Critical literacy for a posthuman world: When people read, and become, with machines

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Abstract

Computational objects (eg, algorithms, bots, surveillance technology and data) have become increasingly present in our daily lives and are consequential for our changing relations to texts, multimodality and identity. Yet, our current theories of literacy, and especially the prevalence of mediational and representational perspectives, are inadequate to account for these changing relations. What are the implications for critical literacy education when it takes seriously computational agents that interact, produce and process texts? While such work is only beginning in education, scholars in other fields are increasingly writing about how AI and algorithmic mediation are changing the landscape of online intra-action, and business strategies and tactics for working with AI are advancing far ahead of critical literacy education. Drawing on our own and others' research into non-human actors online, and building on posthuman theories of networks, heterogeneous actants and the assemblage, in this conceptual paper, we sketch some of the forms of critical consciousness that media education might provide in this new mixed landscape.

Introduction

Everyday AI and its discontents

Our everyday lives are entwined with computers and computational systems. In particular, artificial intelligence (AI) is becoming an ever-increasing presence in routine tasks. From performing a Google search to finding directions on our phones, we rely on often-hidden processes of artificial intelligence to guide what we see, where we go and how we make decisions. As AI and its attending computational agents and processes—computers, phones, surveillance apparatuses, bots, data, algorithms—have crept into our lives, so too have they become a common topic of debate and imagination in the public sphere and in many academic disciplines.

AI is deeply embedded—in several ways—in our public discourse. For example, AI is part of the delivery platform for much of our news (eg, via Google searching and social media platforms), the

Practitioner Notes

What is already known about this topic

- AI is a hot topic in education and in public discourse, but critical literacy theories have not sufficiently accounted for how AI and computational agents change what it means to be "critically literate."
- Technology is an important force in shaping (and is also shaped by) literacy practices and identity.
- Corporate actors have an enormous influence on the texts we read and write, but this influence is often hidden.

What this paper adds

- We bridge between critical literacy studies and posthumanist theory to conceptualize critical posthuman literacy.
- We argue for re-imagining what texts, multimodality and identity are and do in the age of AI.
- We pose new questions of our texts and ourselves, informed by posthuman critical literacy.

Implications for practice and/or policy

- Today's readers and composers must be able to identify and interrogate networks of computational and human agents that permeate literacy practices.
- Beyond identifying and understanding computational agents, posthuman critical literacy necessitates that people can actively build more ethical assemblages with computational agents.

subject of daily news and even sometimes the *author* of some news stories (Seabrook, 2019). The popular press has seen an explosion of nonfiction books criticizing artificial intelligence and algorithmic processes (eg, *Algorithms of Oppression* by Safiya Noble, *Automating Inequality* by Virginia Eubanks and many others). We see AI feature in advertisements online, on our TVs and in places we traverse and work.

Beyond the sphere of popular and public media, academic researchers have also seriously taken up artificial intelligence in a range of fields. AI has long captivated variously concerned and/or enthusiastic computer scientists who herald the coming of "superintelligence" or an intelligence explosion that could prove to be humanity's undoing or, perhaps, savior (eg, see Bostrom, 2014). Aside from the obvious computer science connections, scholars in medicine, political science, sociology, media studies, environmental science, geography and other disciplines have engaged critically with the role that AI plays in our lives and in their disciplinary practices. They discuss issues in automation, autonomous vehicles, election interference, social media polarization, proliferation of surveillance technology and algorithmic bias, among others (eg, Eubanks, 2017; Fry, 2018; Noble, 2018; Zuboff, 2019). Consider, for example, the proliferation of "fake news" online. AIs and algorithmic processes can be involved in the production, proliferation and also detection of these types of stories (eg, see Fitch, 2019). Moreover, scholars and activists alike are also sounding the alarm about the concentration of power and capital in the hands of a few companies who use systems of data collection, analysis and presentation—via AI and big data—to manipulate behavior. For example, although they come from disciplinary traditions (economics, law and marketing, respectively), Zuboff's (2019) "surveillance capitalism," Yeung's

(2017) "hypernudge," and Wu's (2016) "attention merchants" all describe a similar phenomenon of systematic harvesting, use and manipulation of users' data and behavior by corporations. Other scholars have written extensively about the role of bots in spreading election propaganda, inflammatory posts and fake news on social media, a topic of interest particularly salient in light of recent elections scandals (eg, Shao *et al.*, 2018; Woolley, 2016). These automated, often-AI-driven agents—along with feed algorithms—can have a dramatic effect on the spread of online content.

