

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

How do people experience the temporality of everyday life changes? Towards the exploration of existential time in HCI

This is a pre print version of the following article:

Original Citation:

Availability:

This version is available <http://hdl.handle.net/2318/1886224> since 2023-01-19T13:40:52Z

Published version:

DOI:10.1016/j.ijhcs.2022.102899

Terms of use:

Open Access

Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

How do people experience the temporality of everyday life changes? Towards the exploration of existential time in HCI

Author: Amon Rapp¹

Affiliation: ¹University of Torino, Computer Science Department, Torino, Italy

Abstract

The idea of time as an existential concern has found scarce attention in the Human-Computer Interaction (HCI) community. Still, time in our life is mostly experienced in connection with important existential matters. Life changes are emblematic examples of aspects of our existence that are fundamentally temporal. In this article, I explore how people experience the temporalities of “change”, by asking 16 participants to report on life changes they consider relevant and their temporal aspects. I found that temporal features like velocity, direction, and synchronization deeply impact the process of change, by affecting the participants’ opportunities to make sense of and act upon their own transformations. The study findings point to a conception of existential time that contributes to both HCI research on time and life changing events, by highlighting the relativity of temporal slowness and speediness, the malleability of time, and the fundamental openness of our time experiences.

This is a pre-print version of an article published by Elsevier in International Journal of Human-Computer Studies on 2022, available online <https://www.sciencedirect.com/science/article/pii/S1071581922001227>. The published publication is also accessible via DOI: <https://doi.org/10.1016/j.ijhcs.2022.102899>

To cite this article: Rapp, A. (2022). How do people experience the temporality of everyday life changes? Towards the exploration of existential time in HCI. International Journal of Human-Computer Studies, 167, 102899, 1-14. doi: 10.1016/j.ijhcs.2022.102899

© <2022>. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <https://creativecommons.org/licenses/by-nc-nd/4.0/>

Keywords: life changing events, time, temporality, existence, temporal technologies, HCI.

Declarations of interest: none

Contact Author: Amon Rapp

University of Torino - Computer Science Department - C.so Svizzera, 185 – 10149 Torino, Italy

Ph. +393462142386 Mail: amon.rapp@unito.it

1 INTRODUCTION

The concept of time is a complex issue that involves fundamental aspects of our existence. The Western tradition, however, tackled time mainly as an abstract matter. Since the modern age, time has been mostly conceptualized as a sort of objective phenomenon, capturable by the clock, a machine allowing its exact measurement (Starkey, 1989).

In the same line, HCI researchers have traditionally addressed time as the time of the machine (Rapp et al., 2022). The HCI community has commonly focused on the design of systems that support productivity, seeing time as a means to maximize efficiency and speed up working practices (Pschetz, 2015), rather than an experience that characterizes our everyday life.

The idea that time cannot be merely reduced to the time of the machine, however, has constantly grown within the HCI community in recent years. HCI researchers have progressively transitioned from an objective and “absolute” perspective on time to a more multifaceted conception that sees time “relative” to the practices that people perform in their everydayness, like time management (e.g., Uhde et al., 2020), cultural (Wyche et al., 2010), remembering (e.g., Chen et al., 2019) and reflective (Odom et al., 2018) practices.

Even though all this research on time-related practices proposes interesting conceptions and designs for going beyond the objective and absolute time that has traditionally informed system design, it still overlooks evidence that we have about time: time is an experience intertwined with fundamental existential matters. In this sense, it represents an existential concern. This idea can be found in Bergson (1913), in existential philosophy and psychology (Gordon, 2012), and in the phenomenological tradition, which conceptualizes the stream of consciousness itself as a temporal flow (Zahavi, 2012). Albeit the idea of time as an existential concern is implicitly encompassed by HCI studies on ageing, legacy and death (e.g., Gulotta et al., 2017; Loup et al., 2017), which explore our intrinsic finitude, as

well as by a few works on memories and rituals (e.g., Petrelli & Light, 2014), existential time is almost never explicitly addressed by the HCI community.

Rather, HCI research attempting to tackle existential matters is often focused on pragmatic issues, such as digital heirloom management (Kaptelinin, 2018). It comes as no surprise, therefore, that one of the most frequent occurrences of “existential time” that we encounter in our everydayness is almost unexplored within HCI: “change” is something that we all experience during the course of life and is essentially a temporal phenomenon. Changes unfold over time and have temporal features that may impact how we perceive and manage them: for instance, we may be not aware of changes that have an extremely slow temporality, and this can undermine our capability of acting upon them. This “change time” is neither the time of the clock, nor the time that is commonly investigated in HCI research on time-related practices, but a time that is fundamentally subjective and tied to people’s existential concerns (Gordon, 2012).

In fact, despite life changing events have been studied by the HCI community, which also reported on the subjective experience of people undergoing a major change in their life (e.g., Herron et al., 2017; Lindley & Wallace, 2015), their temporal aspects have been mostly ignored in favor of the consequences that such events produce on the life on the individual (Cherubini et al., 2020). Therefore, while we have a variety of insights on how people react to or manage a life transformation by using technology, we little know about how the temporal features of changes (e.g., their velocity) may impact on the experience and the outcomes of the process of change itself. Apart from a few insights on the general nature of the “temporality of change” as subjective (Rapp et al., 2019), the temporal aspects of change and how change time is configured have not been thoroughly explored yet. This exploration is important because it may allow us to design technologies that better help people face crucial processes in their life: in fact, current online services and tools appear often inattentive to the needs of people experiencing changes (Cherubini et al., 2020). Understanding the temporal features of change may also put in the foreground the multiplicity of time, allowing us to go beyond traditional time dichotomies (e.g., slow vs. fast technologies, objective time vs. social time) in HCI research (Rapp et al., 2022), enriching the conceptualization of time in HCI. Finally, it may respond to the call for adopting an existential perspective in HCI (Kaptelinin, 2018): examining the temporality of everyday changes may

identify potential uses of interactive technology to support people in dealing with existential questions coming from life transformations.

