

Making Time

Siân Lindley

Microsoft Research

21 Station Road, Cambridge, CB1 2FB, UK

sianl@microsoft.com

ABSTRACT

This paper draws on research on time and technology, with a view to examining the notion that technology is implicated in the speeding up of everyday life. We begin by looking at research that shows how the adoption of the clock and of ‘clock time’ was framed by more general shifts in ways of conceptualising and using time. Likewise, we suggest that the ways in which digital technologies are said to shape experiences of time need to be understood in the context of the fractured routines of the modern Western world. We argue that ‘redesigning’ these experiences necessitates a broader way of dealing with the temporal structures of social life. Technology may play various roles here, for instance by shaping temporal infrastructures and highlighting reified temporal patterns. However, complex challenges also need to be addressed, central to which are recent accounts that position time as collective and entangled.

Author Keywords

Temporality; clock time; digital time; plastic time; socio-temporal pattern; rhythm; routine; temporal experience.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Time is a topic that is pervasive in HCI, yet it is also one that is hard to unpack. Unlike concepts such as ‘space’ and ‘place’, which have been the subject of careful enquiry and definition [17, 11], time is considered sporadically and in rather heterogeneous ways (see, for example, topics covered in various HCI workshops held over the years [18, 26, 52]). Recently, though, it seems that particular attention is being paid to how digital technologies intersect with the experience of time. In his book *Present Shock*, media theorist and commentator Douglas Rushkoff [40] argues that we are losing sight of what ‘organic’ time is through our relationship with digital technologies and the related need to be always-on and always-connected. This general theme can also be seen in Bell’s [4] critique of the lack of opportunity

to experience boredom, said to be exacerbated by the always-availability of digital technologies, and in Pang’s [36] book *The Distraction Addiction*, in which he addresses the question: ‘Can we reclaim our lives in an age that feels busier and more distracting by the day?’ Pang’s book is aimed at a general audience (its tagline is ‘Getting the information you need and the communication you want, without enraging your family, annoying your colleagues, and destroying your soul’), but perhaps the strongest evidence that these concerns have become part of the zeitgeist is that the phrase ‘digital detox’ was entered into the Oxford English Dictionary in 2013.

The motivation in writing this paper is to examine some of these ideas about time and technology. The notion that digital technologies in themselves have a temporal quality that is problematic is questionable. Yardi Schoenebeck [58] has recently pointed to the moral panics that may drive users to give up or take breaks from social media when the technology may in fact be harmless or even beneficial, and propositions that the pace of life is speeding up, this being compounded through our relationships with technologies, are not new. The steamship, railway and telegraph led to the phrase “the annihilation of time and space” becoming commonplace in the 19th century [47], and arguments that position the introduction of technologies as responsible for shifts in the ways in which people understand and experience time have been critiqued as technological determinism [e.g. 12].

In this paper, we take a careful look at research that indicates how technology is bound up with experiences of time. We begin with a classic example of this: the adoption of the clock and of ‘clock time’, by considering research that shows how the introduction of the clock was framed by broader sociocultural shifts in ways of thinking about and using time. We then consider ways in which the experience of ‘digital’ time is linked to the fractured routines of the modern Western world, with digital technologies having evolved alongside increased flexibility of personal schedules and variance of leisure and work rhythms. This leads us to argue that ‘redesigning’ the experience of time as mediated by technologies necessitates a broader way of dealing with the rhythms and routines that frame their use. We consider what role technology might play in this, through shaping temporal infrastructures and shifting reified temporal patterns. We conclude by noting the considerable challenges that this entails, especially in view of recent accounts that position time as collective and entangled.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.
CSCW '15, March 14 - 18 2015, Vancouver, BC, Canada
Copyright 2015 ACM 978-1-4503-2922-4/15/03...\$15.00
<http://dx.doi.org/10.1145/2675133.2675157>

CLOCK TIME

Clocks are associated with a historical shift in the way that time is understood, with clock time often being described as abstract, generic and interchangeable. Yet, to suggest that clock time simply came along with the invention of the clock is, of course, simplistic. In this section, we first look to research that highlights how underlying sociocultural shifts in the ways in which time was conceptualised and used in the Western world framed the clock's invention and acceptance. We then detail a position outlined by Glennie and Thrift [12], in which clock time is described as a series of practices rather than a concept created by new timekeeping technologies.

We begin with work by the historian Alfred Crosby [9], who argues that the development and acceptance of the clock was preceded by a shift in thinking about the nature of time, and of reality more broadly. Prior to this, numbers were not neutral ways of quantifying, but were “dramatic, even melodramatic, and teleological” [p. 47]. They had religious and spiritual connotations; for instance, the number 7 signified perfection, 11 sin, and 12 judgment. He writes,

“The old Europeans preferred broad focus and settled for imprecision in the hope of including as much as possible of what might be important. Often they were reaching not for a handle on material reality, but for a clue as to what lay beyond the scrim of reality. They were as poetic about numbers as about words.” [pp. 46-47]

The move to interpreting numbers as a way of measuring things of continuous quality, and the conceptualization of time as something that could be understood in this way, was significant. Crosby links these changes to advances in a range of areas, including music, painting and book-keeping. For example, he argues that music was essential to the development of “[f]aith in absolute time, which the musicians who invented Western mensural notation were among the first to think about seriously [...] Such a faith altered perception of reality and promoted a reordering of the ways to understand it” [p. 157]. These broader shifts, and the different ways of thinking about time that they were bound up with, were essential to innovations in mechanical clocks.

Glennie and Thrift [12] have also noted how music, alongside dance and even the etiquette of turn-taking, were part of a ‘culture of the interval’ that prefigured and strengthened the hold of clock times in general society. They avoid asserting causality, but see clocks as being integrated into existing time-based practices that drew on ‘unequal’ hours (divisions of the sunlit day, which vary with the season and were indicated using technologies such as sundials) and other temporal indicators:

“the spread of clocks, the use of clocks to keep equal hour time, and the use of time markers to structure daily life were all intertwined. We cannot see one of these as determining the others, whichever way we point the causal ar-

row. Although equal hour clock time became used for very many purposes, it was often taking over existing – and essentially similar – functions of unequal hour time.” [p. 26]

Glennie and Thrift suggest that the grounding of new practices around clocks depended, quite simply, on “whether they ‘worked’ on an everyday basis” [p. 410]. Indeed, central to their argument is the position that there was (and is) no singular concept of clock time. For them, clock time is best understood as sets of practices, which are bound up with time-reckoning and time-keeping technologies, but which vary and are shaped by different times, places and communities.

