Digital Humanities as Epistemic Cultures: How DH Labs Make Knowledge, Objects, and Subjects

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Abstract

This essay develops a conceptual framework for examining and practicing digital humanities (DH) and DH labs from the perspective of science and technology studies and laboratory studies. We argue that the "situatedness" of DH labs extends beyond physical/institutional space and includes also epistemic, political, sociological, and disciplinary issues. To explore this, we first outline the constructivist model of laboratory knowledge practices developed through feminist laboratory studies, and how that model's focus on the laboratory as a producer of research subjects, rather than a container for them, runs counter to narratives about laboratories in DH. We then show how DH labs produce research objects, research subjects, epistemic context, and disciplinary legitimacy. Finally, we present the case of the Tactical Humanities Lab (THL) at Rensselaer, a DH lab situated through Science & Technology Studies and housed within an engineering-centered institute. Through the highlighting of two student-led projects, we show how THL knowledge workers navigate issues of our own identity, the boundaries of STS and DH, the practice of social justice through DH, and the social construction of the boundaries of laboratory work.

1. Introduction

How we as digital humanities (DH) scholars construct the laboratory — as a space, as a culture, as an imaginary, as a process, as an apparatus — contributes to the material and epistemic production of DH labs, their spaces, cultures, practices, and products. Our foci in this essay are the disciplinary constructions of the laboratory and its products as epistemic cultures [Knorr Cetina 1999], and the expansion of the "situatedness" of DH labs beyond physical/institutional space to include epistemic, political, sociological, and disciplinary concerns. Rather than narrowly framing labs as spaces of technical production and inquiry, we begin from the premise that laboratory structures and cultures produce specific kinds of knowledge practitioners. These practitioners in turn produce and police the boundaries of legitimate and recognizable knowledge work — including in the Digital Humanities. All of these productions are, in part, results of particular institutional and disciplinary positions, even as they can sometimes be presented as "matters of fact" [Latour 2004]. An "opening up" of the imaginations of how DH situates itself and of how DH practices configure and reconfigure researchers can, in turn, serve as an opening up of new disciplinary, institutional, and political formations of DH knowledge work.

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We will make this case by using Science & Technology Studies' (STS) "Laboratory Studies" literature to examine DH labs and their practices, and through illustrations of how the Tactical Humanities Lab (THL), an STS-situated DH lab at Rensselaer, grapples with its own identity, the constructed boundaries of STS and DH, and the social construction of the boundaries of laboratory work. The THL is in many ways an improvised space, operating out of shared spaces and funded by a new professor's startup fund, contrasting with more institutionally supported labs (e.g. [Foka et al. 2017]). With this spirit of relative outsider, the THL operates as an inverse of the typical imagination of the relationship between DH theory and practice. Rather than asking how technical tools can be applied to humanities questions, the THL focuses on how method and inquirer are mutually shaped through research practices, and on how the "divide" between

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technical and interpretive scholarship and methods is a historical and contingent one. This flipped model encourages faculty, graduate students, and undergraduate students in the THL to co-theorize about the multiple social constructions of the digital and the virtual in humanistic and social scientific cultures, and to experiment with using DH to produce new situations for social justice.

2. Laboratory Studies and the Production of Subjects and Objects

Laboratory Studies of the late 1970s/early 1980s represented a seismic shift in the then-still-emerging field of STS. While work in the Sociology of Scientific Knowledge (SSK) had been present in British STS circles since the late 1960s [Bloor 1976] [Collins 1975], SSK had largely focused on the relationships among macro-social and historical narratives and events upon scientific enterprise, particularly in terms of how scientific controversies are created, debated, and resolved. The social, ideological, and historical were either treated as external factors that potentially led to the "incorrect" interpretation of work generated by scientific research, or were constructed as variables that intersect with scientific knowledge [Bloor 1983].

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Through the use of ethnographic method, Laboratory Studies focused on scientific work as *in situ* practice, where the wider results of "science" were negotiated and produced through the everyday activities of scientific practitioners and knowledge workers. Perhaps the most broadly recognizable early Lab Studies work was Bruno Latour and Steve Woolgar's tracing of knowledge production in Roger Guilleman's Salk Institute labs in *Laboratory Life* (1979). The book would build the foundations for Latour's later work on Actor-Network Theory (ANT), whose "flattening" of the agency of non-humans and things in daily life would become majorly influential both inside and outside of STS circles. The presence of ANT can be seen in DH work [Bianco 2012], flat ontology [Bogost 2012], object-oriented [Bryant 2011], speculative [Harman 2011], and media archeological [Parikka 2016] literatures.

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While ANT's highlighting of the agency of objects and "the missing masses" [Latour 1992] is often positioned as a "counter" to social constructivist critique of science [Bloor 1999], STS has tended to treat these approaches as dual components of a broader "both/and" analysis of scientific practice [Winner 1980]. Object-oriented fans of Latour's later ANT work may be surprised reading *Laboratory Life*, which uses a clearly social constructivist interpretation of scientific practice. Latour and Woolgar conceive of the scientific fact as constructed — not only in terms of the processes of interpretive, interpersonal, and methodological negotiations that occur during research practices, but also in terms of the need for political and social institutions to legitimate scientific knowledge. Though this argument is accused by some of radical postmodernism or correlationism [Harman 2011] [Bryant 2011] or of denying reality [Eidin 2004], its analytic power has been made even more evident during the US Trump administration. The "production of ignorance" [Kleinman et al. 2013] about global warming, for example, is more than just the spread of misinformation and deletion of data. It is also the systematic undermining of the institutions that give scientific facts their legitimacy and political power — universities, government agencies, grant agencies, congressional commissions, educational systems, and the media. From this more relational perspective of ANT/social constructivist approaches, the networks of humans, non-humans, institutions, and infrastructures that produce knowledge appear less like antagonistic or collaborative forces pushing against one another, and more like a mapping of the contingent material and social forces that "lash-up" the realities and practices we believe to be concretized [Bijker et al. 2012] [Molotch 2003].