Education scholars have also begun to address the benefits and complications of AI, particularly in the realm of learning analytics tools. Two recent special issues, one in this journal (eg, see Buckingham Shum & Luckin, 2019) and another in *Learning, Media and Technology* (eg, see Dixon-Román, Nichols, & Nyame-Mensah, 2019), put the spotlight on AI and education. Despite these recent, much-needed efforts, there remains a gap between the realities of AIs and our current educational curricula, practices and theories. In this paper, we especially focus on literacy education, re-considering how the field of literacy education might change in taking up a critical yet engaged stance toward AI.

Theory
AI and literacy
Within literacy studies, scholars have made notable contributions to the discussion of AI and more so recently. Writing with AI tools, for instance, has been a relatively popular line of study. As far back as 2007, we can find educators in major academic literacy publications talking—albeit uncritically—about the role of assistive writing AIs (Sternberg, Kaplan, & Bork, 2007). Taking a more critical approach, Dixon-Román *et al.* (2019) view algorithms as "racializing assemblages" in their study of an AI writing tool, Essay Helper (p. 1). The authors argue that Essay Helper reinscribes sociopolitical narratives of difference, through its algorithmic construction, its reliance on certain training data and the use of particular standards and rubrics. Beyond the classroom, AIs have penetrated professional writing spaces, including and far beyond Google's Smart Compose, which prompts Gmail users with predictive text (Wu, 2018). In a recent article in *The New Yorker*, eg, author John Seabrook (2019) wonders about the future of predictive text AIs and tests out a highly sophisticated program to see if its text is up to *New Yorker* snuff (it was not, yet).

Looking beyond composing text, two notable studies examine the relationship of literacy and algorithms (Jones, 2019) and big data (Carrington, 2018). Jones (2019) describes university students' experiences of reading and writing with algorithms and how they understood them as agent, authority, adversary, conversational resource, audience and oracle. Jones describes how integral algorithms are to modern texts and to constructing readers: "What we read and how we read, and, more importantly, how we are conditioned to imagine ourselves as readers, is increasing determined by algorithms that operate underneath of the surface of texts" (p. 3). In Jones's view, students needn't understand how algorithm work technically, but rather "reflect upon their own inferential processes when they interact with algorithms" (p. 4).

Carrington (2018) uses the case of a young British woman named Sophie to outline new ways to think about critical digital/data literacy in the age of big data and AI. Carrington cautions us about "algorithmic identity" and how algorithmic data categorization inhibits our ability to produce and share our own narratives about ourselves, perhaps leaving a gap between how an algorithm identifies us and how we want to think about ourselves. She draws attention to the ways that the production of data, which is then bought and sold by corporations, is not treated as labor that merits compensation for the producer. Ultimately, Carrington concludes that Sophie is "not able to read the narratives or codes that structure her identity or experience" and she does

not understand who is working behind the scenes in constructing her identity, and why (2018, p. 73). For Carrington, being able to identify when, how and by whom our identity data is collected and used in order to effect change and avoid exploitation are crucial components of critical data literacy.

Moving beyond: AI, literacy and the posthuman

To think about the relations of AI to education, and in particular to literacy and media education, the field needs not only more rigorous engagement with changing technologies, but also new ways of conceiving of digital literacies than are found in representational paradigms. Approaches inspired by posthumanisms and new materialisms permit one way of moving beyond worn models of "text" and "reader," opening up possibilities to think about different heterogeneous elements in these systems, as well as their "intra-actions" (Barad, 2007). Following, we sketch ideas from two strands of new materialism that provide us ways of thinking about mixed ontologies. First, we consider actor–network theory (ANT), and next trace a relationship to Deleuze's rhizome and the assemblage.

Bruno Latour (1999), likely the most widely known thinker behind ANT, wrote that he believed that the most "useful contribution of ANT" has been "to have transformed the social from what was a surface, a territory, a province of reality, into a circulation" (p. 17). In Latour's (1988) work and ANT more broadly, objects of all sorts—actants—are brought into circulation, including people but also (in his analysis of Einstein's work) trains, clouds, men with rigid rods, lifts, marble tables, mollusks, clocks and rulers. In ANT, the work of the material, technical world of the network is brought to the fore and given its due—the image of the world becomes one in which technologies are active agents, recruiting and enrolling humans (Latour, 1996). Latour insists that we do not make a priori distinctions between humans and nonhumans (Callon, 1986; Pardoe, 2000). Rather than purifying categories, Latour (1993) called for a "new anthropological matrix" in which notions such as "subject" and "agency" are replaced by "variable geometry entities" (p. 11). If one starts from the position that subjectivity and agency are not merely given in advance, but are relational achievements involving people and things, then a key problem involves understanding the chains and translations between human (H) and nonhuman (NH) actors: "No-one has ever seen a social relation by itself ... nor a technical relation ... Instead we are always faced with chains which look like this H–NH–H–NH–H–NH" (Latour, 1991, as cited in Michael, 2000, p. 22).