This view of clock time is quite different to that often depicted in the literature, where it is positioned as abstract and mechanistic. For example, in his classic analysis of the history of the machine, Lewis Mumford [30] notes that,

“Abstract time became the new medium of existence. Organic functions themselves were regulated by it: one ate, not upon feeling hungry, but when prompted by the clock: one slept, not when one was tired, but when the clock sanctioned it.” [p. 17]

Similarly, E. P. Thompson [53], in his paper on time discipline and industrial capitalism, suggests that a view of time as an interchangeable commodity came to replace what had been a more task-oriented approach to time use. Glennie and Thrift argue against this conceptualisation of clock time. They acknowledge that people’s consciousness of time was disrupted by the clock, but disagree with a notion of clock time that is “inauthentic, unnatural, omnipotent” [p. 50], that follows the metaphor of the production line, or that adopts a narrative of a world that is intensifying and speeding up. Instead, technologies and the uses made of them are positioned as coevolving, with new temporal knowledges being gradually accumulated and integrated into the practices of everyday life.

As noted in the Introduction, a narrative of a world that is intensifying and speeding up is increasingly associated with digital technologies and the experiences they offer. Yet, as is the case for clocks, a careful treatment of the topic should consider how technologies, practices, and broader shifts in time use have coevolved. In the following section, we look at how ‘digital time’ has been described by both media commentators and scholars, before considering research that demonstrates its links with certain features of modern Western time use. We then consider what this might mean when it comes to developing technologies with the aim of designing for certain temporal experiences.

DIGITAL TIME

We begin this section by considering what is actually meant by ‘digital time’. Rushkoff’s [40] writing on the topic summarises how technology is often described in the media in terms of its relationship with temporality. He notes that computers are disconnected from the personal and collec-

tive rhythms of everyday life, be these “natural and emergent” [p. 98], reflecting solar and lunar cycles, or the rhythms of those around us (whether biological or social; for example, group members are known to pace themselves against each other). Rushkoff argues that technologies provide people with the means “to ride roughshod over all these nooks and crannies of time [...] what we often forget is that our bodies are not quite as programmable as our schedules” [p. 92]. Furthermore, and differentiating digital time from clock time, he suggests that a lack of adherence to chronological time is compounded by the fact that digital technologies connect with a flow of information that is always and instantly available. He argues that continual change, which is bound up with web services such as social network sites, blogs and the news, is central to the experienced need for constant connectivity.

A related, but richer, argument is made by the sociologist John Tomlinson [55], in his account of the ‘condition of immediacy’. Tomlinson argues that speed is central to modern cultural practices, experiences and values, and he focuses on immediacy in particular because it has three connotations. One of these is a play on the word media: the condition of *immediacy* is bound up specifically with electronic media, which convey a notion of speed that is effortless. Secondly, immediacy is chosen because it indicates the notion of a “culture of instantaneity – a culture accustomed to rapid delivery, ubiquitous availability and the instant gratification of desires” [p. 74]. Finally, immediacy expresses a sense of directness and an increasing sense of connectedness with others. In contrast to mechanical speed, which “displayed the will, the force and the effort involved in the overcoming of distance” [p. 91], the culture of immediacy has at its core the notion that the gap is already closed:

“in one way or another, electronic media try to hide their mediation. Far from advertising it, they obscure the artifice of their practice and present their product or their access to communication as pristine, untouched, immediate.” [p. 99]

Research in HCI has illustrated how this notion of immediacy is upheld through the social conventions associated with technologies, as well as through their design. For example, Harper *et al.* [16] have described the lived experience (or *durée*, following Bergson [6]) of Facebook as being located firmly in the now, and have noted that this necessitates a particular approach to the performance of identity on the site by its users. They observe that interactions privilege the present and underpin an impression of events unfolding as they happen (even if this is not the case in terms of spatial time, or Bergson’s *temps*). Because of this, the performance of identity is one of the moment: users reported feeling it inappropriate to post old content, and were similarly aggrieved when others uploaded photos that surfaced ‘out of time’. Research by narrative theorist Ruth Page [35] (a co-author on the above paper) considers further how Facebook users learn to interpret social media

posts when reading the newsfeed. While the series of snippets of ‘breaking news’ posted by a variety of members of one’s social network do not offer a typical narrative, readers nevertheless draw their own story-like experience, using their knowledge of those posting content to build a backstory, whilst imagining what may happen next. They create what Adam [1] calls the ‘expanded present’, by creating a relevant past and future that serves to enrich the moment.

This research suggests that the impression of *nowness* associated with social media is upheld partly through the interface and partly through social conventions. The temporal experience is as much a product of the ways in which the technologies are used as it is a feature of their design. This points to how, just as has been argued for the case of clocks, digital technologies and practices have coevolved to underpin particular experiences of time. However, social media is obviously a rather narrow example of this. Accordingly, and in the interests of exploring how broader shifts in time use have may coevolved with digital technologies, we now look to work by Rattenbury *et al.* [37], which relates the always-on quality of digital technologies to more general shifts in the organization of everyday life. These are changes that have resulted in a temporal experience that they describe as *plastic*, a temporal experience that is both shaped by and shapes the use of digital technologies.

Plastic Time

Rattenbury *et al.* [37] observe that while the amount of leisure time available to those in the United States went up during the 20th century (citing Aguiar and Hurst [2], who looked at surveys from 1965 to 2003), the occurrence of sustained moments of free time is decreasingly likely in modern life, especially for women (here they draw on Bittman and Wacjman [7] and Deem [10]). With this as their starting point, Rattenbury *et al.* conducted a large-scale study of mobile personal computer use (in this case, of notebooks), to explore how daily life rhythms are made manifest through use of technology. They argue that the usage patterns their participants exhibited suggest a particular temporal experience, that which they refer to as *plastic time*. Plastic time is described as unanticipated, un-reflexive and fluid, as the “experience of temporal ‘scraps’, of gaps in the schedule”, and as “the negative space of busyness” [p. 233]. Plastic time flies under the radar, being unplanned and non-immersive, and associated with neither productivity nor leisure. It is interruptible, but can also expand until some other activity presents itself.