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Further, Latour and Woolgar argue that the construction of scientific knowledge — and in particular, of "facts" — socially produces neutrality and objectivity. While the scientific method is far from neutral, and while scientific knowledge workers spend large amounts of time debating and negotiating interpretations of experimental results, these results tend to be reported as objective fact in scientific publications; the rhetorical and epistemological frame of "facts which speak for themselves." In this way, Laboratory Studies scholars argue that the broader institutional, cultural, and political milieus of scientific practice are not the *contexts* of laboratory practices, they are *productions* of those practices. The results, methods, interpretations, and political impact of scientific research are thus co-produced and co-legitimized through the practices of scientific knowledge workers.

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The Laboratory Studies of the 1990s would extend the analysis of the laboratory as a site of multi-modal production. Among the most vital work of this era was that of Karin Knorr Cetina, which culminated in the publication of *Epistemic*

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Cultures in 1999. Knorr Cetina's research, a comparative analysis of ethnographic experiences at a molecular biology lab and at the CERN High-Energy Physics (HEP) lab, served as a major blow to the "Unity of Science" epistemological frame — the idea that all scientific practices are united under a grander methodological and empirical truth, and therefore that all scientific practices, properly arranged, can contribute to an unbroken, consistent accounting for the natural and social world [Knorr Cetina 1999]. Rather, Knorr Cetina argues that different scientific disciplines — and even different localized scientific research apparatuses — produce different epistemic cultures: different ways that knowledge is produced and disseminated, facts and research are legitimized, the "empirical" and the "theoretical" are defined and related, laboratory apparatuses and equipment are socially constructed, and institutions and structures are built and maintained. "Science," then, is radically disunified — the practices and epistemic frameworks of different scientific knowledge spaces are not interoperable without further interpretive, constructive, and political work, and do not "add up" to a unified view of the world. The production of a unified Science is more institutional than it is epistemic, with the separation of the "objective and neutral" disciplines from "softer and interpretive" ones providing political and ideological legitimacy, often accompanied by larger funding streams and infrastructural support [Malazita 2018b].

Earlier Lab Studies work tended to make agential cuts between the labor of laboratory practitioners and the outcomes of laboratories; i.e., the material and social productions of laboratory work were the results of the collective action of lab workers and the actor-networks of which they were a part. Knorr Cetina, however, argued that the lab workers themselves, subjectively and epistemically, were also products of the laboratory apparatus. The intra-actions [Barad 2007] of discursive, material, and institutional networks produce laboratory researchers as "epistemic subjects" [Knorr Cetina 1999], or practitioners attuned to particular ways of knowing, of ways of bounding internal and external disciplinary knowledge, and ways of producing the institutions and infrastructures needed to legitimize that knowledge and its boundaries. Latour and Woolgar's observations of the production of the "neutrality" of a scientific fact can be extended through Knorr Cetina: scientific knowledge workers also co-produce themselves as knowers of "neutral" research. ₈

As the identities and subjectivities of scientific practitioners are not pre-given, neither are their objects of study, which Knorr Cetina calls "epistemic objects" (1999). Epistemic objects are produced through the boundaries drawn around what makes an object knowable. These boundaries are material and social. Global Warming, for example, can be produced as a scientific object, an economic object, a social object, a political object, and/or a synthesis of any of the prior through the apparatuses enrolled [Callon and Law 1982] to know and bound it, through the practices of scientists, journalists, politicians, and their interests, and through the theories and technologies of knowing capable or chosen to be deployed. The co-productions of epistemic subjects and objects are not "just" rhetorical or framing moves; how we construct the formation of our objects of study and our relationships to them produces lasting and durable infrastructures and institutions of knowledge. ₉

The production of epistemic objects, subjects, and infrastructures transverses and co-produces the boundaries of applied and theoretical work, as well as the boundaries of the physical and the virtual. For example, in her studies of HEP, Knorr Cetina describes how the laboratory apparatus is designed through the co-constructions of the physical high-energy particles and their digital representations: ₁₀

> The experiment designs and builds the apparatus in which the particles register. Physicists, however, do not start with the particles, they start with representations of the detector, that is, "offline" manipulations of the signals extracted from detectors after data have been taken. This level of representation reconstructs the events in the detector and slowly molds these signals into a form that echoes the particles of interest to physicists. [Knorr Cetina 1999, 49]

The typical rhetoric of the physical/virtual divide is complicated in laboratory knowledge practices. Rather than the digital representations of particles being "results" of physical particles, they are embedded among physical particles and among the epistemic objects of particles, made perceptible by laboratory researchers as epistemic subjects and by the apparatus of which they are a part. The relationship between the laboratory apparatus, the researchers, the material, the discursive, and the virtual, is thus not one of transition between multiple layers, or of a causal chain, but rather is a co-constitutive relationship; they all produce each other, participating in one another's existence. ₁₁

1990s Laboratory Studies' use of ANT and social constructivist models of knowledge production, blended with the concurrent emergence of feminist, cybernetic, and posthuman configurations of subjectivity [Haraway 1991] [Braidotti 1994], signaled a shift from first-order cybernetic models of the laboratory, where humans were observers and manipulators of large-scale systems, to second-order cybernetic models [Mead 1968], where the actants within systems, including humans, are always part of the system itself, and where the "bounds" of the system are always under negotiation. Though *Epistemic Cultures* is generally considered to be the last "mega" Laboratory Studies work from an empirical perspective — it synthesized over a decade of comparative ethnographic research across multiple laboratories and continents — more recent work in and around Lab Studies has continued its synthetic work on the production of materiality, subjectivity, and epistemology in scientific spaces. Feminist Science Studies and its subset, Feminist New Materialism, have been particularly prominent in the decades since, including the quantum and intra-active theories of Karen Barad (2007) and the multiply-produced ontologies of Annemarie Mol (2002).

While there has been scholarship bridging STS literature with DH practices [Boeva et al. 2018] [Hamraie 2018] [Parikka 2016] [Resch et al 2018], much of this writing has focused on labs as imaginaries and as spaces of material and speculative production. More connections can be built between DH's acknowledgement of the cultural qualities of laboratories and Laboratory Studies' examinations of the social and material processes that practice those qualities into being. These connections include:

- An interrogation into methodological and epistemological disunity of Science
- The laboratory as a site of social construction of facts, and
- The co-production of laboratories, researchers, research objects/subjects, and institutional legitimization

We want to highlight these potential connections for two reasons. First, we argue that lack of attention to laboratory practices leads to the stereotyping of scientific and computational practices by DH scholars. In turn, this stereotyping reinforces hegemonic institutions that thrive on the constructed neutrality, rationality, and unity of Science. It can also limit imaginations of when, where, and how DH can intervene in and subvert hegemonic institutions. Second, the social, subjective, political, and epistemological work found in scientific laboratories happens in DH labs as well. The acknowledgement of this work can allow for the reflexive proliferation of more diverse models of DH labs.

