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Virtual Artifacts and the Digitization of Cultural Heritage

The 3D modeling of artifacts poses an intractable dilemma for cultural heritage museums. On one hand, this emerging technology can offer effective new educational methods, increase visibility and access to collections, and help share valuable scientific and historic data that might otherwise be lost. On the other hand, by conflating these digital representations with the actual material objects, museums risk ignoring or obscuring the many non-visual, sensory qualities of artifacts. Thus, museums must be extremely careful and critical in their application of these technologies. Digital 3D models of cultural heritage artifacts lay bare the basic paradox facing museums today: how does an institution rooted in the preservation and display of material objects function in an increasingly "dematerialized," information-based world? How do the processes of digitization effect how an object is perceived and understood, and what responsibility does the museum have to help shape that understanding? What are the responsibilities and protocols of publishing digital 3D models and who should determine them? I argue that by replacing the embodied, affective experience of a physical object with digitally mediated "content," the museum fundamentally alters how we relate to these artifacts, and how we understand "cultural heritage."

For cultural heritage museums, the most practical and clearly advantageous application of 3D modeling is as a form of documentation. This documentary or "evidentiary" value stems from the initial step in the model-making process: the 3D scan. A 3D model is essentially an interactive digital visualization of a set of measurements and photographic images. At their core, these models consist of a dataset of "the surface geometry, on to which information about the

colour and other surface properties at each point is overlaid."[1] To create this dataset, the object itself must be scanned or "captured." As a rapidly evolving and growing technology, standards within this field are still emerging. There are a wide variety of different technologies and methods for creating a scan, and most commonly, museums produce models through a combination of multiple methods and types of scanning.

These scanning techniques can be broken down in two main categories: 1) "passive, in which shape is derived from images of the scene, and [2)] active, where a laser or other light source is projected into the scene and its interaction with the scene is measured."[2] The least expensive and simplest of these, is a passive method known as "photogrammetry," in which the geometry of a 3D object is derived by compositing a series of photographs taken from different angles. Using inexpensive commercial software such as Stereo Scan or Autodesk ReCap one can convert this series of overlapping images into a "point cloud" or "mesh" (essentially a dataset of x-y-z coordinates) which can then in turn be edited and manipulated in computer aided design (CAD) software[3] and 3D printed using stereolithography. Photogrammetry is the most wide-spread and accessible technique because it can be accomplished (in relatively low resolution) with nothing more than a digital camera. Moreover, these "passive" techniques have even been used to retroactively "scan" artifacts and heritage sites that have been destroyed, or no longer exist, using crowd-sourced images posted on the internet.[4] However, large cultural heritage museums with dedicated "digitalization" programs such as the Smithsonian Institution and the

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[1] Arnold, David, and Jaime Kaminski. "3D Scanning and Presentation of Ethnographic Collections—Potentials and Challenges." *Journal of Museum Ethnography*, no. 27 (2014): 78-97. http://www.jstor.org/stable/43915864.
[2] Ibid
[3] Champion, Erik. 2017. The Role of 3D Models in Virtual Heritage Infrastructures. In Cultural Heritage Digital Tools and Infrastructures European Perspectives, 15-35. Oxford and New York: Routledge.
[4] Morehshin Allahyari's "Material Speculation: Isis" project produced 3D models of 12 artifacts that were destroyed by ISIS in 2015, including a statue of King Uthal of Hatra from the Mosul Museum. See "Material Speculation: Isis," Morehshin Allahyari, accessed June 12, 2018. http://www.morehshin.com/material-speculation-isis/

British Museum tend to employ the much more accurate and expensive "active" techniques for recording the surface geometry of an object. Currently, these techniques include, most notably, laser arm scanning and structured light scanning, in which the reflection of light off the object is measured from different angles in precise detail.[5] While the specific methods of these scanning or "capture" technologies are constantly evolving, the essential point for museums is that through these processes, they can produce an extremely detailed and accurate dataset describing and documenting the formal, geometric, and visual qualities of an object in their collection. And like photographic documentation or artist renderings before that, these 3D scans can be used for everything from monitoring conservation needs to assisting in scientific or historical research.

While these object-derived datasets have obvious documentary and evidentiary value, they also point to a central dilemma for cultural heritage museums: what is the relation between the data and the actual, material artifact? How can this immense set of measurements serve the mission of the museum in ways that go beyond mere documentation? In the United States, perhaps the most prolific and high-profile adopter of these technologies is the Smithsonian Institution, with their Smithsonian X 3D initiative. Their answer to this question, as indicated on their website is: "once an object or research site is scanned we are able to use that data in many different ways, including: deliver content online using our 3D Explorer, [and] allow schools to freely download and 3D print iconic Smithsonian objects in the classroom."[6] The language here is worth exploring in detail, because it cuts to the very heart of the digitization process and demonstrates the way in which these new technologies are shifting meanings within museums.