In sum, in this article I will make two substantial contributions to HCI. First, by adopting a phenomenological perspective I will explore how people perceive and make sense of the temporality of the changes they experience. Second, I will propose some implications for both the theory and design of temporal technologies and systems aimed at supporting people in managing their own changes.

2 BACKGROUND

2.1 Time and HCI

Time in HCI has been traditionally framed within the “clock perspective” (Rapp et al., 2022), which is also the dominant narrative of time in Western civilization (Bardon, 2020). The clock is a mechanical instrument which enables the recording of the exact quantity of time, making it measurable, objective, uniform, “absolute,” and predictable (Starkey, 1989). The objective conception dates back to Aristotle, which distinguished time from the phenomenon of change: while change is real, time “*is the number of change with respect to before and after.*” In other words, time is a measure of change that, albeit existing only in the sense that it is a unit system that we use to count, is something objective, because it passes equally for everything everywhere, capturing a real aspect of nature (Bardon, 2020). Newton (1687) gave further substance to this notion of time, conceptualizing it as an absolute dimension that contains objects and events, a sort of “thing” that has its own reality and stability. Despite the Einsteinian reconceptualization of time in a more malleable dimension that is relative to one’s frame of reference, the idea of time as objective and absolute dominated the Western “common sense” about time until recent years (McGrath, 1988).

According to this dominant perspective of time, HCI research has originally viewed time as the time of the clock, being time conceived either within a functional frame (Hildebrandt et al., 2004), focusing for instance on system and user response times (Dabrowski et al., 2011), or as a descriptive feature of interaction (Card et al., 1980). More specifically, the HCI community has commonly designed time-centered systems and interfaces to support work-related activities, optimizing efficiency and

productivity: this often resulted not only into the strengthening of the taken-for-granted conceptualization of time as an “objective entity,” but also into encompassing the Western idea of universal acceleration (Pschetz & Bastian, 2018).

However, the mainstream conception of time, which sees time as objective and absolute, has been soon counteracted by the idea of time as “relative” to the practices that people perform in their everydayness. Lindley (2015), for instance, emphasized that time is produced within certain social practices and technology might play a role in shaping those practices that are bound up with the experience of time.

In this vein, HCI research investigated a variety of *time-related practices*, and, in so doing, they progressively attempted to go beyond the clock time. A first line of research that shows how HCI transitioned from an objective perspective on time to a more multifaceted conception refers to the *time management practices* (e.g., Whittaker & Schwarz, 1995, 1999; Bellotti et al., 2004). Traditionally, this kind of research has looked into developing technologies to improve efficiency of time usage, allowing for collective management of time and collaborative scheduling of tasks, through systems like Groupware (Palen, 1999) and Ambush (Mynatt & Tullio, 2001). This search for the optimization in coordination systems, however, was not exempt from undesired side effects, as it could neglect the idiosyncratic needs of people interacting with these systems (Uhde et al., 2020), as well as the natural time, that is the patterns and rhythms created by human physiological processes (Janböcke et al., 2020). Leshed and Sengers (2011), for instance, examined the relationship between experiences of busyness in everyday life and the use of productivity tools, including planners and calendars, finding that people lack freedom in controlling their own schedules, seeing being busy an important part of their identities and establishing this in the ways they use their productivity tools. To go beyond this conception of time, HCI researchers developed a variety of alternative designs. Albeit still encouraging time optimization, for instance, Kairoscope (Martin & Holtzman, 2011), removes our reliance on a fixed time system, automatically adapting people’s schedules as situations change. Janböcke et al. (2020), instead, presented a calendar application, which uses chronobiological knowledge to support people’s planning activities. The calendar encourages users to think more about their bodies and to appropriate times for particular activities, supporting them in negotiating external demands and personal wellbeing. Likewise,

HAZE (Bowler et al., 2022) is a speculative design in the form of a digital calendar that allows events to be added based on an uncertain time, date, and location, making respective uncertainties visible to peers so that they can be negotiated. A qualitative study using HAZE as a probe revealed that people often cover up their experiences of uncertainty, their concerns regarding clock time and potential moral judgments associated with living with uncertainty; by contrast, their idiosyncratic needs, like those coming from their health condition, may require to dismiss certainty in the scheduling of their everyday activities.

A closely related strand of research refers, more in general, to time-related *organizational practices*. Technology research on organizational time has approached time predominantly referring to the homogeneous time of the machine (O’Riordan et al., 2013; O’Connor et al., 2017). This kind of research mainly considered how Information Technology artifacts reconfigure the time boundaries of team work within organizations, which may be scattered across time and space, influencing specific temporal variables (Shen et al., 2015), like the rhythms of technology development projects (Sarker & Sahay, 2004). More recently, alternative perspectives to machine time in organizational practices have been adopted by HCI researchers, who looked at time as socially constructed. In this sense, studies on the routinization of temporal rhythms in organizations have investigated the social nature of time (Jackson et al., 2011) and explored alternative temporal logics to the socially legitimated assumptions embedded in a given society (Mazmanian et al., 2015). Rapp (2022), for instance, studied how time is produced within game organizations in massively multiplayer online role-playing games: the complex interaction between the design features of the game and the norms, routines and expectations that are part of the players’ in-game organizational life produces a variety of temporalities that deeply engage players in the game time, providing a temporal escape from the real-life time. Jagannath et al. (2019), instead, highlighted how the temporal rhythms of time-critical medical work, like medical resuscitation, are shaped by the organizational work of nurse documenters within the medical team, which in turn is affected by the “tools” used during the work (like paper and pen and electronic flowsheet).

