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Clues. Anomalies. Understandings.
Writing Images
Beyond the Map
The Idea and Image
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critical making

DESIGN and the DIGITAL HUMANITIES

Jessica Barness
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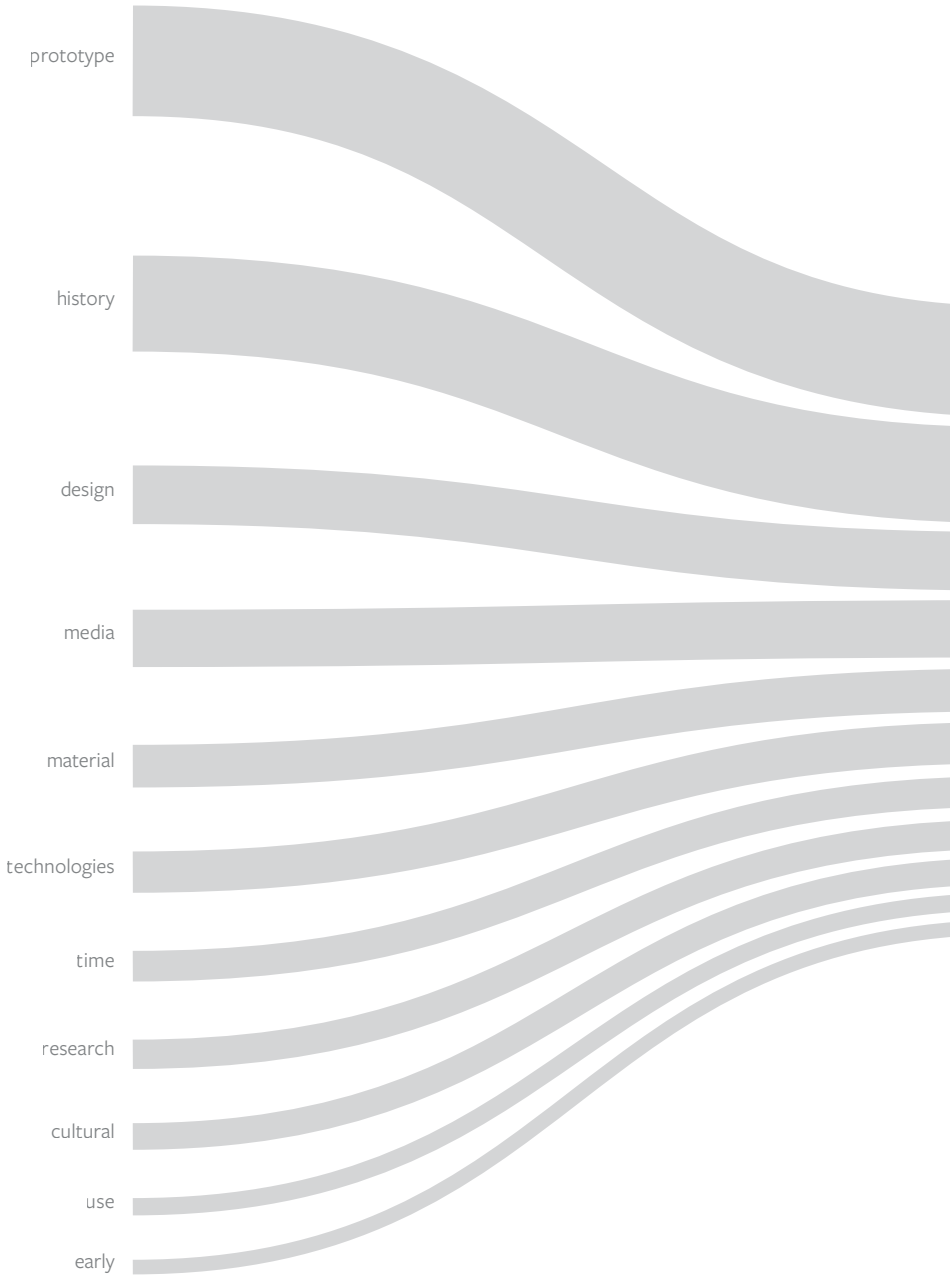
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Prototyping the Past

Jentery Sayers

Abstract

This article outlines a methodology for combining media studies with rapid prototyping and computer numerical control (CNC) techniques premised on remaking technologies that no longer function, no longer exist, or may have only existed as fictions, illustrations, or one-offs. Called "prototyping the past," the methodology understands technologies as entanglements of culture, materials, and design, and it explains how and why technologies matter by approaching them as representations and agents of history. Informed by hermeneutics, it refuses to take historical materials at face value. It situates media history in a particular thing and the contradictory interpretations that thing affords. It also relies upon trial-and-error negotiation across modes of 2-D and 3-D production, creating media that function simultaneously as evidence and arguments for interpreting the past. Yet most important, prototyping the past does more than re-contextualize media history in the present. It integrates that history into the social, cultural, and ethical trajectories of design. To demonstrate the methodology, I detail how the "Kits for Cultural History" project at the University of Victoria prototypes absences in the historical record and prompts audiences to examine the conditions of that record. I then dedicate my attention to one Kit in particular: the "Early Wearables Kit," which remakes an 1867 electro-mobile jewelry piece from Paris. After interpreting the Early Wearables Kit from three different perspectives, I articulate eight ways to understand prototyping and media history together, with an emphasis on how prototyping the past stresses the contingent relations between matter and meaning.

Keywords: jewelry, media history, rapid prototyping, reverse engineering, wearables design

Introduction

New technologies can now be used to fabricate old ones. With rapid prototyping techniques, a nineteenth-century mechanism from Cornell University's Kinematic Models for Design Digital Library (KMODDL)[1] can be downloaded, translated into code, fed to a 3-D printer, and used to repair a watch, all in about an hour. While 3-D fabrication tends to fetishize objects, in the following paragraphs I propose an alternative for media studies: "prototyping the past," which prompts scholars to remake technologies that no longer function, no longer exist, or may have only existed as fictions, illustrations, or one-offs. Conceptually, prototyping the past understands technologies as entanglements of culture, materials, and design, and it explains how and why technologies matter by approaching them as representations *and* agents of history. Practically, it is a trial-and-error negotiation across modes of 2-D and 3-D production, and it creates media that function simultaneously as evidence and arguments for interpreting the past. Yet most important, it does more than re-contextualize media history in the present. It integrates that history into the social, cultural, and ethical trajectories of design.