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[5] Smithsonian. "3D Scanning at the Smithsonian" Youtube video. Posted May 13, 2013. https://youtu.be/AWoqTGEw7WA

[6] "3D Imaging Program" accessed June 14, 2018. https://dpo.si.edu/3d-imaging-program

The use of the nebulous, yet ubiquitous internet-related term "content" here refers to the interactive 3D models, accessible through the Smithsonian's web-based, custom-built platform. This language echoes current trends in media and online publication, indicating that the Smithsonian clearly sees itself as the "producer" of this "content." In other words, their role as interpreter of the object is clear. On the other hand, they suggest that this data allows one to "print iconic Smithsonian objects" without any kind of qualifying term like "replica" or "model," thereby indicating a direct one-to-one identification between the digital model, the 3D print derived from this model, and the original physical object itself. While this may seem like an inconsequential, or semantic point, it is representative of a larger trend within museums to uncritically present digital or virtual versions of objects as surrogates for the objects themselves. Of course, this trend has been prevalent in libraries and archives for years, and it is in line with the colloquial usage of the term "digitize:" the information remains the same, it simply takes a new form. But if museums are now claiming that they can digitize not only texts, photographs and 2D art, but all kinds of material objects, it begs the question of what might be lost, or added to our experience of these objects in that process.

To explore this question, it will help to offer a case study of a digital 3D model and the way in which it is published and encountered online. As stated above, the Smithsonian has developed a custom "3D Explorer" in partnership with Autodesk, which allows online users to interact with a highly detailed, fully colorized digital 3D model of a scanned artifact. Still in "Beta," the Explorer allows visitors to engage with the 74 different 3D models currently published on the Smithsonian X 3D website, each "browsable" and searchable by title or keyword.[7] In a web browser, clicking on a model launches an embedded application that presents

[7] "Smithsonian Digitization 3D" accessed June 15, 2018, https://3d.si.edu/

the user with an intuitive, simple interface for interacting with the "object". The user can "turn" the object or zoom in and out using simple mouse and keyboard commands, instructions for which are overlaid when opening the model. This allows the user to view the object from any angle in extreme detail. Set against a grayscale gradient background and overlaid with a "grid defining the ground plane,"[8] the model appears to float in an empty, 3D space. As Sarah Younan and Cathy Treadaway describe, "digital 3D models of museum artefacts are perceived 'in an unreal, virtual space that opens up behind the surface' of the computer screen" resulting in "a liminal space, somewhere between the tangible and the imaginary, with the potential to enable creative engagement with the experiential realm of the museum dream space." [9] So while the artifact appears both real and trustworthy, the user also recognizes the inherent "unreality" of the interaction and the virtual space.

This highly mediated and designed process (scan, model, website, "Explorer") allows viewers to experience qualities of the artifact that would be impossible even during an in-person encounter with a physical object. For example, with the Explorer, one can view small details on the underside of an armchair made by John Hewitt in 1810[10] or the inside of a bottle-shaped vase at the Smithsonian's Freer Gallery of Art.[11] Moreover, each Smithsonian X 3D model has a corresponding guided "tour," in which, by clicking on overlaid indicators, text descriptors appear and relay information about the object. According to the description on the Smithsonian X 3D website, "tours are similar to PowerPoint presentations, but are always 'live'. At any time during a tour, you can interact with everything you see in the viewer."[12] This kind of enhanced

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[8] "The environment Tool box" accessed June 15, 2018. https://3d.si.edu/article/environment-toolbox
[9] Younan, Sarah, and Cathy Treadaway. 2015. "Digital 3D models of heritage artefacts: Towards a digital dream space". *Digital Applications in Archaeology and Cultural Heritage.* 2 (4): 240-247.
[10] https://3d.si.edu/explorer/armchair-with-slip-seat-usa-ca-1820
[11] https://3d.si.edu/explorer/bottle-shaped-vase-f1982-19
[12] https://3d.si.edu/article/navigation-3d-and-25d

experience through digital tools is what then Secretary of the Smithsonian G. Wayne Clough advocates for in his 2013 book *Best of Both Worlds: Museums, Libraries and Archives in a Digital Age.* He argues, "there is a place for both the physical and the digital, with one complementing and leveraging the other. The physical museum offers visitors the opportunity to experience the real object and to share their impressions with family and friends, and also provides the content, expertise, and collections that digital museums draw upon. Digital access can then provide limitless opportunities for engagement and lifelong learning."[13] While Clough clearly recognizes the inherent difference between experiencing "the real object" and being granted "digital access," he views both as an essential element of what he terms the "Smithsonian experience." And he continues, "The 'Smithsonian experience' is often described as a spark or catalyst that prompts curiosity. But this raises the question: why should such an experience be limited to those who can visit in person?"[14] Like the terminology regarding "content" creation, Clough's focus on digitally recreating "an experience" points to the question at the core of this issue: can the experience of encountering a piece of cultural heritage be recreated digitally, online? Are the "opportunities for engagement" in digital museums really "limitless?"