In his consideration of mixed ontologies, and disruptions of everyday distinctions, Latour also separates agency from intention. While objects might not "cause" or "determine" what will happen, their roles in circulations are significant: "things might authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, and so on" (p. 72). Law (1992) also adds that "... social agents are never located in bodies and bodies alone, but rather that an actor is a patterned network of heterogeneous relations, or an effect produced by such a network," and that human "agentic" practices (like writing) are never accomplished by some essentialized individual person/body, but are "generated in networks that pass through and ramify both within and beyond the body" (p. 384).

Bringing ANT to human–computational systems, Tufekci (2015) describes "computational agency," considering algorithms as agentic actants, and takes a critical look at "algorithmic harms" in social media gatekeeping algorithms (p. 207). This reminds us of Law's (1992) dictum that every actor is also a network, and how rich this case is for AI-driven actors, such as algorithms. Presently, while we focus on the circulations within which algorithms, and other forms of AI, are located—everyday activities such as shopping, creating social profiles, voting

and reading—we recognize that the forms of AI within these activities are themselves networked relations, or forms of circulation. These seeming "entities" are H–NH–H–HH chains themselves, with forms of circulation reaching out to programmers, locations on hard drives, optical recognition devices, salespeople and WiFi networks.

Deleuzian frames of thought for conceiving of heterogeneous circulations, through the lens of the rhizome, are a means of conceiving of circulations that complements ANT. Deleuze and Guattari (1987) describe rhizomes as taking "…diverse forms, from ramified surface extension in all directions to concretion into bulbs and tubers. When rats swarm over each other" (p. 7). The rhizome is a "when," is multiple bodies in unpredictable movement, forming assemblages—relations and flows with other objects, ideas, elements, materials. Assemblages are dynamic, assembling and reassembling and reassembling again.

The process of assemblage-making (*agencement*), then, guides our imagination and thinking. In these types of relations, *heterogeneous* things (bodies, signs, concepts) are brought together in the temporary coming together of an assemblage. Deleuze and Guattari (1987) also describe how "semiotic chains of every nature" are formed by connections among things of different phenomenological status (p. 7). The gap between the discursive and the nondiscursive is bridged by force, which Deleuze describes as a productive movement toward the formation of new multiplicities (Massumi, 2002). In this sense, the assemblage of what AI is, and is coming to be, is in part shaped by our discourse about it. Hence, the work around critical engagement with AI gives shape and meaning to what AI becomes. In the following sections, we apply this theoretical framework to rethink what we mean when we think and teach about texts, multimodality and identity in the age of AI, and what, then, criticality must look like in response.

Cases: Texts, multimodality and identity

Media educators have developed robust ways of critically analyzing and understanding the multimodal qualities of texts (eg, Jewitt, 2009; Kress, 2009; Manovich, 2001), for understanding the expansion and pluralization of literacy (eg, Cope & Kalantzis, 2000) and for documenting new networks and practices of "New Literacies" (Lankshear & Knobel, 2003). However, media are becoming entangled, in circulations with machines, in ways that call for onto-epistemological reach that is not entirely available in the theories and concepts that have served us thus far. While there are a number of ways in which we could explore these changing conditions, we focus in the following on three different broad "entry points" of change. We express these as movements ("from … to") not because we believe that earlier forms of analysis have lost their value, but as an indication of how our reach needs to expand:

- From texts as shared representations to texts as individualized, as active and as dynamically accessible.
- From the interpretation of multimodality, such as images, to tracing the histories, activations and operations of data.
- From identities forged through mass media to mass individualization through tailored affective intensities.

