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The Politics of Real-time:

A Device Perspective on Social Media Platforms and Search Engines

Esther Weltevrede, Anne Helmond and Carolin Gerlitz, University of Amsterdam.

Abstract

This paper inquires in the politics of real-time in online media. It suggests that real-time cannot be accounted for as a universal temporal frame in which events happen, but explores the making of real-time from a device perspective focusing on the temporalities of platforms. Based on an empirical study exploring the pace at which various online media produce new content, we trace the different rhythms, patterns or tempos created by the interplay of devices, users' web activities and issues. What emerges are distinct forms of 'realtimeness' which are not external from but specific to devices organized through socio-technical arrangements and practices of use. Realtimeness thus unflattens more general accounts of the real-time web and research, and draws attention to the agencies built into specific platform temporalities and the political economies of making real-time.

Introduction

The micro-blogging platform Twitter 'is a real-time information network'[i] where "the real magic [...] lies in absorbing real-time information that matters to you,'[ii] Facebook's Newsfeed ticker 'shows you the things you can already see on Facebook, but in real time'[iii] and search engines such as Bing and Google make efforts to include real-time updates in their result pages so that 'relevance meets the real-time web' (Singhal, 2009). This paper engages with the centrality of real-time in online media by embedding it in a larger understanding of the web as a temporal medium. Historically, emergent online technologies have elicited different notions of media time and temporality (Hassan and Purser, 2007). Among the key approaches were attempts to universalize web time, in 1998 Swatch for instance introduced Biel Meantime (BMT) as a universal reference for 'internet time' which requires a universal or absolute time for everyone in every place:

> Cyberspace has no seasons and no night and day [...] Internet Time is absolute time for everybody. Internet Time is not geopolitical. It is global. In the future, for many people, real time will be Internet Time (Negroponte in Nickell, 1998).

Such universal notions of time online have been addressed as 'timeless time' (Castells, 2000), 'atemporal medium' (Sterling, 2010), 'simultaneity of non-simultaneous' (Brose, 2004; Laguerre, 2004). In recent years, the conceptualization of web time has increasingly drawn attention to its tensions and instabilities, as some authors claim that the web is characterized by an interplay between permanence and ephemerality (Chun, 2011; Schneider and Foot, 2004). Other authors further problematize universal notions of online time by noting how search engines and platforms rewrite the past, create 'multiple presents' (Hellsten et al., 2006) and provide a multiplicity of times (Leong et al., 2009).

More recently, it has been the notion of real-time (Gehl, 2011; Berry, 2011a; Chun, 2011) that has become central to discussions of web time. 'Real-time' has not only emerged in academic discourses on time online, but has especially been promoted by the industry to label the post-Web 2.0 era. The 'real-time web' therewith functions as a successor of the less well-known 'live web' which sought to break with the 'static web' organized around webpages and links as initially imagined by Tim Berners Lee (Searls 2005a; 2005b).[vi] The term real-time web was coined 'to describe the exploding number of live social activities online, from tweets to status updates on Facebook to the sharing of news, Web links, and videos on myriad other sites' (Hof, 2009). In addition, real-time entails the promise of an experience of the now, allowing platforms and other web services to promote the speed and immediacy at which they organize new content and enable user interaction (Gehl, 2011). Geert Lovink even goes as far as to say 'real-time is the new crack' (2012) as engines and platforms increasingly invest in the optimization of both real-time processing of information and the possibilities of real-time user engagement. The notion of real-time is thus used to describe media characterized by fresh, dynamic or continuously processed content in opposition to static or archival media. Non-real-time media feature non-dynamic or historical content and are not designed to continuously process and present latest or most relevant content.

With this focus on dynamism and change in the present, real-time is also used as a universal temporal container in both academic and commercial discourses, suggesting a flat understanding of the term. Instead of thinking of platforms and engines as operating 'in real-time', we argue that real-time is created in specific ways. Real-time, we suggest, does not explain, it needs to be explained. Our objective is to unflatten real-time and to empirically study the relationship between real-time and platforms, by introducing a medium-specific perspective that

takes into account how various platforms create distinct real-times. We approach real-time as a form of information organization and aim to specify and qualify its assembly.

For this purpose, we focus on the intersection of real-time processing and experience and trace the technical features and developments, which have been historically deployed to organize real-time online. We attend to the role of push and pull technologies as well as syndication and streaming protocols. Then we turn to the notion of 'pace' and develop an information based view of real-time, which is tied to the algorithmic ordering and presentation of information. In order to explore pace empirically, we trace the actors, infrastructures, features, objects and activities that organize pace in a selection of platforms and engines. Drawing attention to how pace is specific and internal to online devices, we do not solely focus on the technology of platforms but take into account the social arrangements and cultural practices that they incorporate and enable. Following Niederer & Van Dijck (2010) and Bucher (2012), we use the term 'technicity' to focus on the socio-technical relations that produce real-time online.

More precisely, in our case study we explore the pace of an issue across search engines and platforms to identify how the organization of content, its presentation and user actions produce very specific rates of pace. Of particular interest is the relation between freshness and relevance as modes of organizing pace, following the assumption that fresh and relevant content create distinct paces. Media do not operate in real-time, devices and their cultures operate as pacers of real-time — a perspective which complicates universal accounts of real-time (Berry 2011a, 2011b) and real-time research (Back and Puwar 2012, Back, Lury and Zimmer 2012). We suggest to address the fabrication of these specific temporalities as 'realtimeness,' giving consideration to the fact that real-time is not a framework in which media change, but is in itself assembled through the technicity of platforms. In contrast to flat notions of real-time, focusing on

'realtimeness' foregrounds the distributed fabrication of real-time and opens up discussions on the politics of real-time.

Real-time experience and processing

The notion of real-time is typically approached from either a user experience perspective or viewed as a computational process within media studies, creating a twofold focus on technical and experienced time (Leong et al., 2009: 1277). In his early discussion of online temporality, Adrian Mackenzie contends:

> real-time concerns the rate at which computational processing takes place in relation to the time of lived audio-visual experience. It entails the progressive elimination of any perceptible delay between the time of machine processing and the time of conscious perception (1997: 60).

He distinguishes between the real-time processing of information through algorithmic and computational processes and the real-time experience offered to users through web interfaces. Real-time, Mackenzie's account suggests, is not an external time frame in which events or web engagement occurs, but is a fabricated temporal condition, in which the processing of information shall be organized at such speed that it allows for access without perceptible delay. The real in real-time is thus not a concern of immediacy - which is literally impossible - but a question of speed and the organization of content in relation to time. Hence, Mackenzie's account resonates with computational perspectives on real-time, which focus on real-time as operating under time constraints. Here, real-time refers to systems and processes performing tasks in predetermined temporal windows, most notably in micro- or nanoseconds and the computational challenges of this.