Time-related *cultural practices*, instead, have been studied by HCI researchers who aim to capture cultural differences that impact on people’s behavior in dealing with everyday time, highlighting the power effects that are encompassed by the Western temporal logics. Research on technologies for the

workplace in Kenya, for instance, shows that Internet technologies promoting “access anytime and anywhere” embed a variety of cultural biases, perpetuating power asymmetries that may negatively impact on local rhythms (Wyche et al., 2010). Likewise, it has been highlighted that digital technologies which encourage values of planning may not be suitable for cultures that do not hold these values (Taylor et al., 2017). In this perspective, Pschetz and Bastian (2018) emphasized that time works to support systems of inclusion and exclusion, representing a form of social power. Therefore, they proposed the idea of Temporal Design, an approach to time in design that shifts toward a pluralist perspective on time, aiming to empower “*alternative temporalities that are neglected by the dominant narratives*” (p. 174).

As we may see, all this research progressively attempted to go beyond the Western clock conception of time proposing a more multifaceted perspective that sees time as relative to the social and cultural practices in which people are entangled. Despite the attention given to people’s temporal needs by some of the aforementioned studies, however, in this kind of research there is almost no room for the exploration of the time of our everyday existence, being its focus mostly on the collective modalities of the “production of time.” Nonetheless, the HCI community also emphasized that time may be related to those practices that are tied to the individual’s private and intimate life, which may be clouded by the clock time. Two of these practices, which have been extensively investigated by HCI research so far, are the reflective practices and the remembering practices.

As for the *reflective practices*, the HCI community has found in time an essential means for promoting reflection and (self- or time-) awareness. The idea behind most of this research is that constant time acceleration characterizing the Western societies and technologies has undermined the individual’s opportunities for reflection, and an alternative perspective on time may reestablish a reflective attitude in people’s personal life. The slow technology movement (Hallnäs & Redström, 2001), for instance, which has enjoyed great success in HCI (Odom et al., 2012), sees slowness as a prerequisite for reflection and proposes technological artifacts that slow down the users’ experience of time (Loup et al., 2017). Olly, for instance, is a music player that randomly selects several songs belonging to the user’s digital archive each week. It has a pacing that cannot be modulated and invites the user to reflect on the abundance of her digital possessions (Odom et al., 2018). Differently from

systems where (objective) time is simply displayed, in the form of e.g., timelines (Di Bartolomeo et al., 2020), such slow designs allow users to experiment slower temporal experiences. Despite the predominance of “slow artifacts” in research on time-related reflective practices, a few designs also attempted to act upon the “presence” of time. Harrison and Cecchinato (2015), for instance, built on the Ancient Greeks’ distinction between Chronos and Kairos, the former referring to the chronological sequence of time, while the latter relating to the qualitative experience of being in an opportune moment, to propose a wearable device that vibrates every five minutes, which may self-enhance people’s awareness of time through peripheral tactile interactions.

As for the *remembering practices*, instead, HCI has traditionally looked at individuals’ memory as a repository of objective memories that can be effectively retrieved thanks to the capabilities of digital technologies, promoting a sort of “total recall” through, e.g., lifelogging devices (van den Hoven et al., 2012; Sellen & Whittaker, 2010). Nonetheless, soon HCI researchers have started looking at the conditions of reminiscing as well, considering the multiple ways in which people remember and the malleability of the individuals’ memories. For instance, it has been highlighted that individuals constantly reconstruct their memories depending on their present state (van den Hoven & Eggen, 2008). Moreover, it has been noticed that remembering practices are relative to the material surroundings and that people commonly use a variety of mementos to remember their past (Uhde & Hassenzahl, 2022). In this vein, HCI research put effort in designing physical or digital mementos that may encourage the natural process of reminiscence (e.g., Petrelli et al., 2008). For example, Petrelli & Whittaker (2010) conducted a field study to compare physical and digital mementos in the home, finding that digital mementos are perceived as less valuable, being somewhat limited in function and expression, and concluding that they should be more accessible and integrated into people’s everyday life. Likewise, family rituals may provide the conditions for creating chains of memories of the past, anticipations of the future, and a sense of the present, intersecting with the lives of others to whom people are connected and to important person’s past life events (Petrelli & Light, 2014). Alternatively, HCI researchers have developed devices that elicit personal (van Gennip et al., 2015; Elsdén et al., 2016), family (Petrelli & Whittaker, 2010), and social (Jones & Ackerman, 2018) memories by prompting different types of “cues” (e.g., van Gennip et al., 2015) or by selecting specific past experiences from the user’s digital

possessions (e.g., Chen et al., 2019). Pensieve (Peesapati et al., 2010) and MUSE (Hangal et al., 2011), for example, are two systems that send by email memory triggers in the form of photos and text, either retrieved from external collections (Pensieve) or from the user's personal archives (MUSE), in order to elicit natural ways of reminiscing. Likewise, Chronoscope enables the user to explore a wide range of connections from different points in the past that are captured in her personal photo archives, allowing her to move backward and forward in time within a specific timeframe mode (Chen et al., 2019).