More common in art, design, engineering, and architecture than the humanities, rapid prototyping entails producing materials through a combination of computer numerical control (CNC) machines — such as 3-D printers (additive manufacturing) and routers (subtractive manufacturing)[2] — with manual approaches to wood, paper, clay, cardboard, and the like. The aim is to subject a model to repeated feedback and hands-on use throughout the development process. In this sense, the design cycles are small, not grand. Also, the models are versioned. Instead of working toward a single model for all audiences and contexts, multiple models are maintained and tested throughout production. This approach is steeped in "design-in-use," which privileges situated activity over some ideal model or user (Botero, 2013).[3] Through design-in-use, a prototype is treated like a congealed dialogue or relationship between interested groups. Recalling Marx, it is necessarily social.

Given common associations of rapid prototyping with waste and trinkets, researchers should be skeptical of enthusiastic applications of CNC techniques to media history. One reason not to integrate CNC into scholarly inquiry is solely for the sake of wow or whiz-bang (Sayers, 2015a). All too often, CNC machines, especially 3-D printers, are gadgets unrelated to research, and they are quite conducive to a "print now, think later" mentality. Other reasons to avoid rapid prototyping include the learning curve, the costs of acquiring and maintaining CNC machines, and the labour demanded by the manufacturing and post-production process. Additionally, scholars

1 See kmoddl.library.cornell.edu.

2 More specifically, CNC work involves the use of computer-aided design (CAD) and manufacturing (CAM) to fabricate models in tactile form.

3 I would like to thank Kari Kraus for pointing me to design-in-use.

who stress process over product may worry that prototypes — as objects — too easily mask the decisions involved in making them.[4]

With such concerns in mind, below are a few reasons why scholars of media history may wish to experiment with prototyping the past as part of their research. These reasons are informed by materialist media history[5] and inspired by the work of Kari Kraus (2009), Anne Balsamo (2011), Leah Buechley (2012), Hannah Perner-Wilson (2012), Morgan Ames (2014), Larissa Hjorth (2014), Kat Jungnickel (2014), and Daniela Rosner (2014). They also correspond in part with arguments published in "New Old Things" (2012), by Devon Elliott, Robert MacDougall, and William J. Turkel. There, Elliott *et al*. express two important points. First, "matter [is] a new medium for historical research. Working with actual, physical stuff offers the historian new opportunities to explore the interactions of people and things" (2012, p. 122). Second, prototypes may be understood as *situations* for interpretation, without an impulse to create exact reproductions of historical artifacts (2012, p. 127). Reading these two points together, the use of matter as a medium for historical research need not fetishize the past. Instead it can become a time and space to interpret the intricacies of materials design and interaction, both now and then.

Reasons to Prototype the Past

One of the most obvious appeals of remaking technologies that no longer function, no longer exist, or may have only existed as 2-D media is that remade technologies may be circulated as tangible reminders of what was forgotten, ignored, destroyed, or lost. Yet prototyping the past also affords critiques of what is ready to hand, either online or off. That is, *it refuses to take historical materials at face value*. Through trial-and-error experimentation, it iteratively tests the plausibility of historical claims.[6] After all, what is depicted in a journal, patent, illustration, or notebook may not be accurate. It may contain redactions, deliberate omissions, purposeful obfuscations, or accidental occlusions. Using historical materials to prototype a technology amplifies the meaningfulness of these absences.

Put this way, prototyping the past is deeply intertwined with hermeneutics and close reading.[7] However, its emphasis on physically remaking historical technologies expands those legacies to include the centrality of translation and tacit knowledge to media history. For example, as material is expressed across schematics, laboratory

4 For more on process over product, see Ratto on critical making (2011). For more on prototypes as arguments, see Galey and Ruecker (2010).

5 For example, see Kittler (1999), Gitelman (1999, 2006, 2014), Bowker and Star (2000), Sterne (2003, 2012), Chun (2005, 2011), Galloway (2006), Kirschenbaum (2008), Vismann (2008), Ernst (2012), Parikka (2013, 2015), and Starosielski (2015).

6 Here, we might follow Kraus's arguments for conjectural approaches to texts and editorial styles, especially her comments about the "attested states of texts" (2009, n. p.).

7 For a history of hermeneutics by way of media theory, see Galloway (2013): "Hermeneutics tries to, as it were, unmask the status quo, focusing on a development or reform of the work… [A]ny hermeneutic reading will tend to run 'against the grain' of literal or latent truth visible in the work" (2013, p. 37).

experiments, notebooks, and journal publications, information is both gained and lost.[8] Indeed, changes occur across media. Even if they cannot be fully recovered, prototyping puts pressure on these changes, opening them up to speculation. By re-contextualizing historical technologies in the present, prototyping also accentuates differences across time, including discrepancies between materials, modes of production, conditions of use, and habits of perception. When, for instance, a technology from the 1860s is prototyped in the present, we are reminded that — echoing Jonathan Sterne (2003, p. 19) — we cannot inhabit the world like they did back then. Social interactions, including interactions with technologies, are not somehow ahistorical or universal. The ways in which technologies are perceived and shape perception are situated, too. What was once an innovation in the 1860s becomes an antique or relic in 2015. Alternatively, these differences across time may turn things of the past into the stuff of present curiosity.

Rather than transcending such differences or romanticizing them through nostalgia, prototyping the past grounds media history in a particular thing and the interpretations it affords. Following the work of Karen Barad by way of Donna Haraway, such grounding posits prototypes as entanglements of meaning with matter by attending to the substance of "fine-grained details" (Barad, 2007, p. 90).[9] Here, neither meaning nor matter can be relegated to a concept or abstraction. Again, situations are significant. And prototyping reminds scholars of that significance. It is a deeply embodied process involving frustration and surprise. It also troubles paradigms of humanist control over technologies by distributing agency and intent. The material intricacies of prototyping highlight how technologies do not effortlessly emerge from the minds of brilliant inventors, engineers, geniuses, or makers. They also remind scholars that 1) the sources of matter and meaning are forever unstable and under dispute, 2) historical materials are not "total" works or complete objects but rather compositions of parts that change — degrade, rot, morph, warp, break, swell, or grow — over time, 3) numerous contributors and negotiations are always involved in a given design cycle, 4) technologies structure knowledge and perception, and 5) materials resist or diffract as many interpretations as they facilitate.