The interplay between experience and processing, Mackenzie continues, is situated at the heart of the internet and is fundamentally concerned with information production, access and

algorithmic sorting, opening up an informational account of real-time. However, Mackenzie's distinction between real-time processing and experience has been developed in the mid 1990s during a period of the web that was dominated by mainly static pages and very few platforms and engines, so that the question emerges whether this relation needs to be revisited in the contemporary state of the web, which is dominated by platforms, engines and their dynamically updating content.

The informational viewpoint on real-time has also been put forward by Paul Virilio who determines the value of information based on the speed of access as 'the reality of information is entirely contained in its speed of dissemination ... speed is information itself!' (Virilio, 1995: 140). Early debates of real-time situated in the 1990s are thus fundamentally entangled with the idea of the information superhighway as 'the global movement of weightless bits at the speed of light' (Negroponte, 1995: 12) in which the key potential of the internet was seen in its capacity of enabling information access at high speed. Manuel Castells (2000) inquires into how speeding up alters users' experience and suggests that the constant focus on accessing information now not only limits the focus to the present, but also isolates it from both future and past. What emerges is a 'timeless time' or a 'non-time' without past and without duration. Formulated during the early years of the Internet, the critique of 'timeless time' experiences a revival in recent years in relation to the increasing prominence of streams, which are perceived as encapsulating users into an 'eternal now' (Uprichard, 2012). In a similar fashion, newly emerging attempts to collect and analyze data 'live' as it is being produced, that is to do 'real-time research', often face critical voices suggesting that such attempts of being 'live' may render research atemporal, trapped in the present and merely speed-driven (Back and Puwar, 2012).

When engaging with the contemporary real-time web and social media platforms, the focus of user experience on immediacy and speed is still perceived as relevant, yet in different

form. No matter what users do, where and why, there is always a platform that invites them to share that information. Twitter asks, 'What is happening?' Facebook prompts 'What's on your mind?' and both platforms in a similar manner inform users when someone else has acted upon their shared activities immediately. Real-time experience is no longer limited to the elimination of a perceptible delay between the request, processing and presentation of information, instead it informs modes of engagement, interaction and the speed at which responses to one's own actions are being shown.

The question therefore emerges to which extent the social web alters the way real-time experience and processing as perceived by Mackenzie (1997) inform each other. User front-ends of social media platforms, so Gehl argues (2011), are characterized by numerous features for immediate and speeded up content engagement - opening up questions about the political economies of real-time media. Whilst user interfaces are focused on immediacy, only platform owners and partially cooperating partners can access and process the content in the archival back-end (Stalder, 2012). Gehl claims:

> Here, we confront a contradiction: the smooth interfaces that users enjoy appear to be comprised solely of immediate connections and instant information, but the servers powering them are maintained in large part due to their long-term, archival potential. This contradiction is the motor that drives Web 2.0. (2011, 2).

It is the immediate, ongoing user interaction that allows to fill the associated databases with new data points, contributing to a constant interplay between '"real-time drives" and the archival impulse' (Gehl, 2011: 6) and the emergence of a two-fold temporality of web devices to which not all actors have access. Although Gehl's distinction between front- and back-end temporality creates a rather general notion of real-time in front-ends, he brings to attention how temporality is not external but fundamentally internal to media in a wider sense. However, these agential capacities are not necessary immanent to the technologies as such, but informed by the politics of

platforms (Gillespie, 2010) which rely on economically valorizing user interaction and data. Platforms, Gehl's work suggests, are not real-time media, they produce distinct forms of real-time for specific users, which we seek to conceptualize as realtimeness in the course of the paper.

The most central feature around which many discussions around real-time emerge is streams. Streams are automatically updating content flows and have become key elements of websites and social media platforms (Berry, 2011a, 2011b; Borthwick, 2009; Lovink, 2012; Manovich, 2012): 'A stream is a dynamic flow of information (e.g. multi-modal media content). They are instantiated and enabled by code/software and a networked environment' (Berry, 2011b). The increasing presence of streams, software studies scholar David Berry (2011a) argues, is closely tied to the rise of the social web where users do not have to search for content on static web pages - as in the 'destination web' (Berry, 2011a, 142) or 'static web' (Searls, 2005a) - but content is brought to them instantly through automatically updating streams, recommendations and other dynamic elements. Different platforms offer different encounters with stream content, which come at 'varying lengths, modulations, qualities, quantities and granularities' (Berry, 2011a, 144).

Engaging with the various features that organize the experience of immediacy and speed, a couple of insights emerge. Firstly, the web does not merely change 'in real-time', but actually produces specific temporalities through its engines, platforms and their web cultures. Secondly, especially in the context of streams, creating a clear differentiation between real-time experience and processing becomes problematic as real-time media content is both produced, processed and engaged with in real-time while at the same time the activities of users in the front-end inform the processes of processing in the back-end. Thirdly, the interrelation between processing and experience is increasingly subjected to platform political objectives. In order to account for the specific fabrication of real-time we thus need to consider the interrelation between experience

and processing and will do so by engaging with a device perspective which explores the interplay between technicity, actors, practices and experience of web devices.

Contemporary dominant web devices are engines, where each search engine has its own logic of ranking content or sources, and platforms, where each platforms hosts and organizes specifically formatted content. Such perspective on the device does not solely focus on its technicity but considers their agential capacities as informed through the social arrangements, cultural practices and politics that online technologies incorporate and enable. In other words, platforms and engines are epistemological machines that capture, process, analyze, rank, recommend, format and aggregate data on the web (Rogers, 2009; 2013). By placing them both under the umbrella term of the 'online device' we draw attention to how these platforms and engines organize their information, how this information is produced, engaged with and entangled with practices. From such perspective, devices do not come with clearly delineated boundaries and agencies, but inform and are informed by a multiplicity of actors, dynamics and practices. Additionally, device-driven research emerges in relation to recent developments in science and technology studies-informed social research that focuses on the role of the device as structuring both culture and research, including the work of Ruppert et al. (2013), and the special issue on 'The Device' edited by Law and Ruppert (2013). The authors explicate the device-driven approach by focusing on how digital devices are part and parcel of the production and performance of contemporary sociality.

In what follows, we seek to develop a device approach to real-time and differentiate between the modes of real-time enabled in the front-end and its relations to sorting, processing and organizing content in the back-end. Examining real-time as a socio-technical arrangement, this approach allows us to investigate 'the interaction between user and [platform or] engine, the data that are collected, how they are analyzed, and ultimately the [...] recommendations that

result', referred to as 'device cultures' (Rogers et al 2013: 161). In the next step, we turn to the technical organization of web real-time, bringing to attention different ways to fabricate real-time and addressing the role of users in it.