To summarize, all the research I reviewed in this section proposes interesting perspectives and designs for going beyond the objective and absolute conception of time that has traditionally informed HCI system design. However, on a closer look, this kind of research does not pay much attention to time as connected with the existential issues that we all encounter in the course of life. On the one hand, research on social, organizational and cultural time-related practices overlook the “subjective” time stemming from existential accounts of time; on the other hand, despite a few insights about how people subjectively remember their own past coming from studies on remembering and rituals (e.g., Petrelli & Light, 2014), research on personal time-related practices often focuses on pragmatic (e.g., how can I better remember a memory?) rather than existential issues (Kaptelinin, 2018). This apparent lack of a thorough understanding of existential time within HCI is particularly relevant because existential time, which is the time we experience as existential matter, is the primary way through which we experience temporality in our life.

To possibly find insights on existential time, therefore, we may have to look at HCI research dealing with important existential matters, like dying and life transitioning. In particular, life changes may be emblematic to study time from an existential point of view. They are phenomena that characterize every human existence and are intrinsically temporal. Moreover, we may say that the time of existence becomes “visible” primarily when we experience important changes in our life (Schutz, 1970; McAdams, 2001).

2.2 Existence, change and HCI

Existential matters have been mainly tackled by HCI research with reference to mortality and death, as well as to people who have experienced major transitions in their lives (Kaptelinin, 2018). The HCI community has addressed the experience of dying especially with reference to bereavement and legacy, highlighting how technology may help us remember the dead, e.g., through social networking, and may allow us to shape how we want to be remembered (Massimi et al., 2011). On the one hand, the intrinsic finitude to which points the inevitability of death implicitly refers to the time of our existence, which progresses towards an end that cannot be avoided. On the other hand, legacy represents the possibility of passing something on to the next generation (Hunter & Rowles, 2005), thus being intrinsically oriented towards a future lived as an existential concern. Despite this underlying connection of legacy and dying with existential time, however, HCI research has rarely investigated the nature of the temporality of death, rather preferring to focus on pragmatic issues, such as digital heirloom management (Kaptelinin, 2016). In this sense, a variety of studies have been conducted to understand, for instance, how people deal with digital remains (Brubaker et al., 2018), how passing down digital objects had been integrated into traditional practices regarding the transmission of physical objects (Gullotta et al., 2013), and how people manage their self-presentation online in order to shape how they will be remembered (Gullotta et al., 2014). In this sense, the existential time that may be revealed by the experience of dying has passed substantially unnoticed within HCI. An exception is represented by Sas et al.'s (2016) work who highlighted that the time of rituals of letting go enacted by people after the loss of a significant other consists of a distinct beginning, middle, and end, and is usually perceived as passing too quickly, so there is an explicit effort to slow down time. Despite this interesting finding concerning the time of a particular dramatic event in individuals' existence, HCI literature about legacy and death did not provide any detailed and thorough account of the nature of existential time.

Another strand of research that could be potentially useful to understand existential time might then be found in HCI literature on life changes. Life changes may be even more emblematic than the experiences of death in revealing the nature of existential time, as they are intrinsically temporal and pervade our entire life. The connection between time and change dates back to the philosophy of

Ancient Greece, when Heraclitus, one of the greatest early philosophers of nature, claimed that our experience and the world itself undergoes a constant change. For Heraclitus, change and time somehow overlap, constituting the very essence of the world. Later on, as we have seen, Aristotle distinguished time from change, paving the way for the idea of time as an objective and absolute phenomenon (Bardon, 2020). However, when we look at the changes that characterize our life, they appear inextricably intertwined with a time that is not objective. Life changes are characterized by the time experienced in our consciousness, which is fundamentally subjective and connected with relevant existential concerns (Rapp et al., 2019). This kind of time, however, has been rarely explored within HCI dealing with life transformations.

In fact, HCI work on life transitions has investigated how technology is used to deal with the effects resulting from changes like separations, (e.g., Herron et al., 2017), illnesses (e.g., Liu et al., 2015), and relocations (Lindley & Wallace, 2015). For instance, Sas & Whittaker (2013) report on interviews with 24 people about their possessions after a romantic breakup, highlighting that digital possessions are often evocative and upsetting in this context, leading to a variety of disposal strategies. Likewise, Herron et al. (2017) explored the break-up stories of 13 individuals in order to support people in decoupling and disentangling digitally in the wake of a breakup. They discovered that digital possessions may make people reflect on and reminisce episodes of their past relationships and that such possessions may be seen as negative so to require complete deletion. Lindley & Wallace (2015), instead, explored elderly's transition of moving to a new home and reported insights on how technology might be used to support "placing in age." In certain cases, like moving into a care home, relocation is framed by some form of crisis, so that it is needed to support continuity through change, for instance by designing technologies that may allow the continuity of the person's interests despite the loss of her possessions. In the same vein, Shklovski et al. (2008) showed that emails and phone calls may help people keep social relationships after a relocation, while social networking sites and texting can help children maintain vital connections during periods of forced hospitalization (Liu et al., 2015). Often, however, current technology may reveal its own inadequacy in supporting individuals in adapting to and make sense of the changes they are experiencing: for instance, they may be inattentive to the level

of details or the care that people require after an important life change, being unable to understand their specific needs (Cherubini et al., 2020).

