DATA EMBODIMENT

Irrupting space with digital narratives

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Abstract

Sharing content on the internet has become an everyday practice. Digital communities use social media as a platform to develop discussions using hashtags, centred around both trivial and politically relevant subjects. By creating a dynamic data sculpture, *Ephemeral Data*, this thesis examines whether embodying LGBT-related hashtags into a physical form has the potential to create space for empathy, discussion, and engagement. In so doing, *Ephemeral Data* explores the transition of digital information into physical artefacts, becoming a new medium to signify political debate within the digital realm. Examining whether alternative forms of representation of a data stream can change our perceptions and whether this transition to an embodied object can reframe the semantic meaning of these digital bits of self-generated content. This thesis concludes that seeing data visualised physically in space can raise awareness of a controversial subject matter. It does not, however, appear to change the literal meaning of the subject in question.

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TABLE OF CONTENTS

INTRODUCTION

"We are drowning in information but starved for knowledge."

John Naisbitt

In an era when we are commonly overwhelmed with information, social media plays a key role in generating an extensive amount of data that belongs to the 'big data' phenomenon.[1] Sharing content on the internet has become an everyday practice, and people use it not only to share their personal information but also to share their thoughts, feelings, and opinions.

Digital communities use social media as a platform to develop all types of discussions using hashtags, whether the topics are trivial or politically relevant. The relevance of the discussion is measured by the volume of tweets labelled via hashtags, with some eventually becoming trending topics. From one moment to the next, the discussions can be transcendent or ephemeral due to the speed of the conversation. In this thesis, I want to focus on social and political turmoil as a result of these discussions, as well as

how the digital narratives around them are communicated and digested by the society.

This project is based upon the exploration of digital narratives I did during my MA studies at Aalto University in the New Media program (Fig. 1). I became increasingly interested in the ways in which new media can be used as a tool to transcend invisible phenomena into physical space, revealing new perceptions to the users or viewers. My interest was focused on the role of how new media can engage with collective action and political activism. Given the explorations that have come before, the aim of this thesis is to try to answer the question of how the meaning of digital information can change when it is embodied within a physical space.

Pondering such a question, I started to experiment with various materials.

[1] Big data' is the growth in the volume of structured and unstructured data, the speed at which it is created and collected, and the scope of how many data points are covered. 'Big data' often comes from multiple sources, and arrives in multiple formats (Radcliffe, 2017).

These studies resulted in an installation framed as a dynamic data sculpture called *Ephemeral Data*. The work operates as a new medium to signify political discussion within the digital realm. The installation maps LGBT-related hashtags to physical materials and use its affordances to visualise the flow of the discussion, placing said discussion in space and time.

Ephemeral Data is structured as an approximation to explore the transit of digital information—in this case, keywords and hashtags in Twitter—and turn them into tangible artefacts within a new medium. Moreover, I wanted to explore how this transition can reframe the semantic meaning of these digital bits of self-generated content.

Structure of the document

This thesis is structured into five chapters. Following this introduction, chapter 2 starts by setting the background for this work, describing the impact of social media and its implications in society when used as a tool for collective action and political activism. I also describe some examples where the usage of hashtags has ignited political controversies. Chapter 3 discusses the use of data visualisation as a medium to bring empathy into abstract data. I examine the implications of transforming a two-dimensional representation into a physical embodiment, and explore my research questions. Later on, in chapter 4, I expand into my research approach by presenting my argument, research questions, and methodology. I describe the steps I take in order to answer my research and set the aims of the work. I proceed further in the fifth chapter by outlining the creative and practical processes of my installation, Ephemeral Data. I introduce the way in which I constructed this installation, and then reflect upon the reactions it raised. Finally, in chapter 6, I conclude this thesis by discussing the learnings and offering future steps to continue this study.

Figure 1: In the right, SongPost, my first exploration with the embodiment of data. Songpost is a software to visualise songs into the printed medium. In the left, Narcissus by Bárbara Rebolledo and Ian Tuomi. The installation was built for the Media installation course in Aalto University. Narcissus explored the visualisation of electromagnetic fields using a large scale Chladni plate and water.

BACKGROUND:

exploring digital narratives

Under the influence of social media

Creating and sharing content on the internet is an everyday practice, and has become the essential driver of our digital lives. The space where these interactions take place is what we call social media. Helen Margetts, Director of the Oxford Internet Institute, defines social media as "internet-based platforms that allow the creation and exchange of user-generated content," usually using either mobile or web-based technologies. In her definition, these media can take many forms, "including blogs and micro-blogs (such as Twitter or Weibo); social networking sites (such as Facebook, Twitter, Tumblr, Tuenti, Instagram, Snapchat, or Orkut); content sharing sites (such as YouTube, Flickr, and Vine); social bookmarking sites (such as Digg, Reddit, or Delicious); projects to produce online goods (such as Wikipedia or Baidu Baike); and virtual worlds for gaming or socializing (such as Minecraft and Second Life)" (Margetts et al., 2016).

In spite of this broad set of social media

applications relying on the internet, their use has grown so much that they have become the way most users experience the internet, beating—in terms of use intensity—any other media. According to Apple, in 2015 the average American consumer was spending 198 minutes per day on apps compared to 168 watching television, not including the time spent in the mobile web browser (which, if included, raises the figure up to 220 minutes per day) (TechCrunch, 2015). Almost 2 hours (116 minutes) of that time corresponds to the aggregate of average time spent per day on just 5 platforms: YouTube (40 minutes), Facebook (35), Snapchat (25), Instagram (15) and Twitter (1) (MediaKix, 2016).

People use these social platforms to create, publish, and share content from small contributions such as a 'like' in Facebook, the share of a 'selfie' in Instagram, a 'story' in Snapchat, or 140 character statements or 'tweets' in Twitter to more elaborate pieces of content such as blogposts, videos, and even games. When this content is shared on these platforms, the idea of

Figure 2: Pepe the Frog (The Daily beast, 2016) and **#BlackLivesMatter**, two ways in which social media influenced political action

a digital social conversation emerges, influencing our perceptions, ideas, and behaviours. From the private sphere of influencers (such as the opinions and likes of our Facebook 'friends') to wide open and broad social influencers (such as 'hashtags' and 'trending topics'), they are the key drivers of relevant public 'conversations'.

This phenomenon is particularly important in the way it frames debates and creates socio-political realities. It has been a tool in democratic revolutions such as Arab Spring, in which social media supported activists in the organisation of events on the ground and helped spread democratic ideas across international borders (Howard et al., 2011), or serving as the main platform for extreme right-wing movements such as the Alt-right, an online fascist group using counterculture discourse and memes such as the Pepe Frog to support

Trump in the 2016 US Presidential election (Nuzzi, 2016; Beauchamp, 2016). In addition, social media even stands as a pertinent artefact of emerging civil rights movements such as **#BlackLivesMatter**, an international movement against violence and racism towards black people, "linked not by physical closeness or even necessarily by political consensus, but by the mobilising force of social media" (Day, 2015), symbolically organising cross-platform activism by means of a hashtag.

According to Margetts's research on the influence of social media in collective action, one of the two key forms of influence in digital environments is what is called 'social information', "the knowledge that helps people decide what they are going to do with reference to a wider social group and that, in so doing, has the potential to activate people's social norms"

(Margetts et al., 2016). Based on previous research on how changes in social information influence the popularity of cultural artefacts such as songs and the perception of their quality, Margetts and her team argue that because of the capacity we have in digital environments to "provide real-time information about what other people are doing politically, social media affect the perceived viability of political mobilizations and hence the potential benefits of joining, thereby altering the incentives of individuals to participate" (ibid.).

The exceptional mastering of 'social information' through digital platforms became the key driver of the **#BlackLivesMatte**r movement. "A hashtag on Twitter can link the disparate fates of unarmed black men shot down by white police in a way that transcends geographical boundaries and time zones. A shared post on Facebook can organise a protest in a matter of minutes. Documentary photos and videos can be distributed on Tumblr pages and Periscope feeds, through Instagrams and Vines" (Day, 2015), focussing any action or event on the topic, contributing to a larger discourse in an ongoing digital conversation, and influencing the perception of the public opinion and the behaviour of the public.