3. Producing Digital Humanities Laboratories

How does the construction of Science and scientific laboratories shape DH identity and practices? How do DH Labs produce Digital Humanists as epistemic subjects, and our objects of inquiry as epistemic objects? To begin, the DH Lab produces and is produced by a network of scholars, practices, institutions, epistemologies, ideologies, and cultures of STEM, the Humanities, higher education, and society writ large. And although "analytic cuts" [Barad 2007] are part of the process of making knowable the epistemic object of DH Labs, critically evaluating these cuts can help us to understand how the epistemic subjectivities of DH researchers take part in are co-produced through broader narratives about DH and Science.

Though the genre of "defining DH" articles and essays [Kirschenbaum 2012] has been criticized as "absurdly self-referential" [Raley 2014], work from Laboratory Studies suggests that the absence of these public debates does not mean that disciplinary boundary constructions are settled. Rather, the lack definitional discourse is a product of the "making invisible" [Garforth 2012] of the debates, interpretations, and legitimizing and de-legitimizing practices that always occur in knowledge production.

Rita Raley describes common attacks on DH as part of a broader criticism of the metrically-oriented university, including arguments that "quantitative analysis is unthinking and its investments in 'precise measurement' hopelessly naive; the epistemological certainty that data visualization seems to offer is equally fantastic" [Raley 2014]. While these critiques of quantitative and data cultures are certainly legitimate, they also reinforce the social construction of science as an interpretively naive, yet empirically neutral, knowledge system. We can see some of the issues of this reproduction even in definitional work that supports DH scholarship. James Smithies and Alan Liu have each written about the usefulness — when paired with caution — of scientific and computational methodologies applied to humanities research [Liu 2012] [Smithies 2017]. Similarly, David M. Berry and Anders Fagerjord write: "There is clearly also a danger for the humanities

when their work is seen through the optic of computational approaches. Hence, it is important that digital humanities remains focused on the research questions that are drawn from the humanities, even whilst working in and through computational approaches" [Berry and Fagerjord 2017, para 50].

This position, that DH practices represent the "application" of tools to Humanities questions, is a common one. However, in the co-productive model of knowledge construction, there can never be a separation between the methods we use and the questions we ask. Rather, they are embedded within one another and co-produce each other. Use of these methodologies enrolls broader institutional and epistemological apparatuses when defining "computational approaches" or "humanities questions." As a case, we can take the Introduction to Jentery Sayers's DH course "Unlearning the Internet" at the University of Victoria (2018). In the introductory course notes, Sayers explains to his students that:

> [This] is not a computer science course. The only technical competencies I assume are that you know how to send an email and also check this website. [It] is not about defining "digital humanities." We will treat digital humanities not as a field but as a collection of strategies for conducting humanities research with and through digital technologies. We will emphasize techniques and practices over the use of specific tools and software. [Sayers 2018]

Note the epistemological and identity work performed in this syllabus. The descriptor of "not a computer science course" is clearly not intended as a disclaimer about the institutional location of the course, but rather as an epistemic claim. Computer Science is constructed as a set of "technical competencies," presumably difficult-to-master ones, in opposition to, or at least orthogonal to, the kinds of knowledge that will be valued in Sayers's class. The claim of non-definition of DH is followed by a reasonable frame of DH, but one that constructs DH as a collection of practices rather than as a discrete epistemic culture. Finally, the class is positioned as focused on technique and practice rather than on particular digital tools; presumably in opposition to more "instrumental" STEM classroom cultures [Cordell 2015].

The syllabus produces a particular construction of identity, epistemic subjectivity, and disciplinary difference. This production enrolls a variety of constructed facts, including particular imaginations of Computer Science, internal narratives of the strengths of the Humanities, and an anticipation that Humanities students will be intimidated by what they construct as heavily technical work. These facts may be incommensurable with facts from another epistemic culture. For example, despite the common association of Computer Science with toolsets by DH scholars, it would be very outside the norm for Computer Science faculty to frame their course as focused on "specific tools and software" rather than on "techniques and practices" [Malazita Forthcoming]. Similarly, the construction of Computer Science as a technical or instrumental discipline also makes invisible the deeply political and historically contingent dimensions of computer science research practices [Dourish 2004] [McPherson 2011] [Malazita and Resetar 2019].

Constructing external disciplinary situatedness such as Computer Science as overly technical and naively instrumental gives other, "alternative" technical practices, such as DH, internal social capital. It also serves to construct humanist subjectivity as "non-technical," and therefore erects barriers around what kinds of educational or scholarly practices are imagined as practical or possible. Raley, for example, dismisses a course or curriculum that "satisfactorily train[s] students in different modes of text analysis… visualization techniques, and GIS, along with… literature and a philosophical approach to informatics" as "difficult to imagine." [Raley 2014]. Ryan Cordell and Rafael Alvarado too argue that the epistemic boundaries of DH are too varied to ever be counted as a discipline, as only a select few polymaths could ever hope to teach or learn such a hybrid cannon [Alvarado 2012] [Cordell 2015]. The construction of a premade humanist or scientific subjectivity thus forecloses the imagination of what can be produced, sustained, and institutionalized through DH practices.

Digital Humanities labs too can rhetorically reproduce the bounding of technical method and interpretive inquiry. For example, Katy Kavanagh Webb describes a DH lab as:

> a space that includes technology such as multimedia software and high-powered computers. Some hybrid spaces, such as Georgia State's CURVE (Collaborative University Research and Visualization Environment) lab, also have visualization screens. Another important aspect of DH labs is the types of meeting and work spaces they can offer to scholars. Duke University even offers

lockers where faculty can store research materials. Most DH labs have a strong web presence that showcases the projects that researchers have created. The websites vary from blogs to digital collections (many of them created with Omeka software). [Webb 2018]

Similarly, UMass Amherst describes their DH lab as "contain[ing] necessary hardware and software to facilitate the research agendas of the DHI faculty" (University of Massachusetts). Harvard's East Asian Digital Humanities Lab "exhibits ongoing or completed DH projects that can be used as models and provides information about databases, tools and methods that are used in creating these projects," and "... is arranged according to the usual workflow of digital humanists, starting from finding and managing data and moving subsequently to analysis and presentation" (Harvard).