The technicity of web real-time

Although the recent popularity of real-time is closely related to the rise of streams as found on social media, real-time has a longer history (Chun, 2011) and informed the becoming of the internet from its early stages onwards. Focusing on the socio-technical relations that compose real-time, we seek to trace the technical features that allow to automate, speed up and organize immediate access to new content and provide an indication to how real-time is fabricated across both front- and back-end.

In the early days of the web the timeliness of content delivery or information retrieval was often framed in the existing models of 'push' and 'pull' technologies. In a pull model the web user 'pulls' information by requesting a website at a chosen time and this transaction is initiated by the user or client itself. In a push model the provider or server initiates the transaction at specified intervals and the content is 'pushed' to the user without a specific request (Franklin and Zdonik, 1998: 516). In the mid 90s push technologies were being presented as a way to automate requests for new web content, therewith addressing the novel problem of 'information overload and the inability for users to find the data they need' (Franklin and Zdonik, 1998: 516) that came with the increasing number of web pages that bypassed the browser to retrieve content from the web (Kelly and Wolf, 1993).

In the heydays of the push era (1996-1997) push technology companies such as PointCast and Marimba offered software where users could subscribe to specific channels and automatically receive new, pushed content. These updates were delivered in intervals specified by the user or

client (Gerwig, 1997: 14) to achieve 'the appearance of having real-time updates' (Franklin and Zdonik, 1998: 516). Such push technologies, however, do not provide a continuous inflow of new content but are scheduled or periodic pulls that simulated the idea of push. While in the pull model the delivery of fresh content is defined by the user, in the push model this is specified in software settings that initiate the retrieval in predetermined intervals.

The major browser players at the time, Internet Explorer and Netscape, both became actively involved in developing push technologies on a standards and software level. In 1997 they developed push interfaces to the computer's desktop, respectively Microsoft Active Desktop and Netscape Netcaster, which no longer required the launch of a browser in order to retrieve updates from the web. To achieve this Netscape used existing standards while Microsoft developed the Channel Definition Format (CDF) providing a new delivery mechanism for web content that would 'turn every desktop window into a channel. Instead of a window framing a static page, it frames an ongoing stream' (Kelly and Wolf, 1993). However, in the pre-broadband era of the late 90's, the push hype came to an end when these technologies clogged networks by using excessive bandwidth to retrieve updates in intervals (Bicknell, 2000). After browser companies Netscape and Microsoft discontinued their push products Netscape continued developing their underlying standards for the syndication of new content for their Netscape Netcenter portal.

With the increasing amount of web pages and the need to find and navigate between them a number of web devices were introduced to organize and order content on the web such as directories, portals and search engines. These devices often use web-native objects such as the hit, the link or the timestamp to organize and rank content. In the mid 90s the portal became an important entry point to the web as it provided a one-stop destination for relevant and fresh web content aggregated from a variety of sources. Portals marked a shift from an all purpose static

destination web to a more personalized and dynamic web (Steinbrenner, 2001: 1). Of particular interest is the My Netscape portal, which differed from other portals because it included a newly developed format for publishers to syndicate fresh web content: RSS.[1] It allowed every webmaster to define channels on their website that could be monitored for new content, which enabled the portal to become an aggregation infrastructure for customized and timely content. RSS did not enable engagement with content in continuous real-time, but portals would pull in new content in scheduled intervals by polling blog subscriptions or feeds. Whenever users load the portal page, they would be provided with updated and time stamped content, creating a specific experience of real-time. Users could either manually request or 'pull' new content by reloading the page or automatically retrieve new content by adjusting the refresh rate of the intervals for pages in the preferences. With a new syndication format in place to automatically retrieve new content from external sources the portal presented an early idea of a 'real-time web environment'.

When AOL acquired Netscape in 2001 it dropped the support of RSS, which was then passed on to software developer Dave Winer's company UserLand Software (Winer, 2000; Festa, 2003) who had experience in developing blog software and had worked on an early syndication format called <scriptingNews>. This format, which turns a website into a 'specialized content flow' (Winer, 1997), eventually merged with Netscape's similar RSS format and with its uptake in popular blog software RSS became the default for syndicating blog content. Blogs, with their reverse-chronology to display the latest content on top, now send out RSS feeds by default and are used to subscribe to new content updates aggregated and read in a feed reader. Besides RSS as an update mechanism blogs also notify engines of new updates using ping. This mechanism was introduced in 2001 by Winer and is used by (blog) search engines to send a notification to a

ping server that can be polled by search engines for new content. These ping servers provide a way for search engines to keep their index fresh with the latest blog posts.

Portals and feed readers use a pull mechanism where the server is periodically polled for new data but in recent years several technologies such as PubSubHubbub (PuSH) and HTTP Streaming have been developed to immediately push new content and provide instantaneous updates (Leggetter, 2011). Since 2006, with the rise of micro-blogging platforms like Jaiku and Twitter and social aggregators such as FriendFeed there has been a focus on immediate updates. Returning to the idea of the real-time web, a number of new computation and web server frameworks have been developed that focus on the real-time processing of information streams including Tornado[2] (developed by FriendFeed) and Storm[3] (used by Twitter). With the launch of Twitter and the Facebook News Feed in 2006, streams have become a key element in social media platforms. By now, Facebook even features a multiplicity of streams on its homepage, from the News Feed organized by its EdgeRank algorithm, which can further differentiated into a streams focusing on 'most recent' content, photos only, close friends only or all friends, to the Ticker which displays even more fine-grained information at high speed to the possibility to create a series of interaction streams through Facebook chats. What is technically innovative about streams compared to previous technologies is that for example Twitter's Streaming API establishes a persistent, two-way connection when a filter (e.g. hashtag or keyword) is created.[4] Facilitated by Storm, a distributed real-time computation system, Twitter uses stream processing 'to process a stream of new data and update databases in real-time' and continuous computation to 'do a continuous query and stream the results to clients in real-time' (Marz, 2011). Whenever a new tweet that matches that filter arrives in their database, a trigger is activated that pushes the tweet into the persistent connection between their server and the user. This mechanism is novel

as the previously mentioned ones work on open/close connections, polling servers and pulling in information on request or scheduled.