Smithsonian's 3D Explorer replicates the experience of an artifact's material, physical presence through an intensely mediated and designed virtual environment. By utilizing the detailed visual and geometric information gained through scanning, the museum can create a publishable virtual encounter with the artifact. Here we can see the final step in what Sandra Dudley has identified as "a view within museum studies and practice that the museum is about

[13] Clough, G. Wayne. *Best of Both Worlds: Museums, Libraries, and Archives in a Digital Age*. Smithsonian Institution, 2013. https://doi.org/10.5479/si.9780981950013.
[14] Ibid., 5

information and that the object is just a part –and indeed not always an essential part–of that informational culture."[15] Echoing Clough's discussion of the physical/digital pairing, Dudley suggests that most museums are primarily concerned with displaying what she terms "object-information package[s]," or, cultural and informational framing mechanisms that attempt to "speak" for the paired objects. However, unlike Clough's more optimistic stance, she sees this as possibly limiting and minimizing the bodily, sensory experience of the materiality of the object itself.

While Dudley is primarily concerned with didactic displays and informational framing mechanisms within the museum, her critique of the "object-information package" can be applied to these digital framing mechanisms as well. Through the digital 3D model, we are told that the presence of the material object is not an essential part of our experience of it. And for Dudley the danger of this kind of practice is that the "object-information package…threatens to foreclose a more basic, but no less potent, bodily and emotional response to the material itself."[16] In other words, information about an object can sometimes diminish or at least "foreclose" upon our embodied, emotional response to its material presence. Even calling an object "cultural heritage" alters how we interact with it. But what is behind this "bodily response" to the "material itself" and is it replicable through a digitally mediated interface? Dudley's analysis focuses on our sensory and physiological interactions, but of course, within museums, objects are often behind glass and rarely is one permitted to handle or touch a cultural heritage artifact. Moreover, the digital 3D model offers an enhanced visual capability and even enables 3D printing, which allows for a tactile experience beyond the physical museum's capabilities. So, if our sensory capacities are in many ways enhanced through the virtual, information-based experience, what is

[15] Dudley, Sandra H. *Museum Materialities: Objects, Engagements, Interpretations.* London: Routledge, 2010, 2
[16] Ibid., 17

it about the material presence of the object that is so important to our experience and understanding of it? By examining a particular Smithsonian 3D model, I will suggest two concepts that can help explain our embodied, emotional response to the presence of cultural heritage artifacts: aura and affect.

In this context, "aura" refers to the specific, unique spatial and historical qualities of an artifact. Walter Benjamin's influential and oft-debated essay "The Work of Art in the Age of Mechanical Reproduction" discussed the ways in which "reproductive" media like photography and film diminish the "aura" belonging to earlier art forms like painting or sculpture. Discussing the aura of traditional art he suggests, "even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be."[17] Benjamin's prescient insights about the effect of film and photography on the aura of artworks continues to be relevant, however more recently, many media studies scholars have challenged his conclusion that reproducibility diminishes the public's interest in the aura of artworks. Rather, as Bolter et al., argue "the desire for immediacy and for auratic experience has paradoxically survived in the face of increasing levels of mediation that digital technology makes possible."[18] Pointing to today's "new media" like virtual reality and augmented reality, they contend that "the specificity of the here-and-now" is still a powerful part of the way people relate to art and media.

The Smithsonian's 2012 replication of the Kéet S'aaxw, or Killer Whale Hat, clearly demonstrates the power and importance of an artifact's "aura" in the face of its "reproducibility." In 1904, the sacred carved wooden hat was taken from the Tlingit Dkl'aweidi Clan by

[17] Benjamin, Walter, and Hannah Arendt. *Illuminations: Essays and Reflections*. Doubleday, 2012. Pg. 220
[18] Bolter, Jay David, Blair MacIntyre, Maribeth Gandy, and Petra Schweitzer. "New Media and the Permanent Crisis of Aura." *Convergence* 12, no. 1 (February 1, 2006): 21–39. https://doi.org/10.1177/1354856506061550.

