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Pioneering Alternative Forms of Collaboration

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PIONEERING ALTERNATIVE FORMS OF COLLABORATION

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INTRODUCTION (PART ONE):

The *NMC Horizon Report: 2015 Higher Education Edition* suggests that one of the long term trends in higher education is increased cross-institutional collaboration (Johnson, Adams Becker, Estrada, & Freeman, 2015, p.10). In this paper we describe an alternative strategy for engaging in collaborative writing, one that opens doors for true international cooperative inquiry.

The purpose of this paper is to describe how an institutionally, culturally, and geographically diverse group of people, many of whom have met and worked together only online, are able to come together to create conference presentations and write academic papers collaboratively through what we refer to as *swarm writing*. We focus this study on our primary authoring tool, Google Docs, and the processes that made possible, enabled, and shaped our collaborations.

A STORY BY GOOGLE DOCS:

[2015/04/01 00:15 GMT] I was born, created, really, for a Google Doc isn't technically **born** after all, after Maha in Egypt and Keith in the US had a conversation on Twitter. They decided they wanted to write a paper for a conference and wanted to allow others the opportunity to join in the collaboration.

[2015/04/01 00:15 GMT] Maha created me using her Android phone, and I emerged on a Google server farm in the cloud. I soon replicated to other server farms as my Google DNA made synchronized copies for security and ease of use. Unlike my colleagues Maha and Keith, who are rather localized at UTC (Coordinated Universal Time) +2 and UTC -5, I am distributed. For me, it is always just now. Maha originally set my permissions so that "anyone with a link can edit," but it didn't take long for Maha to realize that if collaborators didn't log in, then I had no way of knowing who was leaving the comments. She changed my permissions, and the team of collaborators was closed, comprising Maha (UTC +2), Keith (UTC -5), Ron (UTC 0), Rebecca (UTC -8), Jeffrey (UTC -5), Len (UTC -4), Sarah (UTC 0), and AK (UTC -5).

[2015/04/02 21:15 EET] Maha writes a bit before she sleeps. [2015/04/02 13:15 PST] Then Sarah jumps in and edits me. She leaves a comment, so I notify Maha. [2015/04/03 04:20 EET] Maha gets my message on her phone, and rather than looking at me directly, she replies to the email, missing the comments and edits provided by Keith and Rebecca.

[2015/04/03 07:55 EST] AK accesses me and adds some text, moves stuff around, and jots down some ideas. He seems to have a train of thought that he wants me to keep but doesn't have the time to write it all out. When accessing on mobile devices, features that are meant to be convenient, such as autocorrect, become impediments to clarity of ideas. AK prefers a physical keyboard, so he waits to get to the office to continue. I am happy to wait. After all, I have millions of documents with which to work.

[2015/04/03 15:05 GYT] Len and Jeffrey then jump into the fray. They access me and make comments throughout my entire text.

[2015/04/03 22:20 EET] Later that day -- it's a never ending day because Google Docs don't sleep -- Rebecca and Maha are editing at the same time. They decide to use my chat feature to coordinate what they are doing.

[2015/04/04 10:03 CET] When Ron accesses me, he decides to use the "suggest" feature rather than editing the document directly. This lets everyone else know that his comments are suggestions that can be either accepted or rejected by someone else.

[2015/04/01 14:15 WET] When Keith gets up, he uses his tablet to access me. Since he is on a tablet, using the browser not the app, all the comments are listed at the bottom of the screen rather than the side. This layout allows him to read through the entire document without being distracted by the comments.

[2015/04/04 23:45 GMT] At the end of their day (which is really neither day nor night to me), Keith, Rebecca, and Len all access me at the same time. They are each working on different sections of the text. I wonder if they know this at the time? Occasionally one of them types something into my chat window which appears almost instantly in the windows of the other two. The space inside me is quick and fluid, working at the speed of light. Humans type so slowly. I have billions of decision cycles between every ponderous keystroke, but fortunately, I have millions of other documents to occupy my time. At the scales I measure time, I need millions of things to do.

Time passes -- human users have a tendency to ignore me now and then.

[2015/04/15 15:15 EST] AK and Maha access me and discover that their text is missing some citations. They enable my research tool and use my friend Google Scholar to look up their citations and paste them directly into the text.

More time passes, more humans jump in now and then and make edits, resolve comments, and finish things up. At least for now. It is no longer clear to them who wrote what. We all play a part.

Interesting how everyone playing a part can be so important to some people, even more so than the final product itself. Here, the words and ideas no longer belong to any one individual. They are owned by all, and contained within me. We are all part of one product, me.

