Exploring the Trading Zones of Digital STS

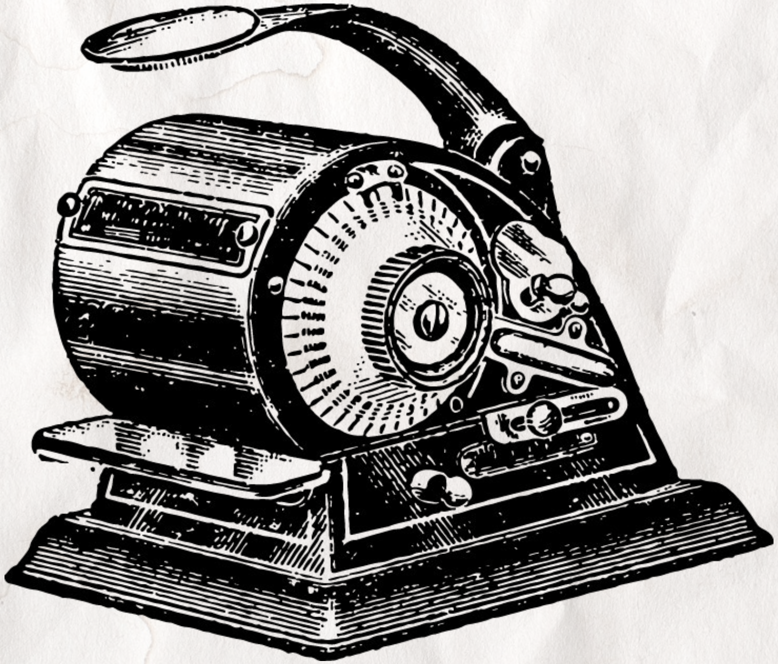
Jensen, Torben Elgaard

Published in:
STS Encounters - DASTS working paper series

Publication date:
2020

Document Version
Publisher's PDF, also known as Version of record

ENGAGING THE DATA MOMENT



Special issue
Volume 11• Number 1 • 2020

STS Encounters
Research papers from DASTS
SPECIAL ISSUE
Volume 11• Number 1• 2020

Exploring the Trading Zones of Digital STS

Torben Elgaard Jensen
TANTLab, Department of Culture and Learning, Aalborg University, Denmark

DASTS is the primary academic association for STS in Denmark. Its purpose is to develop the quality and breadth of STS research within Denmark, while generating and developing national and international collaboration.

Abstract

Over the last couple of decades, one of the significant developments in digital STS has been the rapid growth in digital methods and tools for data harvesting, analysis and visualisation. The increasing availability and deployment of digital tools raises questions about how to develop an analytic practice that reconciles the theoretical sensibilities of STS with tools and data that may sometimes be grounded in assumptions alien to STS. This article explores these challenges by reporting on two related digital STS projects that were carried out at the Techno-Anthropology Lab in Copenhagen. Drawing on science historian Peter Galison's notion of trading zones, the article analyses how project participants from different communities of practice exchanged and combined tools, theories and projects in a variety of ways. The article identifies two particular trading strategies: the introduction of assisting ontologies or mini-theories, and the introduction of project-specific problems and success criteria. In the final discussion, the article argues that a reliance on these trading strategies in the future will require digital STS to maintain and cultivate its theoretical sensibilities through a continued dialogue with the broader field of STS, including, in particular, new interventionist forms of STS scholarship.

Keywords: Trading zone, Digital STS, Digital methods, Actor-network theory, Modularity class.

Introduction: New tools and new challenges in STS

The field of STS has been exploring the role of scientific tools and instruments for a very long time. Its anthropological studies of laboratories described scientific instruments as inscription devices that translated physical phenomena into figures and text, later enabling scientists to draw things together and create powerful centres of calculation

(Latour 1987, Knorr-Cetina 1995). Historians of science have described how new instruments and methods established specific standards for objectivity, which simultaneously created ideals for the scientist as a particular kind of scientific subject (Shapin & Schaffer 1985, Haraway 1988, Daston & Galison 2007). Feminist and infrastructure studies have shown how the standards and classification of tools and instruments may perpetuate built-in assumptions, create particular kinds of visibility and invisibility and lead to unevenly distributed consequences and benefits (Akrich 1992, Bowker & Star 2000, Law 2004). To put it briefly, STS scholars have shown scientific tools to be a creative, powerful source of world-articulation and construction, while, at the same time, being problematic, contested, and an inevitable cause of invisibility and marginalisation.

With this backdrop, it is noteworthy that the tools and instruments of our own field––of STS––are also constantly growing and undergoing revision. The specific development on which I focus in this article is the rapid growth of digital tools in STS. Over the last couple of decades, an increasing number of STS researchers have begun to use and develop digital tools for data harvesting, analysis and visualisation. In some respects, these new tools resemble tools that STS researchers previously studied in the hands of others—tools that construct worlds, define subjectivities and create new invisibilities. One of the first and now classic examples of a digital tool in STS was the Issue Crawler, which was developed by Marres and Rogers (2008). This device—a so-called web crawler—was used to trace the network of hyperlinks between homepages. Thus, the Issue Crawler would be fed the URLs of a few homepages that were relevant to a particular issue, say the construction of a dam in Central Asia (Marres & Rogers 2008). From this starting point, the Issue Crawler would follow the hyperlinks of the first set of homepages to a second set of homepages, which would, in turn, contain hyperlinks that could be followed to a third wave of homepage. Based on this crawling, the Issue Crawler would produce a visualisation––a network graph––showing which homepages were hyperlinking to each other, and, hence, provide an image of a peculiar type of ontology performed by the homepages, namely, identifying which home pages were recognised as relevant by the other homepages engaged with a particular issue. Using this tool, STS researchers employed a practice that was similar to that of other developers of scientific tools. They created new knowledge, since no one had surveyed issues in this way before; they created new invisibilities, emphasising hyperlinks rather than other kinds of online and offline associations; and they created new subjects of science, as STS researchers began to present themselves as contributors to the articulation of issue publics.

The Issue Crawler was the beginning of what has now become a large assembly of tools for a variety of different kinds of data harvesting, automated analysis and visualisation. A growing number of people in STS find the use and development of digital tools to be an interesting development. However, it should be noted that the field of digital STS includes several other types of research, including speculative design, as well as more traditional ethnographic fieldwork studies of digital practices (Vertesi & Ribes 2019).

