Experiments in Transductive Writing and Rhetoric with the Kinect

Matthew Halm, North Carolina State University
Steven Smith, North Carolina State University

The emergence of networked and physical computing technologies has prompted scholars of rhetoric to reevaluate the canon of delivery. Collin Brooke (2009) and Sean Morey (2016) each explore digital delivery through the lens of posthumanism and argue that digital technologies act as a prosthesis to the hand or body; this allows delivery to extend into cyberspace networks and create reciprocal relationships between the audience and *who* or *what* may be doing the delivering. This interaction occurs through processes of transduction, or "the conversion of one form of energy into another" (O'Sullivan and Igoe, 2004, p. xix). In the context of digital rhetoric and writing, transduction can be framed as integral to the processes of invention: "discovering the available means of transduction is the basis for invention" (Rieder, 2017, p. 14). Furthermore, transduction demonstrates how persuasion, articulated as eversion, or a folding "of the virtual into the real," occurs (Rieder, 2017, p. 14). This paper describes experiments using the Microsoft Kinect (a depth camera) to focus on the concept of transduction as a means of describing rhetoric and writing in complex contexts such as those presented by digital media.

The emergence of networked and physical computing technologies has prompted scholars of rhetoric to reevaluate the canon of delivery, which has traditionally focused on human attributes like gesture and tone of voice during oration. Collin Brooke (2009) and Sean Morey (2016) each explore digital delivery through the lens of posthumanism and argue that digital technologies act as a prosthesis to the hand or body; this allows delivery to extend into cyberspace networks and create reciprocal relationships between the audience and *who* or *what* may be doing the delivering. David Rieder (2017) explores the canon through the emergence of physical computing technologies, or interactive objects and environments that sense and respond to the analog world. This interaction occurs through processes of transduction, or "the conversion of one form of energy into another" (O'Sullivan and Igoe, 2004, p. xix).

In the context of digital rhetoric and writing, transduction can be framed as integral to the processes of invention: "discovering the available means of transduction is the basis for invention" (Rieder, 2017, p. 14). Furthermore, transduction demonstrates how persuasion, articulated as eversion, or a folding "of the virtual into the real" occurs (Rieder, 2017, p. 14). The Microsoft Kinect is one such method of making transduction visible by everting reality. The experiments described below use the Kinect to focus on the concept of transduction as a means of describing rhetoric and writing in complex contexts such as those presented by digital media.

Transduction and Delivery

Transduction is a term used in a variety of disciplines to describe a process of movement and change. In the context of physical computing Dan O'Sullivan and Tom Igoe (2004) describe transduction as "the conversion of one form of energy into another," such as an electrical impulse being used to trigger the movement of a motor, or a change in lighting conditions causing an alarm to sound (p. xix). Attempting to name exactly what has "transduced" in these examples is difficult. In a certain sense the electrical impulse has "become" movement of the motor and in a certain sense it has not. Under this definition there is less attention paid to "what" is transduced—all that matters is that transduction has happened.

Transduction is also a term widely used in the context of genetics, where it refers to the relocation of DNA from one cell to another as a byproduct of the movement of a third entity (a virus) between the other two (Griffiths et al, 2000). A virus incidentally picks up DNA from one cell and when it moves to another cell it leaves some of it behind. As a simplistic metaphor, the muddy boots of a burglar might unintentionally leave tracks in a variety of different homes as the burglar engages in an entirely different process. Much like O'Sullivan and Igoe's definition, transduction here emphasizes a conversion—if the result of the process is taken as a whole, the combination of DNA is different at the end than it was at the beginning. But genetic transduction also provides a connotation of mutation. For geneticists, transduction is a key way of understanding species diversity; transduction causes unexpected results.