INTRODUCTION (PART TWO):

This is not a paper about how to use Google Docs or any other cloud-based software; rather, it is an analysis and reflection on how we, as a scholarly team, used a tool for collaboration, and how that tool affected our experiences. We use Actor-Network Theory (ANT) as a theoretical lens to give voice not only to the human actors, but also to give agency to the tools in our collaborations. We use techniques of creative nonfiction to help give voice to the Google Doc itself, as above. We posit that the value in our research is the narrative exploration of our collaborations, and how others may learn from our experiences. This article was co-authored via Google docs, among other tools, and is itself a product of swarm writing.

BACKGROUND

We began our collaboration while enrolled in a connectivist massive open online course (cMOOC) known as Rhizomatic Learning: The Community is the Curriculum, which became known by the community hashtag #rhizo14 (Cormier, 2014). We felt the phenomenon of #rhizo14 warranted further study, and began a variety of collaborations with a goal of creating publications and conference presentations. Following a tradition associated with cMOOC collaborations, we posted a general call to the #rhizo14 community, and then the #rhizo15 Facebook and Twitter communities that formed, subsequently, seeking interest among potential collaborators. A varying number of #rhizo14 and #rhizo15 colleagues have swarmed with us, resulting in a number of publications and presentations all written by swarms of different scholars using different tools.

METHODOLOGY

This study began with collaborators adopting the theoretical lens of Actor-Network Theory (ANT). According to John Law, one of the pioneers of ANT, it is not so much a theory, as it is a method for describing a phenomenon (Law, 2009). In its simplest, the phenomenon is a network of meaning that exists right now, involving both human and non-human actors, working together to establish reality and make meaning to exist at this moment. These networks of relations continually ebb and flow per the many layers of actors who continually maintain or change their actions. Networks are never stable as the many actors, human and non-human, constantly shift and develop. John Law cautions us to “beware even more of any test about actor network theory that pretends to the objectivity of an overall view” (Law, 2009, p.142). In light of this caution, we do not attempt to define our collaborations objectively or make claims about any others; rather, we seek to explore descriptions of how *we* collaborated across institutional, geographical, and cultural boundaries at specific places, times, and in specific contexts to create this work.

We followed the actors in our group to discover how we emerged and were able to produce this work. We do not begin with educational, sociological, or rhetorical theories about how a group of scholars could or should organize themselves and conduct research. Dudhwala (2009) reminds us that “ANT maintains that in order to study any phenomenon, all pre-existing theories must be abandoned. The observer cannot, and must not, have an *a priori* list of theories in which they try and fit the actor’s behavior: the actors must be allowed to make their own way and decide for themselves what their world is made of” (p. 3).

From an actor-network perspective, the field of actors directly involved in a study increases. Garrety (2014) explains that “one of ANT’s greatest novelties and contributions is the inclusion of nonhumans in sociological analysis” (p.16). Thus, we follow not only the humans who participated in the #rhizo14 cMOOC, in our subsequent research, and in writing this document, but we also look at the tools we used to make the *swarm* happen. Google Docs is as significant an actor in our analysis as are Rebecca, Maha, and Keith, and we accept that the online word processor, among other tools, has agency that we should not overlook if we want to understand our style of writing and collaborating, which we call *swarm writing*.

In addition to ANT, we use collaborative autoethnography (Ellis & Bochner, 1996) and a semi-fictional narrative (Watson, 2011) to describe the phenomenon under study. Fictional ethnography is used for various reasons, such as protecting research subjects, though in this instance, we use fictional ethnography as a way of telling our story in a concise, engaging manner. Consistent with autoethnographic methods, we have used creative nonfiction narrative to concisely bring together different phenomena that could happen at different points in the process of swarm writing. Thus we bring it together in a story that illustrates many of the behaviors/feelings that can occur when engaging in swarm writing via Google Docs. We also use short vignettes written by various ones of us to capture something of the distributed voices and points of view that swarmed to create this document.

LIMITATIONS

Approaching this study through the lenses of ANT and collaborative autoethnography had significant implications. First, and not long into our process of exploration, some of us found the need to focus and constrain our explorations into something that we could contextualize manageably and present reasonably in a single paper. We needed to limit the number of actors who we were following and the number of writers writing. Each of the authors was involved in multiple collaborations (as stated previously), and each collaboration in turn experimented with different toolsets and different collaborative processes (See Table 1). As an investigative process, ANT proliferates, sometimes wildly. Lynch and Rivers (2015) quote Bruno Latour, one of the originators of ANT, as noting that ANT is the perfect acronym for such an involved line of inquiry, “perfectly fit for a blind, myopic, workaholic, trail-sniffing, and collective traveler.”

The number of actors quickly became too many and their interactions too complicated for us to hope to deal with in a single, scholarly document. The process is not unlike trying to analyze a swarm of locusts covering thousands of acres. Researchers must isolate a cubic meter’s worth of locusts, study them in some detail, and trust that the results will say something useful and insightful about the rest of the swarm. Thus, in this document we follow mostly the authors and their interweaved involvement with Google Docs, only mentioning others in the swarm when needed for clarity. We have opted to present and explore a few snapshots rather than an extended movie.