Data-driven narratives and social information overload

The case of **#BlackLivesMatter** illustrates the potential that social media can have in influencing collective action through the organisation of social information under a hashtag. However, digital communities use social media as a platform to develop all types of discussions using hashtags, whether the topics are trivial or not. In general terms, the relevance of the discussion is measured by the volume of mentions in each hashtag, with some eventually becoming trending topics and thus impacting the 'conversational weather' of a topic or controversy. However, the ephemeral nature of these artefacts of meaning can shift discussions from being transcendent to defunct in a matter of moments, due to the speed and abundance of social information and the blurred context in which they function.

There is a problem of social information overload. This overload is mostly built by self-generated data and "although self-generated digital data is becoming more relevant in a universe of multiple digital information streams, users' daily existence is circumscribed in a big data overload" (Lyon, 2014). This gives a wide space to data-driven surveillance models, but provides few spaces for individual control and sense making. With the amount of data that people generate at such a fast pace, understanding and making sense of this

information becomes a challenge.

In the case of Twitter—the first platform to introduce the hashtag as a content organiser—people share their thoughts, emotions, ideas, and actions in a stream of up to 140 characters.[2] Even though these entries are archived and indexed in cyberspace, their volume and semantic meaning may be lost and manipulated precisely because of information overload and lack of context, changing our emotional and cognitive understanding of them.

This particular media phenomenon has hugely influenced the emergence of a new political reality, characterized as the 'post-truth-politics', "denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief" (Oxford Dictionary, 2017b).

These public opinions and beliefs are built on the repeated assertion of key messages that become viral, as well as through 'trending topics' on social media platforms that become far more important and credible than concrete facts. The Economist—the newspaper that highlighted this phenomenon in 2016—acknowledged the fact that on Facebook, Reddit, Twitter, or WhatsApp, anybody can be a publisher. In an article in The Economist, it is argued that "content no longer comes in fixed formats and in bundles, such as articles in a newspaper, that help establish provenance and set expectations; it can take any shape—a video, a chart, an animation. A single idea, or "meme," can replicate shorn of all context, like DNA in a test tube. Data about the spread of a meme has become more important than whether it is based on facts" (The Economist, 2016).

It is precisely this phenomenon that this thesis wants to tackle. In the context of a political controversy, how can we build narratives that make sense within the context of massive streams of information? Is possible to overcome the post-truth bubble when we change the form and media of representing a data stream?

The limited and bias perception of a digital data stream

Currently in political conversations on Twitter, the hashtag has become the key influencer of narratives. By creating a content-organisation artefact, it can articulate digital dialogues between people addressing the same topic. The trending topic—that is, the quantitative measure of a data stream about a topic—has become the metric of what is important, skewing the perception and meaning of what is reality and what is the impact of the information we produce.

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[2] This is true as of September 2017. Currently, Twitter is implementing a test by expanding the character limit from 140 to 280 characters (TechCrunch, 2017).

From a cognitive[3] perspective, we can say that people tend to think about data in an abstract way. When presented in its raw state, as quantitative and qualitative variables, it is very difficult to fully understand the purpose and meaning of it. Data by itself creates neither facts nor meaning. However, when data becomes 'social information' without context, it appeals only to the emotional driver of social influence, thereby creating environments of meaning disconnected from factual reality.

That is why the perception we have as users about these streams of digital dialogue is limited in the digital space. It is a problem of volume, scale, importance, and meaning. Stephen Few states that conscious thinking is much slower and less effective than visual perception (Few, 2013). Because of this reason, and due to the vast volume of streaming data in our social media, it is difficult to make relationships between digital dialogues, and makes it very difficult to build a narrative that make sense inside these clusters of hashtag-typified topics.

The importance of trending topics is measured by volume. The more that people talk about them, the more important they are. When we base the impact and influence on this parameter, it is very easy to have a perspective that doesn't necessarily correlate with reality. Data becomes bias and easy to manipulate, creating a skewed version of facts that makes it difficult to assess when something is meaningful. Social media becomes an echo chamber or 'bubble', in which people fail to understand the political and social impact of these digital conversations.

How can we overcome this bubble of perception when dealing with these streams of social data? How does the lack of context affect the perception of meaning that we have about the data we perceive within these streams of information? How can we overcome the potential lack of perspective concerning what we post when the stream of data becomes too big?

As we will review later in this document, the main goal of this project is to explore alternative forms of representation of a data stream generated by political controversy in Twitter, observing how our perception and meaning of the discussion changes when the media changes.

By creating an installation addressing controversy surrounding recent LGBT issues in Russia, I want to represent some of the topics brought forward

[3] Cognition is defined as "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses" (Oxford Dictionary, 2017a).

through Twitter discussions in the form of material interactions. By mapping hashtags into visual form, these tweets will become part of a narrative that interrupts space in time. Through my installation, I want to demonstrate that placing data flows into a human context has the potential to create space for empathy, discussion, and engagement. I argue that by doing so, our personal narratives/stories and the stories of others can bring empathy to these conversations. Consequently, the dialogue becomes different.

However, before doing so, I will first discuss data embodiment and physical visualisation, emphasising how these two topics are interconnected.

BEYOND DATA VISUALISATION:

towards embodiment and meaning

As discussed in the previous sections, the increasing use social media facilitates growth in the data overload that surrounds us. As Jer Thorp (2013) says, "we are all data-making machines," and a big part of that data comes from social media. All this information becomes 'information overload'[4], making the information we generate incomprehensible without context.

David McCandless (2010) says that the solution for this overload might be visualising this information. In his TED Talk, he refers to data visualisation as a way of taking the patterns and connections of data and designing in a way that it makes sense and tells a story (ibid.).

Lev Manovich (2010) defines information visualisation "as a mapping between discrete data and visual representation." Living

in this era of information overload, the discrete information Manovich refers to is replaced by data, making data visualisation the primary way to communicate large sets of data, either in science, design, journalism, and even art.

If we take Manovich's definition of visualisation literally, we could map social media information as a visual representation. In doing so, we would put it into context and add value to the narrative around it. I argue, however, that data can be grasped only within a specific context, as it is linked to specific discourses. Visualisation serves a purpose, as it can be used to build narratives of digital data by placing them within a certain context. For example, in one of his works, Thorp mapped out all the "good morning" tweets throughout the US as a visual

[4] 'Information overload' is a term coined by Bertram Gross to refer to the phenomena that occurs when "... the amount of input to a system exceeds its processing capacity. Decision makers have fairly limited cognitive processing capacity. Consequently, when information overload occurs, it is likely that a reduction in decision quality will occur" (Gross, 1964).

map, using different colours depending on the time. By doing so, Thorp was able to assign other significance to the information: for example, he could quickly see that the west coast woke up later than the east coast. By putting small pieces of data together, he was able to generate more value than when displaying them as tweets in the timeline (Thorp, 2013).

Designers generally agree that by giving an empathic approach towards data storytelling, it enables another level of understanding reachable by using methods other than textual representation. For example, Munari (1966) argues that "it was understood that with the means proper to the visual arts one could say many things that could not be put in words." In other words, by being able to represent different pieces of information simultaneously, visualisation provides a more holistic method of storytelling. In addition, it also offers alternative points of view in understanding data.

Data and meaning

Visualising information helps to make sense of information too big to relate to or understand with a simple glance. Manovich states that data visualisation carries:

the promise of rendering the phenomena that are beyond the scale of human senses into something that is within our reach, something visible and tangible. This promise makes data mapping into the exact opposite of the Romantic art concerned with the sublime. In contrast, data visualisation art is concerned with the anti-sublime. If Romantic artists thought of certain phenomena and effects as unrepresantable, as something which goes beyond the limits of human senses and reason, data visualisation artists aim at precisely the opposite: to map such phenomena into a representation whose scale is comparable to the scales of human perception and cognition (Manovich, 2002).

In some ways, data visualisation has become a way of democratising access to information, since it provides information to a larger number of non-experts. Concurrently, it has stepped away from the more traditional uses of visualisation that has developed to represent data for trained experts (Dourish et al., 1999 cited in Zhao and Moere, 2008). In other words, by representing this data, its meaning and significance becomes relatable to the viewer.