Acknowledging the current dominant account of real-time, which focuses on streams within social media, we additionally want to draw attention to aspects of real-time that are not covered by the stream, such as the increasing attention for real-time by search engines. Search engines typically do not present their results in a stream, but rather in a ranked list. The current default Google experience with Instant is that the result page updates itself in real-time when users type a query, with real-time suggestions for formulating that query with AutoComplete. Whereas this is a move towards real-time in the front-end, there is also an increased move towards real-time in the back-end of the engine. Google's famous PageRank algorithm measures the relevance of webpages by valuing hyperlinks, however Google increasingly includes other signals in their algorithm. Important in the context of this paper is that since 2001, Google has been making algorithm changes to facilitate being a 'real-time' search engine for 'hot' or 'happening' issues privileging fresh results over relevant ones in terms of their PageRank (Wiggins, 2001; Singhal, 2009; 2012). A significant moment in Google becoming increasingly real-time is the introduction of google.com/real-time in 2009 which made it possible to search social media results, but which is no longer in effect due to discontinued contracts with the main content provider Twitter (Sullivan, 2011). A second significant moment is the Caffeine update to their index, also introduced in 2009. Before the Caffeine update Googlebot agents were sent out to index changes and new content in scheduled intervals, which meant that Google's main index would be refreshed every week, whereas with the new update fresh content in the index is updated almost instantaneously. In addition to the Caffeine update, Google started to increasingly privilege fresh results over relevant results allegedly to comply with the post-September 11 demand by millions of users for real-time news and trusted websites (Wiggins,

2001). Noteworthy is for instance the Query Deserves Freshness algorithm, which is developed to determine whether a topic is 'hot' and therefore the query may need fresh results in the top of the result page, as in the case of breaking news stories (Singhal in Hansell, 2007). Similar to the Google search engine, the Google News index is filled with content that is crawled by googlebot. However, the ranking algorithms of Google News follow the updating cycles of the news sites that are included in the index. Google Blog Search' index, which includes blogs sending out an RSS or Atom feed, is updated by monitoring ping services, including its own Google's Blog Search Pinging Service, to retrieve the latest updates from blogs and includes them in their index almost immediately.

Having traced the technologies and standards which inform content organization in the back-end of various devices such as pull, push, RSS, ping, persistent connection and the Google's Query Deserves Freshness update, a device approach to real-time is attentive to the technical standards used by devices, how they organize content - both algorithmically and by user activities and interaction - and how content can be queried and is presented. These various features and agents contribute to the pacing of information available on the web, the rhythm through which it is found, retrieved, sorted and displayed throughout both front- and back-end. Setting out such understanding of the assembly of real-time, we now ask how we can empirically qualify the specific real-times a device fabricates.

Empirical study: Pace Online

Our device-oriented contribution to thinking about real-time online is by approaching it from the perspective of 'pace' as a specific mode of real-time. The information organizational logic of online devices is often related to both the relevance and freshness of the content.

Pace, closely related to rhythm or tempo, is a term used to describe the relative speed of progress or change, or the rate of some repeating event and provides a way to study real-time dynamics empirically. Pace calls attention to the ways in which fresh content is delivered by web devices. So far, we have approached pace as the rhythm through which a multiplicity of features, agents and practices associated with a device organize the flow of new content online, or, put differently, pace it. In its general understanding, pace has often been linked to pacing devices, may this be in the context of sports where pacers or pacesetters control the speed of runners or cyclists during long distance training, or cardiac pacemakers which control the rhythm of heart muscle contraction. Pacing devices thus strategically organize the speed at which movement and change occurs, bringing attention to the collaborative fabrication of speed and time. Moving beyond a more universal notion of real-time, we start specifying how paces are different and can be described empirically by focusing on the relation between freshness and relevance per online devices. Our assumption is that freshness and relevance create different paces and that the pace within each engine and platform is internally different and multiple in itself.

In our empirical study we focus on one issue prominent at the time of research in summer 2010: Pakistan Floods. Focusing on the interval of 24 hours (from 15:40 hours (CET) on 18 July until 15:40 hours (CET) on 19 July 2010) we explored the pace at which various devices present new content through Facebook, Twitter, Wikipedia, Google, Google News, Google Blog Search, YouTube and Flickr.[5] The question the case study seeks to address is to assess what devices do with the different paces of content. How can these paces be characterized, what is the relation between relevance and pace and how relevant is freshness? Real-time media are often used as platforms for crisis communication during disaster events (Vieweg et al. 2010; Bruns et al. 2012), including the 2010 Pakistan Floods (Murthy and Longwell 2012), which raises questions about the affective nature of the unfolding disaster and ethical concerns about the subjects and suffering

involved.[6] This paper acknowledges these issues but does not directly engage with the affective experience of floods, nor the subjects engaged in or commenting on the crisis as no usernames were published. Instead, the case study is used to research the realtimeness of a current event that unfolds on online media. For this purpose, we decided to monitor the pace at which new content is provided to users for 24 hours by setting 5-minute intervals.

For each of these devices, queries are designed to fit the platform or engine as content is organized and offered differently per device. While search engines return results for *a query*, micro-blogging platforms encourage users to organize content around *hashtags* which are tags prefixed by a hash symbol that can also be used for searching. Thus, engines and platforms have dominant entry points or preferred queries.[7] In other words, by querying the devices we created result lists or content streams for the cross-comparison of pace. We scraped the above-mentioned devices for the corresponding queries for the 2010 Pakistan floods by taking into account the preferred queries as put forward by the device or its users. For example, Google recommends the query [Pakistan Floods 2010][8] whilst Twitter users decided on [#pakistan] as the most dominant hashtag.[9] Finally, we queried Facebook using its search feature for [Pakistan flood] in Posts by Everyone,[10] which returned public mentions of Pakistan flood in All Post Types (Links, Status Updates and Wall Posts, Notes) by everyone. Most devices offer a (default) result page, which is ordered either by relevance, by date or by some variation on these.[11] In this case study we looked at the two dominant modes of organizing content online, relevance and freshness, which were shared by most of the selected devices. For the eight devices the default mode for presenting results is: Facebook (posts) by date, Google News by date, Wikipedia by date, Google by relevance, Google Blog Search by relevance, YouTube by relevance, Flickr by relevance and Twitter also by relevance (displaying Top Tweets). These default modes show that the search output of devices do not necessarily reflect how 'Web 2.0's interfaces heavily emphasize the new

even at the cost of other modes of organization such as relevance or importance' (Gehl, 2011: 5), as Twitter emphasizes fresh content in their default interface, they turn to relevance as their mode for presenting content as the output of a search query.

Before querying and saving the results a 'research browser' (Rogers, 2013) was created and the interface settings of each of the devices were adjusted to meet the research design, i.e. the result pages were ordered by freshness and relevance where possible. In a similar spirit as following the recommendations made by the devices in the query design, we chose to use the default settings for result pages if possible (e.g. with the Google engines, this meant retaining the default 10 results per page). From each of these devices, the content of the page is saved on a local computer with an interval of five minutes and the number of new results compared to the previous interval is noted. Finally, the number of new updates or new results within the relevance setting for each interval are calculated for each platform or engine and plotted in a barcode chart where each barcode line represents one new piece of content (see Figure 1).