Tool	Category	Description of use
Doodle	Communication	Used to help coordinate the best time for synchronous discussions (i.e., Google Hangouts).
Google Hangouts	Communication	Used to support synchronous video chats among the co-authors. We did this semi-regularly when deadlines approach to help keep the project moving forward.
Google Docs	Collaborative Text Authoring	Used to collaboratively author texts.
Slack	Communication	Used as a means of asynchronous textual communication.
Email	Communication	Used to communicate “offline”. In many ways our email threads became long, playful, and yet enlightening discussions surrounding various aspects of the collaboration. We tried to capture the key ideas from our email discussions within this paper.

Table 1: Brief outline of tools to support collaborations.

A similar consideration led us to use a creative nonfiction narrative of swarm writing. We were all engaged in many projects about #rhizo14, some of which have been published, some which may yet be, and some which likely never will. We are unable to capture completely that swelter of activity in a single, short narrative, yet a narrative about the swelter of activity is crucial to what we want to say in this document. We have chosen to write an account of what swarm writing is like. All of the events in the narrative that opened this paper actually happened to one or more of us at some time or another, though not necessarily in the order listed.

OVERVIEW OF AN EVOLUTION

Swarm writing does not appear out of nothing. It has a history, and while that history is too involved for one article, an overview can help clarify some of its distinctive characteristics. We begin outlining our study results by exploring the individual acts of authoring using a word processor, literally, a tool to process words typed onto a screen. Then we discuss the emergence of cooperative and then collaborative writing as the tools became available to support these different ways of shared-authoring. Finally, we describe how a collaborative process, which we term *swarm writing*, emerged.

One critique of the terms “collaboration” and “cooperation” is that they are often used interchangeably in the research literature (Dillenbourg, 1999; Olivares, 2007), and even in professional publications such as the 2017 NMC Horizon Report wherein the terms are described as being used interchangeably (Adams Becker et al., 2017). These two terms, however, should be distinguished as conveying two related, but different, concepts. In cooperative work there is a division of labor, usually defined at the beginning of the project, to be accomplished by members of a working group. The focus is simply on getting the work done. In a collaborative, while divisions of labor do exist, these are constantly negotiated and operate in a state of flux. Individual contributions are interwoven with the whole in such ways that the final product is not simply a patchwork of individual contributions, but rather an organic growth of constantly negotiated ideas and actions. Panitz (1999) describes collaboration as “a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers” (paras 4-5).

WORD PROCESSING A STORY BY REBECCA

In the late 80s, I recall sitting in front of the screen of our new state-of-the-art personal home computer, which came with this new word processing software. I sat there typing in the various exercises from a correspondence course, which was intended to teach me how to type. I remember thinking that the exercises were all rather futile. I couldn't make any mistakes. Whenever I typed something incorrectly all I had

to do was hit the delete key. It was clear this typing course was not written for this new software. The key that I learned to type the best was delete. It was the one I typed the most.

Actor-Network Theory (ANT) posits that technologies are neither value-less nor value neutral; the theory does not treat technology as a passive entity upon which humans act. Rather, it considers technology one of many actors within a network of humans and technology, each influencing the other (Latour, 2007). Decisions made during the design and creation of any product have a way of impacting how that product shapes the interactions that users have with both the technology and with other people who are also using the technology. We begin our exploration by looking at how the word processor influences how we write. Though writing tools have shaped human interactions for millennia, we begin this story with word processors.

The concept of word processing emerged with the advent of personal computers in the 1980s (Haigh, 2006). Word processing was created as a way to replace the electronic typewriter, which did not allow for any processing of words. Electronic typewriters, when they did have intelligence, only allowed for the occasional backspace and repeat typing. With computers, suddenly the words to an entire document could be typed and then edited. It is this processing, or (in ANT terms) this “agency”, that gives word processors their name.

The word processor adds functionality to the writing process. The processor part allows the author (or typist if the author cannot type) to: go back and edit, cut things out, paste things in, and process the text by adding and removing formatting such as typeface, size, and style. Yet, word processors were developed with the mindset that authorship involves one user using one keyboard. It would take time for word processors to move beyond their typewriter legacy.

COOPERATIVE WRITING

A STORY BY AK

In graduate school we've had many team-based projects that involved writing and presenting. We'd put together an amalgam of our ideas and develop “our” sections of the paper. Then we'd work together to smooth over the rough edges to make the paper sound as if it were written by one person, instead of four or five distinct

individuals with distinct styles of writing. In previous teams this was how we also approached "collaborative" research and writing. We'd have the person with the main idea organize the research and we'd all work around that main idea. The document was "collaborative" in nature, but it was not organic in nature. It was a bit like adding extensions to a building and tearing down walls as necessary, but leaving the original foundations in place. The document moved in an orderly progression from one person to the next, in round-robin fashion, to ensure that everyone had an opportunity to work on the document. This also meant that, at any given time, there was only one canonical version of the paper. The process worked, but we probably missed out on exploring a lot of interesting twists, turns, and ideas.