I belong to the part of the digital STS community that believes that the deployment and development of digital methods within STS work is an important vehicle for studying not only the digital but also the social in a broader sense. However, my aim here is not to advocate. The aim of this article is to focus attention on how exactly STS researchers manage to incorporate digital tools into their projects in practice and, in particular, how they manage to reconcile specific tools with their broader theoretical commitments and analytical interests. I do this by presenting an up-close and partly autobiographical account of the tensions, difficulties, and possible solutions that arose in two related projects that had committed themselves to a data-intensive, digital methods approach. This close study of situated tool practices is important, because it gives us a glimpse into how a part of our field is currently developing data and tool practices in close collaboration with adjacent fields, such as media studies and data visualisation.

To reflect on the role and negotiation of tools, I draw on Galison's (1997) notion of trading zones, which he uses to describe how the

relatively uncoordinated development of tools, theories and experiments in the field of physics nevertheless come together at particular locations. I briefly present Galison's ideas in the first part of the article. Following this, I describe the two related digital projects, which together serve as the article's main case. I follow the projects through a series of struggles to reconcile tools and theoretical commitments. Third, I conclude with a reflection on what we might learn from this case about the future development of an STS equipped with digital tools.

On tools and theories

The American historian of science, Peter Galison, has described and analysed the history of physics in a number of widely read books (Galison 1987, 1997; Daston & Galison 2007). Physics is generally recognised as a strong and stable field with a very long and proud history. However, despite this, Galison observes that physics is characterised by a great deal of disunity; the field consists of several communities, most notably, experimentalists, tool builders and theorists. Each of these groups has their own journals, conferences, summer schools, invisible colleges, specialized institutions, and career paths. When a change happens in one community, the others do not necessarily change at the same time. Even a radical theoretical change, such as the introduction of Einstein's theory of relativity, did not cause an equally radical rupture in the practices of instrumentalist or experimentalist physicists. On the contrary, Galison describes how both Einstein and the pre-relativistic Newtonian opponents of his theory all agreed to continue building on the same data from the same experimentalists. This observation of continuity in some dimensions at a time of rupture in others leads Galison to propose an 'intercalated periodization' (Galison 1997:799; see also Figure 1). Intercalation—layered, asynchronized development—explains how the *dis*unity of science is actually a source of strength and continuity rather than a source of fragmentation (see

Figure 1)[1]. Galison suggests that this is very similar to how the strength of a thread comes from the multiple fibres woven into it rather than the continuation of one particular fibre.

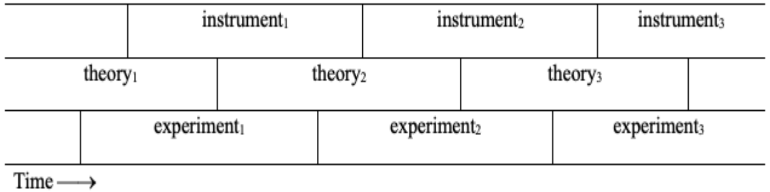


Figure 1: Galison's depiction of the intercalated development of instruments, theories and experiments in physics. Drawn from Galison (1997: 799).

If instruments, theories and experiments are potentially out of sync as they develop within different communities, then it becomes important to understand how they are connected in practice. To this end, Galison introduces the notion of a *trading zone*, which he borrows from anthropological analyses of how different cultures come into contact with each other (Galison 1997: 804). For Galison, a trading zone is a specific location where instrument builders, theorists and/or experimentalists come into direct contact. One example was the Los Alamos project during WWII, where several types of physicists and engineers located in the same building worked on developing the hydrogen bomb. Galison emphasises that trading zones are not melting pots where cultural differences blend into uniformity. Trading zones are locations where communities develop boundary objects (Star & Griesemer 1989), simplified pidgin languages or hybrid creole languages that may facilitate exchange. These local symbolic and material actions, Galison argues, bind together the culture of science.

The field of physics is obviously vastly different from the field of digital STS in terms of history, size, resources and circumstances. However, I would still contend that the challenge of connecting different layers or communities is not entirely dissimilar. Digital STS has a number of theoretical commitments, which are largely shared with the broader community of STS researchers (Vertesi & Ribes 2019). Digital STS also involves interacting with communities of software developers and data visualisation specialists, who constantly offer new digital tools and data opportunities (Venturini et al. 2017). Finally, digital STS scholars are working with a range of different partners and collaborators outside STS on an incessant stream of projects that always come with their own agendas (Munk et al. 2019; Elgaard Jensen et al. 2020). There is, therefore, plenty of need to create trading zones where communities come together and test possible connections between theories, tools and projects. It is precisely this kind of pragmatic trading zone dynamic that I attempt to portray with the case below. I present the events from an insider's view as I was a participant in both projects. The flow of events that I define as the case includes shifts in the tool layer, the theory layer and the project layer (see Figure 2). However, pointing out the shifts in the various layers is merely a preliminary step. The key question that I pursue across these shifts is how the participants in the case (including myself) managed to create material and symbolic devices that allowed us to combine the layers and move a small step forward with our projects. It is this trading zone work that I wish to articulate and reflect upon in my final discussion.

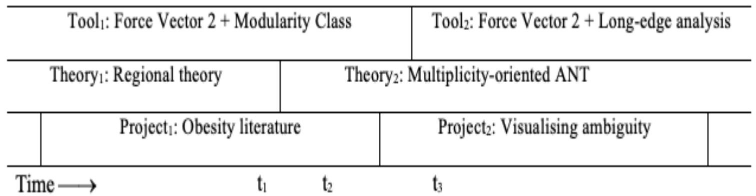


Figure 2: The intercalated development of tools and theory in TANTlab projects related to obesity.

[1] With this view, Galison positions himself in opposition to both positivists and anti-positivists. Positivists believe that physics has a growing continuous foundation of basic observations, which guarantees the continuity of the field despite changing theoretical interpretations. Anti-positivists believe that all observation is theory-laden and that paradigmatic theoretical change will therefore create simultaneous ruptures in observation and experimental practice.