Across all of these examples is the reproduction of a practical construction of DH laboratories, and of laboratories in general: as physical or virtual infrastructures that provide equipment or collaboration spaces for researchers. Again, the technical method and inquiry are reproduced as separate: the lab is the site of technology and method, the humanities researcher is the locus of interpretation and inquiry. In this construction, the lab and its technical apparatus becomes framed as passive; as a necessary holding ground for technology and technique, but one that is ultimately a tool at the service of rotating groups of researchers. Laboratory Studies scholars have shown this is not the case. Labs are active spaces, their very presence on campus reshapes expectations for research, the identities of researchers, the imaginations of objects of inquiry, and the legitimization practices for making knowable those objects. A lab space does not emerge out of an epistemically neutral position. The choices to have a DH lab on campus in the first place, how to staff it, how to outfit it, and which faculty and students are imagined as its audience all contribute to broader constructions of scientific and humanistic knowledge work.

DH labs are also responsible for producing their outcomes as "knowable." Labs must contribute to the legitimization of lab practices and material products for particular epistemic cultures in the Humanities. The "Kits for Cultural History," products of Sayers's University of Victoria Maker Lab [Sayers 2015], serve as models for thinking through the construction of an epistemic object of DH. Designed as enticing artifacts that allow their users to materially experience media history, each kit contains incomplete reconstructions, archival documents, hidden materials, making tutorials, and reflections about an extant or speculative object. One of the earliest disseminated of these kits was a speculative recreation of Victorian era electro-jewelry, personal wearable technologies, which the authors describe as evoking a sense of wonder and alterity in contemporary viewers. In writeups the kits are described as "foreground[ing] how the past is interpreted through present conditions… Hidden compartments point to absences in the scholarly record, implying more omissions exist somewhere beyond the container…." [Sayers 2015]. Jussi Parikka argues that the kits become a "disjuncture on a time-axis and [work] to enrich the sense of the contemporary as an overlapping set of temporal layers." [Parikka 2016, 85].

However, if we assume a non-universality of audience and the general existence of multiple, competing epistemic subjectivities, we must ask: for whom are these kits built, and for whom do they do the critical historical work of interpreting the past, implying omission, and disjuncturing time? The audience who can know the kits as doing this work must be produced; the material arrangements of wood, plastic, and paper of the kits themselves are not enough. The kits are co-produced and situated by their write-ups and their journeys through media. The subjects for whom they are intended, humanities scholars and students, must be produced as epistemic subjects through the interactions of their education, the objects, the field, and the documentary and critical writings about the objects. The lab practitioners at the Maker Lab must be produced as epistemic subjects capable of translating their historical and material negotiations to an imagined external audience. The kits as material artifacts must be co-produced alongside the validity of their interpretive operation. If any of these productions do not occur, the kits do not function; at least, not in the way described by the Parikka and by the Maker Lab. The "results" of DH labs are more than virtual and physical objects. Labs produce documentation, contextualization, and subjectification. DH scholars, DH journals, and DH audiences are as much an outcome of laboratory work as any artifact.

DH Labs are therefore not just institutionally or materially situated; they produce situations, and from there, situatedness. Researchers do not interact with lab equipment and personnel and leave unchanged. Rather, researchers

become epistemically and subjectively reconfigured within labs, even as they reconfigure and extend the lab. They are produced as a different kind of epistemic subject capable of knowing the world in different ways. DH labs thus operate not only as knowledge structures [Knorr Cetina 1999], structuring the methods through which research is conducted and circulated, but also as epistemic infrastructures [Malazita Forthcoming], producing how researchers ask questions and bound their identities.

DH knowledge workers have constructed a particular onto-epistemic model of their own scholarship and practice, one of the application of "technology," broadly understood, to humanities questions. Acknowledgement of this boundary work is not intended as an attack on DH; *all* knowledge practices create subjects, objects, and boundaries. Rather, we want this critique to serve as an *opening up* of DH practices, and thus of DH labs. As DH labs create situatedness, Humanities scholars can use laboratory spaces and practices as modes of intervention across diverse institutional, epistemological, and disciplinary contexts. These interventions do not have to be constructed as instrumental, as in bringing tools and techniques to "non-technical" spaces; nor as evangelical, as in bringing the light of critical inquiry to naive technical practitioners. STS argues that the Sciences should not be constructed as a monolithic, anti-interpretive technical enterprise, but rather a collection of diverse, at times contestational and agonistic, persons, networks, and knowledge practices. What can a similar articulation of DH as contestational, diverse sets of epistemic spaces open up?

Articulating a Disunity of DH alongside the Disunity of Science would impact both the subjectivities of DH practitioners and the situatedness of the DH labs through which we are produced. While the DH work this essay has thus far addressed manifests in more textually-oriented Humanities programs — or, as Kirschenbaum puts it, "in English Departments" (2012) — DH could also be constructed as a vehicle for producing knowledge in non-textually dominated humanities fields, or as tactical reconfiguration of non-Humanities fields, including in STEM [Malazita 2018a] [Malazita Forthcoming]. In the case of synthesizing DH and STS, this would mean undoing some of the present boundary work which has positioned STS as a separate, though allied, disciplinary arena from DH [Liu 2012] [Resch et al 2018].

The Tactical Humanities Lab (THL) at Rensselaer is our effort to epistemically and institutionally produce DH and DH labs as within the boundaries of STS [Malazita 2019]. The word "tactical" has for us a double meaning. First, it is a recognition of the deployment of the term already in DH, used somewhat flippantly as a way to "get things done" [Kirschenbaum 2012] in the contemporary university. While we certainly do not support the managerialization of higher education, we believe that "tactical" in this sense can be more than just a way of "accepting [our] parasitic relationship to the host" of academic administration [Raley 2014]. Tactical-as-instrumental can also a way of making humanities and social science research knowable to administrative systems, funding systems, and broader cultural narratives of academic research. In this way, "tactical" DH operates as an intra-institutional translational platform [Malazita 2018a], in similar ways that translational medicine practices have been constructed as ways of empathetically bridging biomedical research and diagnostic practices with patients and the public [Wang 2012]. The lab must always acknowledge our situatedness in an engineering-centered institute, where laboratory practices and technoscientific innovation are the major knowable genres for framing social and political change. Our lab meetings consistently evolve into discussions and venting sessions about being humanists and critical theorists in the context of an engineering-centered institute. As such, the THL must be made readable as legitimate knowledge practice to STS and Humanities scholars, and within the framework of a technical university.