It is this unexpectedness that is emphasized by post-structural theorists like Bernard Stiegler (1998) as well as Gilles Deleuze and Félix Guattari (1977), who get their understandings of transduction from Gilbert Simondon. According to Simondon (2009) transduction is "an operation—physical, biological, mental, social—by which an activity propagates itself from one element to the next" (p. 11). This propagation is not a one-to-one transfer, however, since as noted above transduction requires a change in form. At each "stop"

along the way the transduced element "mutates," becoming something slightly different. The physical computing examples of O'Sullivan and Igoe still hold: an electrical impulse "mutates" and becomes a motor's rotation. The addition of the notion of mutation emphasizes the fact that this rotation may not correspond directly to the electrical impulse—indeed it cannot correspond in an exact way since it is not the same form of energy. It must, by necessity, be different.

Considering the canon of delivery with transduction in mind complicates traditional assumptions about how it operates. While traditionally the study of rhetorical delivery encompassed voice, or the tonal delivery of an oration, and gesture, which focused on the hand positions, body poses, and mien, contemporary uses have sought to expand the canon in light of the emergence of digital technologies. Collin Gifford Brooke (2009), for example, makes the argument that scholars should see delivery as both a practice *and* a performance as opposed to its traditional roots as a transitive process between a speaker and audience. By keeping in mind the classical idea that successful delivery requires good personal character (*ethos*), Brooke believes that online, interconnected media can cultivate performative environments that allow for the transmission of information. To justify this theory, he cites two examples (one from a personal blog, and another a critique of Wikipedia) of how anonymous users online can establish *ethos* for themselves via delivering credible content to open-source interfaces such as Wikipedia. Delivery in new media, then, is the *act* of establishing ethos in networked environments and using that credibility to create discourse that is capable of circulation. The fact that this requires multiple venues and technologies means that transduction is implicit throughout the process; we can see this process occurring regularly given the rise of multimodality in our composing practices, wherein a range of semiotic components such as animation, graphics, sound, and visuals may be transduced and manipulated to create digital discourse.

In focusing on contemporary uses of delivery, Brooke neglects to explore delivery's traditional aspects of voice and gesture and their influence on the pervasiveness of digital technologies. Sean Morey (2016) seeks to address the ways that delivery and digital technologies interact with one another. Through his inclusion of *posthuman* theories, he argues that digital technologies act as a prosthesis to the hand that allow delivery to extend through cyberspace networks. For Morey, the idea of delivery still very much involves the body, but with an emphasis on the body's extension into virtuality. The significance of the reciprocal relationship between the "deliverer" and "audience" is still stressed, and it is ultimately the connection between deliverer/audience/digital technologies that blend together and push us to become *posthuman*. Again, viewing delivery as posthuman and prosthetic foregrounds the role of

transduction: because there are a complex of technologies and forms of media involved in delivery, the actions of a rhetor must be transduced numerous times. This is not necessarily a new state of affairs but it is one highlighted by digital technologies.

The Kinect

Originally released by Microsoft in 2010 for the Xbox 360, refreshed in 2013 for the Xbox One, and discontinued in 2017, the Kinect is a depth camera capable of detecting human users and relaying the movements of those users to various software applications. The Kinect achieves this by projecting infrared dots onto the space in front of it and detecting those dots with an infrared camera. The exact mechanisms of this process differ between the two generations of Kinect, but the result is a three-dimensional "depth map" of the area directly in front of the Kinect. Software then generates human-shaped "skeletons" made up of joints placed in locations according to the human shapes detected by the depth camera.

Despite being a "dead" technology (for now), the Kinect offers a way to make visible the means through which it interacts with the physical world, in Rieder's terms "everting" the technical reality in which it is situated. The residual traces of that interaction—the leftover evidence of the various mutations and changes in energy involved in transduction—are taken up by bodies engaged in its processes (perhaps by being conditioned to move in a certain way to accommodate an anomaly in the way the Kinect "sees"), and these residual traces can be used as a method for seeing and understanding the relationship between the "inside" and "outside" of a technological subject (as explored, for example, by Sánchez, 2017). The following examples show two such approaches toward using the Kinect to reveal the technical and material processes at work in rhetoric and writing.