Speaking generally, then, prototyping the past refuses to essentialize technologies. It versions them, investigating how they are variously interpreted, by hand, on paper, on screen, in the past, over time, and in the present. In so doing, it expands what we imply by scholarship, including how scholarship is communicated and interpreted, and how it may shape the trajectories of design practice. Consider an example.

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8 These expressions may be understood as remediations. For more, see Bolter and Grusin (1999).

9 Writing about the work of Niels Bohr, Barad argues: *"apparatuses are the material conditions of possibility and impossibility of mattering;* they enact what matters and what is excluded from mattering" (2007, 148). Later, she notes: "Causality is an entangled affair: it is a matter of cutting things together and apart (within and as part of phenomena)" (2007, 394).

The Kits for Cultural History

At the University of Victoria's Maker Lab in the Humanities ("Lab"), which I direct, the Kits for Cultural History ("Kits") project remakes technologies from the past, packages them in bespoke containers, contextualizes them with historical materials, and encourages people to disassemble and reassemble them in numerous ways. Comparable to Heathkits[10] of yore or Adafruit[11] kits of today, the Kits include components and guides for assembly.[12] However, the guides are not reducible to instruction manuals. They are steeped in cultural history (e.g., how the technology at hand was entangled with material conditions) and do not assume a single or "correct" approach to assembly. By design, this resistance to determinism and uniformity is essential, since the Kits focus on technologies that are, for all intents and purposes, inaccessible today. These technologies are not found in galleries, museums, archives, or collections; they no longer function as they once did; or they were never actually built or mass-manufactured. Such inaccessibility necessarily entails a degree of uncertainty and ambivalence where research is concerned. Rather than approaching this uncertainty at a remove, *the Kits prototype absences in the historical record and prompt audiences to examine the contingencies of that record.* Anchored in design-in-use, this iterative method presents the prototype as a negotiation, not a definitive replica of the historical technology under examination. In the case of prototyping the past, to assert the latter would be disingenuous at best.

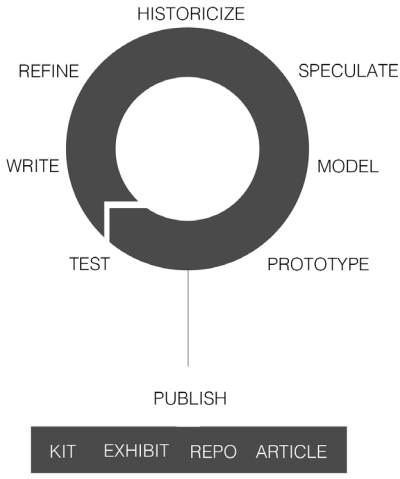

Figure 1. Design Cycle for the Kits for Cultural History, Care of Nina Belojevic, Tiffany Chan, Nicole Clouston, Katherine Goertz, Shaun Macpherson, Kaitlynn McQueston, Danielle Morgan, Victoria Murawski, and Jentery Sayers

The design cycle for the Kits is visualized in Figure 1, with the understanding that stages in the cycle routinely overlap and that, despite the tidiness of Figure 1, messiness and surprise are fundamental to the Kits as forms of inquiry.

Once the Lab selects a technology for remaking, we historicize it through archival materials: component parts, patents, illustrations, recordings, reviews,

10 Heathkits are a brand of do-it-yourself electronics kits for building everything from radios to robots. For more on Heathkit culture, see Haring (2006).

11 Adafruit is an open-source hardware company that makes and distributes electronics kits with a bias toward creative applications.

12 Kits currently under development include an early wearables kit (based on an 1867 electro-mobile skull stick-pin), an early magnetic recording kit (based on Valdemar Poulsen's work in the 1890s), and an optophone kit (based on Raoul Hausmann's work in the 1920s and 30s). For more on the design of the Kits, see Sayers (2015b).

photographs, notebooks, and even works of fiction. Informed by existing theories of media and technologies, the Lab then speculates about absences in the historical record and determines how those absences might manifest in tactile form. Next, we model, fabricate, and assemble the technology's component parts into prototypes, which we then test and share with other researchers. After testing and feedback, the Lab writes about the prototyping process and related media history. When bundled together, the writing, prototyping, and testing refine our research, and the design cycle is repeated until we deem a Kit persuasive. Once a Kit is ready for circulation beyond the Lab, we publish it in tactile Kit form (delivered by hand or post), as an online repository ("repo"), and as part of an *in situ* exhibit.[13] With these, the Lab also authors scholarly articles about the Kit's contribution to media studies. Even if they do not emerge simultaneously, we treat these publications — the tactile Kit, repo, exhibit, and article — equally as elements of scholarly communication.

Throughout the design cycle, the Lab asks several questions of the technology we are prototyping: 1) Who made it? For whom? When? 2) How was it made? Of what? How did it work? How and why was it used? 3) Do any instances of it still exist? If so, then where are they, and can they be handled, used, de-manufactured, or reverse engineered? 4) Under what assumptions was it made and used, and with what relations to history? 5) How might prototyping it shape design in the future?

While these questions resonate with existing media studies methodologies, they also push historical inquiry into a praxis informing how design can or should happen. Again, prototyping the past is more than re-contextualizing media history in the present. It constructs situations for integrating that history into the trajectories of design practice. Consider an instance in the Kits project.

The Early Wearables Kit

Part of the Kits series, the Early Wearables Kit ("Wearables Kit")[14] contains digital and analog components, a guide, and historical materials for assembling, disassembling, and interpreting an early wearable technology — specifically, a mid-nineteenth-century, electro-mobile jewelry piece made in Paris (see Figure 2). At the time, the piece was understood as a personal ornament and an innovative gadget.