In design, Karl Krippendorf (2006) argues that meaning arises in the interactions between the user and an object in a particular kind of discourse, as well as in the interface between artefacts and human beings. However, whereas the interactions are created by discourses, the meaning itself comes from the affordances and constraints gathered in these interactions

(ibid.). This means that there is not a subjective entity, but rather something that can be verified by acting. Our actions depend largely on language.

The semiotician Umberto Eco (1976) argues that 'meaning' is the mental content that is given to a linguistic sign. It is the concept or idea that is associated with the sign in all types of communication, such as mental content. The challenge that is commonly perceived, however, is that 'meaning' has a deeply subjective component: each person assigns his or her own value to the mental meaning. In order to create optimal communication, 'meaning' by convention therefore must be equal between all the viewers of the said sign.

Attila Bujdosó (2012) refers to data visualisation as "a tool to build understanding in the perceiver because a complex dataset is filtered, scaled down, compressed, translated, and represented in such way that it fits the perceiver's perceptive and cognitive capacity." I argue that it can also be a tool to raise awareness and define meaning.

Embodiment and data

As Manovich (2010) argues, "The meanings of the world 'visualise' include 'makes visible' and 'make a mental image'. This implies that until we 'visualise' something, this 'something' does not have a visual form. It becomes an image through a process of visualisation." In the previous section, I have discussed that by visualising data we bring meaning and context, making it more human (Thorp, 2011). Examples of such include Thorp's projects *GoodMorning!* and *Cascade[5]*.

Even through these examples, we can see that visualisation works as a sense-making tool, bringing empathic understanding towards the data displayed. Following the Oxford definition of 'embodiment' as "the expressing of (or giving a tangible or visible form to) an idea, quality, or feeling" (Oxford Dictionaries, 2017c), it could be said that Thorp embodies digital data into a visualisation using computer-based tools in his examples. However, these embodiments occur only in a two-dimensional space, restricting our cognitive understanding to screen-based media.

[5] *Cascade* is a Project developed by Jer Thorp while he held the position of artist-in-residence at The New York Times. Cascade allows for precise analysis of the structures which underlie sharing activity on the web. This first-of-its-kind tool links browsing behaviour on a site and sharing activity in order to construct a detailed picture of how information propagates through the realm of social media. While initially applied to New York Times articles and information, the tool and its underlying logic may be applied to any publisher or brand interested in understanding how its messages are shared (New York Times Lab, 2015).

If visualisation facilitates sense-making, but having a digital screen-based approach limits the use of our senses, perhaps the physical approach is more comprehensive. As Zhao and Moere (2008) argue, "Physicality plays a key role in understanding our environment because humans are inherently proficient in interacting with the real world using mainly auditory, visual, and tactile senses."

Zhao and Moere have also published an article in which they propose the concept of 'data sculpture' as an alternative approach to visualisation. They define a data sculpture as a "data-based physical artefact, possessing both artistic and functional qualities, that aims to augment a nearby audience's understanding of data insights and any socially relevant issues that underlie it" (Zhao and Moere, 2008). This concept is described as a system of physical representation and abstract data fused through embodiment (Bujdosó, 2012).

Referring to Zhao and Moere's study, Bujdosó (2012) states that "if data embodiment is viewed as a signification, physical representation is the signifier and the data set is the signified." In Ephemeral Data, I examine the use of embodiment as a methodology to express an abstract set of data by mapping it onto a physical object, and its repercussions on the message delivered that the data set visualises. In the next section, I explore in more detail what happens when data becomes physical or takes a physical form.

Fabricating meaning

In the previous section, I argue that making data visible through the use of two-dimensional graphic media enables a better understanding, but that it is not enough to fully bring context to the never-ending streams of digital data. Physical embodiment provides the opportunity to fully grasp the significance and meaning to be communicated, allowing the viewer to have a fuller sensorial experience when consuming the information provided.

Given these statements, my question is: is there a difference in the cognitive understanding of digital narratives when it intervenes in the physical space?

I have argued that the perception of meaning changes during the transmutation of digital data into physical form. For example, Zhao and Moere (2008) state that the affordances of a physical object "have the capacity to be interpreted in a functional way, thereby conveying informational meaning, as they forego higher-level visual abstraction." Therefore, when embodying digital data into physical space, our understanding of said data and the way we relate to it alters.

Examples of this include Print Wikipedia by Michael Mandinberg and Murmur study by Christopher Baker, which I will describe in more detail later in this thesis. Following Zhao and Moere's idea,

certain questions arise. Namely, what happens with data when you translate a graphic visualisation representation into a physical embodiment, and does it become more meaningful, or does the meaning change? As previously mentioned, the moment that we see this data in physical shape, we can relate to it and it becomes meaningful, or our perception of said meaning changes.

As detailed in previous sections, a number of artists have explored such transmutations between digital data and physical space. Mandinberg's Print Wikipedia from 2009, as well as Christopher Baker's Murmur study are two examples of works that have transmuted socially-generated contributions of online data into physical forms in the spatial dimension.

Mandinberg's work consists of printing 7600 volumes of Wikipedia entries. The core idea was to aid people in realising how vast an online archive like Wikipedia is, and to visualise the quantity of information it holds (Mandinberg 2015). The project is still growing with crowdsourcing funds, and as such it showcases the rapid evolvement in the amount of information that is reposited online[6].

Whereas Mandinberg's work serves to visualise the amounts of online data

records that are being stored in public encyclopedias, the Murmur study by Baker is a live Twitter visualisation and archive. The installation consists of 30 thermal printers that monitor Twitter for emotional utterances such as 'argh', 'meh', 'grrrr', 'oooo', 'ewww', and 'hmph', printing these utterances out on paper, thereby visualising the stream of emotional exchanges as piles of paper below the printers (Baker 2009). His work points out that while these messages appear to disappear in the endless data stream, they do in fact become accumulated, archived, and digitally-indexed by corporations (ibid.).[7]

In both cases, the artists use print as a medium to explore the embodiment of digital data, therefore assigning volume and space to the information. By providing relatable parameters, the artists have ensured that the viewer can relate in an intrinsic way to the impact of this data, assigning a meaning by witnessing its physical scale.

However, whereas these works have sought to embody words or textual data, my question is concerned more directly with data that has political content and possible social repercussions. Does data embodiment change the discourse around the topic? Does the meaning we assign to the topics change?

6   For more detail, see the Print Wikipedia project on http://printwikipedia.lulu.com/.

7 For more detail, see the Print Wikipedia project on http://printwikipedia.lulu.com/.

Intangible   *Tangible*

RAW
DATA

GRAPHIC
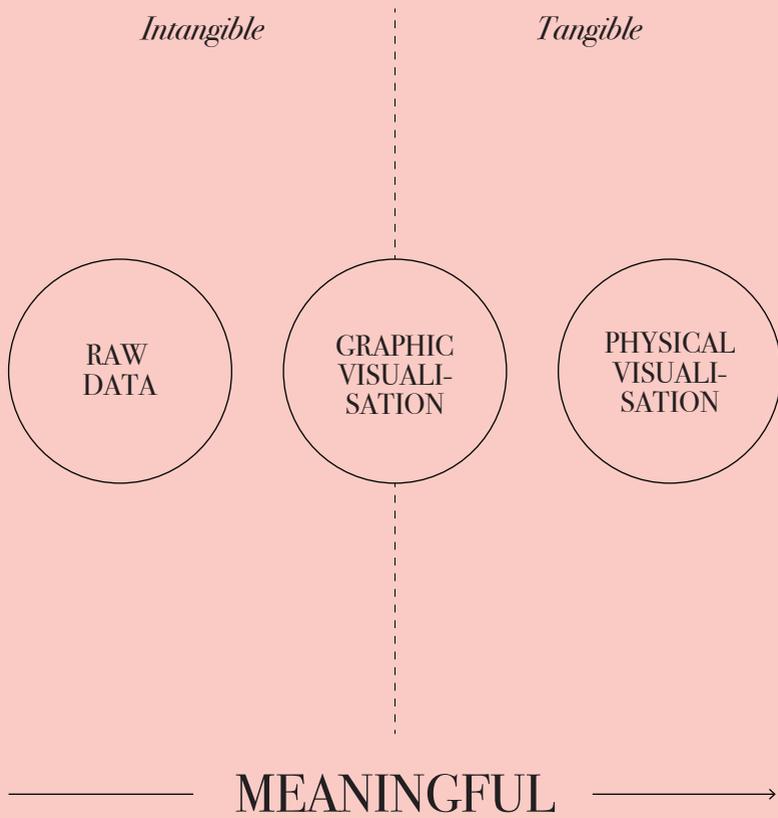VISUALI-
SATION

PHYSICAL
VISUALI-
SATION

MEANINGFUL

Figure 3: Transition between the dimensions of data visualisation.