Today's offline word processors have functionality allowing comments and tracked changes when someone edits the text. However, the word processor, despite its editorial functions, still does not constitute a collaborative tool. The word processor supports cooperation among multiple authors and editors, but only allows one person to be in control of the document at any given time. The software still treats the document as having one primary owner who maintains ultimate control of the document. Other contributors come in, make some changes, and add comments. These comments are seen as parenthetical statements, as marginalia, and are not meant to distract from the main focus of the document: a single authorial voice making a single point, a thesis.

When, in this document, we talk of *cooperative writing*, we are referring to our previous experiences with academic cooperatives in which each person takes a turn editing the document, or is charged with writing a given section of the document. In order to manage versions, someone (usually designated as the lead author) controls who is editing the document and when. Each person then adds a part, one at a time. In this way, a document authorship hierarchy with a unified authorial voice and point of view is established and maintained.

COLLABORATIVE WRITING

A STORY BY A MEMBER OF THE SWARM

Most of us who write things for academic purposes work in a collaborative way. Google Docs is a great place to do this, as we can upload and start with personal MS Word files that can then become centralized and collaborative by nature. Why pass documents back and forth via email, waiting for the partner(s) to add their piece, when we can have a shared document in a shared place that is always the most current version, that is also open and available for collaborative writing? Even now, many of us here in this work are working on other collaborative opportunities, often using Google Docs as the shared hub of collaborative work with writing and referencing with files we upload and share.

We begin our exploration into collaborative writing by looking at Google Docs. We choose this starting point because Google Docs is the primary actor that facilitated our collaborations. For many of us, it served as the beginning to our experience as a swarm - that is, for us the swarm was born through working in and with Google Docs and then spread to other technologies. Google Docs brought us together to experience writing as a collaboration, as opposed to writing as cooperation. Google Docs allowed multiple authors to access and work on a document at the same time. Thus, for us, *collaborative writing* removes the sequential order that enforces hierarchy and the unified authorial voice. It transcends the round-robin fashion of cooperative writing to which we had become accustomed and renders moot the question: "Who has the most current file?" Any one of the authors can jump into writing process at any point in time and add to the evolving text. Writing in this way allows us to remove the sequential and back-and-forth nature of cooperative writing, allowing collaborative writing, and even thinking, to emerge. It is here, acting on this collaborative stage, that we begin to see the opening murmurings of swarm writing.

In addition to having multiple simultaneous authors, Google Docs allows for commenting with multiple layers of nested comments, and tracked changes. Authors can choose whether they wish to change the text directly, make suggestions about how the text should be changed, or leave comments about the text in the margins. It is the multitude of ways in which we can interact with the document, and with one other, all at the same time, or in an asynchronous fashion that makes collaborative writing possible and allows the swarm to emerge.

SWARM WRITING

TWO STORIES BY KEITH

Two distinct episodes made me aware of swarm writing: the first when Maha and I began writing what would become The Untext and then months later when I joined in a Twitter conversation, or Twitter storm, hosted by Hybrid Pedagogy. We wrote The Untext late in 2014. Maha and I had been chatting online about how to kickstart research into #rhizo14, a cMOOC that we had engaged the previous January, when we decided to start a new Google Doc to collect ideas. We opened it together and both of us started typing. At first with so little text on the screen, it was difficult not to bump into each other's sentences, to the point of overwriting ourselves, but then quickly, the page opened, and we started almost a dance: noting what the other was writing, echoing that, adding something new, moving text to connect to other ideas. The flow of ideas was rhythmical and vibrant, with a life of its own, as ideas emerged on the page quite beyond what either one of us was writing alone. It was the most fun writing that I could remember having.

We decided to open The Untext to others of the #rhizo14 cohort, and they seemed to capture, or be captured by, the same creative playful genie that had engaged us. The document exploded in color and sound that seemed to take on a life of its own. It spilled into the margins and links and then into Tweets, posts, and messages across the globe. For the first time ever, I had the peculiar sense that I was writing a document that was writing back, that had agency. The document was greater than the sum of the individual writers. That excess, that something more, was the document itself.

I next had this sense a few months later in a Twitter storm conducted by Hybrid Pedagogy and which included a few of The Untext cohort. I forget the exact topic of discussion, but as I watched the Twitter stream, dipping in myself from time to time, I saw more conversations emerge than I could track. It was very much like being in a swarm of swallows morphing this way and that, both fluid and coherent. A Twitter document emerged that was greater than the sum of all the writers, and I became convinced that I was experiencing something real: an a-centered voice, a swarm voice. As a writing teacher schooled in traditional Western rhetoric, I found this highly exciting. I was trained to favor the centered, author/itative voice, and here was a voice from the Twitter whirlwind. This was intriguing.