Although wearables date back to wristwatches (designed for women) from the 1790s (Ryan, 2014, p. 26), *bijoux électro-mobiles* from Paris remain some of the earliest — and most ignored — wearables across histories of fashion and technology. Among these electro-mobile pieces were bird-shaped hairpins as well as skull and rabbit cravat pins ("stick-pins"). As Charlotte Gere and Judy Rudoe suggest, these pieces are "objects that would be hard to believe existed were it not for the contemporary documentation" (2010, p. 200).

13 The Kits are not intended to generate profit.

14 A repository for the Wearables Kit is at github.com/uvicmakerlab/earlyWearablesKit.

Figure 2. Photograph of an Early Wearables Kit, Care of Nina Belojevic, Tiffany Chan, Nicole Clouston, Katherine Goertz, Shaun Macpherson, Kaitlynn McQueston, Danielle Morgan, Victoria Murawski, and Jentery Sayers

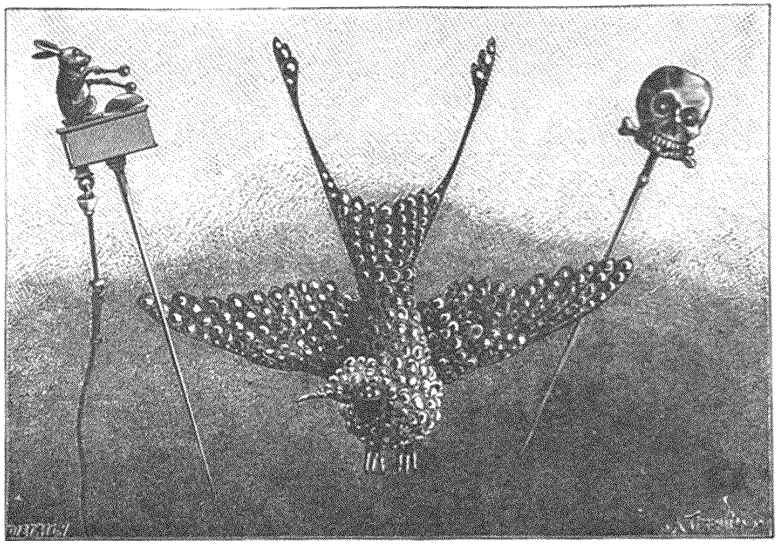

Figure 3. "Large Scale Representation of Rabbit, Bird, and Skull Electro-Mobile Jewelry," Care of *La Nature* (1879) and Barral (1891)

To the Lab's knowledge, only one of these pieces is currently housed at a memory institution: an electro-mobile skull stick-pin at the Victoria and Albert Museum ("V&A") in London (M.121-1984)[15] (see Figure 3, the pin is on the far right). It is possible, too, that none of the other pieces in Figure 3 existed as anything other than

15 At the V&A, the stick-pin is located in Jewellery, room 91, case 23, shelf A, box 12. Another instance of the stick-pin circulated through Sotheby's in London in 2003.

Figure 4. Care of the Victoria and Albert Museum, London (Museum Number M.121-1984), Two Photographs of an Electro-Mobile Stick-Pin by Gustave Trouvé and Auguste-Germain Cadet-Picard.

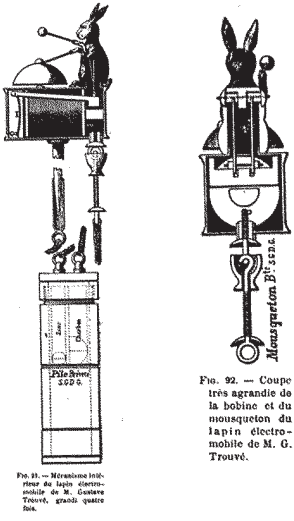

Fig. 91. — Mécanisme intérieur du lapin électromobile de M. Gustave Trouvé, grandi quatre fois.

Fig. 92. — Coupe très agrandie de la bobine et du mousqueton du lapin électromobile de M. G. Trouvé.

Figure 5. "Inside Mechanism of an Electro-Mobile Rabbit Enlarged Four Times" (left) and "Enlarged Image of the Coil and Carabiner of the Electro-Mobile Rabbit" (right), Care of Barral (1891).

a prototype or one-off.[16] The Lab is certain, though, that none of them, including the skull, was ever mass-manufactured.

Designed by Gustave Trouvé (an engineer and instrument-maker[17]) and made by Auguste-Germain Cadet-Picard (a jeweller), the electro-mobile skull stick-pin at the V&A is 9.2-centimeters-tall, 1.5-centimeters-wide, and 1.6-centimeters-deep.[18] Dated 1867, it is made of gold and enamel with diamond sparks. Originally, the eyes of this "death's head" were said to roll, and the jaw was said to snap, both when charged by "a miniature hermetically sealed battery" hidden inside the wearer's pocket (2010, p. 210).[19] The intended wearers were middle-class men (e.g., merchants and entrepreneurs) who

16 George Barral (1891) suggests that the bird, skull, and rabbit all functioned at some point. However, his text is prone to hyperbole, and working instances of neither the bird nor the rabbit exist today.

17 For more on Trouvé and nineteenth-century instrument-making, see Blondel (1997).

18 Details are available via the V&A's online collections: collections.vam.ac.uk/item/O115814/stick-pin-cadet-picard-auguste/.

19 Trouvé is frequently credited with designing the first miniature hermetically sealed battery, which he patented (granted on July 1, 1865, No. 67294).