A digital project on obesogenic environments

The location of the case is the Techno-Anthropology lab (TANTlab) at the Copenhagen campus of Aalborg University. In a physical sense, TANTlab is a large room with a meeting table, a sofa area and a collection of digital equipment, including large screens and some Virtual Reality equipment. TANTlab is a digital methods lab founded in 2015 with the intent of creating a digital methods experimentation hub for the researchers in the Techno-Anthropology Research Group at Aalborg University as well as their external collaborators (Abildgaard et al. 2017). The lab is directed by Anders Kristian Munk, one of several participants who would describe themselves as STS researchers. The lab also includes people with considerable technical skills, such as Mathieu Jacomy, an engineer and software developer who has played a key role in developing several of the most widely used digital tools in STS. It should be noted, however, that the distinction between 'technical' and 'STS' is actively blurred in the lab. Many of the participants, including Munk and Jacomy, have put considerable effort into developing both technical competencies (including programming) and knowledge of the field of STS. Over the years, the TANTlab has hosted a stream of projects, seminars and events that have brought together STS researchers, technical developers and external collaborators. The lab is thus, at least potentially, a trading zone between STS communities, technical communities and others.

In 2015, the newly established TANTlab was approached by Astrid Jespersen, who was the leader of the Copenhagen Centre for Health Research in the Humanities (CoRe) at the University of Copenhagen. At that time, CoRe was part of an international, interdisciplinary research project on obesity, and they were keen to explore whether digital tools and resources might provide new ways to study and understand how particular constellations of environmental factors, such as sedentary lifestyles and highly processed nutrition-rich food, might cause specific populations to develop obesity. In the obesity literature, this is referred to as *obesogenic environments*.

TANTlab accepted the invitation, and, in November 2015, arranged an intensive three-day workshop[2] in which obesity researchers, digital STS researchers, social scientists and students from CoRe and TANTlab worked on the topic of obesogenic environments. Ahead of the workshop, large datasets were harvested from Facebook, Instagram and scientific article databases. The aim of the workshop was to visualise, frame and cut the data in various ways to produce viable data projects and perhaps even tentative conclusions. One subproject, which I will discuss here, worked with a dataset consisting of a large collection of frequently cited scientific articles. The subproject included people from CoRe, TANTlab, and Stanley Ulijaszek, a professor in nutritional anthropology from Oxford University. During the intensive days of the workshop and the more than two-year collaboration that followed, we discussed and analysed the datasets in several ways. We eventually published our results in an article in *Obesity Reviews* (Elgaard Jensen et al. 2019).

In the following, I will discuss three moments that occurred during the work with the obesity dataset. The moments are marked as t1, t2 and t3 in Figure 2. At t1, the participants used a standard tool to identify so-called discursive regions in the obesity literature. At t2, the participants gradually realised that the first use of the tools was associated with a style of theorising of which they were critical. Some workarounds and novel concepts were, therefore, developed to enable a shift to a different type of theorising, which could roughly be described as multiplicity-oriented ANT (Vikkelsø 2007). At t3, the obesity data was included as a test sample in a new project. This project continued the commitment to multiplicity-oriented ANT while attempting to develop new digital tools that would articulate ambiguities rather than regional commonalities in the data. In sum, the case depicts a process of continuities and shifts as the changing crowd of participants engaged with two sets of tools, two types of theoretical commitments and two different projects. Next, I will explore the trading zone work that unfolded at each of the moments (t1-t3).

[2] The workshop followed the so-called data sprint format (See Munk et al., 2019).

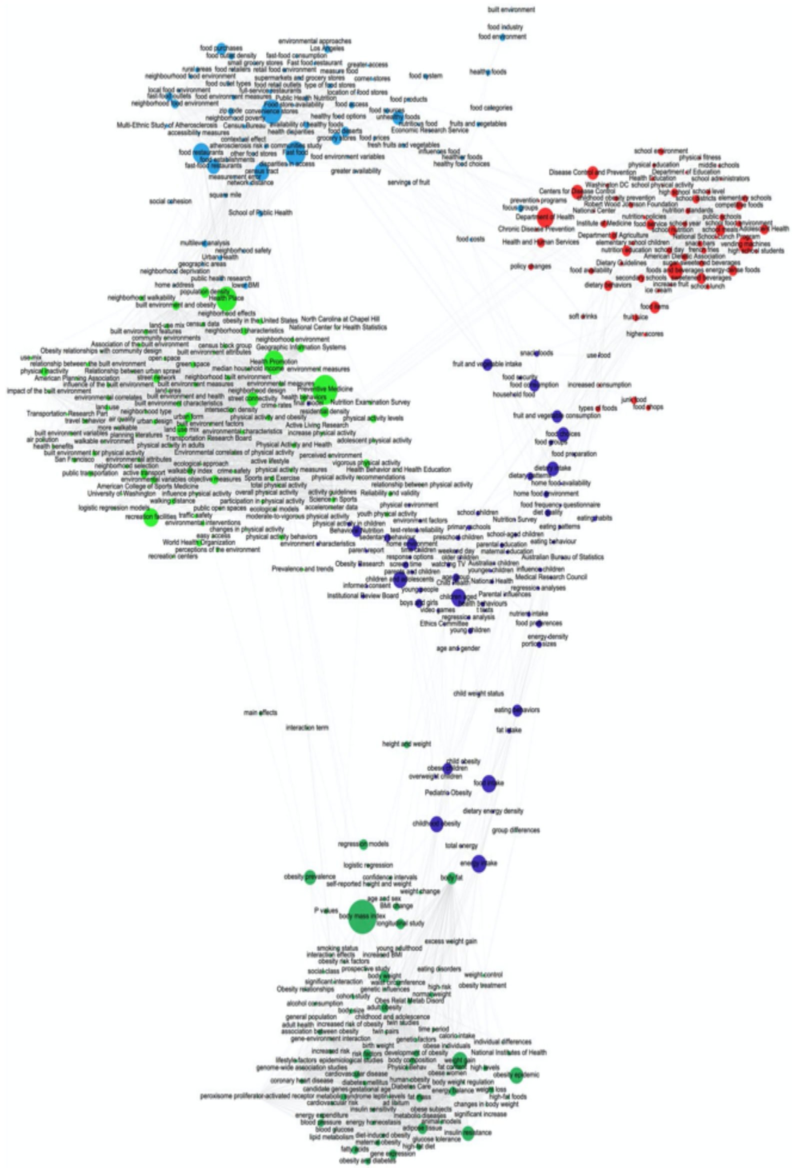


Figure 3: The map of five discursive regions published in *Obesity Reviews* (Elgaard Jensen et al. 2019).