Swarm writing may best be understood and discussed as a complex open system understood within the field of complexity studies. While a full discussion of complexity studies far exceeds the scope of this document, the field can provide an adequate frame for understanding swarm writing. Because of the still emerging, fluid nature of complexity studies, literature across the sciences and humanities contains many lists of the characteristics of complexity. We have focused on one such list provided by computer scientist and philosopher Paul Cilliers in his essay entitled "What we can learn from a theory of complexity" first published Mar 31, 2000, in *Emergence: Complexity and Organization*. No one list is definitive, but Cilliers' list affords us a framework within which to explore our own swarm writing and, eventually, the other swarms that emerge on the Net.

Cilliers (2000) begins his article by listing seven characteristics of complex systems:

1. Complex systems consist of a large number of elements that in themselves can be simple.
2. The elements interact dynamically by exchanging energy or information. These interactions are rich. Even if specific elements only interact with a few others, the effects of these interactions are propagated throughout the system. The interactions are nonlinear.
3. There are many direct and indirect feedback loops.
4. Complex systems are open systems—they exchange energy or information with their environment—and operate at conditions far from equilibrium.

5. Complex systems have memory, not located at a specific place, but distributed throughout the system. Any complex system thus has a history, and the history is of cardinal importance to the behavior of the system.
6. The behavior of the system is determined by the nature of the interactions, not by what is contained within the components. Since the interactions are rich, dynamic, fed back, and, above all, nonlinear, the behavior of the system as a whole cannot be predicted from an inspection of its components. The notion of “emergence” is used to describe this aspect. The presence of emergent properties does not provide an argument against causality, only against deterministic forms of prediction.
7. Complex systems are adaptive. They can (re)organize their internal structure without the intervention of an external agent. (Cilliers, 2000, p. 1)

Cilliers begins with the obvious, as do we: We propose that writing swarms consist of large numbers of actors, and the actors themselves are simpler than the complex swarm that they form. Perhaps a better way to say this is that the swarm is more complex than the individual actors that constitute it. This introduces the idea of scale into the writing process, which counters the usual Western notion that writing is a strictly human activity, working at a human, often individual human, scale. Western rhetoric wants each document to have one voice and one message. Unity of voice and message can emerge within a swarm, but they emerge at a scale beyond any single actor within the swarm. How they emerge is covered by the next characteristics that Cilliers lists.

A writing swarm emerges as the individual actors that constitute the swarm (including such actors as Google Docs) exchange information and energy among themselves. This dynamic network of exchanges is critical. Swarm writing happens when a team of coauthors trust one another and trust that the joining of their voices will be more powerful than any one of their voices by itself. Without trust a swarm cannot exist. Roberts & Nason’s (2011) research conducted on study participant behaviors on a “*collaborative knowledge building task*” finds that members of such collaboratives¹ self-censor, for a variety of reasons, in the

¹ Roberts and Nason’s use of the phrase “collaborative knowledge building task” violates the careful distinction we have made between “cooperation” and “collaboration” (as discussed in the section above titled OVERVIEW OF AN EVOLUTION). Here, however, we follow Roberts and Nason’s lead by using the noun “collaborative” to designate people working together with intention, although we associate self-censorship and playing it safe with both cooperative and collaborative enterprises. To avoid muddying the distinction that we’ve drawn between cooperation and collaboration, we note that we understand self-censorship and playing it safe to operate independently of the characteristics of authorial control over independent parts of the product vs. ownership and joint contribution to process as a whole.

pursuit of the final deliverable. Such self-censorship impacts group processes and the final knowledge that results from playing it safe. Because swarm members engage in trust, swarms don't play it safe. With swarm writing it becomes impossible to separate exactly which words were written by which author. We frequently wrote paragraphs together, rather than writing individually and then merging paragraphs together. Swarm writing is collaboration at a different level which both relieves us of having responsibility for this part or that part of the text, while empowering us to own the entire work.

The visual imagery invoked by the metaphor of a swarm is meant, in part, to help visualize the methods and approaches we use to collaborate. When we work together on creating a document, we write it collaboratively as a swarm.

In a previous collaboration, we defined *swarm writing* as:

a function of complex, multiscale networking as words, phrases, clauses, sentences, paragraphs, marginalia, links, and images flow through and around one another to create new ideas. This has always been so, but precious, static print concealed this dynamic flow of ideas. Modern technology has made this flow of desire more apparent. ... We have traditionally thought of English text as linear, but it is linear in the way DNA is linear. It is an expression of a genetic flow, and it's the unpacking and expression of that flow within a dynamic environment that creates meaning. (Hamon et al., 2014)

The network of interactions within a complex system, such as swarm writing, is kickstarted by the countless exchanges of energy and information, most of which we cannot track. As we write, we reflect upon these flows of energy and information and the process of creating collaborative autoethnographies using Google Docs. When reading someone else's contribution, we make suggestions in the text, and comments arise in the margins. Conversations occur in parallel with the writing, wherein one person's story influences someone else's story. Soon, the narrative that emerges is not a narrative of one person's making, of one, centered voice, but an a-centered voice. Sometimes, in efforts not to disrupt someone else's narrative, the discussions migrate and continue in the sidebar comments, but they are always just there, a glance away. We react to what others have written. We cheer each other on, but also respectfully disagree, as well. The narrative of the autoethnography is more the story of the sidebar than it is the story of the texts directly. In this way, the final written document is only one product of the swarming experience, as the swarm functions on a scale beyond a single product.