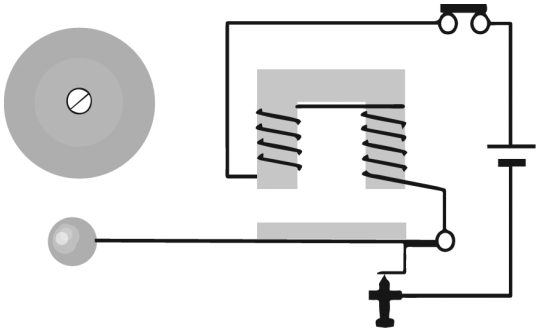

Figure 6. Diagram of an Interrupter-Type Electric Bell (Image in the Public Domain)

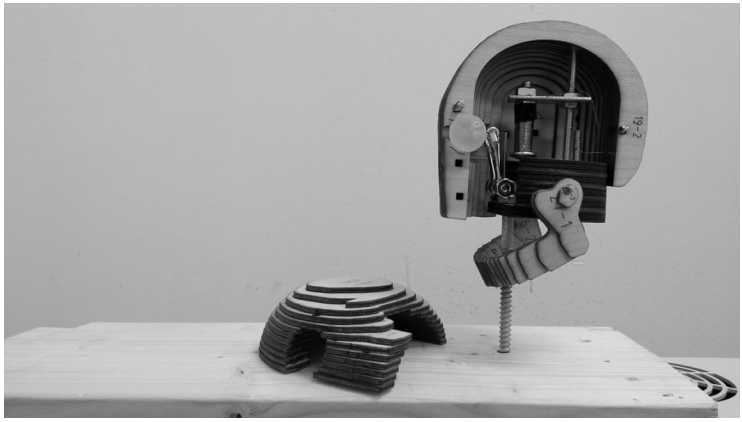

Figure 7. Photograph of a Large-Scale, Functioning Prototype of an Electro-Mobile Skull Stick-Pin, Care of Nina Belojevic, Tiffany Chan, Nicole Clouston, Katherine Goertz, Shaun Macpherson, Kaitlynn McQueston, Danielle Morgan, Victoria Murawski, and Jentery Sayers

could afford novelties (2010, 190). A work of neither high art nor exquisite jewelry, the electro-mobile skull aimed to entertain.[20] It was never fashionable.

Today, the skull stick-pin at the V&A (see Figure 4) is not animated. Indeed, batteries are not included.[21] They did not stand the test of time, and thus the skull's eyes and jaw do not move automatically. The piece is also behind glass and cannot be handled — let alone de-manufactured — by researchers.[22] This means the skull's interior remains nearly invisible to audiences, with the mechanisms for animating its eyes and jaw rendered practically opaque. What is more, Trouvé's archives were destroyed in a fire (Desmond, 2015, p. 179). With these factors combined, determining how

20 During the 1880s, Trouvé made illuminated jewelry, which combined his hermetically sealed battery with newly developed incandescent lamps made with carbon filament (Gere and Rudoe 2010, 210). This illuminated jewelry received attention from *Scientific American, The Voice, The Electrician, La Nature,* and *The Jewelers' Circular and Horological Review.* Illuminated jewelry tended to display masculine innovation on women's bodies during stage performances and theater productions.

21 Gere and Rudoe write: "The battery no longer survives but the connection for the wire is visible beneath the crossbones" (2010, p. 210, Figure 162).

22 In an email to me, dated 15 May 2015, Richard Edgcumbe of the V&A's Metalwork Collection wrote: "There is no access to the works of the V&A's pin."

Figure 8. Photograph of an At-Scale, Functioning Prototype of an Electro-Mobile Skull Stick-Pin, Care of Nina Belojevic, Tiffany Chan, Nicole Clouston, Katherine Goertz, Shaun Macpherson, Kaitlynn McQueston, Danielle Morgan, Victoria Murawski, and Jentery Sayers.

Trouvé and Cadet-Picard animated the skull — *if they actually animated it* — is difficult. However, some digitized illustrations of *bijoux électro-mobiles* remain, including the illustration in Figure 5 of an electro-mobile rabbit:[23] With some additional research and contextualization, including newspaper publications about the stick-pin's demonstration at the 1867 *Exposition universelle* in Paris, these 2-D images can be translated into a functioning electro-mobile skull, which — as Figure 5 suggests — was animated by a mechanism found in interrupter bells.

After the development of electromagnets during the 1820s, such bells were common in Europe by the 1860s. They were found in doorbells, alarms, telegraphs, and — later in the century — telephones, too. These everyday devices probably informed Trouvé's electro-mobile pieces. Relying on digitized illustrations, the Lab therefore combined nineteenth-century bell and jewelry designs, including illustrations in Figures 5 and 6, to create functioning prototypes of the skull stick-pin. While the prototypes are not exact reproductions of the original, they give researchers a tangible sense of its composition. With computer-aided design (CAD) software and CNC machines, the Lab also experimented with large-scale prototypes, which are easier than the original to examine and test by hand (see Figure 7). The large-scale prototypes help the Lab gradually fabricate and assemble prototypes at scale, including the prototype pictured in Figure 8.

Collectively, these prototypes serve as situations for research across meaning and matter, with an emphasis on the assumptions under which the skull stick-pin was

23 Thanks to Lab researcher, Danielle Morgan, over two hundred illustrations of Trouvé's work are publicly available at github.com/uvicmakerlab/trouve. Morgan extracted these illustrations from Barral's 1891 Trouvé biography and translated all captions from the original French into English.

made and used. As the prototypes re-contextualize the past in the present, they also inform future design practices. Consider three interpretations of the Wearables Kit.

Mourning, Ornament, Protocol

The skull stick-pin at the V&A was novel in the 1860s because it combined electric bell designs with designs for mourning jewelry and personal ornamentation. This historically unique combination resulted in a popular attraction (at the 1867 *Exposition universelle*) that also received rather negative reviews from critics. As one may guess, the pin was ultimately deemed more of a technical achievement than an aesthetic innovation. However, it also operated across several social and cultural registers, as a commentary on nineteenth-century protocols for bereavement and dress.

While mourning jewelry is typically understood as a gesture of remembrance and respect toward the dead, it is also a *memento mori*: a reflection on mortality and transience — on the inevitably of death and the passing of time (Taylor, 2009, p. 185). During the 1860s, fashion appropriated various mourning mementoes (e.g., skulls, bones, hair, and teeth) from centuries ago (2009, p. 185-189), with mourning jewelry frequently functioning as a status symbol. While it was accessible to many, the quality of materials worn nevertheless marked class and social standing. Lou Taylor writes: "Special jewellery and accessories become yet another expensive item to be added to the long list of requirements considered socially essential after bereavement" (2009, p. 185). Indeed, across Europe, including England and France, decrees as well as norms of etiquette, gender, and sexuality regulated mourning during a time when, by today's standards, mortality rates were high and life expectancy was low, particularly in urban areas. After a death, mourning jewelry was to be worn almost immediately (Gere and Rudoe, 2010, p. 125), and there were prescribed stages of mourning (e.g., "first mourning" and "second mourning") as well as acceptable jewelry colors, usually white, black, and gold.[24]