Identifying discursive regions (t1)

Figure 3 can be considered the first official analytical result of the project on obesity literature. The figure is a network graph published as a part of our *Obesity Reviews* article (Elgaard Jensen et al. 2019). In the article text, we explain that our aim is to unpack the notion of obesogenic environment in the scientific literature, and we argue that the figure shows five different discursive regions, indicating that *environment* is talked about in five different ways. We call these environments the institutional environment, the food environment, the built environment, the family environment, and the bodily environment.

To understand how we used particular digital tools to produce the network graph and the five types of environment, some further explanation of our production process is needed. As we explain in the *Obesity Reviews* article, the discursive regions were produced in the following way. First, we used the semantic analysis software, CorTexT, to extract key terms from the text corpus and generate a map of terms that co-occurred in the articles. Then, we exported the graph to the data visualisation software, Gephi (Bastian et al. 2009), where we performed two operations that each separated the network into parts. The first operation, called the ForceAtlas2 spatialization, ensures that nodes[3] connected by many edges are lumped together on the network graph, while nodes connected by fewer edges are drawn apart. The second operation, called the Modularity Class, performs what is known as community detection. The Modularity Class is based on an algorithm that calculates different ways of separating the network into parts. After a number of iterations, it selects the partition that cuts through as few edges as possible, and, finally, it gives each of the parts a separate colour. ForceAtlas2 and the Modularity Class work more or less in tandem; the

[3] The terms nodes and edges that I use here is standard terminology for mathematical graph theory. Nodes refer to the fundamental units of which a network is formed, whereas edges refer to the relationships between the fundamental units. In a network of friends, the nodes would thus be names of people, and the edges would be friendship relations that connect particular sets of people. On a network graph, a node is visually represented as dot or a small circle, whereas an edge is represented as a line between two nodes.

terms that are placed together in a cluster by ForceAtlas2 will often also be given the same colour by the Modularity Class.

The use of the digital tools in the obesity project worked well in the sense that they produced a map. The (trading zone) question, however, is how they connected, or were connected by us, given our STS theoretical sensibilities. To approach this question, it should be noted that spatialization and modularity tend to make a particular kind of data interpretation almost unavoidable. For instance, the obesity expert in the group, Ulijaszek, might look at Figure 3 and make the following point: *The dense red cluster to the right is the food environment*. In a straightforward sense, he would be completely right. There is a dense set of nodes brought there by the spatialization algorithm. All the nodes are red, coloured in this way by the modularity algorithm. This assemblage of red nodes was what we chose to call a discursive region, assuming that the 'thing' on the map constituted a particular discursive region.

The problem with this interpretation, however, is that it could easily be seen as a somewhat crude categorisation. It says nothing about *process*, even though the underlying data was articles published over a 15-year period, many of which cited each other. The designation of 'this' as 'a region' may also be seen as a *homogenising* move, suppressing all differences within the cluster and setting one cluster radically apart from the others. The potential criticism of the designation of regions that I am suggesting here is in line with STS analytical sensibilities––or similar social science perspectives that emphasise the processual, situated, contextualised, or practiced nature of social phenomena. To mention just one well-known example from the STS literature, Mol and Law (1994) characterise a broad range of traditional social science approaches as *regional*. In the regional mode of thinking, they say, 'objects are clustered together and boundaries are drawn round each cluster [...], neat divisions, no overlap. Here or there, each place is located at one side of a boundary' (Mol & Law 1994: 647). By contrast, actor-network theory and later developments of this approach attend to materially heterogenous relations, their tensions, their effects and how they change over time.

To the participants in the project, the critique of regionalism was well known[4], so we were interested in looking for ways to move beyond regional theorising, especially if this could be done without discarding all of the previous work and the maps.

Shifting toward a non-regional style of theorising (t2)

The *Obesity Reviews* article, the written product of our work, can be seen as a strikingly heterogeneous affair. In the first four pages, the article reports the use of digital tools and algorithms, such as CortexT, Force Vector 2 and Modularity. Based on this, the article presents what it calls 'a map of five discursive regions' (Elgaard Jensen et al. 2019: 622). In the second part of the article, from page four onwards, the language shifts. Now, the entities on the map are no longer referred to as 'discursive regions' but as 'notions of environment'. On the final page of the article, the meaning of the map is described in language that clearly suggests complex movement and interrelations rather than a regional segregation: 'The field can be interpreted variously as being simultaneously integrating and disintegrating, a partially coherent hierarchy, and/or a pattern of simplification and complexification' (Elgaard Jensen et al. 2019: 628).

In the following, I will analyse the specific manoeuvres that made it possible to produce an article that both contained a regional map and a type of theorising that was distinctly non-regional. I trace these manoeuvres by following the sequence of arguments in the *Obesity Reviews* article. The first move away from the regional is made in the following way:

[4] This included our topical expert, who had recently published a paper on complexity directly inspired by John Law (Ulijaszek 2015).

> Each cluster in [Figure 4 in the present text] represents what we have termed a discursive region: a particular way of framing obesity as indicated by a tendency to use particular sets of terms. The aim of the qualitative analysis was to explicate these 'ways' or more precisely the underlying notions of obesogenic environment—the figures of thought that appear to guide the researcher's choice of how to frame and speak about their research objects. (Elgaard Jensen et al. 2019: 624)

What is introduced here is a distinction between surface and depth. The clusters on the surface of the map show the tendencies to use particular terms—the overt language behaviour, so to speak. However, behind each of these surface clusters, we—the authors—claim the existence of underlying 'figures of thought' or 'notions of obesogenic environment' that guide obesity researchers. In the next part of the text, the idea of underlying notions is further developed:

> To structure our qualitative analysis, we posited that any particular notion of [the] obesogenic environment could be characterized by describing three key elements: (a) the kinds of elements and processes that constitute the environment, (b) the kind of 'obesity object' that is believed to be contained and influenced by that environment, and (c) the presumed mechanisms of interaction between object and environment. This simple conceptualization was used both to guide our qualitative analysis and to summarize its results. (Elgaard Jensen et al. 2019: 624)