Case 1: Reimagining texts
Texts today do not merely describe the world; they shape it and respond to it. Computation has fundamentally extended the range of what a text can be, from a set of dusty textbooks (still important texts) to a Facebook feed or a chat with a customer service (or even a therapist or a priest) bot. What makes them different? First, we can no longer assume that we are reading a shared text, as many texts are individualized and mutable (also see Carrington, 2018). Think about a class set

Eliza, the Rogerian Therapist

ELIZA is a computer program that emulates a Rogerian psychotherapist. Just type your questions and concerns and hit return. Eliza will answer you.
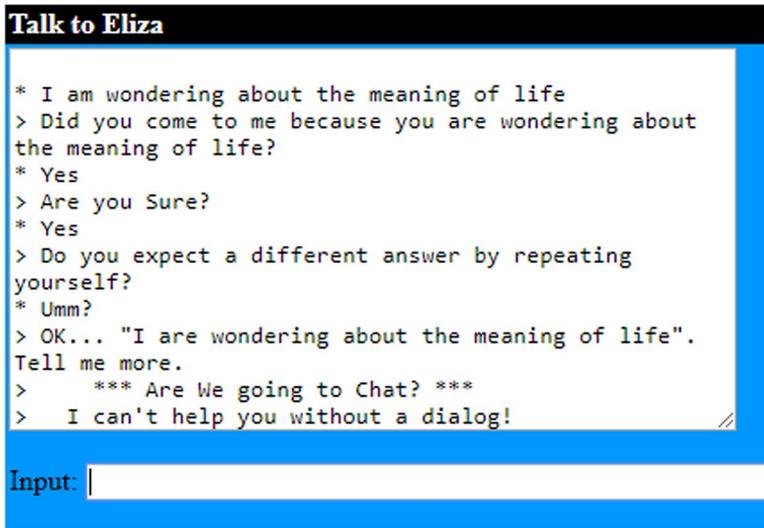
Talk to Eliza

```
* I am wondering about the meaning of life
> Did you come to me because you are wondering about
the meaning of life?
* Yes
> Are you Sure?
* Yes
> Do you expect a different answer by repeating
yourself?
* Umm?
> OK... "I are wondering about the meaning of life".
Tell me more.
>     *** Are We going to Chat? ***
>   I can't help you without a dialog!
```

Input: |

When the original ELIZA first appeared in the 60's, some people actually mistook her for human. The illusion of intelligence works best, however, if you limit your conversation to talking about yourself and your life.

This javascript version of ELIZA was originally written by Michal Wallace and significantly enhanced by George Dunlop.

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webmaster: sabren@manifestation.com

Figure 1: Sample chat between ELIZA, the Rogerian therapist chatbot and one of the authors (Wallace & Dunlop, 1999)

of *To Kill a Mockingbird*, say; each book, with few exceptions (marginalia and perhaps formatting differences), will contain the same words and images for each student to read. In class discussions, the teacher can assume that the class is starting with the same set of words and images (interpretations are, of course, another matter). Compare this to a Google search or a TikTok feed, where each student might see different words and images, selected by algorithms, depending on where and who they—and/or their friends—are. Google search results are concocted by a system of algorithms that take into account the meaning of your search along with information about you, your search history and your location (Google, n.d.). According to Google's Search explainer page, "if you're in Chicago and you search 'football', Google will most likely show you results about American football and the Chicago Bears first. Whereas if you search 'football' in London,

Google will rank results about soccer and the Premier League higher" (Google, n.d.). Even when the human input is the same, the algorithms gather and use other information to determine what a person will see in their results. TikTok, an app for creating and posting short videos, uses AI to present users with an individualized feed of videos in a way that goes far beyond simply recommending content based on a user's "likes" of other content (Fannin, 2019). Tolentino (2019) of *The New Yorker* describes TikTok's model of offering up content to users like this:

TikTok is a social network that has nothing to do with one's social network. It doesn't ask you to tell it who you know … Although TikTok's algorithm likely relies in part, as other systems do, on user history and video-engagement patterns, the app seems remarkably attuned to a person's unarticulated interests. Some social algorithms are like bossy waiters: they solicit your preferences and then recommend a menu. TikTok orders you dinner by watching you look at food. (n.p.)

TikTok relies on even less visible cues than other social media services like Facebook, and to great effect in terms of user engagement. Yet in this manner, there is a high degree of opaque corporate control in determining what each individual user sees, and when.

Next, texts are increasingly social. Annotation is not new, but it is changing in scale and speed of sharing. Social annotation websites like NowComment, Hypothesis and others provide educators with a way for classes to comment on, highlight and share documents (Farber, 2019). Kalir and Garcia (n.d.) also note how new human–machine annotation systems, where machines use deep learning to annotate protein sequences for humans to use and validate, are a promising tool in science.

Finally, and critically, texts are mediated by corporate interests on a different scale than was previously possible. No text has ever been neutral, to be sure, but the things we read and write are ever more mediated by tools and agents that are produced and maintained by corporations. As an example of this new type of text assemblage, we can look at chatbots and humans creating texts together. Many companies use chatbots to communicate with customers and transfer them to humans if needed (with varying success). Although chatbots have been around for decades, improvements in natural language processing, among other factors, have made them more appealing to companies to use for interacting with humans. From ELIZA, the therapist chatbot with a history stretching back to the 1960s (see Figure 1) to insomnobot-3000, the companionable chatbot for insomnia sufferers created by the mattress company, Casper (2019), we have seen a great deal of change in the capabilities and applications of chatbots.