Popular publications proliferated these dress rituals by helping to commodify death. While offering suggestions for mourning fashionably (2010, p. 125), magazines documented how high society mourned in public. For instance, on April 1, 1867, the *Ladies' Treasury* in London reported how Queen Victoria was publicly mourning the 1861 death of her husband, Albert, Prince Consort:[25] "At the Court recently held by the Queen, Her Majesty wore a black silk dress, with a train trimmed with crape, and

24 Of course, these colors were worn outside of mourning: "[t]he use of black in Victorian dress is intensely ambiguous, especially in light of mixed feelings about the brilliant colours that became available in the 1850s. A preoccupation with death that permeated Victorian culture at all levels has led to the assumption that women depicted in black with jet jewellery must be in mourning. But this must be backed by evidence showing that the trimmings are of crape, a fine wrinkled silk, or that the dress is made from the twilled silk and worsted called bombazine, both materials specifically decreed for mourning wear" (Gere and Rudoe, 2010, pp. 120-121).

25 As Gere and Rudoe note, when Albert died, "[m]emorial pendants with the Prince's photograph by Camille Silvy taken on 3 July 1861, in a setting of Fountainebleau-style strapwork, were ordered for many of the Queen's closest confidants. . . . Men were presented with stick-pins with the portrait set in gold martyr's palms" (2010, p. 56).

the Mary Queen of Scots cap, with a long veil of white crape lisse, and a coronet of jet. Her Majesty also wore jet ornaments, the Riband and Star of the Order of the Garter, and the Victoria and Albert Order" (1867a, p. 186).[26] Among these, jet jewelry — such as French jet (a type of glass) and Whitby jet (a type of fossilized wood) — was quite popular during the period. Across Europe, but especially in England, mourning jewelry was a lucrative industry. Businesses that invested in jet mining, carving, and supply thrived during the 1860s and '70s (Taylor, 2009, p. 195-199), and they did so without bespoke production. Since mourning pieces were worn just after a death, they were simple and impersonal (Gere and Rudoe, 2010, pp. 124-125), making them all the more conducive to standardized manufacture.

Alongside the popularity of mourning jewelry during the 1860s, men routinely wore — and were expected to wear — pieces such as cravat pins, rings, cuff-links, and neckwear. Later in the century, watches and watch-chains gained traction. As with mourning jewelry, these pieces marked status and wealth, and they, too, were regulated by norms of etiquette, gender, and sexuality.[27] On the topic of stick-pins in particular, Gere and Rudoe write: "Stick-pins were vehicles for little masterpieces of jewellery, for novelties of all kinds, including mottos and puns" (2010, p. 135). This observation applies to the electro-mobile skull. A novelty somewhere between mourning jewelry and personal ornamentation, it is a pun on *memento mori*: With its snapping jaw, death literally reminds people of itself. An ornament not only made of gold but to be worn on the chest, it is also a rather playful expression of death's reminder. It could have even been a joke directed at British severity about Albert's passing. It may have mocked the sternness of Victorian dress guides that advised against trends, false jewels, elaborate styles, and conspicuous dress.[28] And it may have revelled in mourning culture as a lucrative industry at the time. Whatever the interpretation, it certainly experimented with decrees and etiquette. Yet, in so doing, it actually reaffirmed their potency. It demonstrated how, more often than not, puns in design merely accentuate the pervasiveness of norms.

Prototyping this pun foregrounds how, as both metaphor and matter, it intersected fashion with technology, mourning with ornamentation, jewelry with gadgetry. The pin is treated not as a complete object to be consumed but rather as a series of component parts to be reverse-engineered and reassembled. Doing so traces how seemingly diverse materials — diamonds, gold, wires, electromagnets, iron, carbon, zinc, and more — collectively became a novelty in 1867. It also tests historical accounts of the pin. Shaped by the rhetoric and whiz-bang of grand exhibitions, these accounts lean toward the hyperbolic, and they come with their own assumptions. For instance, after attending the *Exposition universelle,* a reporter for *The Times* in London said a button caused the "death's head to chatter and roll its horrid eyes" (1867b, p. 9).

26 Gere and Rudoe (2010, p. 124, Figure 79) quote these two sentences; however, their quote does not correspond exactly with the content of the source.

27 Gere and Rudoe write: "there were many opportunities for men to wear jewellery in much the same way as women" (2010, p. 135).

28 For an example of how skull stick-pins were perceived in London, see Leech (1853).

Aside from the value judgment implied by this description (which rehearses cultural apprehensions toward animating inanimate objects, or giving life to the dead), the stick-pin was not button-triggered. Instead, the wearer actuated a hermetically sealed, 1.5-volt pocket battery — made of zinc and carbon and activated by ammonium chloride — by flipping it from a vertical to a horizontal position.[29] Perhaps this detail is too fine-grained, but it meant the wearer had less agency over the skull's animation than a button would afford. In this sense, electro-mobile jewelry differed from electric bells found at hotels and railway stations during the 1860s.

For current design practice, the stick-pin's composition and cultural function remind us that wearables are not merely additive or superficial. They should not be reduced to symbols or accessories, or to forms of romantic self-expression. They are imbricated with protocols that shape choice, behavior, identity, and interaction. Today, with wearables producing data about people's physical and social activities, this lesson is all the more important.

Miniaturization and Nostalgia

An electrical engineer trained in clock- and watch-making, Trouvé specialized in experiments with miniaturization. In 1882, *Scientific American* borrowed language from Alexandre Dumas to suggest that Trouvé's fingers had "at once the strength of those of the Titans and the delicacy of those of the fairies," noting, too, that "[i]t is in small works that electricity excels" (1882, p. 5767). Later, in 1891, George Barral claimed: "One cannot imagine anything more charming, more graceful, more fun than these little figures animated by Trouvé's Lilliputian battery and his electro-motor so microscopic that it can fit in 3 cubic millimeters, barely one one hundredth of a sewing thimble" (translated from original French; 1891, p. 161). These inflated comments position the stick-pin as a crafty gadget. Together with the technical terminology (e.g., "battery" and "electro-motor"), there are references to technological progress (e.g., "excels") and material achievement (e.g., "graceful" and "so microscopic") as well as to skilled manual labor (e.g., "strength" and "delicacy"). Read collectively, the language marks an alignment of aesthetics and miniaturization with mastery and positivism. As Susan Elizabeth Ryan observes of early wearables, such an alignment is historically masculine (2014, p. 29). During the 1860s, it was also steeped in nostalgia, or a yearning for unadulterated life found in miniatures at the fingertips.