Rattenbury *et al.* argue that Internet use is a perfect filler for plastic time. For their participants, this was an activity that could easily be interrupted, could always be resumed, and was not seen as a priority. Interestingly, the lack of rhythm that is sometimes bemoaned of technology is crucial here: “As much as the Internet evokes notions of instantaneity and ‘real-time’ information, the heart of the matter was the asynchronicity – the fact that it did not *dictate* or even set the pace of interaction.” [37, p. 237, original italics]. Com-

puter use becomes fractional through its dependence on a lack of other, higher priority, events; it falls into a ‘temporal remainder’ category. Yet at the same time, it creates a sense of fluidity in daily temporal rhythms; it fits into people’s practices by resonating with the ways in which time is used.

While Rattenbury *et al.* highlight web browsing as the perfect plastic activity, the concept has also been applied to television watching by Irani *et al.* [20]. They observe that by choosing particular kinds of programs and utilizing features such as rewinding, skipping and watching on-demand, television can become temporally flexible. It can be used ad hoc to fill unplanned segments of time, it can be shrunk through actions such as fast-forwarding commercials, and it can be expanded by switching to a broadcast channel, which will fill the time available. Furthermore, and like web browsing, television watching can fly under the radar. Irani *et al.*’s participants were sometimes surprised when shown representations of their own viewing patterns; their memories of watching had already faded.

In these analyses of plasticity we see how, like clock time, digital time is not simply a property of technologies, nor does it straightforwardly emerge as a sociotechnical convention associated with their use. Rather, it has coevolved with broader shifts in the temporality of everyday life, such as the emergence of fractured rhythms, and the associated need to fill the gaps between them.

This underlines the necessity of taking a holistic view of technologies in use when attempting to design for particular temporal experiences. HCI researchers have, on occasion, adopted this approach when building technologies that aim to support particular experiences of time [e.g. 28]. More frequently however, they look to ‘organic’ or ‘human’ time as points of inspiration, or build on the ideology of the slow movement, itself a reaction to the concept of speed-up. In the following sections, we look to examples of these approaches, before considering how we could draw on broader, and multiple, temporalities in designing for temporal experience.

DESIGN AND TEMPORAL EXPERIENCE

The slow technology design agenda, first presented by Hallnäs and Redström [15], builds on the idea that as technologies become more ubiquitous they must do more than prioritise the efficiency and productivity associated with task-completion. In contrast to *fast* technologies that *save* time, the aim with slow technologies is to *produce* time, by serving as an incitement for reflection. Their approach has proved inspirational (see [33] for a brief overview), but for the purposes of this paper we limit ourselves to three examples of work in the area. These indicate how slow technologies are experienced over long durations of time, how they are understood differently when they include organic components, and how they are perceived as better suited to some parts of everyday life than others.

The first study we wish to consider entailed a 14 month deployment of a prototype called *Photobox* by Odom *et al.* [32]. Photobox is a wooden box that prints photos from the user’s Flickr collection randomly and infrequently, so that the user is unaware of what (if anything) they will find when they open it. The intention behind this is to support reflection on and reminiscence about the past, to challenge the “always-on-and-accessible qualities of many contemporary consumer devices” [p. 1693], and to see how attachment to a device that does this would change over time. Odom *et al.* report how their participants expressed initial experiences of frustration, confusion, and attempts to work out what the technology, and study, was ‘really’ trying to accomplish, before they came to accept and eventually appreciate the device. They conclude by highlighting design for anticipation as well as for re-visitation and reflection in the context of slower-paced technologies.

One can juxtapose the confusion Odom *et al.*’s participants initially experienced with reactions to a technology that incorporates organic processes. Kuznetsov *et al.* [24] built a system to visualise bacterial activity inside Winogradsky columns (used for cultivating microorganisms), which were filled with different soil samples and deployed with members of a gardening community. Like the Photobox, and in line with the slow technology design philosophy, it might be more accurate to say that the columns are not so much used in the traditional sense as simply experienced; they demand neither attention nor input. However, participants in this study did not see the system as slow; instead it was viewed as simply reflecting the speed of “real life”. This interpretation is different again to those expressed in a third study by Grosse-Hering *et al.* [14], in which reactions to a juicer developed in line with slow design principles were explored. Here, participants saw slowness as connected with laziness and a lack of productivity, appropriate at weekends but not suitable for weekdays. Grosse-Hering *et al.* conclude by highlighting the importance of balancing slowness with convenience; there are, of course, times when efficiency is important.

Given the acceptance of slowness when bound up with organic processes, and the distinction drawn between the speed of ‘real life’ and that of technology, it is perhaps not surprising that researchers have looked to organic rhythms and embodied experiences in their efforts to design for temporality. Studies in this area include Höök’s [19] reflections on her sense of being in (and out of) time with a horse when learning to ride, and Kosmack Vaara’s [22] exploration of temporality as an embodied experience that emerges during sourdough baking. Here, rhythm and tempo are bound up with living microorganisms and chemical processes. Temporality is inherent in the materials and the movements of the baker, the tempo altering with the changing characteristics of the material. In both pieces of work, the non-digital is looked to as inspiration for what experiential qualities might be supported through technology, with *timing* being emphasised over time per se.

This emphasis on timing is taken further by Martin and Holtzman [28], in their endeavour to design for a more “human experience of time” [p. 1977]. They developed and deployed an automatic scheduling system called *Kairoscope*, which draws on Ancient Greek notions of time and in particular on the notion of *Kairos*. *Kairos* relates to the idea of timing, or the opportune moment, and is contrasted with *Chronos*, which represents sequential time and is typically at the core of scheduling systems. Rather than using *Chronos*, *Kairoscope* emphasises malleability, and positions time as relative to the present. It was motivated as a means of addressing the busyness that is inherent to modern life; accordingly, it assigns precise times to appointments only as they approach, and alerts users to advancing events through an interface that looks like a pie-chart, which gradually changes from green to red. The aim is to remove the need for the user to think about *when* things will happen, so that they may instead simply rest assured that they *will*, and focus on the present. Additionally, the system optimises for social interaction. When used by multiple people, it aims to bring them together serendipitously.