POLITICAL
CONTROVERSY

↓

SOCIAL MEDIA
CONTROVERSY

⟶   HASHTAG # ⟶   MEANING

NEW MEDIA   NEW MEANING

NEW PERCEPTIONS

↓

INFLUENCE IN
PUBLIC OPINION

Figure 4: Diagram of the flow of a political controversy in Twitter

New media as a political signifier for meaning and perception

In an article about the use of hashtags, Camron Shirkhodaie (2015) states that the hashtag could be thought a signifier if it is seen through the lenses of structuralism. "The concept that it produces in a reader's mind is what is signified. It would seem that hashtags operate through the same structuralist mechanisms that traditional language does. For example, #summer should signify the same concept as "summer"" (ibid.). What Shirkhoidaie (ibid.) argues is that structuralism does not account for the entirety of hashtags. As it follows, if we take Shirkhoidaie's statement as a fact, and view hashtags in twitter as a tool for collective action, as was stated in the second chapter of this thesis, we could argue that hashtags are used to categorise data under a cultural and political sentiment.

While Shirkhoidaie (ibid.) coins the concept of meta-hashtags, which refer to hashtags that are bigger or more important than common hashtags, and transcend the Twitter media argument that the hashtags themselves are not profound enough to serve as structural signifiers for greater discussion. The hashtag #summer, for example, may refer to a myriad of isolated phenomena. Despite this, Shirkhoidaie's point enables us to see that when there is a growing political controversy in Twitter, since we use the hashtag as a signifier for its meaning, and it serves to impact the influence of the public opinion of

that topic. Therefore, the question is: would it be safe to say that if we change the signifier for a new media, the meaning changes too (Fig. 4)?

RESEARCH FRAMEWORK:

approach and methodology

Research question: physical embodiment as a creator of meaning

In the previous sections, I have discussed the influence of social media within the framework of collective actions, as well as the use of social media as a tool with which build political discourse. I have also examined the use of data representation through physical embodiment as a tool to facilitate sense making, as well as adding context and meaning to a vast amount of data streams.

The topics previously referred to pose the central questions of this thesis:

What happens when a trending political controversy is embodied in a physical form?

Given the preceding outlines and definitions in this thesis, is it true that if a political controversy manifests beyond a bi-dimensional representation in this form of a physical embodiment, a) will it become more meaningful? b) is it that the meaning changes? or c) is it the perceptual relationship with the discussion that changes?

To answer these questions, I have created a project that consists of an installation, framed as a dynamic data sculpture. In this installation, I represent LGBT-related discussions on Twitter in the form of material interaction.

Twitter was the first social media that introduced the hashtag as a way to tag their messages with a relevant word or phrase. This feature gives users the ability to categorise their tweets depending on the text they have assigned to their hashtags.

By mapping hashtags into visualisations, these tweets become part of a

data-driven narrative that interrupts space in time. Through my installation, I want to demonstrate that placing data flows into a human (i.e. tangible) context gains meaning. I argue that by doing so, our personal narratives/ stories and the stories of others can bring empathy to these conversations. Consequently, the question arises whether or not the dialogue becomes different.

I will explore the use of new media as a political signifier, thereby exploring the meaning and perception a digital narrative controversy has when it becomes physically embodied. My aim is to experiment with the interactions between an API and an Arduino, allowing me to map the hashtags into a physical material.

Methodology: embodying a political controversy

As stated in the previous chapter, in order to answer my research question, I built a dynamic data sculpture that represented a political debate discussed in a Twitter stream. This section explains the steps and methods I planned out when creating the installation and concluding my research.

To explore new mediums of embodying

data and the interchangeability of meaning, I wanted to start by selecting a topic of political controversy. As previously discussed in the second chapter, social media has a key role in driving the relevant public conversation, particularly in the way it frames debates and creates socio-political realities. In the third chapter I also discussed the role that data embodiment plays in the perception of abstract datasets. As Jack Zhao and Andrew Vande Moere (2008) state, "a data sculpture can indirectly convey data-related insights, and encourage people to reflect on social and cultural impacts that surround the conceived dataset."

Given these two points, as well as my interest in political activism, I decided that choosing a political controversy discussed on Twitter would be the best way to start my exploration. In the following chapter I will discuss the topic of LGBT rights in more detail, which was the topic of controversy I chose for this installation.

To map this controversy into a new medium, I decided to use the Twitter developer platform to text mine real-time tweet feeds using Twitter Streaming API (application programming interface)[9]. Using this particular API would allow me to

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[9] An API is a set of commands, functions, protocols, and objects that programmers can use to create software or interact with an external system. It provides developers with standard commands for performing common operations so they do not have to write the code from scratch (Christensson, 2016).

fetch tweets related to two groups of hashtags that I had chosen to represent polarised opinions of the controversy.

Once I would collect the tweets in real-time, I would use them as an input to an Arduino device, allowing me to map it into a moveable or flexible material that could represent the tweet in the real world. When choosing the material, I would take into consideration the affordances and constraints of it, favouring the ones that would change their state depending on the environment.

After having all the elements to transfer the digital information in physical interactions, I would build an interactive installation that would convey the two topics in the same artefact, allowing the viewer to have a visual and spatial perception of the stream of dialogues in a more permanent place. Then I would observe the viewers' perceptions and reactions in regards to the information itself, as well as the representation of it. In addition, I would be able to distinguish whether or not the relationship with the meaning and impact of the topic changed in any way after experiencing the installation.

Finally, I would use my observations and the learning I gained throughout these processes to reflect on the work itself and how I would proceed in the future.

In the next section I will describe in detail the whole process as it happened, outlining in further detail what I have discussed in this chapter.

EPHEMERAL DATA:

a data sculpture installation

Programming for Artists

The project I chose to develop for this thesis was done as part of the Art and Technology study module of Aalto University. As the minor subject is described by Aalto, it "combines media artistic thinking and practice with the aesthetic and philosophical foundations of the field. Students are encouraged to cross over boundaries between technology, art, and design" (Aalto University, 2012).

Part of the minor was a course called Software Studies: Programming for Artists, which was taught by Matti Niinimäki. The course focussed on teaching students how to write basic, simple programmes that would allow the student to experiment with different libraries in order to create interactive installations (or other kind of artworks with audio-visual or physical interaction outcomes).

For the final assignment of this course, we were asked to create a simple interactive installation using the techniques covered during the studies. I took this opportunity to explore and create the first visualisation prototype

of digital narratives. In this exploration, I would represent a recurrent topic that was brought forward through Twitter discussions in the form of tangible interactions.

Addressing a controversy

For the installation, I wanted to focus on a controversial topic that took place throughout the year 2013 regarding LGBT rights in Russia. During the previous year, an amendment to the child protection law was made, directly affecting the rights of the LGBT community. With this event occurring on the opening evening of the Sochi Olympics in Russia, these legislative changes led to worldwide demonstrations in favour of and against LGBT rights.

In 2012, the St. Petersburg governor Georgiy Poltavchenko signed a bill into law that banned "... any public activity [including what happens online] that promotes homosexuality, sodomy, lesbianism, bisexuality, and transgender identity, as well as any display of homosexual conduct that could potentially be seen by minors [which the lawmakers dubbed as promoting

paedophilia]" (Edwards Stout, 2012). This bill came as an amendment to the federal law "On the Protection of Children from Information Harmful to their Health and Development." These amendments prohibit any public LGBT events or discussions inside the city that could be accessible to minors (Reynolds, 2014).