Digital Chironomia (Steven)

The *Digital Chironomia* is a response to ongoing conversations occurring in the contemporary uses of rhetorical delivery (Brooke, 2009; Morey, 2016; Porter, 2009; Welch, 1999), physical computing (Rieder, 2017), archiving (Bernardi 2018; Giannachi, 2016), microethnography (Giddings, 2009; Taylor et al., 2015), and orientation (Ahmed, 2006; Bay and Rickert, 2018), and is an attempt at bridging together the digital humanities and digital rhetoric. The project digitizes 19th century gestures from Gilbert Austin's manual treatise, *Chironomia, or a Treatise on Rhetorical Delivery*, into a program that can track a participant's embodied movements via the Microsoft Kinect v2 and the mul-

timedia software TouchDesigner. The *Digital Chironomia* works threefold: first, archivally, through its alternative methods of archiving inspired by Gabriella Giannachi's "Archive 3.0," which calls for the inclusion of animated or mixed-reality technologies when creating a site of knowledge; second, methodologically, via analyses brought forth by microethnographical research that provides opportunities to explore technocultural activity and the affective relationship between bodies and technologies; and third, theoretically, via what it means to be spatially oriented in the presence of digital technologies. For now, however, I want to draw attention to the transductive potentialities of coding gestures into the TouchDesigner software via the Microsoft Kinect v2.

Coding gestures into TouchDesigner was a lengthy trial and error process that involved setting up the Microsoft Kinect in a spacious room and moving back and forth from my PC to properly input the desired range of bodily coordinates that I wanted to track—because the Kinect tracks a user's entire body, it was necessary to parse out which body parts I wanted it to recognize for each specific gesture. For example, when creating *Supplico*, a gesture explored in Austin's *Chironomia* which is meant to "implore" someone to do something and is achieved by holding each hand in a position relative to the torso, I parsed out the data from my hands and hip provided by the Kinect as it does not recognize one's torso (the Kinect's skeletal data is essentially a set of appendages connected by a spine). From there, the Kinect provided the coordinates of my hands and hip on an imaginary plane and I had to input a desired range for it to track on this plane so that it would cause a reaction in the TouchDesigner software. For my specific purposes, as the location of the room, the distance from the Kinect, and the height of a user all influence how the body is tracked on the imaginary plane in *pixels* (the unit of measurement used in the software). My hands had to be in relation to one another greater than 0.5 pixels across the x, y, and z boundaries but less than 0.7 pixels, and equal to approximately 0.2 pixels in relation to my hip—if my hands were too far apart, too close together, or too far up/down my torso, then the gesture would not be recognized by the software.

The *Digital Chironomia* project showcases the transductive capabilities of technology in the wake of embodied interactions. As a user approaches the Kinect, it begins defining the joints of a skeleton, and that data is then delivered to the TouchDesigner software. When registered by the Kinect, the user's virtual skeleton is placed on an imaginary plane that tracks the x, y, and z coordinates of their joints numerically. As a user moves their body, the Kinect registers those movements and delivers the information to TouchDesigner which ultimately executes the coded program—in the case of *Supplico*, when a participant holds their hands in the correct location relative to what's been coded in TouchDesigner, a *reward mechanism* is executed in the form

of an audio file that explains the use of the gesture. Through the coalescence of embodied manipulation (that is, a physical embodied enactment), skeletal tracking, imaginary planes, and audio files, the *Digital Chironomia* project transduces material/motion energy into sound energy via the vibration of matter. Of course, the practice of gesticulation itself acts as mode of transduction, but the potentialities afforded by today's digital technologies and their inclusion of our modes of sensation, whether sight, sound, touch, etc., allows for a reconfiguration of the ways we approach the study of delivery.

Writing with the Kinect (Matthew)

To generate a program that allows users to use the Kinect to "write" onscreen with their bodies, I used the Processing coding language to create a "sketch" based on data from the Kinect sensor. Using Processing libraries developed by Thomas Sanchez Lengeling (2015), I created functions that use data from the Kinect to write lines on the screen in various ways.