Notably, Martin and Holtzman’s attempt to manage the multiple temporalities that frame everyday life stands alone here. Efforts to design for experiences of temporality tend to focus on the felt experience of the individual: Can technology offer a slow experience? How might technology align with a sense of temporality that is embodied? Yet, Grosse-Hering *et al.*’s findings make clear the need to address multiple temporalities, and prior research in CSCW has emphasised how understanding the ways in which different temporal structures intersect is essential to designing for the felt experience of time. In the following section, we outline research that shows how this is so, before highlighting in particular the concept of quality time in relation to intersecting temporalities.

INTERSECTING TEMPORALITIES

We begin by considering prior work by Reddy *et al.* [38], which indicates how the interplay between temporal structures frames not only the organization of action but also how it is experienced. Reddy *et al.*’s study of information-seeking in medical work led them to identify three temporal structures: rhythms, trajectories and horizons. The temporal sequence of events pertaining to an individual patient (described as an illness trajectory) interplays with the rhythms of the workplace, so as to provide a context for medical workers in seeking, providing and managing information, and in planning, organizing and coordinating activities. Trajectories and rhythms frame temporal horizons, described as knowledge of likely future activities that are drawn upon in the organization of current work. The three together bring orderliness to the working day, with the nature of temporal horizons dictating how flexibly work can be organised, and the urgency with which it needs to be carried out.

The idea that temporal experiences (in this case, urgency) are underpinned by the ways in which temporal structures intersect can also be seen in a rather different analysis of time; one that draws on time diaries and looks to unpack the concept of quality time. Many readers of this paper may understand quality time as that dedicated to being spent with others, although the term itself is relatively new. In his analysis of the concept, Southerton [45] identifies quality time as a contemporary concern, and uses it alongside an analysis of diaries written in 1937 and 2000 to examine the impression that everyday life is speeding up. His findings lead him to argue that the feeling of time pressure that seems inherent to modern life is due to difficulties in coordinating practices, rather than the sheer density of events that need to be accomplished. Of the participants from the year 2000, he writes,

“Respondents described their daily lives as a roller-coaster ride with moments of hurriedness and calm, of ‘hot’ and ‘cold spots’ of temporal activity [...] The challenge as described by respondents was to coordinate within their networks so that cold spots, which were variously described as ‘quality time’ and ‘family time’, were aligned.” [p. 53]

Southerton suggests that these moments of quality time need to be “re-instituted” due to the flexibility of personal schedules and the variance in leisure and work rhythms; coordinating devices become necessary due to the lack of centralised coordination in modern life. This is in contrast to daily life in 1937, when fixed institutional events such as meal and work times meant that coordination was embedded in the routine of daily life. Rush was of course a part of life, but it was a rush to keep within collective rhythms, rather than to pull into alignment individual routines.

Southerton’s account implies that it is the nature of rush rather than its existence per se that has shifted over the years and so, what comes to be valued is positioned as time with others rather than time ‘off’ in itself. A similar view is expressed by Urry [56], who notes how the desynchronisation of “the time-space paths of individuals” [p. 139] has led to efforts to underpin time spent together, such as through short breaks or long weekends away. If we accept that so-called free time is increasing but is also increasingly fractured, then we can see why quality is ascribed to sustained moments of time that can be spent with others.

When considered in light of this research, it is interesting to ask what it would be like to live with a system like *Kairoscope*, where temporal structures and their interplay are managed by computers and hidden from view. Visions for technologies like this have little to say about how a sense of urgency might be underpinned, or the rhythms of collaborative work established. Furthermore, automated systems reduce the expression of choice in relation to how time is spent. As noted by Zerubavel, “[t]ime is definitely one of the principles that can best allow us to establish and organise priority in our lives as well as to symbolically display it” [59, p. 53]. Put simply, quality time takes some of its value

by dint of being time dedicated by one person to another. A situation where time spent together is engineered by a system could resonate with a past in which time spent with others was produced by institutionalised routines, and so was taken for granted.

This does, however, raise the question of how one might design for quality time. Southerton's argument brings us back to the idea of temporality and value, and puts some of the critiques outlined in the Introduction into context. The fractional and distracting experiences that technology is associated with are opposite to how quality time is conceptualised. Designing for an alternative temporal experience means understanding the ways in which multiple temporalities intersect, whether these frame a person's working day, or allow a family to spend time together. While scheduling technologies do of course have a role to play here [see e.g. 31], many of the temporal structures that frame everyday life are not so much scheduled as unfold in a way that is unremarkable [54], or are so firmly established that they are no longer seen as alterable. In the following two sections, we consider two challenges associated with designing for temporal experiences by manipulating temporal structures. The first lies in supporting the recognition that temporal structures, which are seen as immovable, are in fact malleable. The second lies in dealing with the complexity of temporal structures that are collective and entangled.

THE SOCIOTEMPORAL AS REIFIED AND MALLEABLE

Zerubavel [59] has argued that sociotemporal patterns, or the established temporal structure of social life, tends to be seen as rigid. Sociotemporal patterns are neither recognised nor treated as the product of human behaviour, yet this is precisely what they are. He asks, "Given its considerable temporal regularity, cannot social life in itself function as a clock or a calendar which is as reliable as any natural clock or calendar?" [p. 14], and points out that sociotemporal cycles, while being "based, to a large extent, on purely arbitrary social convention" are "usually perceived by people as given, inevitable, and unalterable" [p. 42]. Orlikowski and Yates [34], working in the field of organization studies, build on this point. They argue that time is plural; it can be experienced as objective, quantitative and independent of humankind, but also as subjective, situated and socially constructed. In their view, time is both independent of and dependent on behaviour: temporal structures are produced and reproduced through everyday action, and these in turn shape the rhythm and form of ongoing practices. Existing temporal structures become taken for granted and appear to be unbending, but time is also treated as malleable in that temporal structures can be changed and new ones established. The objective/subjective dichotomy is not inherent to the nature of time, but is a property of the particular temporal structures being enacted at a particular moment. They call for a focus on examining how temporal structures become established for a particular activity, and how they are sustained, reinforced or modified in practice.