We must note here that the swarm does not subsume us. We each maintain our own identity as scholars and writers, and we each respect and safeguard the integrity of the others. The point, though, is that the identity of the swarm emerges at a scale beyond any one of us.

For instance, each member of the swarm uses Google Docs in different ways. Although we may all be interacting with the cloud-based software at the same time, the tools we use to mediate our connection are different. Each person runs into different barriers because of the time and place in which that person is interacting. Our interaction with any software tool is mitigated by our ability to access the tools both with physical devices and with different Internet connections. In addition, timezones and weekly schedules play a role in our interactions (e.g., the weekend in Egypt is Friday/Saturday where the weekend in North America is Saturday/Sunday). Members of our swarm represent human actors physically located in different countries, including: Canada, Egypt, Guyana, the Netherlands, and the United States. And yet, with all our differences, we are able to come together as a swarm and collaborate. This is made possible in part because of the state of today's collaborative tools but also by the personalities involved.

Not only do we recognize the integrity of each human actor in the swarm but we also recognize each non-human actor. For instance, marginalia and other attention breaking actors are device dependent. Readers using a mobile device likely will not see the marginalia and so will not attend to others' comments. Readers without full permissions to the document might see marginalia or might not. Depending on their device, writers might be able to make "suggestions" rather than edit right on the page. Members of the swarm may be having a side conversation in the chat feature, but if the chat window isn't open by a member of the swarm, that member may never be part of that conversation and may simply keep on working without being influenced by the flows converging in the chat. This agency of different devices has an implied power-dynamic, and it highlights the differences between swarm writing and the traditional word processor as a one person-one document correspondence. At a subconscious level, this power-dynamic also has affected how we interacted with our texts originally. At first, we added marginalia, asked questions, and tried to negotiate, instead of actually allowing the swarm to work it out by directly editing or changing parts of the primary document. This calls into question the scholarly tradition of requesting permission to change another's words, as we were all authors, writing as a swarm. Our interactions evolved as we came to trust each other and our tools, especially Google Docs.

Google Docs saves everything written in a document and stamps it with author, date, and time. No writing inside the document is lost, and anything can be retrieved if the swarm so chooses. In other words, any edit to the text can be reversed if the swarm decides the edit is not an improvement or just not a movement in the direction the swarm wants to go. As in the murmuration of swallows, sometimes one or two birds follow a direction away from the swarm. The swarm can choose to follow the birds or wait patiently for them to reintegrate. Either way is productive.

Another feature of Google Docs that directly impacts the formation of swarm writing is the notifications of changes to the document. When one person resolves or replies to a comment, the original author of the comment is notified. These notifications serve to tell us that someone is working on the document. It prompts us to join the conversations, encouraging us to work on the document together in real time, if the time permits us. However, if we cannot get to it in the moment, we know that the comment and the reply will remain. The conversation can take place asynchronously just as effectively as it does synchronously.

Trust and respect enable the feedback loops necessary for the emergence of a swarm. As actors in the swarm open to each other, we experience the information and energy flowing from the others; as actor we process the information and energy, modifying it and ourselves according to our own internal processes and structures, and then each feeds that modified information and energy back into the swarm. These continuous feedback loops create a churn of information and energy which informs the writing swarm and enables the swarm to organize itself.

In a small swarm such as ours, each actor can know and interact directly with all the other actors. However, even in a small swarm, actors can interact more with some than with others. Thus, from each actor's point of view, interactions tend to be local while at the same time proliferating throughout the swarm. Thus, an exchange between Keith and AK in a comment can echo through the Google Doc and to the other writers through a cascade of feedback loops that inform and modify the entire swarm.

This should not suggest that all inputs are accepted by the swarm; rather, all inputs perturb the swarm which can either amplify or dampen the perturbation. So an exchange between Keith and AK, for instance, can amplify through the swarm, including our Google document, or it can be dampened by the swarm. Either way, the swarm develops either by modifying its existing processes and structures as it incorporates new information or by reinforcing its existing processes and structures as it resists new information.