In 2013, Russia's state Duma passed the ban on a national level. When Putin subsequently signed "the ban on 'gay propaganda' into law on June 30, 2013, which criminalised LGBT-friendly public acts and demonstrations, he set off a firestorm of events including arrests, international protests, vodka boycotts, and outrage from public figures and celebrities alike" (Reynolds, 2014).

These events also triggered an ongoing dialogue between the public and their governments, demanding equal rights and anti-discriminatory laws. This socio-political controversy was reflected and augmented by social media, leading to a highly intensive debate. Celebrities like Madonna and Lady Gaga not only talked against the policy in their concerts in Russia, but also took to Twitter as a main channel in which to protest. Lady Gaga, a major LGBT activist, launched a Twitter rant berating the Russian government for its "criminal" stance on LGBT rights. The three tweets garnered a combined 47,000 retweets (Business Insider, 2013). According to the Washington post, Lady Gaga's comments against the Russian government earned more than 20,000

retweets in their first half hour online (Washington Post, 2013). This is only a small example of the volume of tweets being generated, addressing the topic and reaching media coverage in several papers around the world.

Because of the turmoil that these events caused during this time, I thought it would be relevant to visualise the ways in which the narrative of the LGBT conversation took shape on twitter. To do this, I wanted to intervene the hashtag as a symbol and basic component of the debate's representation.

I picked eight hashtags within the LGBT vocabulary, both in English and Spanish, and clustered them in two groups: homophobic and pro-gay rights. There were three homophobic hashtags: **#nohomo**, **#faggot**, and **#maricon** ('faggot' in Spanish). These hashtags represented common derogatory words typically used to demean LGBT people. The other five hashtags were **#LGBT**, **#equalmarriage**, **#itsgetsbetter**, **#gaypride**, and **#matrimonioigualitario** ('equal marriage' in Spanish). These hashtags represented known tag lines that support both the victims of bullying and LGBT rights movements.

The use of Processing libraries and Twitter API

To collect aforementioned hashtags in order to make a comparison between opposing opinions, I turned to the Twitter Stream API to collect them. This API collects from the global stream of tweet data (found at https://dev.twitter.com/streaming/overview). By choosing the public streams as the endpoint, I could mine data from the public data flowing through Twitter, allowing me to filter and fetch my chosen hashtags (found at https://dev.twitter.com/streaming/public).

To connect to the API, I used Processing, a free and open source programming software with its own language. I also used the Twitter4J library, which is a Java library used to connect to the Streaming API of Twitter. The code implemented in order to fetch the hashtags from Twitter is based on an open source app from Michael Zick Doherty called SimpleTwitterStream, an app that retrieves images from the tweet stream based on selected keywords.[10]

The aim of using Twitter's data was to implement the tweets as digital input and activate the behaviour of a physical object as an output, allowing me to map the information onto a physical form. To do that, I used Arduino, an open-source electronic board that can be programmed to interact with physical objects through sensors, lights, and motors.[11]

Using the tools previously described, I first approached the project by programming an application that would connect the appropriate hashtag tweets to LED light, making the light turn on every time there was a tweet. In a second test, I connected the tweets to a servo motor, making the motor move every time somebody made a tweet and transforming the digital data into a physical movement.

Materialising the discussion

Once I figured out the mechanisms that I would use to transfer the digital data into a moving output, I started to experiment with new mediums and materials that would better represent the polarised controversy I was trying to engage with.

Because of my previous explorations with visualising digital flows of invisible data (as described in previous chapters), I wanted to have a very visual statement in order to represent these different opinions. Though I wanted

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[10]   For more details about fetching the tweets, I have added the code to the Appendix.

[11]   I used two sources for researching this aspect: https://www.arduino.cc/en/guide/introduction, and http://www.makeuseof.com/tag/arduino-technology-explained/.

to use typical visualization elements, I also wanted them to be presented in a physical, analogue way.

I chose a new symbol to differentiate the hashtags' meanings, replacing the hashtag symbol with two different colours (representing both sides of the topic). Using colour as an embodiment of data, I researched how colour has been explored as a physical material within several mediums in art.

While researching and collecting references and inspirations on a mood board, I came across a visual artist called Alberto Seveso (https://www.behance.net/indiffident). He creates slow motion photographs of coloured ink in water, shown in Fig. 5. His work helped me realise that the representation of this stream of data information could be very appealing if I approached it like the liquid medium in his images. Even though this ink is a liquid-soluble material, when mixed in water it could become solid with a textured body. Because of their liquid materiality, these two different 'bodies' can create volume, giving the sensation of one colour having the ability to overcome the other.

This way of displaying colour was exactly what I was looking for to embody the data in my installation. This medium could represent the cadence, volume, and texture of the incoming stream. In order to represent such a flow, a liquid medium could allow me to depict the idea of each tweet as a drop of colour in a volumetric mass, interacting with another mass through space and time, and ultimately creating a new body that could show the way that one idea can overcome another.

To achieve this visual effect in an evolving stream, I had to experiment with several materials before choosing the colours for each topic. My first approach was choosing colours that would contrast enough: despite the fact that they could become mixed, I needed them to be clearly different from each other. Initially I experimented with yellow and blue coloured ink in a glass jar filled with water. I wanted to test the temporal duration of the volume created by the mix of colours. The mix worked very well in a visual way, but it was not optimal in regards to time—after a couple of minutes it would just dissolve into green water, making it very difficult to differentiate between the amount of yellow and blue in the water (Fig. 6). After testing with ink, and then with acrylic paint, I realised that I needed to have a material that would not be completely soluble in water. I then tried with oil paint and water, which resulted in little balls of paint that would not expand in the water.

Finally, I experimented with oil pigment and oil medium (see Fig. 7). The pigment was the closest I could get to the desired state. Because it was oil soluble but not a liquid material, the colour would become a liquid when it came in contact with the oil, making the colour volumetric for much longer.

Figure 5: colour visualisation by Alberto Seveso

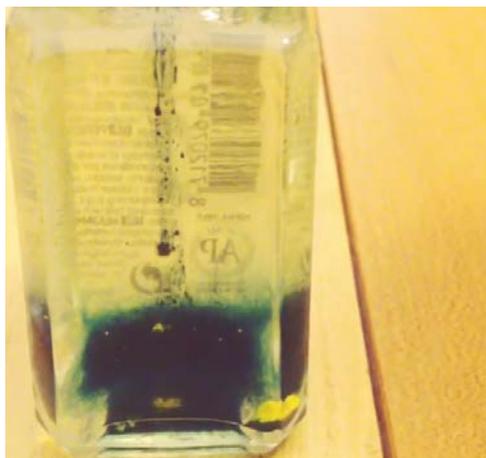Figure 6: Experimentation with water

Figure 7: Experimentation with oil

Ephemeral Data, a first prototype

The installation entitled Ephemeral Data, was exhibited in the frame of the course Programming for Artists, in the Art and Technology minor at Aalto University, as stated previously. The exhibition was called A Night Before Christmas, and took place in Aalto's Open Innovation House in December of 2013. Ephemeral Data was my first approximation to study the relationship between embodied data and meaning via a dynamic data sculpture.

As outlined previously, this prototype was created as a means of studying the ways in which social media serves as a platform to develop all sorts of discussions. These discussions that can be very relevant and generate a lot of noise, but they can also be ephemeral due to the speed of the conversation. In this installation, the hashtag became a 'meta-hashtag': a signifier that transcends Twitter media into the real world, associating its meaning not only literally, but also with movements and socio-political discussions (Shirkhodaie, 2015). With Ephemeral Data, my intention was to replace the signifier with tangible materials, transforming the stream of tweets into an embodied stream of physical interactions between physical elements. This transition enabled me to observe if the meaning and perception of this politically-charged topic changed when they are presented in physical space rather than digital.