This kind of research is certainly interesting for understanding how people use technology during and after a major transformation in their life. Some of the studies described above also report on the people's subjective experiences of the changes they lived and offer a few insights on the role that memories elicited by digital possessions may have in helping people reflect on a dramatic event (Herron et al., 2017; Sas & Whittaker, 2013). These studies, however, do not investigate in depth the characteristics of the existential time of change. In fact, most research on life changes prefers to focus on the *effects* that changes produced on people's life, rather than on the *temporality* of such changes. In other words, while we may have detailed accounts of how people react to and manage the consequences of changes, *the nature and the features of the existential time* that is experienced during a change remain substantially unexplored in HCI. For instance, we know little about how the specific features of change time (e.g., its velocity and direction) are subjectively experienced, and whether they have an impact on the process and outcome of the change itself.

A partial exception is represented by Rapp et al.'s work (2019), who explored how individuals live, account for, and manage a variety of life changes, pointing out that change might be internalistic, multiple, intentional, holistic, and continuous. This study has been conducted in the context of behavior change technology research, which traditionally conceives time as a discrete and objective event, being behavior change researchers mainly interested in the occurring of the desired change in behavior and in how much clock time is needed for reaching this goal (Agapie et al., 2016; Lee et al., 2017; Suh & Hsieh, 2016). Conversely, Rapp et al. suggested that the time of changes is always subjectively lived. This work is certainly inspiring for the present research as it opened opportunities for further investigating the temporality of life changes. However, it did not analyze the different temporal characteristics of the changes that people may experience during their life, which instead may have a considerable impact on the changes themselves. Building on top of this work, in this article I want to explore the temporal features of daily life changes, asking people to report their temporal experiences when they lived an important life transformation.

In so doing, I will adopt a phenomenological approach, which investigates phenomena as they appear in our “life world”, namely the world of our ordinary experience (Fallman, 2003). Phenomenology has been widely used within HCI (Rapp & Tirassa, 2017; Svanæs & Barkhuus, 2020; Kitson et al., 2018; Homewood & Vallgård, 2020; Ehn, 1988; Dourish, 2011). It values people’s experiences and the meanings that they actively construct (Rapp & Tirassa, 2017) adopting the subjective point of view through which we “naturally” live and make sense of the world (Heidegger, 1982; Husserl, 1962). Phenomenology conceives the subject and her experience as fundamentally temporal (Zahavi, 2012) and may provide a useful framework for understanding time as an existential concern.

Valuing the individuals’ lived experience of “change time” may let emerge insights that can contribute to HCI research on both life changes, by focusing them more on changes’ temporal features than on their effects, and time, by widening the design space of temporal technologies and enriching the conceptualization of time in HCI. This means to give an answer to a question like: How is the time that people experience during major changes in their lives configured and how does it impact on the process of change? To answer this question, I asked 16 participants to recount the changes that they considered important from their own perspective, particularly focusing on their temporal aspects. A free exploration of different kinds of changes and their related temporal experiences may let emerge patterns across idiosyncratic transformations, widening the opportunities for generalization and thus the possibilities of applying the collected insights to the design of novel temporal technologies.

3 METHOD

3.1 Participants

I recruited 16 participants (females=8) through emails and snowball sampling. All participants were Italian. I split the participants into four groups depending on their age: age appears the most relevant factor for investigating dynamics of everyday life change (Rapp et al., 2019) because people both self-change and experience different changes as they age (Labouvie-Vief et al., 1995), due in part to the fact that certain life transformations, like the transition from school to work and retirement, may occur at certain ages but not at others.

I did not recruit children, as it appears that they still do not have the cognitive resources to reflect on their identity and, consequently, on the changes they experience in their life (Breger, 1974). Adolescents were also excluded: despite they experience relevant changes especially in their identity (Erikson, 1963), I wanted to involve individuals that had sufficient “time” to live a variety of normative (i.e., like moving out of the parental home) and nonnormative (like the loss of a beloved person) life events (Wrosch & Freund, 2001) as well as to reflect on them. It is only in the early adulthood that most people start experiencing contradictions in their selves and live changes in their social networks (Wrzus et al., 2013), personal values (Vecchione et al., 2016), lifestyle, and self-narratives (McAdams, 2001).

The final sample consists of 4 young adults (age between 18 and 29), 5 adults (age between 30 and 49), 5 middle-aged adults (age between 50 and 65), and 2 older adults (age between 66 and 75). I balanced the sample with reference to gender, profession, education and technology use. Four had a high school diploma, three a bachelor’s degree, five a master’s degree, and four a Ph.D. Professions include university professor, doctor, telecommunication worker, office employee, musician, psychologist, Ph.D. and university students, post-doc researcher, self-employed, unemployed, retirees, data analyst, shop owner, and worker in the public sector. All the participants had a smartphone, but only 12 of them consistently used online services and tools (and only three had a technical background). Socio-demographic information was collected during a preliminary phone interview. The determination of the sample size was based on the principle of theoretical saturation (Glaser & Strauss, 1967). I decided to stop interviewing when I became aware that additional data would not have brought significant new insights for the aim of the study (Bowen, 2008).

3.2 Procedure

The interviews lasted between 90 and 110 minutes. Eight interviews were conducted in person, while eight were conducted through Skype, also due to the restrictions imposed by the COVID-19 pandemic. The main goal of the study was to gain insights on how people experience and make sense of the time of the changes they consider relevant, in order to make emerge a preliminary understanding of how people perceive and account for the temporal features of change.

The interview started in a very open-ended way, by asking participants to describe “the changes that they consider important”. This open-ended approach entailed long narratives as participants recounted relevant changes during the interview. This is similar to approaches by Elsdén et al. (2016), who asked people to recount “what their data is about” in the field of personal informatics. In the second part of the interview, I asked participants to focus on the temporal aspects of the changes they had mentioned during the first part, i.e., how they perceived, “lived,” and understood the time of these changes, in terms e.g., of duration, rhythms, and frequency.