This is a theme that has been picked up in anthropology more broadly as well as specifically within CSCW. Wilk [57] has considered how routines come to be cultivated, observing that every day we are presented with opportunities to "naturalize something new", and turn events into the "precedents" of new routines [p. 151]. He argues that the decisions that surround the adoption of these routines are part of the process of their cultivation, in which unconscious habits are brought forward into consciousness, reflection and discourse. Cultivation can be active or passive (routines may be actively initiated, or forced upon us), and is governed by "tacit rules" that reveal "how often things must be discussed before they can be done without discussion, how often things have to be repeated by agreement or with supervision before they can become an accepted part of shared daily routine" [p. 151]. A shared context is implicit here, but the ways in which rhythms that bind people are shaped has been pulled into sharper focus by Jackson *et al.* [21]. Picking up on Orlikowski and Yates' position, they argue that "distributed collective practices not only have rhythms, but in some fundamental sense are rhythms" [p. 247]. Rhythms shape collective action but are also shaped by it, and efforts to build them and to bring them into alignment are an essential part of collaborative work.

Jackson *et al.*'s efforts to study the shaping of rhythms at work, alongside Reddy *et al.*'s [38] account of the different temporal structures that frame the ways in which it is organised and experienced, underline the relevance of this line of research to CSCW. Yet, what might we say more specifically about the role of technology in shaping and bringing into alignment the rhythms of everyday life? Firstly, we might consider the role of technologies in framing everyday rhythms. A classic, although outdated, example of this is presented by Silverstone [44], who argues that television provided a structure of "public time" that also served as a framework for managing "private time". His 1993 analysis demonstrates how media can underpin "times grabbed and privileged by women at home who use a favourite soap opera or radio program in the middle of the day to free themselves from their mundane and monotonous domestic duties" [p. 303], as well as serving as a focus for families to congregate. Ten years later, Taylor and Harper's [50] descriptions of television use show how television continued to facilitate different means of spending time, from "switching on to switch off" when returning home from work, to engaged viewing later in the evening.

Even Irani *et al.*'s [20] most recent positioning of television as plastic indicates the existence of temporal windows that anchor collective rhythms: people coordinate around digital television as well as broadcast television. The flexibility that the medium now supports suggests that technologies might be used to enable the building of personalised temporal infrastructures. Through time-shifting, television can become the focus of collective rhythms, produced by viewers who coordinate watching to enable synchronous viewing with household members, or to keep to a schedule with

friends and family members who are engaging with the same content separately. By viewing content within particular temporal windows, shared experiences, conversation, and perhaps even quality time can be underpinned. The plasticity of time-shifting produces new rhythms, built upon tacit and explicit coordination.

Of course, this only has relevance where temporal structures clearly involve technology (as in the case of media consumption). A second role for technology in shaping and bringing into alignment the rhythms of everyday life entails using it to modify the naturalised routines that are unthinkingly performed. This is a much more difficult challenge, but there are avenues for research and design here too. One possibility draws on evidence that has shown how making routines visible, and presenting them back to the user in a way that makes them abstract or defamiliarised, could support what Orlikowski and Yates term *temporal reflexivity*, or the recognition that reified temporal patterns are flexible and changeable.

Prior work by Ståhl *et al.* [46], in relation to the *Affective Diary*, and by Lindley *et al.* [27] in relation to *SenseCam*, has shown how simple depictions of daily routine can lead to reflection on behaviour and sometimes to change. In the former, sensor data is captured and represented as abstract visualisations of one's movements and levels of arousal; in the latter, a wearable camera captures images every 20 seconds or so, which can be watched back as a time-lapse stream. Studies of SenseCam [27] in particular have indicated how providing a sense of how time is spent can lead to the realisation that changes can be made. When presented in a more abstract form, people can recognise that those routines that appear to be fixed and outside of their control are in fact flexible. Relatedly, technologies could play a role in highlighting routines that are in the process of becoming cultivated. For example, tracking and monitoring technologies such as *Time of My Life* [51] provide a means to reflect upon how time has been spent. Returning to the idea of intersecting temporalities and quality time, research within CSCW that has focused on how visualizations of work rhythms can be used to support coordination [3] could have a role to play in bringing everyday rhythms into alignment. This is complex, as it requires a consideration of the meta-routines that are based on the interdependencies across people, but Kairoscope [28] provides a good example of what bold thinking in this space could underpin.

To recap the argument so far, we have suggested that design for temporal experience might be supported by efforts to reshape the temporal patterns that form the backdrop of everyday life, with an especial focus on how these intersect. We have noted that while sociotemporal patterns tend to be reified, they are malleable. Technologies can play a role in highlighting this malleability and in supporting their alignment. However, while we have primarily looked at intersections with a view to supporting togetherness, or quality time, a fuller treatment of the topic requires a consideration

of other ways in which temporalities are linked. In the final section, we consider this challenge, building on recent accounts that position time as collective and entangled.

TIME AS COLLECTIVE AND ENTANGLED

To provide some background here, we begin by highlighting what Zerubavel [59] has described as a “temporal division of labor”. He notes that in modern Western life, “group members participate in one and the same temporal order, yet differently from one another” [p. 69]. Action is complementary, coordinated, but it is not collocated. Here we consider what it means to position time in this way, as something that is collective and entangled. We will show that doing so raises a different set of implications for what it means to ‘slow down’, or otherwise design for different experiences of temporality.

In considering time as collective, we look first to Mazmanian and Erickson [29], who recently pointed to a temporal division of labour as a possible means for managing an appearance of availability in the workplace. They observe that there is an increasing need for people at work to maintain an impression of being ‘always-on’, and suggest that by positioning time as collective rather than individual, a front stage [cf. 13] that conveys availability could be sustained, while back stage, individual workers could disconnect.

Pushing this further, Sharma [43] argues for a need to view time as collective not just for workforces, but across society, insofar as the management of personal time is intertwined with the temporalities of those at work. In her recent book *In the Meantime*, she argues that discussion about speed-up ignores the fact that time is experienced differently by different populations, and indeed can be cast as a justification for the exploitation of some by others:

“Whether it is theories of speed or cultural responses to speed, articulating the contemporary moment as one of all-consuming speed adds an element of novelty and urgent necessity to the demand and desire to exert more time control over one’s quickly passing life “in these sped-up times”. Too often, the belief that we are living in a dangerously sped-up culture makes the demand for the labor of others justifiable as a systemic need “in these fast-paced times” rather than the structurally excessive privilege that it is.” [p. 19]

She exemplifies this through accounts of the intersection of the routines of business persons, taxi drivers, office-based yoga instructors, and slow restaurants, noting that taxi drivers are part of a temporal architecture that supports the fast-paced business person, but that in itself can involve long periods of waiting, and often requires the adoption of a temporal ordering that sets them against the conventional nine-to-five working day. Yoga instructors are part of this architecture too, positioned as playing a supportive role in the office, which maintains and normalises elevated time practices, while “[s]low living is mandated as correct yet reserved only for those who have time to make time” [p.