In Ephemeral Data—as explained above—I visualised hashtags referring to homophobic and pro- LGBT rights terms, and represented those hashtags with two different colours infused into a tank full of oil. Every time there was a hashtag tweeted, a bit of coloured powder would be dropped into the oil, giving a body to each tweet and enabling the discussion to become more permanent in time. The more hashtags were named, the more the oil would become saturated with colour; a discussion that stayed active for a longer period would physically visualise the scale and frequency of polarised discussion through the release of these colours (Fig.8).
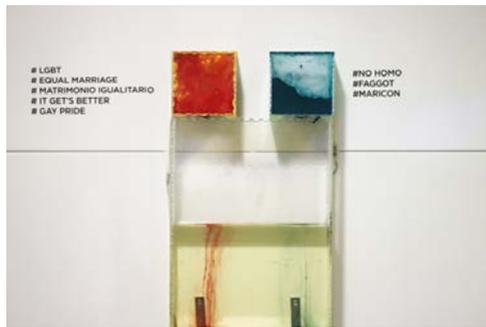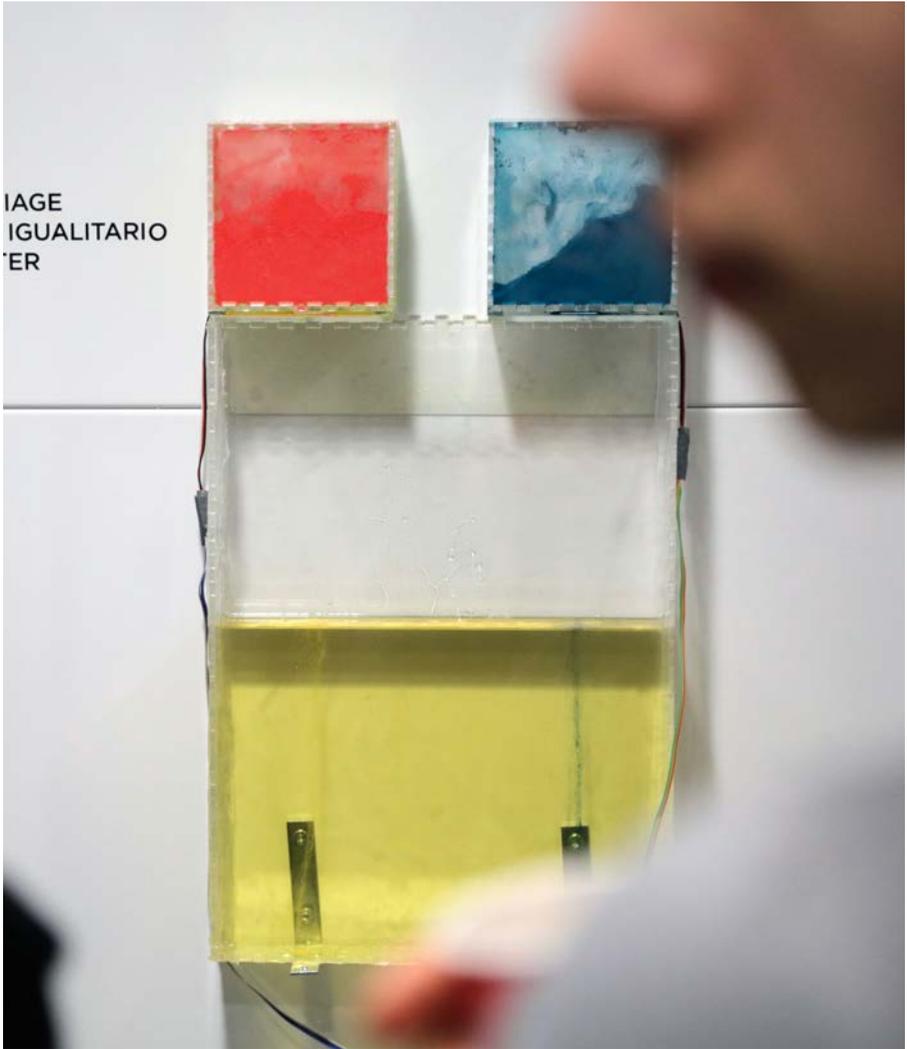
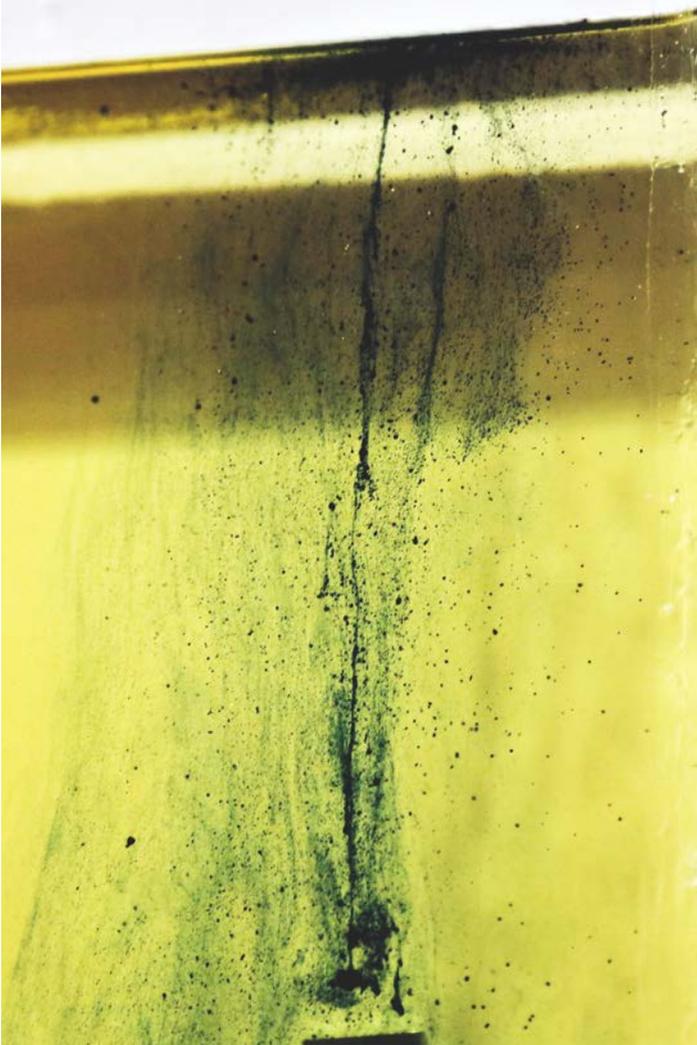Figure 8: Ephemeral Data installation

Figure 8: Ephemeral Data installation

Figure 8: Ephemeral Data installation

Reflections on the work

During this first prototype, I learned that rather than changing the meaning of the digital data used for the project, the relationship with these newly embodied topics changed. Seeing the data visualised in a tangible way (and in a defined space and time) raised awareness of the discussions and the social behaviours around specific issues. The perceptions of reality changed, and with them, perhaps in some ways the meanings we assign to certain words also changed.

From the start, I was able to observe (in terms of scale) the impact of translating digital narratives to physical form. While testing the streams of hashtags with the Arduino code during the first stage of prototyping, the frequency of the homophobic hashtags (particularly #nohomo) was so high that the servo motor couldn't handle the speed. Because of this, I was forced to divide the frequency by three so the installation would work and the motor would not burn out.

When the installation was later set up, I could see that the frequency of the homophobic hashtags was double than those of the LGBT. This observation led me to revisit the tweets I was collecting. I read some of the homophobic tweets and observed that they were not necessarily always used as part of direct hate speech, but rather used as part of everyday language. One example of this was the term 'no homo', which was used

as one of the homophobic hashtags for this work, but that has more complex uses. As Joseph. R. Brown (2011) describes in his article, "The phrase no homo arose in hip-hop lyrics of the 1990s as a discourse interjection to negate supposed sexual and gender transgressions. Today the phrase has gained currency beyond hip-hop culture and pervades racial and gender continua." This means that 'no homo' is often used today by the mainstream simply to denote that the speaker is not gay.

In the installation, some instances of **#nohomo** were used as a "phrase used after one inadvertently says something gay" (Peckham, 2007). You could see such uses, for example, in the tweet by user @T___Howard: "Shout out to my bruh Devin dude show me mad support, I love you bruh. **#NoHomo**" (Howard, 2013). There were other similar instances. Regardless, the replications of the language are still problematic—I noticed that relevant hate speech was normalised in social media to the extent that my motor broke.