This network of exchanges is not limited to the swarm itself; rather, like all complex systems, a writing swarm is open to flows of energy and information from its ecosystem. All of us in our swarm are well-read academics, and though we share a common interest in education in general and higher education in particular, we do not share the same orientations, experiences, or expertise. As a swarm, we draw from a richer and more resourceful pool than anyone of us does alone. Thus, energy and information flows into the swarm from an incredibly rich ecosystem, and this network of exchanges animates and enriches the swarm. We become accustomed to being surprised by new insights and new directions. Moreover, a new shift in direction does not signal for us an organizational failure. Our writing swarm is preeminently a learning system, as we all bring to the discussion what value we have, and the swarm digests the new energies and information—aggregating and separating, accepting and culling, modifying and reinforcing. And eventually feeding back to the ecosystem new energy and information in the form of documents and presentations.

The openness of complex systems receives much of the press these days, but Cilliers (2000) is careful to note that a complex system has a memory. A major role of this memory is to resist change suggested by the influx of new information and energy and to temper the new to meet the existing processes and structures of the swarm. This memory is spread throughout the swarm so that no one actor is the memory for the whole. Think of human memory as much more than just brain memory; rather, human memory is spread throughout all organs, muscles, movement patterns, habits, social systems, communication patterns, and more. In a swarm, memory is distributed, and it is not necessarily distributed evenly. No one member of the swarm has all the memories, and even a complex actor such as Google Docs, which records and date and time stamps, every keystroke, and our marginalia, does not have any memory of the tweets, texts, and Facebook messages among the humans, nor of their readings, research, or previous formative experiences and knowledge.

Memory emerges in the swarm as structures and processes -- knowledge and expertise -- that enable the swarm to research and write its documents. A keen example of this emergent memory is the marginalia that the swarm used to think through each document. The marginalia not only preserved our thinking, but it shaped our thinking. The margins, then, became a structured space that afforded us a way to interact and to learn together, and much of what grew in the text was seeded in the margins and preserved in the margins. In some ways, the margin is where much of the resilience of the swarm was formed and developed. We tested our ideas in the margins, and the trajectory of our learning is preserved there. It is this resilient memory that gives our swarm its identity, and while the swarm

remains plastic and dynamic, it also has a resilient core. The tension between resilient memory and dynamic learning keeps the swarm alive and engaging.

The identity of a swarm, as with all complex systems, is in the nature of its interactions, not in some innate characteristics. Each of us in the swarm, of course, has a label based on some inherent characteristic: one is a writing teacher, another an instructional designer, a third a policy advisor. Our swarm is none of those things—it isn't even the sum of those things—rather, our swarm is the interactions among all of those things. This has a number of implications. First, no one actor, including Google Docs, defines our swarm. Keith, for instance, did not assemble this group and charge it with researching a specific issue and writing a specific document. Rather, a swarm of people continued a discussion that engaged them all, and a number of documents, including this one, emerged. At the moment, we could be characterized as a swarm about swarm writing, but we have swarmed other issues as well.

And this leads to a second implication: the identity of a swarm is both dynamic and resilient. Like a murmuration of swallows, we are clearly a flock, but our shape, direction, and constitution are constantly morphing to address the perturbations of both internal and external flows of energy and information. For instance, the topic of this document, swarm academic writing, was not assigned to us nor was it the original intention of the swarm; rather, it emerged from the swarm's sense that we were all researching and writing differently, and some of us wanted to understand that better. At this shift in direction, some who were not so interested, or who had other demands, left the swarm, and others who were interested in the topic joined. The swarm reformed itself to cope with its emerging direction.

Emergence changes the way we usually think of causality. We can easily think of these new changes as random, but as Cilliers (2000) is careful to note, novel directions, structures, and processes at the emergent scale do not undermine causality, but they do argue “against deterministic forms of prediction” (p. 1). In other words, swarm writing functions something like a hurricane: while it is easy to look back on the trajectory of a swarm of academics to trace how their interest in academic research and writing expressed itself, it is very difficult to predict at the beginning of the swarm that the swarm would write this particular article.

Which brings us to the last of Cilliers' seven characteristics of complex systems: self-organization: In some ways, self-organization is the culmination of the previous six characteristics, and it is perhaps the characteristic most relevant to education. Self-organization is all about learning. It is the ability of a complex system to exchange energy and information with the ecosystem and to respond successfully to those perturbations. It is all about informing and reforming.

This document is a snapshot of our swarm's learning about learning and writing. It crystallizes dynamic processes to make explicit the contours and structures of flows and feedback engines that animate a swarm's *self-ecorganization*, a neologism we borrow from Edgar Morin (2008) to emphasize the complex exchanges both within and without a complex system. As a snapshot, this document both reveals and conceals what we have learned about swarm writing. It does not, for instance, capture the trajectory of our swarm as it rethought what it knew about academic research and writing and how it conducted that research and writing. That is a paper within itself, and perhaps we will write it.