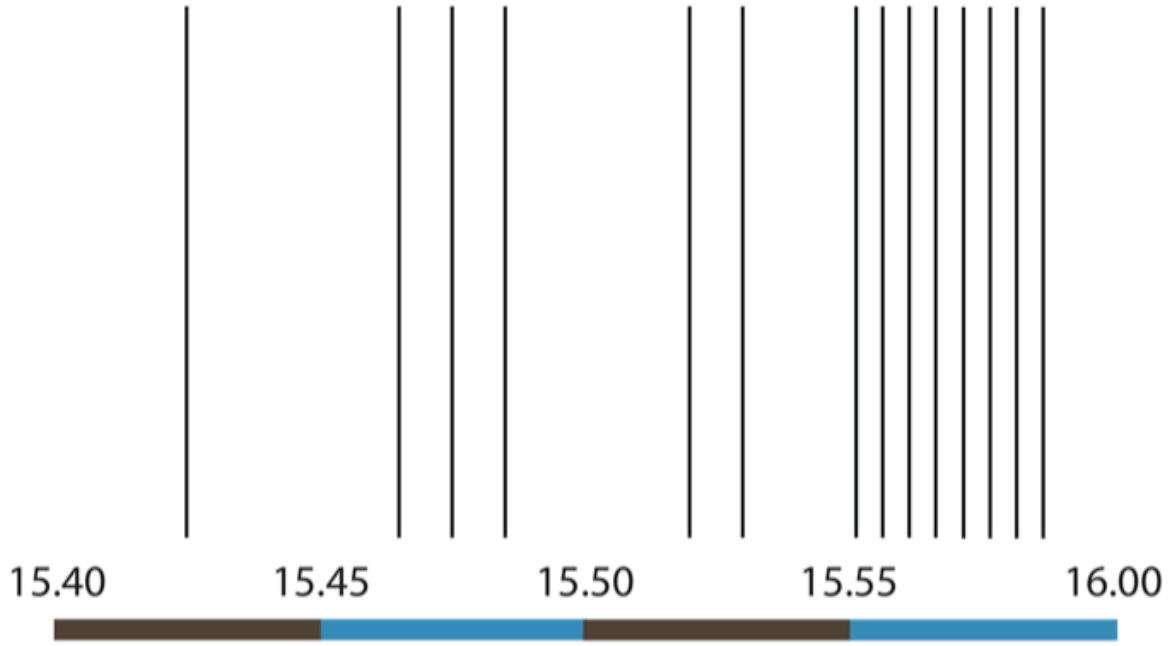

Figure 1: Barcode chart showing the pace of new content where each line represents a new result.

Figure 2 below shows the results of our study. Each device comes with at least one if not two barcode charts of its specific pace. The charts on the left show the pace based on content sorted by freshness and the charts on the right based on relevance. The patterns unfolding when looking at the barcode charts from left to right show the pace of new content across an interval of 24 hours - the legend on the bottom gives an indication of the time (CET) at which change happens in the interface. With each line symbolizing a new entity of content for the query issue, it becomes apparent that devices come with their own pace, which differs in terms of intensity (number of lines), rhythm (pattern of lines occurring) and variation over time.

The visualization suggests two larger findings. Firstly, the web can be said to have a series of distinctive 'real-time cultures'. As argued previously, web devices tend to follow specific update cycles such as news cycles by Google News, algorithmically induced cycles such as Top Tweets

by Twitter, or actively shape update cycles by prompting users for fresh content as Twitter and Facebook do when asking 'What's happening?'. However, the real-time cultures of platforms and engines are not only formatted by the flow of fresh content that has to be processed in the back-end, but also become shaped by how the devices make content accessible in the front-end through their interfaces. By comparing relevance with freshness, we can start to appreciate how web devices construct their own specific real-times. Without surprise, the 'relevance' mode seems to slow down the pace of content compared to freshness, as it filters through social and cultural cues such as authority of source or uptake as a measure. The exception is Flickr, where in the default relevance mode new photos are shown each time the page is refreshed.

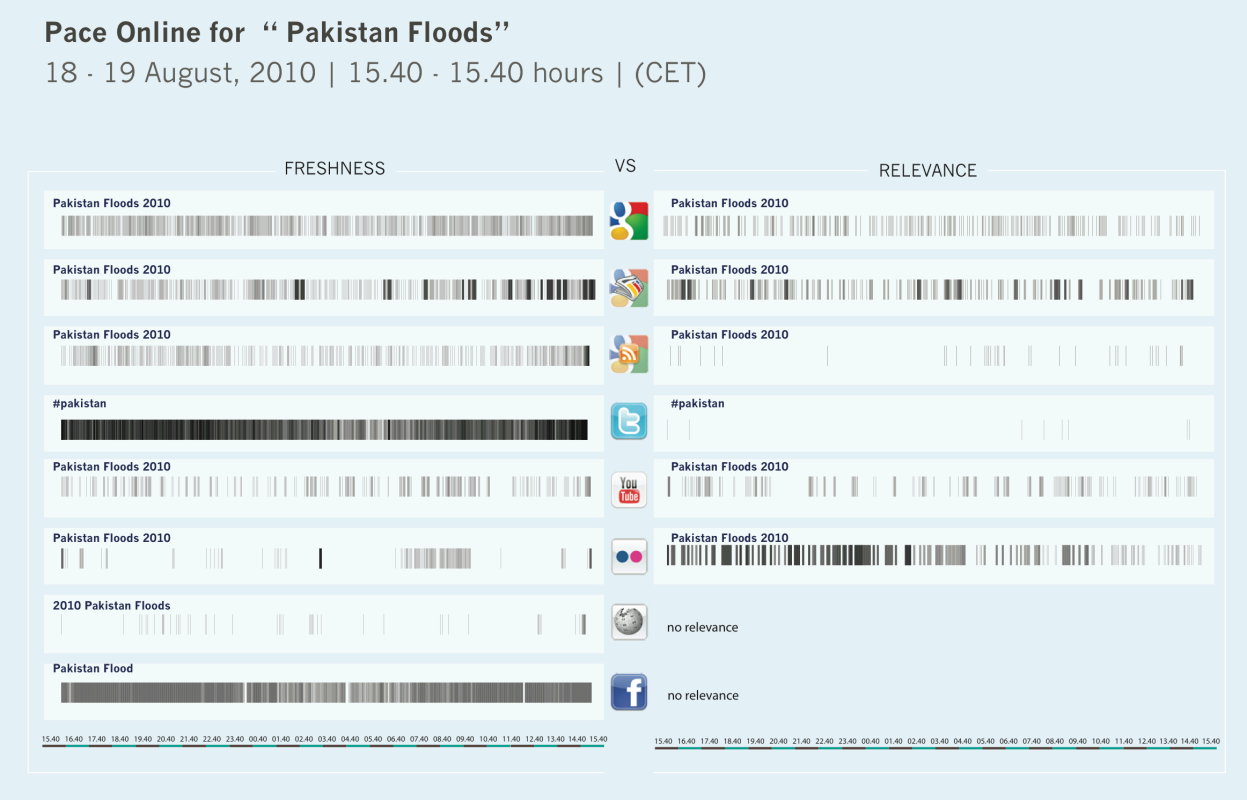

Figure 2: The barcode chart show the pace, each line representing a new result, of the issue 'Pakistan Floods' per web device in both freshness and relevance mode.