Second, we use "tactical" in de Certeau's form, as the practice of small-scale, everyday resistances to larger systems of power [Certeau 1980]. Part of this commitment is disciplinary; STS scholars tend to construct the field as strongly oriented with social justice and normative approaches to scientific, technological, and knowledge practices. We aim not just to change the Humanities and the social sciences, but to change computer science, design, information technology, and biotechnology. This means not only working with self-identified STEM practitioners, but also highlighting–and holding accountable–the epistemic and political frameworks that underpin disciplinary and technical work across STEM and the humanities.

To accomplish these twin goals, the THL takes a bottom-up approach to DH laboratory practices. Rather than having one or two longer-term projects administered through the lab director, graduate and undergraduate students propose semester-long projects to the lab, and are free to work individually or in groups. Though projects can continue for

multiple semesters, every semester-length segment is structured via a particular development and dissemination plan. The lab assumes no prior expertise in technical work or critical inquiry; students and faculty share readings, run discussions and workshops, and skillshare throughout the semester. The topics of these workshops and reading groups vary depending on the projects pursued in a given semester. The lab has no formal funding model or physical space — students and student projects are funded through a combination of scrapped-together internal and external sources, including bits and pieces of grants from the National Endowment for the Humanities, Rensselaer-based internal "accelerator" funds, faculty startup funds, Independent Study credits, and preexisting institutional research infrastructures available for supporting undergraduates. Our physical lab presence manifests through distributed temporary spaces, generally either in a conference room outside of Malazita's office, or throughout various electronics, fabrication, and computer labs on a campus designed for STEM students. In addition to enrolling students from the Humanities, Arts, Sciences, and Engineering across Rensselaer, THL members have also worked to embed themselves back into their home-frameworks with the explicit purpose of bringing this attention to epistemic cultures to research endeavors which may not have initially explicitly valued it. In "broadening and opening" our research output [Golub et al. 2019] we have embraced the shapeshifting nature of our work as evidenced by this attention to the epistemic and brought this internalized understanding of "tactical" knowledge production along with us.

The above may sound familiar to many DH laboratory practitioners — especially the contingent funding, space shifting, and sweat equity involved in holding a physically situated research practice together. Building momentum towards continuous operation is also complicated by the term-to-term, student-driven nature of the lab's research foci. The structure of the lab leads to the production of a wide variety of epistemic subjects and objects. The students and faculty represent multiple disciplines, including STS, Arts, Computer Science, Computer Engineering, Sustainability Studies, and Game Design. The project topics range across critical technical education, data visualization, reverse-engineering and hacking hardware, web-based media production, game production, bioart, installation design, and furniture design. `33`

While the array of projects and disciplines can sometimes lead to a feeling of disjointedness at the beginning of the semester, all projects are united by two lab requirements: the projects must be oriented toward a social or political goal, and the research teams should be interested in making their object knowable by DH and STS audiences. Our collective starting point is that "the digital" is not a set of tools to be deployed to get social justice done. Rather, the digital, as a coagulation of material, symbolic, and epistemic apparatuses, is entangled with histories of justice, appropriation, resistance, oppression, knowledge-making, agonism, and power. Similarly, the digital is not just a set of material and semiotic systems. It is a pattern of thought that exists as cultural, philosophical, and material practices before and beyond computational systems. As such, it is always ideological, always political, always multiple. Most of our projects are in some way oriented toward deconstructing the digital as an epistemic, ideological, and material concept; building spaces that grapple with translating diverse ways of knowing; hacking existing digital networks to privilege women, PoC, and LGBTQIA+ persons; and re-configuring when, where, and how "technical" and "humanistic" work happens. `34`

The discussion of making a THL project knowable to diverse epistemic and personal subjectivity is often the most compelling inter-group activity for lab members. Not only does the articulation of a wide variety of activities "as DH" and/or "as STS" help to build common identity for lab participants, it also gives participants the space to reflect upon how knowledge is produced, bounded, and legitimized in their own fields. This reflective action, ideally, can lead to reflexive action, where THL members can not only better articulate their projects and their impacts to outside audiences, but also imagine the broader array of facts and results that laboratory work produces. In the following sections, we will articulate two of the projects that have emerged from the THL, the *Arbitrary Waveform Generator* and *Politicizing DNA*. The *Arbitrary Waveform Generator* sees students hacking, re-wiring, and designing musical synthesizers to better understand the relations between mathematics, history, culture, and sound lashed up in their construction. *Politicizing DNA* uses "the digital" as a metaphor to explore how DNA testing services are rhetorically constructing race and genetic risk in object-oriented ways. Though each project is topically, materially, methodologically, and disciplinarily divergent, each also aims to challenge the epistemic boundaries of digital and non-digital objects, the split between making and interpretive practices, and the epistemic subjectivities of STS and DH knowledge workers. `35`

4. An Arbitrary Waveform Generator

The *Arbitrary Waveform Generator* develops prior theoretical work by Teboul, who, discussing the history of homemade electronic music instruments, argues that "if most audio devices are a new take on an old concept, then acknowledging lineage is ethically preferable to claiming originality" [Teboul 2018]. What can we learn from a technical project where the specifications are cultural and contextual in nature, rather than scientific and measurable? Can we design a usable electronic music instrument that doubles as a lesson in music technology history and open source research? With contributions from Emily Yan and Caoilin Ramsay, computer science and electrical engineering undergraduates at Rensselaer, the project explores the use of alternative design parameters in the design and prototyping process of electronic synthesizers. Synthesizers, widely construed, are the electronic devices that generate sound to help today's musician develop their work. They, along with their users, are responsible for a significant portion of contemporary musical production. While most synthesizer designs follow a "Kit-of-Parts" approach [Perner-Wilson 2011], where a set of electronic components enable specific sounds at a pre-determined price point, we are building ours to make users reflect upon their own potential as artists, hackers, historians, and anarchists [Striegl and Emerson 2019].