Susan Stewart argues that "[t]he miniature does not attach itself to lived historical time... [A]s an object consumed, [it] finds its 'use value' transformed into the infinite time of reverie" (1993, p. 65). Following Stewart's logic, crafting the electro-mobile skull was synonymous with crafting private time, which — during the second half of the nineteenth century — intersected with the recovery of authentic skills and preindustrial labor amidst the emergence of industrial capitalism and factory work (1993, p. 68). Here, the pin's size and use are crucial. Again, it is 9.2-centimeters-tall,

29 For more on the battery, see Desmond (2015, p. 27-30).

1.5-centimeters-wide, and 1.6-centimeters-deep, and it fits easily in a cravat. It is hand-made, and its battery — ostensibly "one one hundredth [the size] of a sewing thimble" (Barral 1891, p. 161) — is called Lilliputian, a reference to Swift's *Gulliver's Travels* (1726). Returning to Stewart: "As is the case with all models, it is absolutely necessary that Lilliput be an island. The miniature world remains perfect and uncontaminated by the grotesque so long as its absolute boundaries are maintained" (1993, p. 68). A source of power tucked in a coat pocket, the battery is not only small. It, like its engineer,[30] is hidden from view, heightening its influence as both pun and trick by separating it from the skull's performance higher on the body, nestled in a cravat. The material particulars of design, or how this becomes that, matters less than the effect or experience of animation. In fact, too much attention to particulars would contaminate the boundaries drawn between the miniature and its power source.

Prototyping this miniature attends to exaggeration in its historical description, yet it also identifies where the skull may resist or diffract desired effects. Attention to such surprises exposes some of the humanist impulses (e.g., assumptions that people control matter) in Stewart's arguments while granting significant legitimacy to tacit knowledge — both then and now — of the stick-pin. As the Lab discovered, prototyping an electro-mobile wearable at scale is quite difficult even today. However, this difficulty need not reaffirm masculine histories of mastery and manipulation. And it need not facilitate an homage to Trouvé, Cadet-Picard, or preindustrial craft. In fact, it should do quite the opposite: raise questions about the degree to which the discourse of miniaturization corresponded with what was actually made, how it was made, whether it was made, how it was maintained, and how reliable it was.[31] In the last instance, did the skull's jaw snap or eyes move in a persistent fashion? Were they ever animated? We will never know for sure. What we do know is that hyperbole plays a key role in media history, and historical materials should not always be taken at face value. In fact, the inflated discourse around early wearables may also explain, at least in part, why so few *bijoux électro-mobiles* exist off both paper and screen today.

Where future design practices are concerned, early rhetoric of miniaturization maps rather neatly onto current yearnings for pre-digital living. If, during the 1860s, miniaturization enabled a private experience somehow removed from the storm of industrial capitalism, then today many maker movements promote a do-it-yourself ethos that longs for a simpler, slower, more authentic moment prior to the Internet and personal computing. These visions are not only nostalgic for a past that never happened. They are also subtended by technological determinism, and they generally ignore the social and cultural nuances of manufacturing. Indeed, for most people (including workers across 1860s Europe), manufacturing was not — and is not — a leisure activity rife with play and experimentation. It was and remains a situation with

30 Stewart: "The automaton repeats and thereby displaces the position of its author" (1993, p. 60).

31 As Rosner and Ames (2014) argue, maintenance and repair play a fundamental role in technology, culture, and infrastructure.

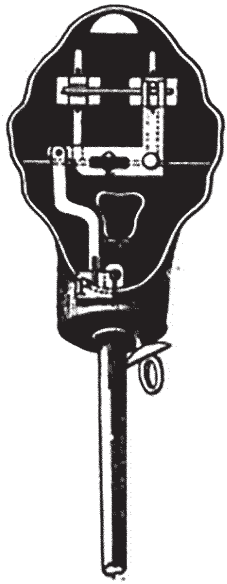

Fig. 93. — Vue intérieure très agrandie (l'électro-moteur étant enlevé) du mécanisme des yeux et de la mâchoire du turco électro-mobile de M. Gustave Trouvé.

Figure 9. "Enlarged Interior View without Electric Engine of Mechanism for the Eyes and Jaw of an Electric-Mobile Turk," Care of Barral (1891)

many risks. As design research proceeds, it could thus attend more to the material conditions of manufacturing, without encouraging a privileged withdrawal into the romantic experience of a maker outside of industry.

Orientalism and the Mechanical Turk

To communicate the technical particulars of electro-mobile jewelry, Trouvé published two illustrations of the electro-mobile rabbit's interior (see Figure 5). While few scholars, including Marvin (1988), Gere and Rude (2010), and Ryan (2014), have written about electro-mobile jewelry, publications across academic and popular venues tend to reference only these two illustrations. To the Lab's knowledge, what has not been addressed is the fact that Trouvé also designed an electro-mobile "turk," which, together with the rabbit illustrations, is the only surviving representation of the jewelry's inner workings. While one of the rabbit illustrations was published in *La Nature* (1879), Figure 9 only appears in Barral's 1891 Trouvé biography.

This illustration suggests that, like many other nineteenth-century engineers, Trouvé redeployed Wolfgang von Kempelen's orientalist construction of the chess-playing Mechanical Turk automaton (1770) for his electro-mobile designs. As Ayhan Aytes explains, the Mechanical Turk performed "a particular form of docility that conveys the idea of the disciplined productive body" (2013, p. 83). The chess-playing automaton was in fact a mannequin manipulated by von Kempelen's assistant, who hid in a cabinet at the base of the mechanism and controlled its behaviors (2013, p. 82). Through this articulation of technology and culture, the Mechanical Turk embodied orientalist assumptions that enlightened, white minds in Europe could program racial others and render them media for rationalist expression (2013, pp. 82-83). Even if Trouvé or Cadet-Picard unconsciously revitalized these orientalist assumptions through electro-mobile jewelry, the important fact is that the assumptions persisted — via design — well beyond von Kempelen's eighteenth-century automaton. In fact, as Aytes points out, von Kempelen's model persists today. In 2005, Amazon named its online micro-tasking platform the Mechanical Turk (2013, pp. 79-81).