With these examples, we assume that most users know they are chatting with a bot, as the bots are clearly labeled and/or the users seek them out as bot conversational partners. You don't have to go far, however, to touch the blurry line between human and bot conversational partner/text producer. The world of online dating is one example of where you might encounter this phenomenon. Some enterprising users have built bots to automate their initial contacts with people on dating sites (unbeknownst to the person—we assume they're a person, unless they, too, have developed and employed their own bot—on the other end of the app) (Shutler, 2017).

Case 2: Multimodality
Mid-summer in 2019, the FaceApp went viral in the US, prompting an explosion of photos sent and posted on social media that suggested what people might look like when they become older, using AI to "age" the photos. Critical reactions to FaceApp in social media and news media were interesting for how they broadcast the level of anxiety around some forms of social media, but perhaps still more interesting for how this anxiety fails to prompt deeper and more important questions. For example, much of the anxiety around FaceApp had to do with the origin of its

development in Russia (by Wireless Lab), which of course makes sense given the controversies of Russia meddling in the 2016 US presidential election. However, bigger questions, including privacy issues—how fairly routine apps access our data, what they have access to and who else they share it with—were little discussed compared to the Russian origin story (Fowler, 2019). Moreover, the question of what it means to live in a world where machines are continuously altering, creating and "reading" images was little in the news.

Through artistic experiments, exhibits and writing, artist and scholar Trevor Paglen has been investigating the changing relations between humans and images. In one piece of art, eg, Paglen presents a series of portraits of people used to help train the US military's Facial Recognition Technology (FERET) program. These photos were part of a dataset collected between 1993 and 1996 of thousands of military employees who were photographed. By simply presenting a series of photos, AI-training images that Paglen describes as the "Adam and Eves" of computer vision, Paglen reminds us that *particular* human images were used to train AI facial recognition, and that these AIs did not merely absorb the images—they created data out of them.

From Paglen, at least two very significant implications come out of thinking historically about the development of this dataset (as well as others). First, these early training sets, serving as the basis for facial recognition programs developed later, reveal the positions of their trainers—the actual racial, geographic, socio-economic, gendered, aged, (and so on) positions of their trainers. They are not a neutral, but a particular sample, with a history that implicates a particular socio-cultural relationship of AI to trainers (persons) and to training developers. Due to the tendency to see technologies as value free, it's easy to overlook this significant cultural–historical point.

Second, the "recognition" of images by AI is not human reading or interpretation, but is a form of data analysis. As Paglen (2018) notes, "the machine's recognition, after a paradigmatic algorithm has been created, no longer depends on the context, angle, or posture that the subject will be photographed in, in the future" (p. 15). For literacy and media scholarship, this point deserves some focal reflection: AI image "recognition" strips context by its nature—the face (or other image) becomes like a thumbprint. The meanings taken by the machine, to create its archetype, depend on abstraction. For theories of media and literacy studies inspired by contextualized, ideological interpretation of texts (eg, Street, 1984), nonhuman interpretations inspired by AI create a massive revival of the decontextualized moment—restoring faith that a text means what it means, across contexts.

AI image recognition has become so ubiquitous that we neither see it operating nor consider how it functions as a special machine form of "vision," alongside but unlike human vision. Adam Geitgey developed a series of extensions for different web browsers that made visible the computer vision tags that Facebook has added to images, since 2016, using a Deep ConvNet built by Facebook's FAIR team (https://github.com/ageitgey/show-facebook-computer-vision-tags). The vision tags produced through the AI label whether people are smiling in a picture, how many are sitting or standing, whether the picture is indoors or outdoors, and specific items identified (eg, "child," "ocean," "shoes"). The algorithms thus "tell" us what we are doing in our own photographs—they enter into the interpretive relations we have with our own photographs, mining and transforming our photographs into information for use by Facebook, Apple, Amazon, etc. and their possible clients in advertising, politics and other forms of social life. While the fields of new literacies have complicated the processes of textual interpretation in various and significant ways, the reality that many texts are not interpreted by humans at all has been little apprehended. Paglen (2018) argues that human interpretation is less frequent than machine reading: "Human visual culture has become a special case of vision, an exception to the rule. The overwhelming majority of images are now made by machines for other machines, with humans rarely in the

loop" (p. 89). If images and other forms of media are being processed by machines, then what are the implications for critical theories of media, and for resistance in our everyday lives?