Why attend to social histories when developing a device that assists in musical composition and performance? Audio electronics often combine otherwise "obsolete" technologies with newer developments in digital signal processing and integrated circuit designs [Paradiso 2017]. Modular synthesizers, introduced commercially in the US by Moog and Buchla in the mid 1960's [Pinch and Trocco 2004] now operate in updated forms alongside software-based synthesizers, themselves descendents of Max Mathews' computer music paradigm from the same era [Mathews and Miller 1964] [Roads and Mathews 1980], [Park and Mathews 2009]. These digital relatives for live performance include Max/MSP, Pure Data or Supercollider.

Interfaces that enable the side-by-side, coordinated use of hardware and software devices are, notwithstanding their common origins, relatively rare and expensive. All use proprietary code which makes them relatively expensive and difficult to study. In these technical limitations, related to the historical developments of related inventions, we see an opportunity for productive cultural reflection. We acknowledge that the audio interface we are putting together will encourage some modes of music-making before others. In wondering what the "best" way to implement a cheaper, more open source, more versatile and most "self-aware" way to do so, we were drawn to two recent devices. The Bela enables a small Linux computer to process many channels of digital audio with no noticeable lag [McPherson et al 2016]. In complement, the arduino-based "arbitrary function generator" designed by Lawson et al (2016) offers a template for an innovative "multi-tool" of sound synthesis. Using the Bela allows us to use Pure data, a visual programming environment for music composition and performance [Puckette 1997]. Pure Data is relatively more accessible and user-readable than C++, the other coding language native to the Bela platform. With those, we are able to interface any computer connected to a local network to any eurorack-format modular synthesizer with a user-editable and performable platform.

Functionally, waveform generator is effectively a programmable oscillator. Because of the physical properties of semiconductors and the history of synthesizers, some waveforms are more common than others: the sine wave, for example, is considered to be the mathematical basis by which all other sound can be reconstructed [Helmholtz 1954], whereas the square wave is constructed as the basis of digital communication. These waves' ubiquity in electronics means they are also responsible for a number of the musical timbres reoccurring in popular music; for example, a very distorted guitar approximates the timbre of a square wave. We play with these norms and expectations in two ways: first, by allowing smooth fades between any pair of those canonical waveforms. Second, by implementing a wavetable, a memory space where the value of each audio sample can be rewritten arbitrarily by the user, for the generation of non-standard waveforms. The choice of coding our audio system with Pure Data, which is almost as easy to modify as it is to use, is made in hopes that future experimenters will feel invited to adapt the system to their needs.

This practical and constructive process is complemented by a deconstructive theory: a "critical and practical reverse engineering" that highlights how different devices and different abstractions of devices can be analyzed side-by-side to extract or represent meaning from/in technical decisions. Making is here seen as a lossy type of compression, because less can be retrieved from an artifact than the intellectual and physical resources that have been put into it. History, then, is a process of dealing with the inaccuracies produced in the decompression of this lossy encoding. This dealing is deeply ingrained in the technological archives dear to the project of the humanities. Here, perspectives from critical

readings of electronic music and electronic music technology force both a wide construction of the text as including the technological [Parikka 2011], as well as a reminder that what cannot be encoded has a frictional relationship with text. The Arbitrary Waveform generator is about rendering a multimodal archive operational as a space for lab-based work.

To that end, Ramsay's work has focused on developing the circuits that allow our device to interact with eurorack format modular synthesizers. A first stage involved breadboarded prototypes, in which electronic components are arranged in temporary circuits without soldering, and we are currently moving to a more permanent "protoboard" stage for which the functioning circuit is more permanently soldered together. Yan's work has consisted of designing audio programs for composition and performance in Pure Data. These are inspired by the features of Lawson et. al.'s original device (2016), that also enabled a connection between software and hardware synthesizers but uses an Arduino and a wavetable with high-resolution samples rather than function calls to iterate the values of a waveform. Yan's software design allows the user to select pairs of the aforementioned "canonical waveforms" and either blend them dynamically, affecting timbre. In addition to that, and a wavetable, we are also implementing a sequencer to automate arbitrary changes of these oscillator settings. Teboul's work, expanding from a role of mentoring the undergraduates on technical and interface design requirements of each component, also consists of linking the team's technical decisions to the musical affordances of the prototype, developing documentation of each of these connections and framing them within a critical perspective inspired by Rodgers and Sterne (2011) or Mills (2011) through the extensive use of system diagrams and code commenting. In doing so we develop a practical understanding of electronic music's technoculture [Haring 2007].

Group technical work as a method for history is both the concern of STS [Boeva et al. 2018] and of media archeology [Hertz and Parikka 2012], but this is also where we build our primary connection to digital humanities generally, and the THL specifically: by operating in the rarefied design space of electronic music, we have a privileged avenue to talk about how arbitrary technical decisions can or should be leveraged to impart meaning to our political artifacts. This is why we complement technical experimentation with critical and cultural research. Each homemade synthesizer is the local reification of the large technocultural system [Hughes 1983] [Wittje 2016] of electronics and musical production, a fragment through which we can see a partial record of these worlds and what they mean to us. We see this project as offering something new in the context of the digital humanities because although digital tools and associated cultures are an essential aspect, the *arbitrary waveform generator* makes obvious that any advantage software and digital signal processing may be able to offer in this context is deeply dependent on both the materiality of the hardware at hand and the sociotechnical context within which it is used.

Reinventing traditional parts of synthesizers in this specifically musical context is a tactic for exposing the politics inherent in every prior instance of these ideas. As such, we do not expect our final prototype to clarify the rich history of do it yourself electronic music instruments through the design of an "archetypical" or "Rosetta Stone" device; rather, we hope to hint at the complexity of the practice of electronic music, the hundreds of arbitrary or materially-derived decisions in influential past devices as reifications of compositional ideas, and the potential for future technical work to address its own supposedly apolitical nature. In other words, synthesizers, because of their post-optimal nature [Dunne 2005] [Teboul 2015] [Teboul 2017] [Teboul 2018] offer a unique, variably coupled [Perrow 2011] environment for us to make statements through technical work. The modes of interaction with the device are the result of wondering how material choices help challenge the "natural" aspect of our traditional musical assumptions. Helmholtz's theory of sound and of the sine as the basic building block of all complex signals [Helmholtz 1954], is not just the premise for communication theory, but also a significant portion of electronic music making [Jackson 2011] [Hui et al. 2013] [Hankins and Silverman 1999]; we are constantly aware that although biases can be challenged in our theories of instrument making, it is in practical use that power relationship are most re-established.