What is presented here can be seen as a mini-theory, a listing of three constitutive elements that define the notion of obesogenic environment. This mini-theory is not just an ontological claim; it is a device that allows us, the authors of the article, to approach the clusters on the map in a new way. In a *regional* mode of thinking, a cluster on the map consisting of, say, 50 terms must be treated as a bulk of language, where presumably all terms are equally interesting. Using this mini-theory of constitutive elements, we could allow ourselves to treat each cluster as a hunting ground. This facilitated a search within the cluster to find the three elements (obesity object, environment, interactive mechanisms) that we had defined as the notion of obesogenic environment. On finding these three elements, we could disregard the rest of the terms in the cluster unless they directly contradicted our findings. This style of analysis is practiced over the next two pages of the *Obesity Reviews* article, where we spell out the underlying notion of obesity behind each cluster. We describe, for instance, the *built environment* where the physical surroundings of humans (environmental elements) lead to more or less energy expenditure in daily life (interactive mechanisms), which, in turn, influences the population's body mass index (obesity object). We also describe the *bodily environment*, where the total functioning of the individual body (environmental elements) stimulates particular physiological processes and types of gene expression (interactive mechanisms) that, in turn, lead to more or less fat deposition in the human or rodent organism (obesity object).

The depiction of underlying notions as indicated above was one step away from a regional style of thinking. The next series of moves in the article brings it further towards a type of theorising that is roundly inspired by ANT or multiplicity-oriented ANT. In the discussion section (ibid: 627-8), we venture into commenting on the current configuration of the entire field of obesity research. To launch our commentary, we introduce a particular government report that Ulijaszek had pointed out as a very important voice in the field. The report, which we would later draw into question, is the widely known and widely recognised Foresight report published by the United Kingdom's Office for Science (McPherson et al. 2007). The Foresight report, we allege, is founded on the normative idea that the entire field of obesity research should become as coordinated and coherent as possible and that the different parts of obesity research should be built into one grand system model that will summarise the totality of factors contributing to the current obesity epidemic in the population.

After introducing the position of the Foresight report, we continue the article by making a series of critical comments. First, we point out that the spatial distribution of clusters on the map (Force Vector 2 algorithm) appears to show two things at once. Parts of the field may have relatively close overlaps, especially the notions of institutional, built, food and family environments. At the same time, the cluster of bodily environments seems to be quite unrelated to the others. This is not what the Foresight report would have expected or wanted to happen. In a second critical move, we revisit the list of different obesity-related objects that we identified behind each of the clusters. These obesity-related objects include obesity in adolescents and children, the institutional food services, and the deposition of fat tissue. We argue that the objects that lie at the heart of the five clusters 'do not add up to a single well-defined and well-described system'. 'Instead, the five clusters overlap, interpenetrate, and leave gaps' (Elgaard Jensen et al. 2019: 628). With this argument, we again question the systemic ambitions and assumptions of the Foresight report and like-minded attempts to develop systemic models for the field. In a final stab, we offer an alternative explanation of the field. In what might be read as echoing constructionist approaches in STS (Knorr-Cetina 1995), we argue that each notion of obesity appears to be organised around a particular set of convenient simplifying assumptions, available instruments, and pragmatic opportunities to study obesity-related phenomena[5]. The measure of BMI as an indicator of obesity is one example; the use of rodents as model organisms in laboratory work is another. With this argument, we again question the Foresight report's assumption that the field can and will come together in a one-system model. Instead, we convey a view of multiple ontologies and partially connected practices. By the end of the article, we have thus made a full move away from regional theorising and towards ontological assumptions similar to the ones found in performative versions of STS (Law 2004). Thus, a shift in theory has happened without discarding the map or the digital tools upon which the map was based.

I have now sketched the arguments that we developed and have shown how these led us to a distinctly non-regional style of theorising toward the end of the article. Let me end this part of the account by pointing out two types of trading zone moves that enabled the somewhat unlikely connection of a regional map with a non-regional theory.

The first type of trading zone move could be called the introduction of *assisting background ontologies*. By this, I mean ontologies that do not question what the map shows, but rather add to it in a way that allows the map to be connected to a new theory. We have seen two examples: 1) the claim that, *behind* the clusters, one can find underlying notions of environment and 2) the claim that, *before* the formation of the clusters, there was a process of finding convenient simplifications and instruments.

The second type of trading zone move is the introduction of a *project-specific problem* that sets up a local success criterion for what the combination of a tool and a theory should achieve. In our case, we argue that the field is dominated by the mainstream view of the Foresight report. Following this, a variety of tool+theory combinations could be seen as relevant contributions to the project because they either question some aspect of the mainstream or suggest an alternative. In our case, we claim that our mapping of five relatively incommensurable notions of obesity draws the holistic ambitions of the Foresight report into question.

As we shall see later, both the introduction of assisting ontologies and the setting up of project-specific problems were moves that we would repeat as we continued to work with the obesity data in a new project.

[5] Recently, Ulijaszek (2020) used this argument in a commentary on productive simplifications and dependency on particular convenient research tools in the field of malnutrition research.

Developing new tools (t3)

The uneasiness about the Modularity Class algorithm was not only felt in the obesity project. There were concerns in several other projects at TANTlab that Modularity Class and other digital tools might have a tendency to produce data visualisations that were too regional, neat, homogenous and simple. To borrow a phrase from John Law, our worry was that complex matters would be distorted into clarity (Law 2004). TANTlab decided to organise a workshop for the purpose of developing digital tools for visualising ambiguity. The workshop was hosted by TANTlab in 2017 in collaboration with an invited group of data visualisation experts from Density Design from Milan. Among the participants were digital methods researchers from ETHOS Lab, ITU and software developers from Médialab, Sciences Po.

The Visualising Ambiguity workshop had several working groups, and I will describe the digital tool development that took place in the working group in which I participated. My reason for this focus is that this working group can be seen as a kind of sequel to the obesity project. Not only did the working group take the uneasiness about the Modularity algorithm as its starting point, it also decided to use the obesity data as its test case and to give me the task of evaluating whether the new tools developed by the group would bring out interesting forms of ambiguity that were absent in the obesity project.