The pro-LGBT rights tweets were significantly lesser in comparison. I noticed that these tweets were directly related to the advocacy for equal rights. This may partly explain why there were so many less pro-LGBT tweets, since the homophobic tweets were words that are somewhat considered everyday language, and the pro LGBT hashtags I chose are terms that are specially constructed for advocacy.

What implications this has both socially and practically could be and should be studied as a topic of its own, but is beyond the scope of this thesis.

In terms of reactions, this installation raises a number of questions. For instance, I observed that many viewers found it very interesting that there was an active discussion concerning a topic that they hadn't realised was recurring to such an extent. This suggests that the installation embodied data in a new way: a topic of political importance became visible through its physical representation.

Many viewers' comments were also about the topic itself. Because the installation was ongoing for a whole week, it brought a sensible and sometimes uncomfortable topic to the workplace—Open Innovation House, the site of the installation, is essentially an office space. In doing so, it revealed the amount of discrimination the LGBT community is often subjected to. The scale and frequency of the homophobic hashtags were a revelation for some observers.

Through the comments that viewers made and questions they asked me about the work, I could also observe that talking about being gay and the social stigma around these kinds of topics are still quite conservative in many societies. Addressing homophobia and discrimination—as well as advocacy—made some viewers uncomfortable. At the same time, it appeared that representing those discussions in a more 'artistic way' made the discussing the topic less awkward. As mentioned already, I feel this a topic that could be pursued in much more detail as a separate project. This suggests that the meaning behind the hashtags did change in some ways: issues that people had perhaps not considered homophobic became questioned as homophobic by engaging with the installation. What I am not certain of is whether it was the awareness of the issue that had the power to shift perspectives, or rather if it was through gaining a better understanding of the meanings of the homophobic slurs people use in everyday language. For me, the discovery was seeing data becoming embodied could create a significant difference in the overall discussion surrounding LGBT rights.

Finally, the prototype could have been improved. What I learned through this installation was how important it was to define the hashtags. I believe that in this case, the polarisation and the representation of it was not as accurate as it could have been due to the reasons stated above. The definition of these 'meta-hashtags' were still vague. The relationship between the pro-gay and homophobic hashtags are not correlative, unlike the hashtags **#blacklivesmatters** and its contrary response **#alllivesmatter** (which diametrically opposed in meaning). I will discuss this point in more detail in the conclusions.

CONCLUSION:

discussions and future steps

This thesis explored and observed how the perception and meaning of a data stream generated by a political controversy in Twitter had the potential to change when assigned a new medium of representation. Through a prototype installation called Ephemeral Data, I represented LGBT-related discussions in Twitter by replacing 'meta-hashtags' of the topic in the form of material interactions. In doing so, I argue that by seeing the data visualised in a tangible way in space and time data embodiment can increase awareness of a topic and its replications, rather than changing the literal meaning of it. However, what can change instead is the relationship with the social significance of said meaning and the relationship that the viewer has with the represented topics.

In my study, I was able to observe that displaying controversial discussions such as LGBT rights and systemic homophobia in the form of a physical artefact with the capacity to visualise the whole stream of data, viewers would react towards the discussion itself. They would do so by acknowledging a representation embodied in space and time. I also observed that by giving a more artistic approach to those discussions, the topic became more approachable and less uncomfortable.

During the time the installation was running, I realised that the hashtags I chose to visualise the specified controversy or the way in which they were gathered were not the most suitable. There was an essential difference between the homophobic and pro-gay meanings and usage. I observed that the homophobic hashtags may be used in common language without necessarily intending to be homophobic, since homophobic language appeared somewhat normalised in daily speech. What suggested that to me and led to this realisation was when I had to reduce the motor speed of the homophobic hashtags to one third so the motor wouldn't burn out. On the other hand, the pro-gay hashtags were generally always used to support a cause and showed a very clear purpose when and how they were used. This led to my supposition as to why the homophobic hashtags were being used at triple the frequency of the pro-gay ones. Having made this realisation, I suspect that there may be a lack of consciousness regarding the use of vocabulary when using social media: tweeting and using

hashtags in digital platforms is more permissive than saying words out loud in physical space.

This is not to say, however, that language is harmless. Quite homophobic slurs are something that may be used at times without much consideration or intention of being homophobic. However, based on this installation, I cannot estimate the social implications of such normalisation of hate speech on social media.

In the future, I would like to explore this same idea with the case of the Black Lives Matters and All Lives Matters movements. The latter being a direct response to the former, I think it would be an optimal example in studying the scale and impact of these discussions. Even though in the background portion of this thesis I refer to Black Lives Matter as a key example of how a hashtag works as a symbolic cross-platform organiser of digital activism, when I started this project this movement didn't exist. It was 2013, and there were still three more years to come before experts would coin 2016 "the year that social media changed everything" (Romano, 2016).

I believe that even though there is an ongoing rise of meta-hashtags (as defined in Chapter 3), and Black Lives Matter is exemplary simply because it's the only one of these hashtags that has prompted a directly oppositional response.

Despite the shortcomings of the installation, this prototype raised important topics: I argue that data embodiment can indeed make us more engaged and aware of political matters, bringing a more empathic approach towards the topics represented. As Jer Thorp (2011) stated in one of his TED Talks, "data put in the human context will automatically build empathy for the people involved." Data embodiment thereby provides a potentially crucial tool for creating sense and meaning, as well as coherently navigating a vast amount of digital data in an era of data overload.

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APPENDIX

Appendix nº1: Fetching Tweets with Processing

Below I have added the Processing code I used to call Certain Tweets using Twitter API and Twitter4J.

