third iteration: label-less icons*

**A screenshot of a cell phone

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However, there is a way that the tool uses quantified data in order to address reading experiences that cannot be quantified. The visualization of heavily annotated areas of text in the “Network” panel allows the instructors to identify moments of collective interest within annotations, and turn them back into sites of affect. The instructors explain that, “By using Lacuna as a window into students’ reading, [we] were able to pinpoint the exact places in the text that generated the most frustration, confusion, or disagreement [among] students” (“Making Reading Visible”). Here, the threaded annotations, where students engage in debate and conversation about the text, serve as an indicator of tension in their reading, creating a "heatmap" of the text's more controversial moments. Instructors can then turn the class’s attention to exploring these moments more fully.

Identifying moments of tension or controversy is one of the goals of my multi-color highlighter. This highlighter contains a degree of opacity, which can be adjusted manually by going into the code. In making the colors almost transparent, one color can be layered over another, creating color mixtures and combinations. Low opacities of primary colors, when used among a group of readers, create a visible palimpsest of readings. Below is an image of the first chapter Virginia Woolf’s *Orlando:A Biography*, highlighted red, blue, and yellow with the modified hypothes.is highlighter.

A screenshot of a cell phone

Description automatically generated

This effect evokes conversations in neuroscience about the ways that embodied cognition works (or fails to work) within social contexts. Although much of neuroscientific work on "embodied cognition" does a good job situating thinking in the body, it tends to overlook how body specificity determines individual experience. According to Victoria Pitts-Taylor, much of this work assumes universal brain structures across all populations. In response, Pitts-Taylor explores how brains are shaped by real inequalities of race, gender, class, and sexuality, asserting that “bodily difference yields cognitive difference” (56). She gives the example of "mirror neurons," which are neurons in the brain which activate when the body engages in or witnesses action, and are thought to enable empathy. "Mirroring" whatever action they perceive, these neurons enact the same process in the brain as if the body were really performing the action. According to Pitts-Taylor, neuronal simulation can actually get in the way of understanding. Bodily difference will cause mirror neurons to make mistakes, projecting one set of assumptions onto another body. She explains that “We cannot rely on simulation, whether propositional or neural, to do the work of knowing the other and of relating to them and feeling for them in nonviolent ways” (92). My tool aims to reveal this limit of identification through the layering feature. It is my hope that alternative reactions to a particular text will render in the color mixtures, in the alchemy of dissonances, combinations, and new concoctions that layering creates.

*8.8.19: Tracing the Click*

*I spent some time trying to understand exactly what happens in the code when a user makes a text selection. But, since it's so complex, I had to break it up. I outlined the parts of the code relevant to highlighting, which Joe pointed out to me. I was able to get a better sense of how the highlighting is processed here, through specific functions and calls. Things really started to come together when I followed the code backward, starting from the end, and working my way up to the event handler in adder.js. Overview of events: The onHighlight option called in addder.js initiates a call to createHighlight which passes "true" for highlight into a larger function called createAnnotation. It's in this function that highlightRange runs with potentially three arguments, which I can configure in index.coffee. Joe suggested that I pass a CSS class into this function as a third argument, which specifies the color of the highlight. That's it!*

A screenshot of a cell phone

Description automatically generated

This tool approaches affect as a type of knowledge that extends into the body, and configures the user interface to engage bodily experience. The process of embodied cognition—how thinking happens with the body—is therefore a crucial consideration to my project. Antonio Damasio, a vocal proponent for embodied consciousness, explains that consciousness arises from emotions in the body of the organism, which are experienced as "somatic markers" such as rapid heartbeat or nausea, for example. These emotive experiences in the body float then up to an organism's awareness, whereby rapid heartbeat might be noticed as anxiety, and nausea as disgust. Damasio makes this key distinction between emotion as a bodily experience and feeling as mental awareness:

Emotions are complex, largely automated programs of actions concocted by evolution. The actions are complemented by a cognitive program that includes certain ideas and modes of cognition, but the world of emotions is largely one of actions carried out in our bodies, from facial expressions and postures to changes in viscera and internal milieu. Feelings of emotion, on the other hand, are composite perceptions of what happens in our body and mind when we are emoting. As far as the body is concerned, feelings are images of actions rather than actions themselves; the world of feelings is one of perceptions executed in brain maps. 116-117

By the time a person is aware of a feeling, it has already released an emoting cascade in the body. According to Damasio, our feelings are often vague because their stimulation often incorporates internal, largely unconscious sensations—or "primordial feelings"—as part of the emoting cascade (108). I intend for my tool to engage the vagueness of embodied feelings through the hapic experience of using the computer interface. My idea is that the user's activity of making a text selection and choosing colors will create a rhythm of response that might harness immediate and primordial feelings that occur during the reading process.

*8.30.19 it works!*

*Last week, I had a meeting with Joe and we were able to iron out the remaining issue of calling the highlight value from the button to configure the highlight color. Basically, we passed the highlight data through guest.coffee into the highlighter module, in index.coffee, where we added a script that configures the appropriate color depending on which button was clicked.*

A screenshot of a cell phone

Description automatically generated

One way to experiment with color opacity is by having color mixtures indicate emotions. Below is a “wheel of emotions” developed by Robert Plutchik, a professor of psychology, who transposes his own theory of emotions into a color wheel. In this image, the color differences indicate changes in emotional quality and saturation indicates the intensity of emotion. The more saturated colors on the inner ring represent more intense forms of the emotion, while the brighter colors on the outer rings are milder. There are eight primary emotions, which run along the second ring: these are joy, trust, fear, surprise, sadness, disgust, anger and anticipation. For example, apprehension (light green) is a mild form of fear, while rage (dark red) is an intense form of anger. Plutchik also theorized emotional dyads, which are feelings composed of two emotions. The dyad between fear and surprise is awe, and between joy and trust is love.

What if students use these colors not only to highlight text according to their feelings or gut reactions, but also to engage with other students’ highlights in the form of layering? I wonder what would happen, for example, if one student were to highlight a piece of text as orange, for “anticipation”, and another were to highlight that same piece as red, for “anger”. The resulting dyad, which would be red-orange, signifies “aggressiveness” on the chart. How does this result change the way we read the text? My sense is that confronting and attending to these feelings will open up ways that students connect to what they read.

*Michael,*

*This is as much as I have for now… I still need to:*

* *add sections that expand on Pitts-Taylor's discussion on mirror neurons to talk about "misfitting" and connection to Queer Theory / Disability studies;*
* *include some color theory (the choice of color palettes and whether or not color use should be used in pre-defined ways or more spontaneously);*
* *and, of course, include my experience using this in the classroom 🡨 most important*

*In any case, thanks for reading what I have so far!*

*Filipa*

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1. Hypothes.is operates as a browser extension and embeddable script, which means that it can be activated and used on any page that appears on a web browser. To use hypothes.is, the user must first create an account on the Hypothes.is homepage. Then, they have two options. They can either navigate to a website that already has hypothes.is embedded and activated, or they can to download a browser extension and activate it. Then, to make an annotation, users highlight the desired text and type their comment in a simple text box that appears. After saving their comment, the original text is highlighted, and all users may view the annotation on a collapsible sidebar. By selecting the “reply” button, users then can respond to the comment, which will appear below the previous annotation on the sidebar. [↑](#footnote-ref-1)