We construe our arbitrary waveform as an ideological object. Wittje (2016) and Patteson (2016) made clear that the political underpinnings of scientistic approaches to sound most clearly exemplified by Helmholtz' work have deep roots in the scientization of acoustic and electrical phenomena in interwar Germany or Europe. Keeping precedents such as those in mind, our work as a team contributes to the slowly growing practice of synthesis as an explicitly political space of experimentation, with the development that statements can be made with technological decisions alongside cultural ones [Sterne 2011] [Rodgers 2015].

This project sits at an uneasy crossroads. We feel the pressure outlined by Brian Massumi in "On The Superiority of The Analog" (2002), acknowledging that ultimately we are making a machine for still-analog humans and their perceptual fields. On the other we are equally unsettled by what may seem as a contemporary focus on the digital. This is visible from digital humanities to digital music instruments ("DMI", see [Jorda 2005] [Calegario et al. 2017] [Magnusson 2017] [Armitage et al. 2017], the latter of which have come to dominate contemporary instrument making dialog in academia. At no point does our project indicate a clear preference for hardware or software, for computation over critique or vice-versa.

Our status as relative amateurs (this is effectively our first digital music interface project, let alone as a research group) is viewed as a motivation more than a hindrance: the technical issues at hand aren't more difficult than the critical questions we are asking, and therefore we are able to avoid prioritization based on comfort. Echoing the *Kits for Cultural History* [Sayers 2015], we hope to smash the archival and anarchival [Striegl and Emerson 2019] together, picking up the pieces and documenting them for future reiteration, offering a robust template and solidified framework for a method in the process. In this work, textual commentary emerges as an undertheorized mode of operationalizing both diagrams and interactive visual programming software such as Pure Data. Inspired by this digital culture technique of the *comment*, we are in dialog with DH and its artificial boundaries: between analog and digital, between human and nonhuman, between media archeology and platform studies [Apperley and Parikka 2015], between engineering and music studies, but always in *practice,* and in service of *a functional result.*

5. Politicizing DNA

The *Politicizing DNA* project analyzes how seemingly objective scientific and genetic data has profound political and social effects on current and future conceptions of race. With the rise of direct-to-consumer (DTC) genetic testing, social conceptions of race are brought back into question. By re-inserting the politics of science back into DNA, this project aims to deconstruct the attempts at presenting DNA as unpolitical or neutral. This project seeks to answer how race is constructed within these genetic test kits by reviewing the mission statements, products, and classifications of racial identity of direct-to-consumer genetic testing companies such as 23andMe and the Genographic Project. The project takes a stance of active refusal: the construction of DTC testing as a political knowledge practice rather than as a material practice allows us to engage with DTC without subjecting our own DNA to the laboratories that house and process these genetic tests, and the legal policies that regulate these laboratories.

Given our refusal to take and materially manipulate DTC tests, why are we constructing this project as DH? DNA is constructed as informational in popular culture [Nelkin and Lindee 2010] and in the laboratory [Thacker 2003] [Chun 2011], both of which borrow rhetoric from computational knowledge practices. These constructive practices are common in laboratory settings, where scientific knowledge workers seek to translate their objects of inquiry into information, and in so doing make the objects knowable by the laboratory apparatus [Knorr Cetina 1999]. For genetics researchers, this construction produces metaphorical, methodological, and ideological assumptions, with the assumption that DNA can be read, coded, and re-coded, and that the relationship between DNA, the body, and the environment is a discrete and networked one, rather than a discursive and ecological one. Though these assumptions have been increasingly challenged [Bolnick et al. 2007], they have produced decades of research agendas and laboratory infrastructures, including $2.7 billion in public funds dedicated to the Human Genome Project alone [Tripp and Grueber 2011].

As genetic testing rapidly moves from-and-through research labs to consumer spaces, DTC technologies seek to enroll the public in biopolitical practices akin to mass data sousveillance [Nelkin and Andrews 1999], packaging and selling our genetic material back to ourselves. DTC testing services reconfigure mass "data scraping" practices into mass "data swabbing" practices. Consumers choosing to not take a genetic test or engage with the broader apparatus of genetic testing are making political decisions to deviate from the new normal of circulating and commercially operationalizing genetic data. These choices intersect with gendered and racialized systems of digital and genetic surveillance, including onto-epistemic [Barad 2007] systems of classification, identity, and belonging that structure the lives and digital experiences of marginalized people [TallBear 2013] [McPherson 2014] [Noble 2018].

Spearheaded by Rafeh and undergraduate researchers Paloma Alonso and Hannah Lightner, the *Politicizing DNA*

project has thus far centered the mediated constructions of DNA, race, and identity with-and-through digital infrastructures. The *Politicizing DNA* team is comprised of women and women of color, particularly rare in an institute like Rensselaer that is majority white and male. This intentional structuring of the project team produces a unique situatedness for the lab, as it recognizes that the positionality of the researchers in a lab co-constructs the kinds of questions asked, the ways in which the epistemic object is bounded, and what counts as legitimate discourse. That women and women of color are investigating DTC genetics is particularly important, due to the history of exclusionary, exploitative, and oppressive practices in medicine and healthcare [Braun 2002] [Roberts et al 2011]. This type of politically situated lab structure reinforces the research group's work of politicizing formerly depoliticized scientific processes.

Of primary analysis was the construction of the relationships between genetics and identity through DTC's public-facing documents. These documents primarily included websites (including 23andme.com, ancestry.com, genographic.nationalgeographic.com/, and africanancestry.com), but also included archival materials such as FDA regulatory decisions, Terms-of-Service contracts, and popular coverage of DTC tests in media. Public understandings of the gene cyclically influence, and are influenced by, scientific understanding of the gene [Bates 2005] [Savard 2013]. At the same time, the epistemic object of the gene known by the public is a different artefact than the gene as multiply constructed by the scientific community [Nelkin and Lindee 2010] [Torgersen 2009]. These differences include how scientific achievements are promoted in the public as more significant or advanced than stated in publications.

