
Replication, Visualization & Tactility: Towards a Deeper Involvement of 3D Printing in Humanities Scholarship and Research

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In a chapter that begins with the question “What would you make if you had a machine that could make anything?” Lipson and Kurman rhapsodically illustrate the myriad uses for 3D printing, from “3D prints [of] a precise, highly detailed replica of [a] fetus” to “the not so distant future [where] people will print 3D living tissue, nutritionally calibrated foods, and ready-made, fully assembled electronic components” (7). On-campus maker spaces often tout 3D printers with the same utopian vigor, yet there is still a great deal of opacity around how introducing 3D printed objects into a Humanities classroom or scholarship would add value to those spaces or work. In my experience collaborating and working in the Digital Media Experience Lab at Ryerson University, when asked to speak with colleagues or students about the potentials for projects that involve 3D printing, two main types of anxiety arise: first, there is the intimidation that comes with learning a new set of hardware and software; and second, there is a large amount of trepidation around what to the technology should even be used for. While the first set of fears can be somewhat mitigated by the sort of community-friendly maker space environment that 3D printers are often housed in, the second set of concerns asks questions that are at the root of not just 3D printing in the Humanities, but Digital Humanities (DH) projects as a whole:

- What are the elements of 3D printing that make it a unique contribution to the Humanities? What are the technology’s strengths and how might they best be harnessed?

- What are the limits of such a technology, from both the hardware and software perspectives?
- As a physical object imbued with potential meaning, how might a tactile object speak to issues of critical theory?
- What are the components of 3D printing that lend itself to a powerful learning or scholarly environment?
- What can 3D printing do that other modes of interface, data visualization cannot?

Scholars like Mark Steфик explains that “digital sensemaking” most often takes place in the ecosystems of “digital information infrastructure, such as today’s web and search engines” and, as such, a great number of projects focus on a DH understanding of digital sensemaking centre around the digital components of virtual object creation. Yet, as Ian Foster argues, “Informational technology can also enhance our abilities to make sense of information, for example, by allowing exploration via visual metaphors” (19). 3D printed objects have the unique ability to make physical/concrete, at varying scales with easy replication, abstract ideas and give scholars and students modes of engagement with metaphors and issues and are not present in other mediums (print, film, music, etc). Drawing from theory and history around sculpture, this paper will ask anyone wanting to begin a 3D printed project, **what** the object they wish to create a metaphor for is, as a physical object imbued with potential meaning. If a student or scholar wants to speak to certain issues, what objects might be the best metaphors for the arguments and issues they wish to discuss? What does adding the layer of technology in 3D printing then add to that argument? What do the specific properties of replication, visualization and tactility add to the metaphor and the argument being made? 3D Printing then becomes another mode to explore visual metaphors but with the unique and obvious understanding that such an object is immediately and equally digital and analog.

Rooted in Jentery Sayer’s work in discussing 3D printing alongside Lipson and Kurman’s “10 principles of 3D printing” (20-24), this paper will begin to answer the above questions by outlining three core considerations, with examples, in an attempt to foster further discussion about how a relatively nascent popular technology might best be understood and undertaken in a Digital Humanities project or classroom.

First, the nature of 3D printing is built around the notion of replication: once virtual objects are constructed, they can be repeatedly printed quickly and easily. This is a massive strength when considering a large scale multitudinous project, or a classroom environment wherein students may be asked to each design or find and print an object. When printing with recyclable material, the technology lends itself exceptionally well to iteration, encouraging prototyping and low-risk failure in service of a finished product. However, the notion of replication also extends to the technology's ability to mirror "real life" (and future, fantasy) objects: projects like Morehshin Allahyari's *Material Speculation* are able to recreate lost objects destroyed by ISIS and reprint them, effectively regenerating a version of the physical object that both evokes the original and challenges its audience by layering the technological on top of the original craftsmanship/artistry. I will blend this with discussion of Odile Fillod's project printing models of the clitoris as an educational and feminist tool of inquiry.

Second, 3D printing allows creative and untapped modes of visualizing data. A number of data visualization tools, especially for beginners in DH, are going to be relatively simple 2D graphics, such as charts, graphs, maps etc; advanced tools will include movement, interactivity, and pleasant aesthetics. Yet, the interfaces that 3D printed objects promote are distinctive in their mix of the physical and virtual. Using examples from Lipson and Kurman's chapter "A Factory in the Classroom," as well as my own work with translating poems into small landscapes-type pieces via a height map application as part of *Loss Sets*, it is clear that 3D printing offers a wealth of opportunities to translate numbers, words, spaces into objects; in doing so, the object is pushed into an analog space that challenges its audience to "read" and "understand" that data in an embodied and physical manner that maintains the pleasingly interactive and evocative arguments about the information selected often found in virtual data visualization tools.

Lastly, 3D printed objects have a sensual tactility that is difficult to get from other (virtual) elements of Humanities scholarship. Once printed, the objects have concrete weight and volume that points to a set of aesthetic values again straddling their digital-analog nature; they can be picked up, turned over, and explored from a multitude of angles. Too, as wearable computing increases, 3D printed fabric projects an engaged scholarship linked immediately to the sensations and shapes of the body. Generating projects

that take advantage of the physicality and materiality of such objects can be an exceptionally effective and emotive mode to considering virtual or past objects, especially as printed objects can be treated, post-printing, to change the plastic's original properties. To this end I will be looking closely at Neri Oxman and the Mediated Matter Group's *Lazurus* and *Vespers*, a "series of death masks" as well as Donna Szoke's *Decoy*.

Before considering potential software or materials and hardware, a DH project involving 3D printing will be most effective if it begins by considering these principles, understanding the strengths and core of the technology itself, and then blending each element together into a symbiotic environment in which the object itself is capable of housing the necessary evocative complexity and wonder that the technology itself often provokes.

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