Installation Final.pde


```
import processing.serial.*;
//import org.firmata.*;
import cc.arduino.*;
Arduino arduino;
Serial myPort;

static String OAuthConsumerKey = "QHCuR8HsfFjTVO9KeVI0sA";
static String OAuthConsumerSecret = "TQZGoVSpEKirPJw7GYjo6jv8SUVKjJh6lCtMhSEtqk";
// This is where you enter your Access Token info
static String AccessToken = "101637045-b5AKDlny5vKHdg88C6XcsnLSrfuH94lIt9YD3uyV";
static String AccessTokenSecret = "rl2y5KOYb5Dmyg4RcDKPFlp5YgUzOhIR6fksOIxwYdCqG";

// if you enter keywords here it will filter, otherwise it will sample
String keywords[] = {
    "#nohomo", "#maricon", "#lgbt", "#LGBT" , "#equalmariage", "#matrimonioigualitario", "#itgetsbetter"
};

TwitterStream twitter = new TwitterStreamFactory().getInstance();
PImage img;
boolean imageLoaded;
boolean NoHomo;
boolean LGBT;

void setup() {
    size(100, 100);
    //arduino = new Arduino(this, Arduino.list()[?], 57600);
    println(Serial.list());
    myPort = new Serial(this, Serial.list()[6], 57600);
    // arduino.pinMode(9, 5);
    //arduino.pinMode(10, 5);

    connectTwitter();
    twitter.addListener(listener);
    if (keywords.length==0) twitter.sample();
    else twitter.filter(new FilterQuery().track(keywords));
}

void draw() {

    if (NoHomo == true ) {
    //    arduino.analogWrite(9, 150);
    //    delay(100);
    //    arduino.analogWrite(9, 50);
    //    delay(100);
    myPort.write(0);
        NoHomo = false;
    }

    if (LGBT == true) {
    //    arduino.analogWrite(10, 150);
    //    delay(100);
    //    arduino.analogWrite(10, 50);
    //    delay(100);
    myPort.write(1);
        LGBT = false;
    }
}

// Initial connection
void connectTwitter() {
    twitter.setOAuthConsumer(OAuthConsumerKey, OAuthConsumerSecret);
    AccessToken accessToken = loadAccessToken();
    twitter.setOAuthAccessToken(accessToken);
}

// Loading up the access token
private static AccessToken loadAccessToken() {
    return new AccessToken(AccessToken, AccessTokenSecret);
}
```

```
71   // This listens for new tweet
72   StatusListener listener = new StatusListener() {
73      public void onStatus(Status status) {
74         String newTweet = status.getText();
75
76         String[] Azul1 = match(newTweet,  "#faggot"); // here Im parsing each word individually
77         String[] Azul2 = match(newTweet, "#nohomo");
78         String[] Azul3 = match(newTweet, "#maricon");
79
80         String[] Amarillo1 = match(newTweet, "#lgbt");
81         String[] Amarillo2 = match(newTweet, "#lgbtq");
82         String[] Amarillo3 = match(newTweet, "#lgbti");
83         String[] Amarillo4 = match(newTweet, "#LGBT");
84         String[] Amarillo5 = match(newTweet, "#gaypride");
85         String[] Amarillo6 = match(newTweet, "#equalmarriage");
86         String[] Amarillo7 = match(newTweet, "#matrimonioigualitario");
87         String[] Amarillo8 = match(newTweet, "#itgetsbetter");
88
89         if (Azul1 != null) {  // If not null, then a match was found
90            // This will print to the console, since a match was found.
91            NoHomo = true;
92
93            println("Found a match in #NoHomo '" + newTweet + "'");
94         }
95         else if (Azul2 != null) {  // If not null, then a match was found
96            // This will print to the console, since a match was found.
97            NoHomo = true;
98
99            println("Found a match in #NoHomo '" + newTweet + "'");
100
101        } else if (Azul3 != null) {  // If not null, then a match was found
102           // This will print to the console, since a match was found.
103           NoHomo = true;
104           println("Found a match in #NoHomo '" + newTweet + "'");
105
106        }
107        else {
108           NoHomo = false;
109           // println("No match found in '" + newTweet + "'");
110        }
111
112        if (Amarillo1 != null) {  // If not null, then a match was found
113           // This will print to the console, since a match was found.
114           LGBT = true;
115
116           println("Found a match in LGBT'" + newTweet + "'");
117        }
118        else if (Amarillo2 != null) {  // If not null, then a match was found
119           // This will print to the console, since a match was found.
120           LGBT = true;
121
122           println("Found a match in LGBT'" + newTweet + "'");
123        }
124        else if (Amarillo3 != null) {  // If not null, then a match was found
125           // This will print to the console, since a match was found.
126           LGBT = true;
127
128           println("Found a match in LGBT'" + newTweet + "'");
129        }
130        else if (Amarillo4 != null) {  // If not null, then a match was found
131           // This will print to the console, since a match was found.
132           LGBT = true;
133
134           println("Found a match in LGBT'" + newTweet + "'");
135        }
136        else if (Amarillo5 != null) {  // If not null, then a match was found
137           // This will print to the console, since a match was found.
138           LGBT = true;
139
140
```

```
140
141     println("Found a match in LGBT'" + newTweet + "'");
142     }
143     else if (Amarillo6 != null) {  // If not null, then a match was found
144     // This will print to the console, since a match was found.
145     LGBT = true;
146
147     println("Found a match in LGBT'" + newTweet + "'");
148     }
149     else if (Amarillo7 != null) {  // If not null, then a match was found
150     // This will print to the console, since a match was found.
151     LGBT = true;
152
153     println("Found a match in LGBT'" + newTweet + "'");
154     }
155     else if (Amarillo8 != null) {  // If not null, then a match was found
156     // This will print to the console, since a match was found.
157     LGBT = true;
158
159     println("Found a match in LGBT'" + newTweet + "'");
160     }
161     else {
162     LGBT = false;
163     // println("No match found in '" + newTweet + "'");
164     }
165
166     String imgUrl = null;
167     String imgPage = null;
168
169     // Checks for images posted using twitter API
170
171     if (status.getMediaEntities() != null) {
172     imgUrl= status.getMediaEntities()[0].getMediaURL().toString();
173     }
174     // Checks for images posted using other APIs
175
176     else {
177     if (status.getURLEntities().length > 0) {
178     if (status.getURLEntities()[0].getExpandedURL() != null) {
179     imgPage = status.getURLEntities()[0].getExpandedURL().toString();
180     }
181     else {
182     if (status.getURLEntities()[0].getDisplayURL() != null) {
183     imgPage = status.getURLEntities()[0].getDisplayURL().toString();
184     }
185     }
186     }
187
188     if (imgPage != null) imgUrl  = parseTwitterImg(imgPage);
189     }
190
191     if (imgUrl != null) {
192
193     // println("found image: " + imgUrl);
194
195     if (imgUrl.startsWith("//")) {
196     println("s3 weirdness");
197     imgUrl = "http:" + imgUrl;
198     }
199     if (!imgUrl.endsWith(".jpg")) {
200     byte[] imgBytes = loadBytes(imgUrl);
201     saveBytes("tempImage.jpg", imgBytes);
202     imgUrl = "tempImage.jpg";
203     }
204     //      println("loading " + imgUrl);
205     img = loadImage(imgUrl);
206     imageLoaded = true;
207     }
208     }
```

```
installationFinal_pare_tesis    ImageServices    arduinoConnection    ▼

209
210    public void onDeletionNotice(StatusDeletionNotice statusDeletionNotice) {
211      //System.out.println("Got a status deletion notice id:" + statusDeletionNotice.getStatusId());
212    }
213    public void onTrackLimitationNotice(int numberOfLimitedStatuses) {
214      //  System.out.println("Got track limitation notice:" + numberOfLimitedStatuses);
215    }
216    public void onScrubGeo(long userId, long upToStatusId) {
217      System.out.println("Got scrub_geo event userId:" + userId + " upToStatusId:" + upToStatusId);
218    }
219    public void onException(Exception ex) {
220      ex.printStackTrace();
221    }
222  };
223
224  // Twitter doesn't recognize images from other sites as media, so must be parsed manually
225  // You can add more services at the top if something is missing
226
227  String parseTwitterImg(String pageUrl) {
228
229    for (int i=0; i<imageService.length; i++) {
230      if (pageUrl.startsWith(imageService[i][0])) {
231
232        String fullPage = "";  // container for html
233        String lines[] = loadStrings(pageUrl); // load html into an array, then move to container
234        for (int j=0; j < lines.length; j++) {
235          fullPage += lines[j] + "\n";
236        }
237
238        String[] pieces = split(fullPage, imageService[i][1]);
239        pieces = split(pieces[1], "\"");
240
241        return(pieces[0]);
242      }
243    }
244    return(null);
245  }
246
```

```
installationFinal_pare_tesis    ImageServices    arduinoConnection    ▼

1  // { site, parse token }
2  String imageService[][] = {
3    { "http://yfrog.com",     "<meta property=\"og:image\" content=\""},
4    {"http://twitpic.com",    "<img class=\"photo\" id=\"photo-display\" src=\""},
5    {"http://img.ly",         "<img alt=\"\" id=\"the-image\" src=\"" },
6    { "http://lockerz.com/", "<img id=\"photo\" src=\""},
7    {"http://instagr.am/",   "<meta property=\"og:image\" content=\""}
8  };
9
10
11
12
13
```

```
installationFinal_pare_tesis    ImageServices    arduinoConnection    ▼

1  Arduino arduino;
2
3  void arduinoConnection() {
4    println(Arduino.list());
5    arduino = new Arduino(this, Arduino.list()[7], 57600);
6  }
7
8
9
10
```

Appendix nº2: Arduino code for the installation

Below is the code I used to programme Arduino to work as the output of the flow of tweets.

```
#include <Servo.h>
Servo servo1;
Servo servo2;
int servo1Pin = 9;
int servo2Pin = 10;

void setup() {
  Serial.begin(57600);
  servo1.attach(servo1Pin);
  servo2.attach(servo2Pin);
  servo1.write(20);
  servo2.write(20);
}

void loop() {
  if (Serial.available() > 0) {
    int inByte = Serial.read();
    switch (inByte){
    case 0:
      servo1.write(100);
      delay(100);
      servo1.write(20);
      break;
    case 1:
      servo2.write(100);
      delay(100);
      servo2.write(20);
      break;
    default:
      break;
    }
  }
}
```

Arduino/Genuino Uno on COM1

To my family. Thank you

Helsinki 2017