Interviews were audio recorded and then transcribed verbatim. Participants were not compensated for their participation.

3.3 Data analysis

The data were analyzed with an Interpretive Phenomenological Analysis (IPA) approach (Smith et al., 2009). This method values individual idiosyncrasies and fits well the purpose of understanding people’s sense making, exploring each participant’s perceptions of what is important in relation to the phenomenon under study. Although the analysis focused on each participant’s personal recount, it yielded a set of thematic codes, identifying patterns across the life changes reported by the participants.

Initially, I read and analyzed the transcriptions defining open codes, by identifying data features that I considered relevant, breaking the data down into separate parts and labeling them. At this stage, I was searching for the elements that could explain the nature and the experience of the temporality of change. Then, I developed axial codes by grouping the open codes into key categories reflecting the main features of the temporality of changes highlighted by the participants (e.g., “Progress,” “Involution”). The conduction of the interviews and their analysis have been an ongoing process: interviews of the participants were conducted at different times, so that the latter interviewees were also used to assess the reliability of the preliminary interpretations developed during the first phases of the analysis, following a “participant researchers” strategy (LeCompte & Goetz, 1982; McDonald et al., 2019).

In total, I identified 78 open codes and 12 axial codes. The three themes that I will recount in the following articulate the three main characteristics of the temporalities of changes as perceived by the participants and represent the selective codes that I defined.

4 FINDINGS

Participants reported a variety of changes, spanning from relocations, ageing, and end of relationships to illnesses, job changes, and transformations in personality. I did not find significant differences in how participants belonging to different age groups experienced the temporality of the changes they recounted. Obviously, participants at a later stage of their life reported different changes with reference to the younger participants (e.g., their retirement, which clearly could not be experienced by a young adult). In fact, the possibility of addressing diverse changes was the major motive for differentiating the sample depending on age: this strategy, indeed, has resulted in covering a variety of changes that would not have been possible to address by involving individuals belonging only to a specific age cohort. However, differences in the temporality of the changes reported by the participants did not show specific trends that could be retraced to their age. Rather, the temporal features of “change” depend on how a specific change is experienced, but such experiences can find similarities across different age groups, or differences within the same age group: for instance, a similar experience of “slowness” has been reported by an older participant (U16) with reference to becoming lazy over time, and by a younger participant (U2) with reference to her personality.

This said, the participants confirmed the general features of the temporality of change found by Rapp et al. (2019), namely that changes are continuous rather than episodic and that the experience of “change time” is subjective. In other words, the participants stressed that the time of change has sense only with reference to the subjective experience, i.e., how they lived the change and its related temporality.

However, the participants also highlighted a variety of temporal features that were not explored by previous work: these features appear to have a profound impact on the process of change itself, affecting how they understood and reacted to changes. In the following, I will focus on three characteristics of the temporality of changes that participants considered important in influencing how they lived, made sense of, and managed relevant changes occurred in their life: the temporal velocity, the temporal direction, and the temporal synchronicity.

4.1 Temporal velocity: Changing fast and slow

In the participants' perspective, the temporality of change is primarily a process that may unfold at different velocities: from very slow processes, as it happens in changes in personality or in the person's body due to the effects of ageing, to fast-paced transformations, as it happens with relocations into another country or with the end of a relationship. Extremely slow and fast changes were found particularly interesting by the participants: in fact, their velocity appeared to affect prominently their ability to make sense of and manage a change.

It is worth to notice that the "slowness" and the "fastness" of the changes reported by the participants have been mostly determined by them in relation to a variety of other changes occurred in their life. Often, they compared a specific change with other changes, highlighting how the target change was much slower or quicker than those they were used to live in their everydayness. The speediness and slowness of the reported changes, therefore, were not seen as "absolute," but relative to the other changes experienced by them so far, thus being substantially subjective.

Slow changes may unfold over several months or even years, often consisting of small transformations that day after day sum up in bigger, more evident changes. Their slowness and gradualness may cover the effects that they produce, so that individuals may be unaware that they are occurring. Slow changes mostly do not have precise beginnings or endings, and their blurred boundaries contribute to make them invisible. By being "silent" and difficult to detect, slow changes are also difficult to manage and are often "passively" lived. U16, for instance, highlights that when he retired, he gradually became more lazy and "slow." This long-term transformation in his personality and behavior, however, is recounted as an inexorable course over which he had no control and of which he became aware only in a subsequent period: *"I became very lazy, longer times to realize, to do things, dilation of time, what I used to do in an hour, now it takes me a day. It was a slow slow slow transformation. It didn't begin immediately, I don't know when, because when you retire you do more or less the same things as before, you only have more spare time [...] It was almost imperceptible, I was not aware of this process until I realized that before was so different and I started comparing what I did before to now, 'I used to do this, now I do this'."*

It is only when people occasionally think of or analyze what they were in the past that these changes might become suddenly visible and their slow temporality can appear in the consciousness. The trigger may be a past representation of the person, like a memento or a picture, a conversation with a friend, or a cue that elicits a process of reminiscence: the past is then compared to the present and what was subtly concealed by the everydayness and perceived as stability becomes material for reflection and reveals itself in its mutability. In this perspective, technology may play a role. U2, for instance, recounts that only when she looks at past pictures of herself on her smartphone, as well as at the chat logs with her friends, she becomes aware of how different she was years ago and how much she has changed: *“When I look at the pictures of me, I see that I’m not that person anymore. You become aware that you changed [...] It’s an aid, because otherwise you cannot see what happened. It is the same thing for the chat logs. They allow me to understand how the relationships were at the beginning and how they evolved over time [...] I see how I was in the chat and I realize how much I was contrived, I become aware of this because I do not recognize myself, from this point of view it’s a support because I say ‘this has really changed’.”*