The first iteration of my Kinect writing program placed small dots at the location of the user's right hand each time the Kinect generated a new position for the user. This creates a built-up network of dots forming a dotted line corresponding to the changes in position of the user's right hand. When a second user steps in front of the Kinect running this iteration of the program, the second user also generates dots based on the position of his or her hand.

The following code snippet shows two lists (*handx* and *handy*, established earlier in the program) each of which are appended with the most recent position of the user's hand (one list contains the horizontal coordinate while the other contains the vertical coordinate). These lists are then used to draw dots for each item in the list, thus building up a chain of dots at each position the user's hand has been at since the program started running.

```
handx.append(joints[HAND_RIGHT].getX());
handy.append(joints[HAND_RIGHT].getY());


for (int n = 1; n<handx.size(); n++) {
stroke(255);
fill(255);
ellipse(handx.get(n),handy.get(n),10,10);
}
```

The code shows that the data originally gathered by the Kinect is not intrinsically identifiable as belonging to any individual human. The Kinect gathers coordinate data, and it is the software that turns that data into what we might recognize as a human image on the screen (in this case, the position of the hand). If the software does not account for the way the data has changed as it moves from the sensor to the eventual output, it will not create something recognizable to humans.

A failure of the sketch to account for transduction is revealed in its second version. This iteration replaced the dots with lines drawn from the most recent position of the user's hand (*n*) to the second-most recent position (*n-1*), shown in the code snippet below. The result is a more continuous version of a line "drawn" by the user's hand.

```
handx.append(joints[HAND_RIGHT].getX());

handy.append(joints[HAND_RIGHT].getY());


for (int n = 1; n<handx.size(); n++) {

stroke(255);

line(handx.get(n-1),handy.get(n-1),handx.get(n),handy.
get(n));

strokeWeight(10);

}
```

However, when a second user steps in front of the Kinect running this iteration of the program, the second user's hand positions are added to the same lists as the first user's just as they were in the first version of the program. While this was not problematic when the software created discontinuous points for each position of the hand, when the points are connected with lines the result is a series of lines running back and forth between the two users' hands. Rather than a separate line for each user, the program treats both users as part of a whole. While this was not the intended result of the program, the second iteration reveals something of its own inner functioning: while it may have appeared in the first iteration that each user skeleton had an associated set of dots tracing his or her hand's path, the program instead records hand position for all users at the same time. Because of this, when the second iteration replaced dots with lines, the lines did not differentiate between users. For the Kinect, under this iteration of my program, all users are treated as a single subject of the sensor.

While the result of the second version of the Kinect writing program may or may not have been unexpected to imagined programmers of varying levels of experience with the Kinect, the result nevertheless reveals one way that the Kinect "sees" its surroundings. In turn, this machine perception is transduced in the form of visible lines which, though they bear an association with what the Kinect "saw," are a new entity in and of themselves. The fact that this version of the program treats all users as a single entity is neither solely a virtue of the Kinect's construction or of my program, but of their interaction. Data which might normally differentiate between distinct users for the purposes of a game, for example, is taken up by my program in a way which does not account for such a difference. The Kinect only sees distinct users if it is instructed to do so *retroactively*. The Kinect, of course, does not "see" like a human does, it gathers coordinate data which is interpreted as sight by a combination of computer software and human perception of that software's output. Each of the changes along the way from a human waving their arms around in front of a device to an image on a computer screen involve a transformation of one form of energy into another (transduction.), and with each of these transformations the information taken up by the next step in the process is altered substantially. Visual data becomes coordinate data which becomes a three-dimensional computer image which becomes a "skeleton" of joints and limbs, able to interact with various software applications on the computer. None of these versions corresponds exactly to the human standing in front of the sensor or to one another.