Secondly, the findings of the case study suggest that there are indeed different patterns of pace. Pace is not only connected to the algorithmic logic of the device but also to the different types of web activities such as posting, linking, editing, sharing, uploading, retweeting that are connected to each device. Platforms and engines allow for different activities that contribute to the specific pace of a device. On the micro-blogging platform Twitter the pace includes platform activities such as tweeting and retweeting where on average 5,700 tweets are uploaded per second (Krikorian, 2013), or 342,000 per minute. Compared against this overall rate of activity on Twitter, the rate for [#pakistan] has an average of 5.84 new results per minute for the 24 hours collected in this case study. Between 2 PM CET and 3 PM CET, Twitter reaches its peak with an average of 16.4 new results per minute. Analyzing the barcode charts led us to define three distinct patterns of pace: stream pace, bulk pace and stale pace.

Stream pace is continuous and frequent. Notably, the platforms that display a typical stream pace request users to add new content such as Twitter and Facebook. Google, in freshness mode, also displays characteristics of stream pace as it shows the number of fresh results indexed by the engine. Looking more closely at the prototypical stream platforms, Twitter and Facebook, we found that the pace of fresh content is indeed high and continuous. However, our results also show a small decline in activity around 5 AM CET where the stream is in idle time, indicating some form of day and night rhythm in Twitter use (see Figure 3). Secondly, bulk pace is characterized by fresh content being added in larger or smaller bulks. Typically this type of pace is found with devices where users upload content in batches, the user-generated content platforms such as Flickr and to a lesser extent YouTube and Google Blogs. Likewise in Google News where editors follow news cycles or in Wikipedia where edits tend to be done in batches as users often save multiple minor edits to a single article within a short timeframe. Interestingly, some devices offer new content in bulk pace in relevance mode too, such as Flickr, Google News,

YouTube and to a lesser extent Google. Thirdly, the pattern of stale pace directly refers to the lack of frequency of new content and specifically to those devices that hardly change their results compared to the others. Notably Google Blogs does not update its relevant stories as often. In comparison, the rate of fresh content in Google in its default relevance mode is rather fast. Additionally, Twitter in relevance mode displaying 'Top Tweets' at the top of the result page, is rather stable and shows a very slow pace.

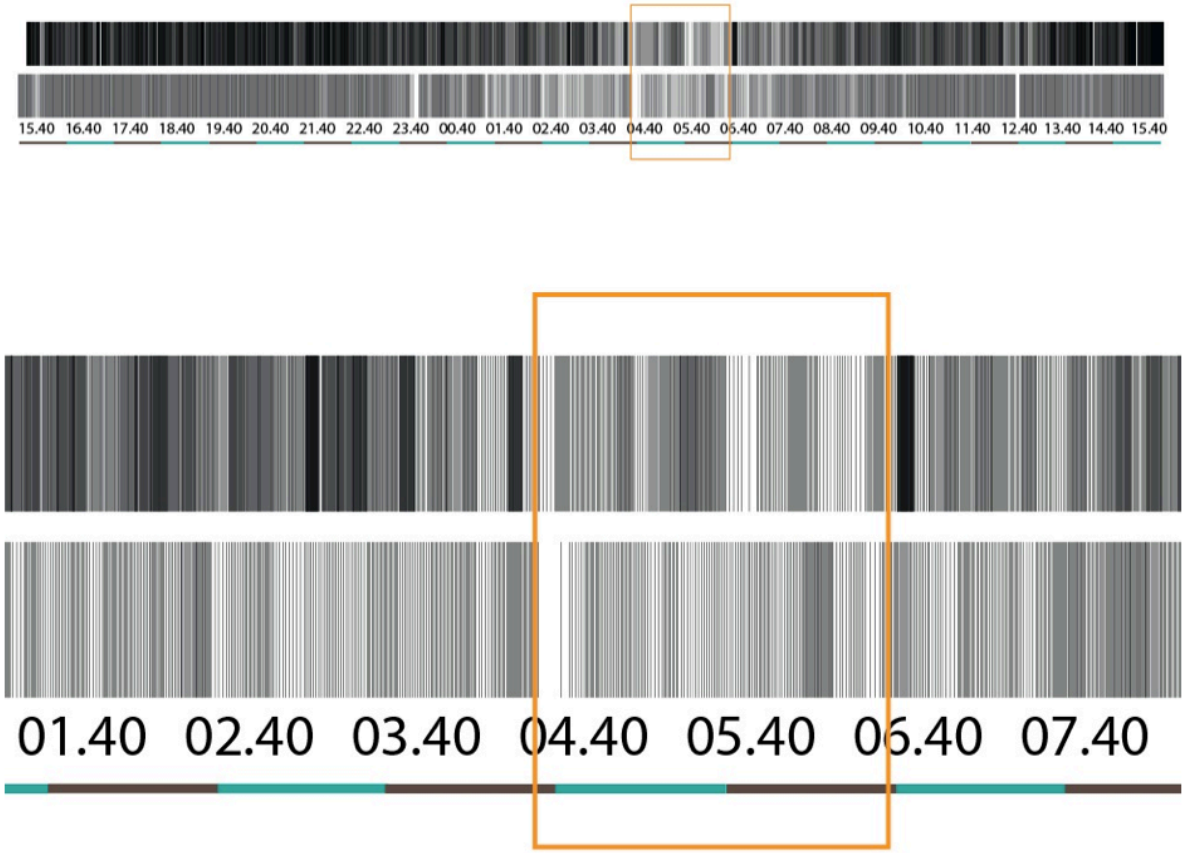

Figure 3: Idle time on Twitter

From real-time to realtimeness

The empirical study opens up a series of contributions to accounts of the real-time web. In a first instance, it allows us to give an account of the *making of real-time* which does not unfold as a flat, eternal now or as a global, high-paced stream, but brings to attention the particular web specific entities, activities and actors determining the temporality of the specific space, as the issue studied unfolds at different speed in relation to different devices. We have sought to demonstrate how the patterns of pace are specific to devices and are the outcome of the interplay of content, its storing and algorithmic processing, interfaces, search and rank algorithms, queries, user activities, but also time and date. After tracing the specific elements that are involved in the assembly of a device-specific real-time, the case study also brought to attention the multiplicity of real-time. The different paces detected in the barcode chart – steam, bulk or stale pace among others – give a first idea of the multiplicity of rhythm. The pace of freshness indicates the rate at which new content in relation to the query is being produced and presented in platforms or taken into account in engine results, while the pace according to relevance is a mode of temporality determined by the relevance algorithms of the devices. Freshness and relevance emerge as two modes of organizing the process of pacing growing amounts of information, and so as internally different ways of introducing rhythm and pattern to their circulation.