The awareness may trigger experiences of nostalgia but may also allow individuals to achieve the conscious acceptance of the occurred change or to gain a partial control over it and its temporality. In recounting the path that led him to join the academia as a professor, U6 stresses that during the first years of his career he thought that he was not changing at all. He perceived himself as static, whereby *“I thought that I was not progressing at all, I am talking about my academic skills, my ability of writing a paper, or making a presentation. I was doing a lot of things, but in my eyes I was at the very same point.”* In a later time, however, he recognized that what he was living was an extremely slow process of change consisting of small, but continuous progresses: when he became able to “see” the temporality of the change, which was previously hidden, he also became capable of acting upon it. *“This somehow changed how I was doing the work. I started pursuing more actively the improvement of the skills that I was lacking, studying certain aspects of English language for instance, and I got better in seeing my improvements. I saw the time that these changes required, it was very long but not infinite, and this made me more open to see opportunities for accelerating the change,”* says U6.

Fast changes, instead, may be marked by an identifiable beginning, an event that kicks off the change. This event may be “external,” as it happens in the case of a loss (e.g., U3), or “internal,” whereby it is the person that decides to initiate the change (e.g., U14); moreover, it may be expected, like the starting of a new job (e.g., U9), or completely unexpected, like the beginning of the COVID-19 pandemic (e.g., U10). Nonetheless, in all these cases, the participants highlight that the event is only a starting point of a transformation that unfolds over time.

In fact, these changes are characterized by an acceleration of the perceived time, which often turns into experiences of anxiety and worry, also due to the individual’s believed incapability of keeping up the speediness of change. U4, for example, recounts the period when she started going to high school “*Suddenly I became independent [...] I began to go to school by myself, I began to manage my day. [...] In the first phase of the change, the experience was negative because I was afraid, I had a sense of inadequacy.*” Sometimes, the temporal velocity of change produces instead similar effects to the temporal slowness, by occluding the person’s understanding of what is happening, leaving her at the mercy of change. Several participants specified that in the initial phases of a fast change they had to react so quickly to its fast pace that they lost the awareness of the change itself. U5, for example, by recollecting the loss of his father, explains that “*Suddenly everything changes [...]. When it happens, you are bewildered, there are many practicalities that you have to deal with, everyone is worried about you, sends her condolences, and you are completely mixed up... you’re not aware of what is happening, of what is really changed... It happens only afterwards when you realize that the change has occurred.*”

Nonetheless, most participants specify that, as time went by, the temporality of these fast changes changed itself. In some cases, participants get use to the temporality of change, which decelerates reaching a sort of stability. U3, for example, highlights that the changes induced by the COVID-19 pandemic abruptly transformed her entire way of living, also given the strict lockdown that was enforced in the country. After a while, however, she adapted to these sudden transformations, even too much, as they became crystallized in new, extremely static, routines. In other cases, participants are able to actively “tame the speed of change,” by reflecting on the speediness of the change itself and consequently deciding to slow down or even stop for a while. U7, for instance, recounts that when he had to move abroad, he initially swamped with the necessity of adapting its old routines to a new way

of life, but after a while he decided to slow down: *“When I moved to UK, I lived in a household with other people, which was a completely new situation for me. I had to quickly adapt to new routines and schedules. It was a big and sudden change in my life, but after a couple of weeks I decided to take my own rhythms and ignore the “pressure” coming from the outside... I mean, there were, for example, a lot of invitations for going out at night, having dinner at restaurants, which was not part of my habits, so I decided to refuse most of them and select those changes that I wanted to follow and those that I wanted to slow down.”* When fast changes are expected (e.g., moving abroad), technology may provide support, by allowing people to find information about how the situation will likely evolve: this somehow prepares individuals for the change ahead, allowing them to decelerate the perceived temporality of changes when they will occur. U7, for instance, recounted that when he had to move to UK, searching on Internet photographs of and information about the city where he would be living somehow slowed down the changes when he was there, as he felt to have the ability to anticipate and drive them more promptly.

In sum, the slowness and the speediness of change may affect how people make sense of and manage the change itself: they may conceal the change and thus hinder people’s self-reflection and their possibilities of exerting agency over the change. However, participants reported that when they “saw” the temporal velocity of change, they were able to reflect on and act upon it, by accelerating extremely slow processes, or decelerating very fast ones.

Moreover, from the participants’ recount we may notice that the experience of the velocity of change has a sort of dual nature, which refers, on the one side, to the experience of change lived when the change is occurring, and, on the other side, to the reflection on the change, which may be enacted in a later moment. In fact, some of the participants who experienced a slow change, quickly realized the change at a certain time point (like U16, who became lazy over time but realized it suddenly); by contrast, several participants experiencing fast changes only slowly realized what was going on and its implications (like U5, who experienced the loss of his father). These two components of the subjective experience points to the fact that the temporality of change may have different characteristics at the time when the change is occurring, and at the time when the person is reflecting on the change that is occurred (or is still occurring).

4.2 Temporal direction: Changing forward and backward

The “arrow of time” of the changes recounted by the participants does not point always forward. The participants highlighted that the temporalities of changes may be also directed backward. Moreover, there are configurations of time that exhibit a sort of back and forth oscillation or even no direction at all. Commonly, the direction of time is associated with positive or negative meanings by the participants depending on their appraisal, which, in turn, appears to influence their own ability to drive the direction of change.