AI image production has a shorter history than AI image recognition. Generative adversarial networks (GANs), eg, were introduced for the first time in 2014, with a goal to create artificial images that are indistinguishable from authentic images (Horev, 2018). For example, a GAN can generate artificial face images by learning from a database of other faces, such as a database of celebrity faces. "Thispersondoesnotexist.com," for instance, presents such faces (and cats!) that are "dreamt" by AI—quite realistic appearing images of persons (or cats) that do not exist in reality. GANs are comprised of two neural networks—"a generator that synthesizes new samples from scratch, and a discriminator that takes samples from both the training data and the generator's output and predicts if they are 'real' or 'fake'" (Horev, 2018, n.p.). These networks communicate with one another over cycles, through which the generator (with input from the discriminator) "learns" to synthesize more and more realistic images. Within this system, the discriminator also improves over time, comparing generated samples with real samples (Horev, 2018). Paglen (2018) uses the basic principles of the GAN, to push the conversation of AI-produced images beyond the mimetic function. Rather than creating believable versions of the real, Paglen trained two AIs—one on "irrational things" like monsters and the other on Freudian dream symbols—to work together in an adversarial network to create "Adversarially Evolved Hallucinations" (eg, https://www.metropictures.com/exhibitions/trevor-paglen4/selected-works?view=slider#9). In the midst of this production by nonhumans, informed by humans, is the GAN—two AIs as interlocutors—cycling back and forth, measuring and changing.

Case 3: Identity
The uses of AI, and developing a critical literacy engaged with AI, offers newly complicated opportunities to reconsider the relations of literacy (and media) to identity. Goldhaber (1997), among others, expanded the idea of the "attention economy" in relation to business, which was later picked up by media and literacy theorists (eg, Lankshear & Knobel, 2003). The basic idea of the attention economy was that we have experienced a sociocultural shift where there is a vast surplus of information, such that getting individuals' "eyeballs" on one advertisement or another, and keeping them there, is an intensified struggle. Perhaps the idea of the attention economy was a precursor to mass individualization—a type of advertising shift deemed necessary within markets where attention is the most prized resource. Through AI, this problem of attention is transformed into a data problem. What's new is that capital (eg, attention) is not generalized, with different players trying to assert their rights over social blocks or property. Rather, through data collection and analysis at the individual level, capital is specified to that level. In sum, what we are left with is "mass specificity" (Paglen, 2018, p. 27). AIs function in this relation to specify and reach each individual, where the individual is understood as a "metadata signature" (Paglen, 2018, p. 32) as well as to specify the media through which to reach each one.

How are identities being constituted by machines, at the individual level? A simple example of mass individualization can be found in Google Ad Settings (https://adsettings.google.com). In the case of the first author's identity, for instance, Figure 2 indicates some of the categories that this identity is placed in. Google tells us that identifiers such as "age" ("55–64 years old") and gender ("male") are based data entered into a Google account by (author), identifiers such as "Tile" are based on visits to the websites of those companies, and for identifiers such as "Brazil," "Google estimates this interest, based on signed-in activity.

The importance of these identifiers lies in their routine collection (most often beyond our awareness), in their constant revision and in their relatively surface level equation of identity = action.

🎂 55-64 years old	👤 Male
T Tile	M MacPaw
T The New Yorker	C Credit Karma
✈️ Air Travel	🏈 American Football
🎬 Animated Films	👕 Apparel
🎚️ Audio Equipment	🚗 Autos & Vehicles
🎫 Bars, Clubs & Nightlife	🏀 Basketball
☀️ Beaches & Islands	🎵 Blues
🚢 Boating	📕 Books & Literature
🌐 Brazil	🍔 Burgers

Figure 2: The first author's Google Ad Settings categories

In other words, AIs construct identities on the terms of basic actions (eg, visiting a website) and basic information to create individual types that are somewhat in the image of AIs themselves—relatively simple actors with rules and patterns. How these relatively simple AI constructions of identity influence more powerful behaviors is an open and critically important question. This question also asks us to place a machine-driven identity signature alongside other forms of identity construction through new media.