The working group had the benefit of including Mathieu Jacomy, a chief developer of Gephi, who had detailed knowledge of the workings of the modularity algorithm and its implementation in Gephi. At the beginning of the workshop, Jacomy explained to us that the Modularity algorithm is not a deterministic procedure; it merely produces an *approximation* of the best way to separate a network into parts. For this reason, an element that is at the border of two clusters may end up in one cluster on one occasion and in the adjacent cluster on another. The group found this flickering between adjacent clusters to be a very interesting type of ambiguity. We therefore set up an experiment where we ran the algorithm several times, each time with slightly different starting parameters. Through this, we identified a small number of "flickering elements", i.e. elements that the algorithm placed in different colour-coded clusters on different ocassions.

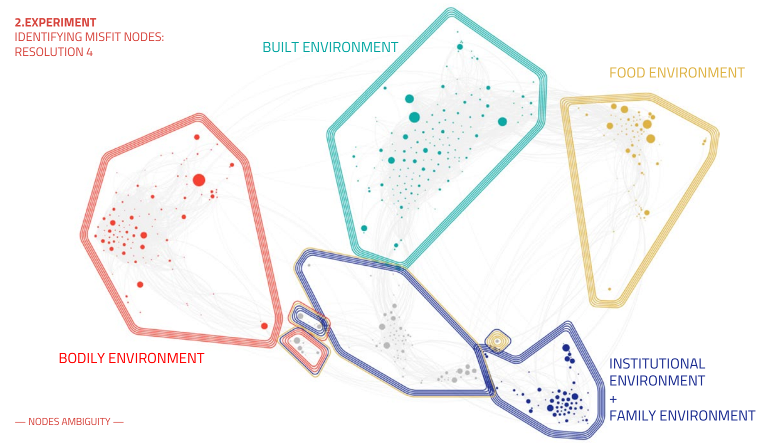


Figure 4: A visualization of the ambiguity of regions produced by the Modularity algorithm. The coloured curves show the clustering of nodes suggested by the algorithm on number of consecutive runs. The figure shows that a small number of nodes are 'encapsulated' in curves of different colour, indicating that their belonging to a particular cluster is ambiguous. (Data sprint on Visualising Ambiguity, TANTlab, December 2017).

Another take on ambiguity was developed by contemplating the map (see Figure 3). As I have previously discussed, the most obvious features of the map are its 'regions'. However, despite the work of the spatialization algorithm, which clustered entities into regions, the map also showed a number of edges (lines) that connected terms firmly located in one cluster with terms that were firmly located in another cluster. The edges were, so to speak, indicating connections from the core of one cluster to another; in this way, the edges were indicating relationships that were exceptions from the assumption that entities could be sorted into regions. We nicknamed these edges the long edges because they connected entities that were located in different clusters and, hence, were far apart on the map. To bring focus to these long edges, Jacomy wrote a small programme that generated a list of the pairs of entities that were connected *across* the discursive regions.

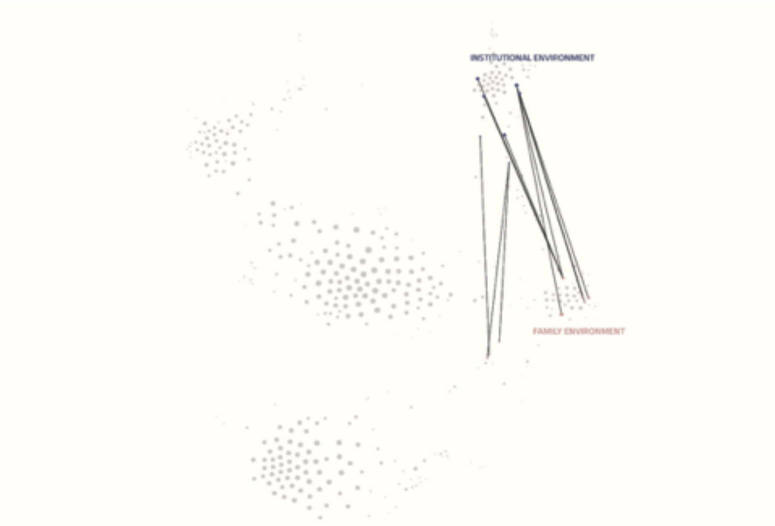


Figure 5. A visualisation emphasising the long edges that connect different discursive regions. In this visualisation, the discursive regions are made to recede into the background, thus reversing the figure-ground compared to Figure 3 (Data sprint on Visualising Ambiguity, TANTlab, December 2017).

In sum, we had two new ways of visualising ambiguity. We could focus on elements that were flickering back and forth between neighbouring clusters, or we could focus on the long edges connecting one discursive region with another.

Since I had previously worked with the dataset, I was asked to interpret the meaning and potential value of these novel visualisations. Upon closer inspection, my assessment was that the flickering terms were relatively uninteresting. They were often broadly used terms, such as food intake or child obesity, and their flickering between clusters was therefore not very surprising. However, the long edges that connected clusters seemed to elucidate something of potential value. In the case of the obesity material, the terms appeared to give interesting hints as to what might be shared between two clusters. These shared things were sometimes an attachment to a particular policy area, such as preventive medicine or public health nutrition. In other cases, there was a shared relation to particular institutions, such as the Department of Agriculture or Ethics Committees. In still other cases, the shared entities were particular kinds of research devices, such as twin studies, census data, the walkability index or BMI. All of these were promising leads, which might stimulate further inquiries into our collection of obesity articles if we were to conduct a follow-up analysis of the material in a future project[6].

In the context of the methods-oriented Visualising Ambiguity workshop, we concluded that long-edge analysis appeared to be a fairly simple but promising tool. Its particular merit would be to bring out the texture of relations that interconnect the parts of a field that from, another perspective, might be seen as separated regions. We also noted that this style of analysis would have affinities with some classic studies in so-called multiplicity-oriented ANT, such as Annemarie Mol's (2002) account of the internal connections between partially disconnected enactments of a disease or John Law's (2002) account of the multiple interfering versions of an aircraft. The long-edge tool was subsequently made publicly available on the open source repository, Github.

The development of the long-edge analysis, which I approved, and the development of the flickering node analysis, which I discarded, were both outcomes of encounters in a trading zone. Next, I will try to explicate the moves that made these products possible.