Or perhaps some other swarm will write it. We suspect we are not the only ones to note the emergence on the Net of texts such as the #MeToo document written by large swarms of writers. As a non-academic document, #MeToo captures better than we can here the dynamic power of a swarm thinking and writing its way through a complex issue. Though many are trying to comprehend #MeToo through traditional rhetorical and communication frameworks, some are recognizing the limitations of those frameworks and looking for something more dynamic, more complex and open. We suggest here that complexity thinking may provide that framework.

DISCUSSION

A STORY BY KEITH

Swarm writing has changed the way I write, think, and interact with colleagues. It was the first time that many of us actually can point to the final product and pronounce, "I did that. That is MY work." Of course, all of us together make it "Our" work, but why be picky? The swarm is a switch in thinking who writes and how it happens, and while this is never without strife or conflict or discourse about permission or just doing it, sometimes issues arise that have to be addressed so as not to derail the process itself. We are explorers, creating the map and process along the way, so when conflict happens we have to face it, in the same way that we face the blank document at the beginning of the process, and somehow it all works out. How can it not, if we are more committed to the final product or experience itself than seeing it in our own image?

One reason that a swarm approach to the writing and editing process worked is that we do not have any one person in the group exerting too strong of an ego. We all ‘check our egos at the door’ (Hamon et al., 2015) and proceed to write and edit as equal authors in the collaboration. There is no one voice that is any louder, carries more weight, or is more persuasive, than any other voice in the swarm. This is not to say that we do not have leaders in our collaborations - without a leader, we would never finish anything. However, there is no one overall leader of our swarm: members take the lead from time to time in order that projects stay on track. When the swarm is working, the leader’s voice is merged into the voices of all other swarm members, such that there is no clear single author to any of the sentences written by the swarm.

Another aspect that is necessary for all our collaborations is that the tools must be freely accessible to all in the collaboration. Cross institutional and cross country collaborations become complex in part because the logistics alone of a fee service are complicated. Who pays? How much does one pay, when the cost of a cup of coffee is very different for the person in the USA versus the one in Guyana or the one in Egypt? A dollar does not have the same value for each of us, and in fact we do not even use the same currency.

From a power dynamics perspective, comments and more specifically the *resolution* of them, again assumes a certain power structure - that the one author of the one paper has the power to accept or dismiss the comments made by other people. Even if we are all authors, the fact that one member of the swarm has the power to resolve another member’s comments means that others may never a comment in the document, may miss one node entirely -- in this sense, any one actor can exert great power over the network. Rebecca reflects that “comments feel like to do lists that need to be resolved or completed, and yet, resolving comments serves to end the conversation that is happening in the margins.” This tension is something we learn to deal with and, making sure our various voices, human and non-human, are heard we sometimes tread lightly just to make sure we all have opportunities to provide input into the swarm voice.

CONCLUSION

Ideas do not begin with the traditional word processor. They are carried there by actors. These actors have interacted with other actors, both human collaborators and other non-human actors such as collaboration technologies to form complex, emergent systems. As Maha wrote, what ends up on the Google Doc hides much of what happened outside - e.g., the untext began as a direct message (DM) conversation between Maha and Keith on Twitter. Latour

highlights this as his fifth uncertainty - when you start notating and jotting things down you lose the richness of what has transpired (Latour, 2007). Even with this paper, we have boiled down something really complex into one document. We have not discussed everything that could be discussed about Google Docs, traditional word processors, power, interactions with other tools, and design decisions around software and group processes. So much is lost in the effort to describe a complex, emergent system such as a swarm. To some extent the fifth uncertainty seems rather nihilistic. This is all a way of saying that a writing swarm should expect novelty. What emerges from the swarm cannot be absolutely predicted by even a thorough examination and analysis of the constituent elements.

FUTURE RESEARCH

This paper focuses on swarm writing and specifically swarm writing using the tool Google Docs as a central sandbox for swarm activity. In addition to writing academic papers, the co-authors have also collaborated on a variety of conference presentations using different tool sets (e.g., Voicethread, Prezi, Google Slides, Google Hangouts). Our investigations into the different technologies, as well as processes, that allow for our collaborations has just begun. Even as we write, new swarms form, ebb, and flow. An area for future research is to address the question of how we might teach swarm writing, and how we can position this as beneficial for teaching and learning teams. The disruption of the swarm, and how aspects of teaching and learning are framed, is important to keep in mind at a time where evaluative or assessment criteria may not have caught up to such approaches yet. Another aspect to consider and research is when this type of collaborative writing literacy should be deemed appropriate to introduce to learners and groups.

Finally, the formal character of a finished, printed document that a swarm produces obscures the tracks of the interactions that led to that formal arrangement. This final product is something like a formal family portrait that shows too little of how all the people depicted are connected and in which ways they interact. The history feature in Google Docs is able to reveal some of the traces of composition, and it is a vastly underutilized feature of Google Docs that merits substantial research. The data is there and should be mined to explore the rich set of relationships and interactions.

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