Smithsonian ethnologist John Swanton.[19] It remained at the Smithsonian until finally being repatriated to clan leader Mark Jacobs, Jr. in 2005. On the day of its repatriation, the hat was used in a Tlingit ceremony for the first time in over 100 years. Then, according to Smithsonian Magazine,

> in April 2010, [the new clan leader Edwell John, Jr.] brought the Killer Whale hat back to Washington, D.C. Over the next two years, the Smithsonian worked closely with John to create a copy that was both respectful of Tlingit culture and suitable for education purposes. Digitization experts laser-scanned the hat, bouncing a beam off of its surface and deriving measurements from the time it took the laser to bounce back, and also collected 3D data through an imaging technique called photogrammetry…The hat underwent a fairly straightforward digitization process…After digitization, the virtual model was translated into reality by a team of Smithsonian model makers with the help of a CNC milling machine, which carved the replica out of alder wood. Finally, the team added paint, abalone shells, hair and a trailer of white ermine skins.[20]

While the replica and original hat are nearly physically and materially identical in almost every way, clearly, they differ in their auratic presence. For the Tlingit, the original and replica are not just different hats of the same form, they are entirely different types of things with entirely different meanings and ontological realities. The replica and the 3D model can be used for educational and documentary purposes, but they are not sacred objects, they are not what the Tlingit call "At.óow." The difference relates directly to each hat's aura. According to Smithsonian.com: "objects become at.óow during a memorial potlatch. At this ceremony, representatives of the opposite moiety recognize the unveiling of an official clan crest object. Without this acknowledgement, the object is considered a piece of personal property, not at.óow."[21] In other words, it is the hat's aura, its "presence in time and space" and it's "unique

[19] Solly, Meilan, "This Replica of Tlingit Killer Whale Hat is Spurring Dialogue About Digitization," Smithsonain.com. Accessed June 15, 2018. https://www.smithsonianmag.com/smithsonian-institution/replica-tlingit-killer-whale-hat-spurring-dialogue-about-digitization-180964483/
[20] Ibid.
[21] Ibid.

existence at the place where it happens to be" that determine its meaning. And that aura is not scannable or reproducible through an online portal or 3D printing. So, while the replica may be physically identical, and even "invoked the emotional response typically associated with real at.óow[22]" the two hats (and the digital 3D model) each have entirely different uses, meanings and cultural relevancy. The example of the Tlingit Killer Whale Hat indicates that, in some cases, an object's meaning is determined by its aura and unique materiality, which cannot be represented through digital reproductions. But, on the other hand, as will become clear, it also indicates that digital representations and reproductions can powerfully alter the way we understand and interact with historical artifacts.

When offered as a surrogate for the original, digital 3D models of historical artifacts can shape the affective power of those artifacts in radically new ways. For example, at the behest of the Tlingit people, the 3D model of the Killer Whale Hat, is one of the few models on the Smithsonian X 3D website that is not available for download and 3D printing, because "Tlingit crests have been appropriated for commercial purposes in the past, and digital files are easily downloaded and abused. The replica…depicts the clan crest and is protected by the Tlingit's cultural property rights." [23] The power of the 3D model and its capacity to be "abused," points to the way in which different digital technologies can shape our understanding of artifacts. So, even though the original sacred, auratic hat has been returned, the 3D model still contains some element of its presence and its meaning through symbols, crests and other information. Thus, I suggest that our understanding of cultural heritage artifacts depends on more than mere information alone and more than material presence alone, but a combination of these factors, an

[22] Ibid.
[23] Ibid.

embodied and "situated" response which we can understand as "affect." For, as Brian Massumi describes, "the body doesn't just absorb pulses or discrete stimulations; it infolds contexts, it infolds volitions and cognitions that are nothing if not situated."[24] Interacting with a 3D model of a cultural heritage artifact on a computer screen elicits its own affective and embodied response, different than, but informed by the material artifact. As Massumi suggests, mind and body "could be seen not as binary oppositions or contradictions, but as resonating levels. Affect is their point of emergence, in their actual specificity, and it is their vanishing point, in singularity, in their virtual coexistence and interconnection – that critical point shadowing every image/expression/event."[25] This "virtual interconnection" between mind and body, affect, is shaped by not just what we can see, hear and touch, but the entire context of our situation, our emotions, our embodied relation to the space we are in, and our sudden, unexplainable reactions to certain images or objects. Further, our affective response matters to the way we ultimately understand heritage artifacts, because, as Jenney Newell argues, "historical understandings and engagements with history are not only created through information and the analysis of data, they are also formed by the learning that occurs through sensory, emotive responses."[26] In other words, our affective response to artifacts shapes the way we understand history. And because digital 3D models elicit vastly different affective responses than material artifacts, these models have a power to shift the way we understand our material history. Therefore, they must be produced and published critically and carefully, with extreme deference to source communities and other communities invested in the artifacts.

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[24] Massumi, Brian. "The Autonomy of Affect." *Cultural Critique*, no. 31 (1995): 83-109. doi:10.2307/1354446.
[25] Ibid., 94
[26] Newell, Jenny. "Old Objects, New Media: Historical Collections, Digitization and Affect." *Journal of Material Culture* 17, no. 3 (September 1, 2012): 287–306. https://doi.org/10.1177/1359183512453534.

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