In the Visualising Ambiguity workshop, the work of the group revolved around the use of the obesity dataset and my role as the evaluator of whether a particular visualisation would offer a new and interesting kind of ambiguity. There is a rough equivalent between this social arrangement and the anthropological studies of trading that inspired Galison (1997: 831-833) to adopt the notion of a trading zone. When meeting a foreign group and offering them some kind of good, the crucial thing is not to fully understand why they are buying it—all you really need to know is *whether* they will buy it. In much the same way, the software developers and data visualisation experts in the group did not necessarily need to fully understand my entire

[6] Unfortunately, it has not been possible to gather participants or momentum for a second round of analysis of the obesity material.

reasoning for 'buying' or 'not buying' a particular type of visualisation. What mattered, pragmatically, was that I could give them a fairly clear and fairly immediate answer. If we turn back to the first obesity project, similar social arrangements were in place. In that project, Ulijaszek, the professor in nutritional anthropology, could immediately tell the rest of us if our mapping of the field contributed anything that could challenge or qualify the mainstream view of the Foresight report. Again, this immediate access to a project-specific evaluation scheme allowed us to quickly sort between valuable and less valuable connections between digital tools, theoretical comments and specific success criteria of the project at hand.

In addition to the introduction of project-specific criteria, the working group also deployed a trading zone move that I have called the introduction of assisting ontologies. In the terms of the semantic analysis software, CorTexT, a long edge is nothing more and nothing less than a representation of the fact that two specific terms tended to occur in the same articles in the obesity dataset. However, in the working group, we added a series of additional ontologies. We talked about the long edges as 'shared things', which we then exemplified as 'shared attachment to policy areas', 'shared relations to institutions', or 'shared engagement with research devices'. All of these ontologies provided further possible points of connection between the long-edge visualisation, the theoretical commitments of the group and specific questions that might be interesting for the obesity project. In this way, yet another set of little connections was made between theory and tools, allowing the further extension of the threads of digital STS.

Discussion: Trading zones and the development of digital STS

In this article, I have drawn on Galison's notion of a trading zone to explore the data and knowledge practices of a part of digital STS that has a deep investment in digital tools. As I have shown, the intercalated view of physics history suggested by Galison also appears to be an apt description of this part of digital STS. In the case described in this article, the tools, theories and projects were developed together, but they clearly did not march in lockstep. Consistent with Galison's intercalated periodisation of physics, there are continuities, as well as ruptures, every step of the way. The participants in the obesity project held onto the same set of digital tools while shifting theoretical commitments. The participants in the Visualising Ambiguity workshop held onto the same theoretical commitments while developing a different set of digital tools.

The shifting connections between tools, theory and projects are indicative of the trading zone work that took place. In my examination of this trading zone work, I have emphasised two specific strategies used by the participants. In what remains of this article, I will revisit these strategies and discuss what they might suggest about the current and future development of the field of digital STS.

The first strategy was the introduction of *assisting ontologies*. This kind of move is typically made by STS theorists in response to the objects offered by digital tools and their developers. In this mode, theorists introduce 'underlying notions of environment' to make better sense of colour-coded regions, or they introduce 'shared attachment to policy areas' to make better sense of the co-occurrence of specific terms. What this suggests, at the very least, is that the current digital tools rarely deliver something that is easily and directly compatible with the theoretical sensibilities of STS. An effort on behalf of the STS theorist is thus required. The process can perhaps be described as the art of 'seeing something as something else' (Asplund 1970). For connections to be made, the STS researcher must figure out a way to see the digitally produced object in different terms than those of the tool maker. Perhaps the digital object is a reflection of an underlying process? Or perhaps the object is an element in a larger structure? The kind of creative analytical move required is akin to how other STS scholars have innovated the way we see particular objects. To mention a few grand examples, Latour and Woolgar (1979) invited us to see a laboratory as a factory of literary inscription, Pinch and Bijker (1984) invited us to see a bicycle as a social struggle, Mol and Law (1994) invited us to see a medical condition as a set of social topologies, and Haraway (2003) invited us to see a dog as a companion species. If seeing something as something else is the kind of work that theoretical participants in digital STS projects must undertake, then it is highly unlikely that engagement with digital tools will develop into a specialised or limited version of STS. On the contrary, the ability to trade with digital tool makers appears to depend on the ability to draw broadly on the theoretical sensibilities of STS[7].

The second strategy, or type of trading zone work, was the introduction of *project-specific problems*. As I have argued, the trick is to set up a local success criterion against which possible combinations of theories and tools can immediately be evaluated. In the obesity project, Ulijaszek could tell us straight away if we had found something that was not in the Foresight report, while, in the Visualising Ambiguity workshop, I could quickly tell my collaborators if they had articulated a type of ambiguity that would add something interesting to the previous project. This strategy of including third parties or issue experts into the trading between digital tool developers and STS researchers is not specific to the projects discussed in this article. The idea of inviting issue experts into the so-called the engine room is a defining feature of the data sprint approach that TANTlab and several other labs have developed and pursued in the past five years (Munk et al. 2019).

In a broad sense, this kind of tri-partite trading zone work can be viewed as an example of an even broader development in STS toward a more engaged and interventionist mode of knowledge production (Sismondo 2008; Zuiderent-Jerak 2015). In recent years, this interventionist movement has been given further impetus by the efforts of Teun Zuiderent-Jerak and Gary Downey (2020) to articulate, enable and cultivate a style of STS research that they call making and doing.

[7] Vertesi and Ribes (2019) make a similar but broader argument, claiming that all parts of the emerging field of digital STS—regardless of whether they are equipped with digital tools—are drawing on a broad spectrum of STS sensibilities.

Zuiderent-Jerak and Downey (2020) point out that, since its beginning as a field, STS has criticised linear notions of knowledge production. The making and doing, they argue, is a way of turning that essential STS lesson onto the field itself. Zuiderent-Jerak and Downey (2020) characterise and define the making and doing movement in a number of ways; its scholarship moves beyond the academic text, it translates STS knowledge into forms that can be fitted or attached to empirical fields, it learns reflexively from its collaborators and it willingly runs the risk of producing knowledge that travels in new ways. All of these characteristics match the trading zone work and the projects that I have described in this article. They move beyond the standard academic text, they fit STS knowledge to specific fields and they disseminate their products through new networks of collaboration. However, the characteristics also match a broad variety of other contemporary STS projects, including meta-activism projects, projects that deliberately challenge academic boundaries and a range of participatory projects (Zuiderent-Jerak and Downey 2020). In my view, these new types of scholarship—and the making and doing STS movement in general—will be valuable companions and conversation partners for digital STS in the future[8]. This could yet be another way in which digital STS may continue to draw on the strength and the sensibilities of STS as it enters into trading zones with other communities.