These different meanings continue to disassemble the idea that "science" is apolitical, or separate from social influence. The public fascination with DNA orients the scientific community just as much as the scientific community orients public fascination. For example, when a lab does publicly engage with the politics of DNA, it is often done in a way that leverages Enlightenment narratives of the public good of scientific enterprise, rather than addressing genetic sciences' history of oppression and abuse, particularly of women and women of color. This follows the prioritization of scientific research over the understanding of the political and social meanings it has in the world for multiple epistemic subjectivities.

Contrary to much DH research, the *Politicizing DNA* project employs close reading rather than distant reading to develop hermeneutic analyses of the digital object of DNA as constructed through corporate websites. The researchers weren't just tasked to look at language frequency or presence/absence, but also to interpret how each company chose to publicly engage with the intersections of race, identity, and DNA. This included both a rhetorical analysis, how these concepts were deployed or not deployed in text, and also a situational analysis, such as whether or not identity content was included in advertising materials, terms and conditions, or legal documentation. Each of these digital-textual formats are governed by different legal standards, giving implied and explicit meanings behind the words companies chose to use.

Given the lingering presence of the "hack vs. yack" debates of the mid-2010s in DH research communities [Nowviskie 2014], the lack of technical sophistication or use of manual analysis over programming may lead to some scholars to construct *Politicizing DNA* as outside the bounds of DH. However, we argue that the project's methodology deeply engages "the digital," deploying a rhetorical and archeological trancing of a digital object across multiple digital media, and as it intersects with legal apparatuses, identity, and materiality. After the initial swabbing test kit that consumers receive and return to DTC genetics companies, the entirety of the consumer-facing genetic test experience is digital. The materiality of DNA has been transformed into a digital experience.

While Berry and Fagerjord argue that "the question of whether something is or is not 'digital' will be increasingly secondary as many forms of culture become mediated, produced, accessed, distributed or consumed through digital devices and technologies" [Berry and Fagerjord 2017, 2], the *Politicizing DNA* project provides an alternative critique of the humanities/technology divide. Further, by constructing this project as DH, we are arguing that asking whether something "is digital" is not a question of technicity or mediation. Rather, it is an ideological and political question, one whose answer enrolls an array of knowledge systems, normative concerns, market logics, and institutional apparatuses. Claiming DNA as digital subsumes it into a larger infrastructures of data processing and computational culture. Similarly, claiming the analysis of DTC DNA testing and its rhetoric as DH allows us to enroll larger systems of analysis and

interpretation that highlight DNA as a transitory object among wet and digital bodies.

Lab work has thus far uncovered ill-defined terminology and unfeasible promises of ancestry on these companies' websites. The websites of DTC genetic test companies do not explicitly discuss race, and instead use wording such as "ancestry" or "population groups". Our results have shown how race and ethnicity are subjective terms exploited by DTC genetic testing websites. This exploitation has been evident through websites' ill-defined terminology and unfeasible promises of ancestry. For example, instead of using race, the three genetic companies use the terms "ethnic groups and tribes," "populations," and "ethnic populations." 56

Even though the companies don't talk about race, DTC genetic tests are used to confirm, deny, or discover racial identities. DTC tests have direct ramifications among several groups of people, including white nationalists [Panofsky and Donovan 2019], African Americans [Nelson 2016], and Native Americans [TallBear 2013], engaging with popular conceptions of what it means to be Black, white or Native. Incidentally, the only website to explicitly discuss race was AfricanAncestry. In their FAQ section of their website, they answer the question "Can a DNA analysis identify my racial or ethnic identity?" with: "There is no test for racial identification. Race is a social construct, not genetically determined. Similarly, ethnicity is more cultural than biological" (africanancestry.com). Not only is it poignant that a DTC genetic ancestry company provides this kind of answer that reflects scholarship in social studies of science, but it is also interesting that the only company that centers itself on ethnic identity also provides information on the social construct of race. 57

Though *Politicizing DNA* is still in early stages, we hope that our findings will contribute to the public understanding of genetics by analyzing the accessibility and representation of genetic information as it affects the public's perceptions of genetics and race. The ultimate goal of this study was to examine the portrayal of race and ancestry in DTC genetic tests by asking how do DTC genetic testing companies classify people into different groups based on ancestry, ethnicity, and race. 58

Conclusion

Constructing laboratories as epistemic infrastructures that produce epistemic subjects, objects, and cultures destabilizes current imaginations of DH practice. While DH labs are often framed as semi-passive resource spaces, where students and faculty can access equipment, trained staff, and research infrastructures, we have argued that labs are instead epistemically active spaces. DH labs produce the epistemic subjectivities of researchers, the textures and boundaries of the objects made knowable by the lab, and the material-discursive practices that make legitimate DH research. 59

This reconstruction of laboratories, and of DH labs in particular, brings with it epistemic opportunities. If the boundaries of DH work are produced through particular imaginations of science and scientific practice, through imaginations of the abstracted "user" of DH spaces, then the shifting of that imaginative landscape can have tremendous impact upon the shapes and structures of DH labs. These impacts may include alternative models of laboratory work, alternative disciplinary spaces where DH work can be practiced, and alternative objects of DH research. Alternative knowledge practices lead to alternative epistemic subjects, new bodies of theory, shifting infrastructural and institutional terrain, and may move us toward a more "radical, unrealized potential" [Posner 2016] of DH. 60

For the Tactical Humanities Lab, this potential includes the expansion of disciplinary and epistemic situatedness beyond textually-based humanities into the humanistic social sciences, cultural studies, and STEM. The THL is one possible configuration of DH that could emerge, one that focuses on the construction of the boundaries of technical and interpretive work, and on the production of DH knowledge and subjectivity through technical work, written argumentation, and labor practices. While this is certainly not the only form DH could take when reading-through STS knowledge practices, and while there are countless other disciplines through which DH could be co-constructed, we offer the THL as an alternative to the tool/application centeredness that dominates contemporary narratives of the digital humanities, and as an alternative for imagining when, where, and for whom DH knowledge practices can happen. 61

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