128]. Sharma describes the slow movement as a consumer choice, and observes that “the return to nature via natural rhythms of the body and eating seasonal fruits and vegetables will not change the fact that the largest group of low-wage workers in the world is farmworkers” [p. 121]. When time is problematized in this way, not as an individual but as a collective problem, it becomes clear that slowing down does not present a solution: “Slowing down does not necessarily change (and certainly does not ameliorate) the ways in which individuals and social groups are tangled together in time” [p. 111].

Of course, Sharma’s argument is political, stated explicitly as a call for a “temporal politics grounded in an understanding of how social experiences of time are multiple and uneven” [p. 149]. But her point that time is differential, relational, and tangled raises a challenge for CSCW and for HCI more generally, one that picks up on Mazmanian and Erickson’s question too. How can we design for time as collective and interdependent, rather than individualised on the one hand, or explicitly scheduled on the other? What does it mean to position collective time not as something that is achieved when people come together, but as a set of relationships through which they are connected? Both Sharma and Mazmanian and Erickson raise this challenge while highlighting the difficulty in addressing it; neither offer a solution. In the Discussion, we draw on the arguments made in this paper to consider what we have learnt about designing for experiences of time, before offering some tentative suggestions with regards to what this would mean when time is positioned as collective and entangled.

DISCUSSION

The temporality of modern life is often cast as overloaded, fast-paced and distracted, yet statistics also indicate that we have increasingly more free time. The work we have considered in this paper indicates that it is the nature of rush that has shifted rather than the amount of things to do: routines become fractured; coordination entails a temporal division of labour; and time spent with others becomes something that is striven for rather than embedded in the sociotemporal patterns that frame everyday life. This is compounded by a sense that it is important to be busy, at least in cultures such as that of the USA. Where there is free time, there is a compulsion to fill it [25].

We began this paper by looking at clock time, noting in particular Glennie and Thrift’s [12] position that clock time can be understood as sets of practices that coevolved with timekeeping technologies. We have suggested the value of a similar treatment for so-called digital time: the sense of ‘nowness’ experienced through social network sites is upheld by social conventions; the Internet has been described as underpinning practices that are perfectly suited to plastic time [37]; and more broadly, sociotemporal structures are enacted through human behaviour. Consequently, efforts to design for temporal experience must do more than simply build desirable temporal models into technologies. Just as

an experience of time as mechanical and quantifiable did not simply come along with the clock, neither will a reconnection with organic time be supported through the undertaking of a digital detox. A more fundamental shift would be required; one that is bound up with addressing the broader practices of which these technologies are part [42].

Notably, a practice-oriented treatment of digital time does open up avenues for research and design, one that resonates with Kuutti and Bannon’s [23] recent account of a practice perspective forming a new paradigm for HCI. They propose that a central issue in a practice-based research agenda is the need to develop the capability to transform practices through technology. Essential to this is understanding the role of computer artefacts in the emergence and transformation of practices, and the possibilities for influencing these by changing the artefacts themselves.

In this paper we have highlighted various ways in which technologies might play a role in shaping practices that are bound up with the experience of time. Technology can, at times, give shape to the ways in which time is organised. We have seen how television, for instance, can be appropriated to support plastic viewing practices, but that it can also frame broader rhythms and routines. Alternatively, technology can underpin temporal reflexivity by encouraging reflection on existing practices. The provision of abstract visualisations of sociotemporal patterns, and of how these intersect both within and across individual schedules, may encourage attempts to shape how these unfold and fit together. Finally, technologies may encourage particular ways of thinking about time, which then influence how they are used. While it is simplistic to argue that technologies can project an idea or experience of time onto human behaviour, we have seen how, in social media for example, the immediacy of the technology alongside coevolving social conventions can come to frame temporal experience.

Importantly, a practice-oriented treatment of digital time also requires a unit of analysis that goes beyond the individual. Kuutti and Bannon posit that practices are a shared resource amongst a community of people. However, design that takes into account and potentially disrupts the ways in which practices are intertwined is challenging. Research in CSCW has indicated how the coordination of rhythms in the workplace demonstrates power relationships, with regards to which rhythms are prioritised and who is brought into alignment with whom [21, 48]. So questions regarding how change can be effected across individuals necessitates a consideration of how alignment work can be supported, not only within organisations such as workplaces, but outside of them as well.

This point ties into the conceptualisation of time as collective [29] and entangled [43]. The infrastructure that supports a 24/7 society is one that relies on people as well as technologies, the conventional nine-to-five work rhythm, for example, being underpinned by people working shifts outside of these hours. Grappling with these broader tem-

poral infrastructures necessitates a close inspection of the multiple temporalities that exist within cities and neighbourhoods, and the ways in which they are interwoven and cross-dependent. Initial approaches to research and design in this space could include making these infrastructures visible and facilitating possibilities for connection across the temporal boundaries that are inherent to them. Sharma highlights the difficulties that workers who keep to temporal orders outside of the norm experience in terms of integration with local communities; some had never met their neighbours. There is a long history of work within CSCW that might be adapted to this problem, ranging from an understanding of how to support awareness [e.g. 41] to community [e.g. 8] to communication across time zones [e.g. 49]. Even technologies such as timebanks could be reimaged with an interpretation of time as collective, by maintaining an idea of community and giving [5], while explicitly recognizing that some people have more time to spare than others, or that some people's time is more fractured.

It is worth noting too, that the above approach could be critiqued as upholding rather than disrupting existing temporal experiences. In her analysis of office-based yoga, Sharma suggests that this is one means through which the elevated temporal practices of office workers are maintained. This viewpoint brings questions of agency and power back into the frame; shifting the problem of how to design for temporality to the question of how to seriously disrupt the rhythms that form the backdrop to everyday life. Taking a holistic approach, whereby technology is seen as part of a broader system, one that might support an emerging social process in which time is positioned as 'our time' rather than 'my time', is a central challenge here.