Through what Anne Balsamo calls "hermeneutic reverse engineering" (2011, p. 14),[32] prototyping the V&A's electro-mobile skull stick-pin underscores how the

32 Hermeneutic reverse engineering is a "framework [that] combines insights from interpretive theory with standard designing practices used by engineers, computer scientists, and cre-

Mechanical Turk (in particular) and orientalism (in general) are meaningful not only as concepts or metaphors; they are also mechanics operating through models and matter over time. Across Trouvé's various electro-mobile designs, his use of an electromagnetic mechanism is consistent. To borrow language from present-day software rhetoric, he simply changed the "skins" of the jewelry pieces. At the time, this combination of consistent mechanics with aesthetic variation was anchored in an electromagnetic worldview,[33] or the belief that electromagnetism could account for all scientific *and* natural phenomena. For Trouvé and others, electricity and magnetism were thus ways to control life itself. From an engineering perspective, they were also ways to automate von Kempelen's assistant and delegate his decisions to a technology. If we map Stewart's interpretation of miniaturization onto an electromagnetic worldview, then von Kempelen's Mechanical Turk could not only be further manipulated through a change in scale, reducing it to a piece worn on the body. Von Kempelen's logic could also be extended to all bodies and life forms. Put this way, during the second half of the nineteenth century, electromagnetic mechanisms[34] became vehicles for rationalist expression through human *and* non-human others. The use of "skins" to render these mechanisms opaque merely increased the appeal of instrumentalist design and its perceived effectiveness as a logical paradigm.

The trajectories of design practice can learn from this history by first recognizing that the past is more than a referent. It is an active ingredient of technologies across their construction, circulation, and use, even if it does not determine their development. Accordingly, Trouvé's remaking of von Kempelen's Mechanical Turk demonstrates one among many reasons why prototyping the past should refrain from fetishizing or commodifying history. Much like writing one's way through an archive, prototyping the past is a form of inquiry: a methodology for unpacking and examining the matter and meanings of media, including absences. *Without hermeneutic reverse engineering, prototyping risks naively rehearsing or celebrating history*. For instance, we may consider ongoing concerns with steampunk (which plays counterfactually with Victorian aesthetics and identities) or, again, a now common yearning for pre-digital living — a nostalgia that ignores political economy to invent historical experiences.

With this nostalgia in mind, prototyping the past highlights how black box[35] theories are steeped in legacies predating cybernetics and software. In the case of von Kempelen's assistant in a cabinet or Trouvé's bell in a skull, an instrumentalist

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ative thinkers… [W]hat is reverse-engineered are the elements that contribute to the meaning of a given technocultural formation" (Balsamo 2011, p. 14).

33 I would like to thank Edward Jones-Imhotep for pointing me to the intersections between electro-mobile jewelry and an electromagnetic worldview.

34 Hans Christian Ørsted is credited with discovering, in 1820, the relationship between magnetic fields and electric currents. William Sturgeon is credited with inventing a seven-ounce electromagnet in 1824. Sturgeon later published his work, in 1826, in *Annals of Philosophy*.

35 For more on black box theory, see Latour (1987): "The word black box is used by cyberneticians whenever a piece of machinery or a set of commands is too complex. In its place they draw a little box about which they need to know nothing about its input and output" (p. 2-3).

worldview turns this into that, under an assumption that "sourcery" (Chun, 2011, p. 19) — or a privileged mastery of technologies as the materialization of reason — allows makers to manipulate life at their fingertips. Historically intertwined with an electromagnetic worldview, sourcery masks more than the magic of technological process. Consciously or not, it masks values, too. That said, while *bijoux électro-mobiles* may appear "quaint" as historical novelties, neither their matter nor their meanings should be romanticized or relegated to amusement.

Ways of Prototyping

The electro-mobile skull stick-pin at the V&A yields no coherent or unambiguous interpretation. It does not add up, and no single paradigm anticipates its relevance. Such is the effect of prototyping the past: *refusing to take history at face value results in irony and surprise*. Here, then, I would like to reflect upon arguments I made in this article by listing ways to think about media history and prototyping together: 1) prototyping the past demands methods and perspectives from across disciplines; 2) prototyping is not always futurist, and it is not restricted to forecasting; in fact, it is arguably fundamental to the practice of materialist media history; 3) 3-D media such as tactile models are not more persuasive than 2-D media such as illustrations; both may include exaggeration and omission, and they should be interpreted in tandem, not in opposition; 4) many aspects of media history remain inaccessible even with direct access to physical materials at memory institutions; having these materials at hand neither resolves issues of absence nor guarantees certainty about the past; 5) contrary to instrumentalist approaches invested in exact reproductions of history, prototyping the past may resist nostalgia, glorification, re-enactment, or fantasies of "being there"; as with any research method, it is not immediate and cannot access "real history"; 6) prototyping the past may be premised on *not* replicating history — on what, from a cultural, social, or ethical position, we should *not* repeat; 7) where it is intertwined with hermeneutics, prototyping may test suspicions we have about history by grounding them in fine-grained details of matter and meaning; and 8) prototyping the past is closer to Derridean deconstruction than Hegelian idealism. It need not aim for a totalizing or rational history without remainders. Instead, it can recognize how many aspects of the technologies we use to reproduce history exceed our control and understanding. Indeed, the speculative elements of prototyping can be anchored in the specificities surrounding historical absences — of what we cannot prove or do not know for sure but certainly shapes us. Most important, prototyping the past may concern itself primarily with the *contingent* relations between matter and meaning. It is not a metaphysical project. It is a realist one, moving from the particulars at hand, to conjecturing what may have been at hand, to prototyping an otherwise inaccessible apparatus in the present, with considerations for future design practices. Rather than fetishizing history, it pursues an objectivity it knows it cannot achieve in the first place.

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