Acknowledgements

I would like to thank my friends and colleagues at the Techno-Anthropology Lab at Aalborg University, the participants in the two workshops mentioned in the paper, two anonymous reviewers, and the special issue editors.

[8] For discussion of a series of TANTlab projects in the context of interventionist STS scholarship see Elgaard Jensen et al. (2020).

Author Bio

Torben Elgaard Jensen is professor in Science & Technology Studies at Aalborg University Copenhagen. He is the leader of the Techno-Anthropology Research Group and a member of the Techno-Anthropology Lab. His research examines innovation, knowledge construction and user involvement across a range of different contexts.

References

Abildgaard MS, Birkbak A, Jensen TE, Madsen AK and Munk AK (2017) Playgrounding Techno-Anthropology. Easst Review 36(2): 16-20.

Akrich M (1992) The de-scription of technical objects. In: Bijker W and Law J (eds) Shaping technology, building society: Studies in sociotechnical change. Cambridge, MA: MIT Press, pp. 205-224.

Asplund J (1970) Om undran inför samhället. Göteborg: Argos.

Bastian M, Heymann S and Jacomy M. (2009). Gephi: An open source software for exploring and manipulating networks. In: Third International AAAI Conference on Weblogs and Social Media, San Jose, California.

Bowker GC and Star SL (2000) Sorting things out: Classification and its consequences. Cambridge, Mass.: MIT Press.

Daston LJ and Galison P (2007) Objectivity. New York: Zone Books.

Elgaard Jensen T, Kleberg Hansen AK, Ulijaszek S, Munk AK, Madsen AK, Hillersdal L, and Jespersen AP (2019) Identifying notions of environment in obesity research using a mixed-methods approach. Obesity Reviews. 20(4): 621-630.

Elgaard Jensen T, Birkbak A, Madsen AK and Munk, AK (2020) Participatory data design: Acting in a digital world. In: Zuiderent-Jerak T and Downey G (eds) Making and doing: expanding knowledge production, expression, and travel in science and technology studies. Cambridge, Mass.: MIT Press.

Galison P (1987) How Experiments End. Chicago: University of Chicago Press.

Galison, P (1997) Image and logic: A material culture of microphysics. Chicago: University of Chicago Press.

Haraway DJ (1988) Situated knowledges: The science question in feminism and the privilege of partial perspective. Feminist Studies 14(3): 575-599.

Haraway DJ (2003) The companion species manifesto: Dogs, people, and significant otherness Chicago: Prickly Paradigm Press.

Knorr-Cetina K (1995) Laboratory studies: The cultural approach to the study of science. In: Jasanoff S, Markle GE, Peterson J and Pinch T (eds) Handbook of science and technology studies. Thousand Oaks, California: Sage Publications, pp. 140-167.

Latour B (1987) Science in action: How to follow scientists and engineers through society. Harvard: Harvard University Press.

Latour B and Woolgar S (1979). Laboratory life. Beverly Hills, CA: Sage.

Law J (2002) Aircraft stories. Durham: Duke University Press.

Law J (2004) After method: Mess in social science research. London: Routledge.

McPherson K, Marsh T and Brown M (2007) Foresight. Tackling Obesities: Future Choices – Modelling Future Trends in Obesity and the Impact on Health. London: Government Office for Science.

Marres N and Rogers R (2008) Subsuming the ground: how local realities of the Fergana Valley, the Narmada Dams and the BTC pipeline are put to use on the Web. Economy and Society, 37(2): 251-281.

Mol A (2002) The Body Multiple. Durham: Duke University Press.

Mol A and Law J (1994) Regions, networks and fluids: Anaemia and social topology. Social Studies of Science, 24(4): 641-671.

Munk AK, Madsen, AK and Jacomy M (2019) Thinking through the databody: Sprints as experimental situations. In: Elam M (ed.) Designs for experimentation and inquiry. London: Routledge, pp. 110-129.

Munk AK, Meunier A and Venturini T (2019). Data sprints: A collaborative format in digital controversy mapping. In: Vertesi J and Ribes D (eds). DigitalSTS: A field guide for science and technology studies. Princeton, NJ: Princeton University Press, pp. 472-496.

Pinch TJ and Bijker WE (1984). The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. Social Studies of Science, 14(3): 399-441.

Shapin S and Schaffer S (1985) Leviathan and the air-pump: Hobbes, Boyle, and the experimental life. Princeton: Princeton University Press.

Sismondo S (2008) Science and technology studies and an engaged program. In: Hackett EJ, Amsterdamska O, Lynch M and Wajcman J (eds.). The handbook of science and technology studies. Cambridge: MIT Press, pp. 13-32.

Star SL and Griesemer JR (1989) Institutional ecology, translations and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. Social Studies of Science, 19(3): 387-420.

Ulijaszek S (2015) With the benefit of foresight: Obesity, complexity and joined-up government. BioSocieties, 10(2): 213-228.

Ulijaszek S (2020) Productive simplification in the use of anthropometric nutritional status. European Journal of Clinical Nutrition, 74(1): 359-361.

Venturini T, Jacomy M, Meunier A and Latour B (2017) An unexpected journey: A few lessons from sciences Po Médialab's experience. Big Data & Society, 4(2): 1-11.

Vertesi J and Ribes D (2019, eds) DigitalSTS: A field guide for science and technology studies. Princeton, NJ: Princeton University Press.

Vikkelsø S (2007) Description as intervention: Engagement and resistance in actor-network analyses. Science as Culture 16(3): 297-309.

Zuiderent-Jerak T and Downey G (2020, eds). Making and doing: Expanding knowledge production, expression, and travel in science and technology studies. Cambridge: MIT Press.

Zuiderent-Jerak T (2015) Situated intervention: Sociological experiments in health care. Cambridge: MIT Press.

DASTS
www.dasts.dk

ISSN: 1904-4372
2020