Conclusion

David Rieder (2017) argues that "all writing, including alphabetic writing is a *transductive* technology" (p. 133). If transduction is a key feature of writing then these examples, which use the Kinect to demonstrate or reveal processes of transduction, can tell us something about how writing works, and might further offer paths for a broadening of what counts as "writing." By way of these experiments and this research, we suggest that writing is a form of gesticulation and shares important characteristics with rhetorical gestures, such as those that are described in Austin's *Chironomia*. Gesture is a manipulation of the body that enables opportunities for communication to take place. Writing introduces an additional (or simply different) medium into the interaction between the gesturing body and a potential recipient. Writing is a result of physical, habitual movements and gesticulation itself is a form of embodied inscription laden with communicative capabilities. Our use of the Microsoft Kinect in these experiments has sought to capture the relationship between gesticulation and writing in real-time in order to put emphasis on

the transductive nature of writing/gesture. The movements that are enacted by participants in either experiment showcase the conversion of energy that occurs during communication, and as such transduction is integral to future studies of writing.

References

Ahmed, Sara. (2006). *Queer phenomenology: Orientations, objects, others*. Durham, NC: Duke University Press.

Bay, Jennifer, & Rickert, Thomas. (2018). New media and the fourfold. *JAC*, *28*(1), 209–44.

Bernardi, Joanne, & Dimmock, Nora. (2018). Creative curating: The digital archive as argument. In Jentery Sayers (Ed.), *Making things and drawing boundaries: Experiments in the digital humanities* (pp. 187-197). Minneapolis, MN: University of Minnesota Press.

Bogost, Ian. (2007). *Persuasive games: The expressive power of videogames*. Cambridge, MA: MIT Press.

Brooke, Collin Gifford. (2009). *Lingua fracta: Towards a rhetoric of new media*. Cresskill, NJ: Hampton Press, Inc.

Bulwer, John. (1974). *Chirologia, or the natural language of the hand, and Chironomia, or the art of manual rhetoric*. James W. Cleary (Ed.). Carbondale, IL: Southern Illinois University Press.

Deleuze, Gilles, & Guattari, Félix. (1977). *Anti-Oedipus: Capitalism and schizophrenia* (R. Hurley, M. Seem, & H. R. Lane, Trans.). New York, NY: The Viking Press.

Giannachi, Gabriella. (2016). *Archive everything: Mapping the everyday*. Cambridge, MA: MIT Press.

Giddings, Seth. (2009). Events and collusions: A glossary for the microethnography of video game play." *Games and Culture*, *4*(2), 144–57.

Griffiths, Anthony J. F., et al. (2000). Transduction. In Anthony J. F. Griffiths, et al. (Eds.), *An introduction to genetic analysis* (7th ed.). New York, NY: W. H. Freeman. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK21760/

Holmes, Steve. (2016). Ethos, hexis, and persuasive technologies. *Enculturation*, *23*. Retrieved from http://enculturation.net/ethos-hexis-and-the-case-for-persuasive-technologies

Lengeling, Thomas Sanchez. (2015). Kinect v2 Processing library for Windows. Retrieved from http://codigogenerativo.com/kinectpv2/

Morey, Sean. (2016). *Rhetorical delivery and digital technologies: Networks, affect, electracy*. New York, NY: Routledge.

O'Sullivan, Dan, & Igoe, Tom. (2004). *Physical computing: Sensing and controlling the physical world with computers*. New York, NY: Cengage Learning.

Porter, James E. (2009). Recovering delivery for digital rhetoric. *Computers and Composition*, *26*(4), 207–24.

Rieder, David. (2017). *Suasive iterations: Rhetoric, writing, and physical computing*. Anderson, SC: Parlor Press.

Sánchez, Raúl. (2017). *Inside the subject: A theory of identity for the study of writing*. Urbana, IL: National Council of Teachers of English.
Simondon, Gilbert. (2009). The position of the problem of ontogenesis. *Parrhesia*, *7*, 4–16.
Stiegler, Bernard. (1998). *Technics and time, 1: The fault of epimetheus* (R. Beardsworth and G. Collins, Trans.). Stanford: Stanford University Press.
Taylor, Nicholas, Kampe, Chris, & Bell, Kristina. (2015). Me and Lee: Identification and the play of attraction in The Walking Dead. *Game Studies*, *15*(1), 1–13.
Welch, Kathleen E. (1999). *Electric rhetoric*. Cambridge, MA: MIT Press.