Limitations

Before concluding, it is worth acknowledging some limitations of this paper. In writing it, we have focused primarily on Western metaphors for, and accounts of, time. Extending the analysis presented here to reflect additional ways of thinking about time presents a promising direction for future work, and one that is obviously essential if designing for users with different cultural interpretations of time. Recent work by Reinecke *et al.* [39] is one example of how culture affects the ways in which people organise themselves around time, and Adam [1] provides a useful account of different cultural metaphors of time, contrasting, for instance, timelines, which emphasise linear, directional movement, with cyclic representations, which represent rhythm and stability.

CONCLUSION

In this paper we have drawn on existing research to suggest that digital time is a reflection of as much as it underpins the fractured rhythms of everyday life and the sense that it is speeding up. Building on this view, we have suggested that rather than designing more 'human' models of time into technology, what is needed is a recognition that every-

day temporalities are multiple, and that it is through understanding and influencing how these intersect that different temporal experiences might be enabled. We have suggested that while technologies have a role to play in shaping the temporal infrastructures of which they are part (television being an exemplar here), richer but more challenging possibilities for CSCW research and design lie in addressing questions such as how broader temporal infrastructures can be made visible, and how temporal reflexivity and agency can be supported. We have highlighted this as especially challenging when time is considered as collective and entangled. Yet it will be essential, if we are to better understand the ways in which experiences of time are not only underpinned by the technologies that we use, but also by the rhythms and routines of the people with whom our lives are intertwined.

ACKNOWLEDGEMENTS

Thanks to Richard Harper and to the reviewers of this paper for their thought-provoking comments. The ideas in this paper were also shaped through a workshop on Temporal Design, organised by Michelle Bastian, Larissa Pschetz and Chris Speed.

REFERENCES

1. Adam, B. *Time*. Polity Press, Cambridge, 2004.
2. Aguiar, M. and Hurst, E. Measuring trends in leisure. *Quarterly Journal of Economics* 11, 3 (2007), 969-1006.
3. Begole, J. "B.", Tang, J. C., Smith, R. B. and Yankelovich, N. Work rhythms: analyzing visualizations of awareness histories of distributed groups. In *Proc. CSCW 2002*, ACM Press (2002), 334-343.
4. Bell, G. Will we ever be bored again? And why it might matter. Presented at *TEDxPortland*, April 2011. <http://tedxtalks.ted.com/video/TEDxPortland-Genevieve-Bell/> Accessed 16 May 2014.
5. Bellotti, V., Cambridge, S., Hoy, K., Shih, P. C., Renery Handalian, L., Han, K. and Carroll, J. M. Towards community-centred support for peer-to-peer service exchange: rethinking the timebanking metaphor. In *Proc. CHI 2014*, ACM Press (2014), 2975-2984.
6. Bergson, H. *Time and Free Will*. Swan Sonnenschein, London, 2010.
7. Bittman, M. and Wacjman, J. The rush hour: character of leisure time and gender. *Social Forces* 79, 1 (2000), 165-189.
8. Carroll, J. M. and Rosson, M. B. Wild at home: the neighborhood as a living laboratory for HCI. *ACM Trans. Comput.-Hum. Interact.* 20, 3 (July 2013), Article 16.
9. Crosby, A. W. *The Measure of Reality: Quantification and Western Society, 1250-1600*. Cambridge University Press, Cambridge, 1997.

10. Deem, R. No time for a rest? an exploration of women's work, engendered leisure, and holidays. *Time and Society* 5, 1 (1996), 5-25.
11. Dourish, P. Re-space-ing place: "place" and "space" ten years on. In *Proc. CSCW 2006*, ACM Press (2006), 299-308.
12. Glennie, P. and Thrift, N. *Shaping the Day: A History of Timekeeping in England and Wales 1300-1800*. Oxford University Press, Oxford, 2009.
13. Goffman, E. *The Presentation of Self in Everyday Life*. Anchor Books, Doubleday, New York, 1959.
14. Grosse-Hering, B., Mason, J., Aliakseyeu, D., Bakker, C. and Desmet, P. Slow design for meaningful interactions. In *Proc. CHI 2013*, ACM Press (2013), 3431-3440.
15. Hallnäs, L. and Redström, J. Slow Technology – Designing for reflection. *Personal Ubiquitous Comput.* 5, 3 (January 2001), 201-212.
16. Harper, R., Whitworth, E. and Page, R. Fixity: identity, time and durée on Facebook. *IR 13.0* (2012). <http://spir.aoir.org/index.php/spir/article/view/8/> Accessed 16 May 2014.
17. Harrison, S. and Dourish, P. Re-place-ing space: the roles of place and space in collaborative systems. In *Proc. CSCW 1996*, ACM Press (1996), 67-76.
18. Hildebrandt, M., Dix, A. and Meyer, H. A. Time design. In *Ext. Abstracts CHI 2004*, ACM Press (2004), 1737-1738.
19. Höök, K. Transferring qualities from horseback riding to design. In *Proc. NordiCHI 2010*, ACM Press (2010), 226-235.
20. Irani, L., Jeffries, R. and Knight, A. Rhythms and plasticity: television temporality at home. *Personal Ubiquitous Comput.* 14, 7 (October 2010), 621-632.
21. Jackson, S. J., Ribes, D., Buyuktur, A. and Bowker, G. C. Collaborative rhythm: temporal dissonance and alignment in collaborative scientific work. In *Proc. CSCW 2011*, ACM Press (2011), 245-254.
22. Kosmack Vaara, E. Kneading time: exploring sensuous dimensions of temporality. Presented at *IxD13*, Toronto, January 27-31 2013.
23. Kuutti, K. and Bannon, L. J. The turn to practice in HCI: towards a research agenda. In *Proc. CHI 2013*, ACM Press (2013), 2543-2552.
24. Kuznetsov, S., Harrigan-Anderson, W., Faste, H., Hudson, S. E. and Paulos, E. Community engagements with living sensing systems. In *Proc. C&C 2013*, ACM Press (2013), 213-222.
25. Leshed, G. and Sengers, P. "I lie to myself that I have freedom in my own schedule": productivity tools and experiences of busyness. In *Proc. CHI 2011*, ACM Press (2011), 905-914.
26. Lindley, S., Corish, R., Kosmack Vaara, E., Ferreira, P. and Simbelis, V. Changing perspectives of time in HCI. In *Ext. Abstracts CHI 2013*, ACM Press (2013), 3211-3214.
27. Lindley, S. E., Glancy, M., Harper, R., Randall, D. and Smyth, N. "Oh and how things just don't change, the more things stay the same": Reflections on SenseCam images 18 months after capture. *Int. J. Hum.-Comput. Stud.* 69, 5 (May 2011), 311-323.
28. Martin, R. and Holtzman, H. Kairoscope: managing time perception and scheduling through social event coordination. In *Proc. CHI 2011*, ACM Press (2011), 1969-1978.
29. Mazmanian, M. and Erickson, I. The product of availability: understanding the economic underpinnings of constant connectivity. In *Proc. CHI 2014*, ACM Press (2014), 763-772.
30. Mumford, L. *Technics & Civilization*. University of Chicago Press 2010 edition, Chicago, 1934.
31. Neustaedter, C., Bernheim Brush, A. J. and Greenberg, S. The calendar is crucial: coordination and awareness through the family calendar. *ACM Trans. Comput.-Hum. Interact.* 16, 1 (April 2009), Article 6.
32. Odom, W., Sellen, A., Banks, R., Kirk, D., Regan, T., Selby, M. et al. Designing for slowness, anticipation and re-visitation: a long term field study of the Photobox. In *Proc. CHI 2014*, ACM Press (2014), 1961-1970.
33. Odom, W., Banks, R., Durrant, A., Kirk, D. and Pierce, J. Slow technology: critical reflection and future directions. In *Proc. DIS 2012*, ACM Press (2012), 816-817.
34. Orlikowski, W. J. and Yates, J. It's about time: an enacted view of time in organizations. Presented at the *58th Annual Meeting of the Academy of Management*, San Diego, CA, August, 1998.
35. Page, R. Re-examining narrativity: small stories in status updates. *Text & Talk* 30, 4 (2010), 423-444.
36. Pang, A. S. K. *The Distraction Addiction: Getting the Information You Need and the Communication You Want, Without Enraging Your Family, Annoying Your Colleagues, and Destroying Your Soul*. Hachette Digital, Inc., 2013.
37. Rattenbury, T., Nafus, D. and Anderson, K. Plastic: a metaphor for integrated technologies. In *Proc. UbiComp 2008*, ACM Press (2008), 232-241.
38. Reddy, M. C., Dourish, P. and Pratt, W. Temporality in medical work: time also matters. *Comput. Supported Coop. Work* 15, 1 (February 2006), 29-53.
39. Reinecke, K., Nguyen, M. K., Bernstein, A., Näf, M. and Gajos, K. Z. Doodle around the world: online scheduling behaviour reflects cultural differences in time perception and group decision-making. In *Proc. CSCW 2013*, ACM Press (2013), 45-54.