Exploring the different devices of our study and their interfaces further, we find more features and practices that contribute to the multiplication of real-time. In fact, the dominant mode of presentation is that there is no single 'generic' or global stream that is experienced by all users in a similar way (Manovich, 2012), as in Twitter users can no longer follow the general 'all tweets' stream[12] and in Facebook a Public News Feed containing all public messages has never existed, but users have to assemble their own streams based on followings, friend connections, hashtags or News Feed settings, all coming with their specific pace.[13] Many real-time devices,

most notably those with streams, also come with a series of third-party mediators or clients that enable users to view content at a different pace by reassembling platform content into new forms. In the case of Twitter, the platform itself recently introduced 'custom timelines' allowing users to assemble their own streams[14] and its Tweetdeck browser extension allows users to configure multiple custom timelines in columns arranged side-by-side, each coming with its own distinct pace. Hence, what users are dealing with are ecologies of streams (Berry, 2011a), as the same data may be assembled into different streams.

Real-time, we conclude, is not only fabricated differently by devices, but is also specific and multiple in their respective front- and back-ends. As introduced before, scholars such as Gehl (2011) have outlined the coupling between the real-time drive in the front-end and archival impulse in the back-end. What is emerging in the context of our empirical work on pace, however, is an insight in the interconnectedness of the front- and back-end temporality, as well as a further differentiation of this twofold temporality. From a pace approach, the experience of real-time in the front-end of devices is not always supported by visual cues. For example, while the pace barcode charts feature the rate of change of search results presented in the front-end of search engines, these search engines typically do not present visual cues for the pace of new content unfolding to web users. In contrast, the web version of Twitter does provide an indication by noting 'x new Tweets' on the top of the stream. Doing so, it both confirms and extends the universal temporal regime (Lovink, 2012) proposed by Gehl (2011), as what emerges is a perspective that shows the medium-specificity of the real-time experience.

Whilst many critics of real-time media and research have outlined the encapsulation into the present (Uprichard, 2012), what is also at stake is a more complex simultaneity and folding of temporalities. The fabrication of real-time may entail an interplay between past, present and future, for instance in the algorithmic calculation of relevant search result. In order to feature

high on the relevance based search results, Google's PageRank Algorithm determines the relevance of results based on the relative authority of the source, taking into account past links, recommendations and content organization. In the case of Twitter, which simultaneously displays fresh, new content and relevant, featured results, relevance becomes a recommendation feature that alters the pace of the freshness stream, as these so-called Top Tweets are designed to produce future user engagement by making them sticky and stay on top of a fast changing stream. Relevance thus brings the past of sources or web users together with potential futures, creating a multi-layered account of real-time. This quality was already noted by Berry, who claims: 'To be computable, the stream must be inscribed, written down, or recorded, and then it can be endlessly recombined, disseminated, processed and computed' (2011a, 151). A stream is hence not just the inflow of new content, but also its constant recombination or pacing based on algorithms, featured content and user activities.

It is here that we return to the question of political economies built into the fabrication of real-time. Features like recommended Tweets allow companies or users to alter the fast paced temporality of Twitter streams by giving content duration, pacing it differently and making it sticky by paying money. Similarly, Facebook offers various related features that allow pacing down the stream for payment, including promoted posts, recommendations and featured pages. Underneath their posts, users are offered the possibility to 'promote' their content so it will remain on the top of their friends' Newsfeed for a longer period of time and will thus receive more attention and interaction. Such promoted content contributes to direct the immediacy of user engagement towards specific content rather than other, introducing the steering of engagement with the stream, for instance through the practice of liking (Gerlitz and Helmond, 2013).

In a similar fashion, social media marketing is concerned with creating content in such a way that users keep sharing so that it returns and circulates across as many Newsfeeds as possible. Again, the objective is to slow down the disappearance of content in the fast paced stream whilst increasing the pace of its interaction - reduction and speeding the pace of different actions are thus tied together. To reinforce this process, a number of third-parties services built on top of social media platforms offer scheduling services that enable to post content at set times to pace the distribution of their content and to ensure it will enter the stream at a strategically relevant time. For Twitter such services include Hootsuite, which contains auto-scheduling features, and Buffer, which uses the Tweriod algorithm to find the optimal moment to post and schedule tweets accordingly.[15] Whilst platforms may have a general interest in high paced content production and user engagement as argued by Gehl (2011), together with the numerous third party applications they also cater for different temporal interest of cooperating partners and paying clients who are interested in slowing down the pace of streams or introducing selected sticky content for gaining attention.

Giving consideration to this specific fabrication of times in devices, our conclusion is to suggest thinking about time online not as events happening *in* real-time, in the now, but as being entangled in the fabrication of specific forms of realtime*ness*. It is the continuous movement of new content, its request and display in devices, as well as the engagement by users through web activities and the filtering of content based on freshness and relevance that constitutes realtimeness. In this sense, realtimeness refers to an understanding of time that is embedded in and immanent to platforms, engines and their cultures. Following the idea of such immanent and device-specific time further, realtimeness brings to attention how the specificity of time cannot be accounted for from the outside, applying extraneous measures, but only from the inside, tracing the increasing or decreasing intensity of pace in each device and its internal variation.

Realtimeness unfolds as a temporal condition to which web users have to respond, which can - as shown in the Pace Online research - itself be subject to variation and is assembled from the inside of device engagement. Most notable, it is thus more specific and imminent than Leong et al's (2009) notion of the multiplicity of time, as it also conjoins the front- and back-end temporalities of devices. Not only does it specify the more general account of the eternal now and the real-time web, but also allows for an empirical perspective on what Leong proclaims to be multiple times.