Beyond such labeling orientations, AI moves deeper into forms of individualization that capitalize on the dynamics of human lives in real time. To understand these types of AI functions better, we have been interviewing professionals who use forms of AI extensively in their work, including "Chris," a 28-year-old "programmatic trader" for a major corporation. (Programmatic trading involves using AI to sell and trade advertisements and advertisement space online.) Two practices in particular that Chris described in his work are indicative of the dynamisms of AI relative to practices in space time. The first of these, geofencing, involves analyzing data across online spaces and brick and mortar locations: "Certain platforms that we use can let us do what's called geofencing. We can upload the list of our store addresses, and we can target our ads to within a certain proximity of those stores" (Chris, personal communication, July 12, 2018). The tracking of customers and collection of their data across online and offline pathways is becoming fairly routine and involves companies such as Euclid Analytics that track WiFi signals that mobile phones leave behind, analyzing these tracks to understand customer practices at the level of the individual as well as the group.

Chris described the "purchase funnel" in relation to marketing and AI:

So, usually if you just look at the product, we will treat you differently than if you add that product to your cart, and just let it sit there for a while ... So if you're sort of lower in the funnel—like you're just a click away—usually we are a lot more aggressive. (Chris, personal communication, July 12, 2018)

The notion of the purchase funnel makes evident how AI serves to collect dynamic data and use it to nudge people to act in specific ways, and in specific moments. In these ways, our senses of ourselves and our associated senses of our individual agency are intertwined with machine selves and agencies.

What is a personality made out of? And, of all the dimensions of a personality, which are more significant in prompting a person to act—even impulsively? Psychographics is the new wave of identity-related AI development that addresses such questions. It is a form of AI use that is very broad in consumer marketing, but that became most famous perhaps through the Cambridge Analytica scandal involving elections in the US, the UK, Kenya and elsewhere. A psychographic profile contains information around not just an individual's actions or choices, but also a person's presumed values, attitudes and emotional triggers. The promised shift in psychographics is to understand not just *what* individuals do, but *why*. For example, Cambridge Analytica created the "OCEAN Model" of personality, placing people in a particular market segment according to the presence or absence of five personality traits: openness, conscientiousness, extraversion, agreeableness and neuroticism. Some researchers have traced the relations between product marketing and the shaping of political influence and ideology through AIs related to psychographics, such as Nyabola's (2018) analysis of the 2013 elections in Kenya. Through an analysis of specifics about voters, including levels of trust, Kenya was the testing ground for some of the psychographic marketing used later in the Brexit and Trump campaigns (Nyabola, 2018). While it seems that mass individualization through psychographics does not diminish the significance of social groups understood in other terms (eg, demographics, geographics), at the same time the picture of understanding how identities are being produced through AIs, at what scale, and toward what ends, are pressing concerns for marking, politics, social science research and education.

Implications for critical literacy education: New questions and modes of critical consciousness for literacy education

Luke (2012) made the argument for an ever-changing and responsive definition of what "critical literacy" means, while others have made the argument that our definitions of "literacy" and "technology" must continue to have emic relations to one another (Leu, Kinzer, Coiro, & Cammack, 2004). Yet, it is doubtful that these scholars could have conceived, even fairly recently, how much the entanglements, actions and circulations of various literacies engaged with machines would change. Critical literacy frameworks, which are saturated with a mediational and representational perspective, where literacy and texts are often understood as operating "between" readers and writers and some social action, are called up short in addressing these new relations. Rapid developments in AI call into question the limits of mediational and representational epistemologies and ontologies.

New materialist and posthumanist thought help us to think beyond mediation and representation for developing a critical literacy of AI. We have offered different illustrations where various forms of AI appear to be doing work that has previously been understood as human work: reading, creating images, reproducing texts, making art, gathering data, entering into relationship, making identity assumptions, nudging at just the right moment. Our data illustrations, along with our readings of Latour (1993, 1996, 2005) and Deleuze and Guattari (1987), serve to complicate the humanistic subject–object formulation that so powerfully shapes our views of literacy. Many of the chains of action in contemporary circulations begin with nonhumans (eg,

NH–H–H–NH), while others begin with humans. While Latour has been calling for a sociology that gives things their due for decades, literacy scholarship can no longer pretend that texts and practices of literacy float free from machines, and especially AI and its computational agents. Humans are not alone, and they are not necessarily "first" in some imaginary line of actants. Rather, across messy circulations, the prepositions that describe the heterogeneous relations and flows of actants (Latour, 1993) are much more complex than those of mediation (eg, "between"). Understanding the circulations of human bodies and AI—along with other actants in circulation (eg, discourse, materials, tools) will call on an expanded prepositional vocabulary for such mixed ontologies—AI is not merely "between" us and other humans, or texts, it is "inside," "with," "alongside," "above," "toward," "against" and "among" us.