40. Rushkoff, D. *Present Shock: When Everything Happens Now*. Penguin Press, 2013.
41. Schmidt, K. The problem with ‘awareness’: introductory remarks on ‘awareness in CSCW’. *Computer Supported Cooperative Work 11*, (2002), 285-298.
42. Sengers, P. What I learned on Change Islands: reflections on IT and pace of life. *interactions 18*, 2 (March 2011), 40-48.
43. Sharma, S. *In the Meantime: Temporality and Cultural Politics*. Duke University Press, 2014.
44. Silverstone, R. Time, information and communication technologies. *Time & Society 2*, 3 (1993), 283-311.
45. Southerton, D. Re-ordering temporal rhythms: coordinating daily practices in the UK in 1937 and 2000. In *Time, Consumption and Everyday Life*, E. Shove, F. Trentmann and R. Wilk (Eds), pp. 49-63. Berg, Oxford, 2009.
46. Ståhl, A., Höök, K., Svensson, M., Taylor, A. S. and Combetto, M. Experiencing the Affective Diary. *Personal Ubiquitous Comput. 13*, 5 (June 2009), 365-378.
47. Stein, J. Reflections on time, time-space compression and technology in the nineteenth century. In *Timespace*, J. May and N. Thrift (Eds), pp. 106-119. Routledge, Oxon, 2001.
48. Steinhardt, S. B. and Jackson, S. J. Reconciling rhythms: plans and temporal alignment in collaborative scientific work. In *Proc. CSCW 2014*, ACM Press (2014), 134-145.
49. Tang, J., Zhao, C., Cao, X. and Inkpen, K. Your time zone or mine? a study of globally time zone-shifted collaboration. In *Proc. CSCW 2011*, ACM Press (2011), 235-244.
50. Taylor, A. and Harper, R. Switching on to switch off. In *Inside the Smart Home*, R. Harper (Ed), pp. 115-126. Springer-Verlag, London, 2003.
51. Time of My Life. <http://www.windowsphone.com/en-us/store/app/time-of-my-life/3ad82b05-ac06-4fe2-b2d6-04d47007566e/> Accessed 16 May 2014.
52. Thomas, J. C., Pan, Y., Erickson, T., Blevis, E., Letondal, C. and Tabard, A. Avec le temps!: time, tempo, and turns in human-computer interaction. In *Ext. Abstracts CHI 2013*, ACM Press (2013), 3303-3306.
53. Thompson, E. P. Time, work-discipline, and industrial capitalism. *Past and Present 38*, (1967), 56-97.
54. Tolmie, P., Pycock, J., Diggins, T., MacLean, A. and Karsenty, A. Unremarkable computing. In *Proc. CHI 2002*, ACM Press (2002), 399-406.
55. Tomlinson, J. *The Culture of Speed: The Coming of Immediacy*. Sage, London, 2007.
56. Urry, J. Time, leisure and social identity. *Time & Society 3*, 2 (1992), 131-149.
57. Wilk, R. The edge of agency: routines, habits and volition. In *Time, Consumption and Everyday Life*, E. Shove, F. Trentmann and R. Wilk (Eds), pp. 143-154. Berg, Oxford, 2009.
58. Yardi Schoenebeck, S. Giving up Twitter for Lent: how and why we take breaks from social media. In *Proc. CHI 2014*, ACM Press (2014), 773-782.
59. Zerubavel, E. *Hidden Rhythms*. University of California Press, Berkeley, 1981.