By developing this multiple and empirical account of real-time(ness), the paper seeks to contribute to a variety of discourses connected to the growing interest in real-time media. Firstly, the notion of pace allows to think the fabrication of real-time as managing the constant and dynamic production of content. In the context of devices, the continuity of content production is a fundamental building block of engines and platforms, which are reliant on the constant provision of new content and interactions. The organization of the pace of updates can be thought of as a pattern through which the continuous production of new content is being organized in ways that are aligned with the specific politics of devices. Beyond our focus on pace as descriptor of fabricated duration or real-time, there are further descriptors possible that might contribute to the qualification and specification of real-time, such as duration, stickiness of content, volume of data, halftime or speed. Whilst the explication of these has to be subject to future research, the study of pace allows to open up a more multi-layered notion of computational real-time and offers alternatives to the generalized use of real-time as a marketing buzz term.

Secondly, the empirical account on realtimeness differs from a variety of current attempts to do real-time research. Following a growing interest in tracing and analyzing phenomena as they happen, social and cultural researchers have recently invested in developing methods for live or real-time research (Back and Puwar, 2012; Back, Lury and Zimmer, 2012; Elmer, 2013). The

approach we followed was concerned with the happening of content as well, but specifically focused on the socio-technical conditions in which devices create such live content. Instead of focusing on making research itself 'live', we focused on the making of what constitutes the 'live itself'. Our approach thus shared an interest the conditions of making of data in live time as developed by Marres and Weltevrede (2013) who also draw attention to temporality as internal to devices. The authors suggest a form of live research that deploys the formats and life cycles of online data as formatted through devices for analysis. In this paper, we were more concerned with differentiating live or real-time itself and thus set out to bring to attention that such liveness cannot be just be proclaimed but has to be accomplished in the first place. Especially when taking the multiple temporalities which may entail a complex folding of pasts, presents and futures in real-time devices such as Facebook streams into account, it becomes apparent that conceptualizing real-time media as mere expansion of the present misses the intricate folding of past, present and futures and the agencies and affordances build into these specific fabrications of real-time.

Third, the paper sought to complicate the relation between computational and experienced real-time. Although reflecting on the role of users, starting from the interplay between push and pull to the assembling of realtimeness, the paper diverted from a purely phenomenological perspective on the experience of real-time. In previous debates real-time media and especially streams have often been met in terms of messianic, unrepresentable accounts of information (Berry, 2011b). Such perspective may coincide with our starting point to view real-time devices as organizers (or pacers) of information, which currently comes, in 'gigantic' or in 'sheer unrepresentable' or even 'messianic' quality. Drawing on Derrida, Berry contents that real-time streams come with a specific structure of experience that requires the user to open up towards an entirely ungraspable and unknown other, a 'waiting without horizon of

expectation' (2011b). Engaging with real-time media means engaging with the expectation of new content, new users and new activities, which, however, remain ungraspable, unknown and push the limits of representability. In this paper, rather than just focusing on such opaque and totalizing real-time experience operated by global streams or black-boxed algorithms, our engagement with real-time technicity and the study of Pace Online have shown that the potential infinity of new content can be further specified when thinking about real-time as immanent to and co-constituted by device cultures. Especially social media platforms invest in a multiplicity of real-time features, which explicitly offer different paces, rhythms, and durations of content engagement to cater the interests of their multiple cooperating partners. The realtimeness of different online devices might be continuous and not limited by an end of new content production, yet, it is fabricated and enacted in specific ways. Rather than perceiving web devices as messianic media, we suggest to think them as pacers of realtimeness whose specific pace is closely tied to the politics of such devices.

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Notes

[1] Initially the format was conceived 'as a metadata format providing a summary of a website' but it became clear that 'providers want more of a syndication format than a metadata format' therewith reshifting the focus on timely content updates, see: www.rssboard.org/rss-0-9-1-netscape (consulted December 2013).

[2] https://developers.facebook.com/blog/post/301/ (consulted December 2013).

[3] http://storm-project.net/ (consulted December 2013).

[4] The Twitter Streaming API is based on HTTP Streaming to push updates to a webclient by keeping a persistent connection open. See: dev.twitter.com/docs/streaming-apis (consulted December 2013).

[5] This case study was selected because the Pakistan Floods was a major unfolding news event that we recorded as it unfolded. We captured a day (July 18-19) which was at a very early stage of the event that eventually became the #3 News Event in Twitter's 2010 Year in Review: yearinreview.twitter.com/2010/trends/ (consulted December 2013).

[6] Sara Ahmed's (2004) work on affective economies may be useful in thinking through how the affective dimension of the flood may be co-produced by specific ways in which real-time media operate, as constantly updating streams may create new forms of affective proximity. Especially the perpetual, high-paced presentation of new insights, perspectives and information on catastrophic events as offered by real-time devices enables users to experience both the unfolding of the event as well as its media discussion as they happen.

[7] Platforms such as Facebook and Twitter both offer streams of content based on friend or follower lists too, however, to render the engines and platforms comparable we access real-time through an event specific query in all devices.

[8] Google Autocomplete suggests relevant queries based on search volume. support.google.com/websearch/bin/answer.py?hl=en&answer=106230 (consulted December 2013).

[9] This choice was based on a comparative analysis between #pakistan, #pkflood, #pkrelief, #pkfloods and #help Pakistan, using the What the Hashtag# service to find the dominant hashtag as adapted by users.

[10] Platforms rename features over time, for example Posts by Everyone is now called Public Posts, but throughout the paper we use the names of platform features as they were at the time of the case study.

[11] For example, Flickr's default result page offers results sorted by 'Relevant', 'Recent' and 'Interesting' where the latter also takes user activities such as commenting or favoriting into account.

[12] Also developers cannot get access to the full stream of tweets, called the firehose, but instead access is licensed to re-sellers such as Topsy, Gnip and DataSift or through commercial partnerships. Alternatively, developers and researchers can use the 1% sample provided by Twitter.

[13] There are exceptions as the ad-free social platform App.net does provide a global stream.

[14] https://dev.twitter.com/blog/introducing-custom-timelines (consulted December 2013).

[15] http://blog.bufferapp.com/how-to-tweet-at-the-best-times-for-your-followers-tweriod-buffer-team-up (consulted December 2013).

Biographies

Esther Weltevrede is PhD candidate and lecturer at the New Media and Digital Culture program, University of Amsterdam. Esther is coordinating the Digital Methods Initiative. Her research interests include digital methods, platforms politics, software studies, issue mapping, national web studies and the dynamics of online data. Contact: esther@digitalmethods.net

Anne Helmond is PhD candidate and lecturer at the New Media and Digital Culture program, University of Amsterdam. In her research she focuses on cross-syndication politics in social media and data flows between web platforms. Her research interests include software studies and platform studies and focuses on data flows and web glues. Contact: a.helmond@uva.nl

Carolin Gerlitz is Assistant Professor in New Media and Digital Culture at the University of Amsterdam. Her research is concerned with the various intersections between new media and economic sociology, including social media, brands, topology, platform activities, issue mapping, numbers and digital sociology. Contact: c.gerlitz@uva.nl