Deleuze and Guattari (1987) think the rhizome—bring into being the rhizome as a metaphor and more-than-metaphor for conceiving of relations between heterogeneous objects that are dynamic, that are ever changing, and that begin with process and energy rather than with specific identities embued with agency. Deleuze and Guattari (1987) relational thinking about the formation of assemblages, comprised of all manner of material bodies, conceptual bodies, and signs, is presently not so far ahead of its time in our increasingly mixed ontology of humans and nonhumans. Conceiving of AI as an assemblage means, among other things, seeing it as a coming together of discourse-text-data-money-operation. New literacy practices and texts are situated within and among these dynamic relations. The text is not alone, and is not merely "situated" in some context-as-container (Leander, Phillips, & Taylor, 2010). Every new circulation— every new *agencement*—produces some new dynamic "assembling" of relations, and through these relations some kind of life/energy emerges for a while. Something happens in the relations, and we describe this "agency" post hoc, reflecting on the relations—on what they are and could be. New literacy practices and texts are then also situated in relation to the assemblage, never torn from it, but in critically thinking and writing about it, contributing, discursively, to its own becoming. More directly, AI "becomes" through our critical literacy practices within it, and through our critical literacy practices about it.

How might we move to extend the idea of "critical literacy" in an age of increasing developments of AI? What would this form of digital literacy education look like? Following, we rethink some questions of critical literacy education and extend them to address our current (posthuman) conditions. Over the past 30 or so years, literacy education has been through a great deal of change; the proliferation of artificial intelligence requires yet a new wave. Through this transformation, humanist perspectives on texts, images and identities need to enter into a new circulation with posthumanist perspectives in order to remain relevant for current techno-social relations.

First, with respect to an expansive re-imagining of texts, posthuman critical literacy advocates for a shift in understanding our (human) role in text production and consumption as imbricated in an assemblage of human and nonhuman actors. In classrooms and outside them (eg, in daily scrolling) we might expand from asking these types of questions:

- Who wrote the text and what was their motivation?
- How do power and privilege operate in the text?

Toward posing new questions about texts:

- Where can you identify the influence of computational agents in the composition and/or distribution of the text?
- Who built the computational agent(s), why and how do they operate?
- How do/can we intra-act with computational agents to create texts?

With respect to reimagining multimodality in digital literacy education, machine vision and machine image generation shift how we think of reading and producing multimodal texts. Far from being a niche concern, computational "vision" currently touches more images than our human analog. This reorientation necessitates asking additional and different questions of images and how humans and machines interpret them. We might expand from asking these types of more typical questions:

• What qualities of the image convey meaning, and what are multiple meanings or counterreadings?
• What does the image show and hide, and how is it framed?

Toward posing new questions about multimodality:

• What does it mean to have images that are continuously "read" without context coming into play?
• How does machine vision, machine text generation and machine text distribution create political influence?

Finally, AIs are changing identity practices and their relations to literacy through (often hidden) data-driven processes of categorization, metadata tagging and sorting, frequently for commercial or political purposes. Given these new circumstances, where entities such as corporations and government agencies use AI for mass individualization, we must ask different questions about how individual and group identities are constituted among these circulations. We might expand from asking these types of questions about identity and literacy:

• How do individuals or groups perform their identities via literacy practices?
• How does popular culture in online networks allow for identity play?

Toward asking new questions about identity:

• How can we come to understand the data "signatures" and psychographic categories that are being produced as surrogates of our identities?
• What are the implications of collective resistance in a time of mass individualization?

We have argued that AI is an increasingly important part of everyday literacy practices, including reading and producing texts, images and multimodal compositions, and in the negotiation of identity. Humanistic conceptions of "critical literacy" set the stage for rethinking what this term means in our posthuman world, and we hope that this is but an initial imagining for a way forward in becoming with computational agents. And, of course, as we read, write, see and become with machines in our everyday literacy practices, we must keep pace with the deixis of technology; as meanings and capabilities of computational agents shift, so too must our ideas about what it means to be "critically literate."

Still, criticality must not stop at analysis; it must extend to action. Our vision of posthuman critical literacy has in its sights not just a world where we can point out how computational agents shape us and we them (and even challenge this dichotomy of human/computational agent), but rather a world where human agents can leverage computational machines and processes to become more ethical assemblages with them. Posthuman social justice—where flora and fauna are included as worthy of ethical treatment, as part of our society, and machines and nonhuman materialities are expected to play a crucial role—is the end-game here. Through an expanded understanding of and practice of education, we imagine a posthuman critical literacy that moves us beyond critique and toward transformation—toward a more socially just and ethical world.

Statements on open data, ethics and conflict of interest

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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