Changes pointing forward may be seen as a progress toward “a better state,” thus being associated with a positive valence. In these cases, the temporal direction of change assumes the meaning of an improvement, e.g., in the working conditions, or a development, e.g., in the individual’s personality, or even an accumulation, in terms of e.g., life experiences. U1 explains that playing an instrument induced a change in his “self” toward a greater awareness and a more “complete personality,” while U6 describes his life, when he was a University student, as a continuous “*progress toward a greater knowledge, it was like I was developing my mental capabilities, and everything that I was studying was a sort of challenge, a step forward, a means for changing my mind to face harder challenges in the future.*” In all these cases, perceiving the change as a progress made the participants more willing to assume a proactive role in its management. Changes of this kind, in fact, may be driven by objectives or projects set by the person, and the direction of their temporality may be seen as a path that, if traveled, will lead to the achievement of the pursued goal, as it happens in work life changes: U4 and U14, for example, purposefully worked hard and invested a lot of resources, either financial or personal, for changing their work condition and build a more solid, or different, career.

Nonetheless, changing forward may also be seen as a decay, a process directed toward a worse state, thus assuming a strong negative valence. When the temporal direction of change is conceived in these terms, the participants show a more passive attitude toward the change itself, as if it were an irreversible and inevitable process. U2, for instance, describes the chronic illness that she has been experiencing for more than two years as an irreversible decline of her own body. In her eyes, this process also connects

to ageing and the irremediable loss of youth, meant as a state of full health: “*you are not the person that you were before and you can never go back to being that person... or even to improve, going back in the sense of returning to a state of health, no it's impossible, you can only go in that direction.*” The participant also highlights how this transformation may proceed at different velocity depending on its own evolution and periods of acceleration may further increase anxiety and worries. By and large, reactions to changes whose direction is perceived in this way are commonly of acceptance or forbearance, as if the change were “a fate” that is pointless to fight.

Changes may also be directed backward, that is, toward a state tied to something “located” in the past. In a positive sense, this kind of directionality is a sort of back to basics, an opportunity for recovering something that had been lost. U8, for instance, recounts when he decided to move from Milan, a big city where he worked and lived with his family, to a small town on the shore of a lake, where he lived when he was child. In his eyes, this change was a “homecoming”, a way to go back in time offering to his children the same quality of life that he experienced when he was young. In this sense, going backward elicits a sense of satisfaction, a renewed appreciation of places, relationships, and even identities that were neglected for a long period of time.

However, when seen in negative terms, changing backward becomes an involution in the participants’ eyes, a regression to a previous stage of life, which may make them lose some of the gains that were achieved until that moment. For U2, for instance, returning in the same neighborhood where she lived during the childhood, next to her mother’s house, has meant something completely different from the return to a golden age recounted by U8: “*I lived it as a going back, but pejorative, in relation to my identity, it questioned a lot of things... ok, I came back here, physically, then does it mean that I’ve never grown up? Does it mean that I’ve never been able to disidentify from my mother? Will I have the same problems as before? [...] So, I ask myself whether this will hinder my positive change, my possibility of growing up.*” In the participants’ eyes, perceiving the change as a step back induces states of doubt, delusion, or disappointment toward oneself, and may elicit the idea of not being able to take the reins of change: this may ultimately undermine the individual’s actual capabilities of becoming an agent of her own change and to reverse its directionality, as U9 suggests.

Finally, the directionality of change may assume either an oscillatory or a random movement, which may ultimately hinder the opportunities for completing the process of change. Temporal oscillation may be clearly seen in behavioral and relationship changes: U11, for example, recounts his attempts of quitting smoking and his constant relapses, which eventually led him to acknowledge “the impossibility of changing permanently.” Here, the temporality of change continuously moves back and forth, inducing a sense of stasis that may undermine the individual’s self-confidence in carrying out the process, rather making her remain at its mercy. Participants emphasize that these “oscillations” sometimes are produced by technology, which may prompt cues from the past encouraging the person to take a step backward, even in changes that initially were firmly directed forward. U7, for example, points out that technology often rowed against the relationship changes that he was trying to accomplish: *“Seeing pictures on Instagram or Facebook, or reading the chats with my past girlfriends often took my mind back to those periods and that conflicted with my desire to end those relationships... and it was also often a problem at the beginning of a new relationship... it was like constantly going back to a previous period of my life making me feel unable to move forward.”*

This sense of stasis is yielded also by changes that are perceived to have no precise directionality: participants describe this kind of change as a product of chance and their temporality neither as a progress or as a regress, rather a random movement that points to nowhere. U16, for example, describes the main changes of his life (e.g., relocations, work changes, relationship changes, internal changes) as *“there was no progress at all, it was random, completely random, the chance, purely the chance, due to circumstances beyond my control, that led me to think one way rather than another, but due to chance [...], there was no direction, I went a little here a little there depending on what happened around me [...] It is not a proactive perspective, I may say that it is reactive, a reaction to the changes that happened by chance.”* When the temporality of change is conceptualized in these terms, participants show to react against rather than act upon a change, or to passively accept its process and outcomes.

In sum, it appears that how the temporal direction of change was perceived impacted on the attitude that participants had toward the change itself. When it was seen as progress or back to basics, the participants showed a proactive disposition toward the change, which encouraged them to reach the “end state” toward which the process was directed. By contrast, when the temporal direction of change

was seen as a decay, an involution, an oscillation or a random movement, the participants tended more to let themselves get carried away by the flow of change, interpreting it as an irreversible process on which they could not exert control, a failure that made them feel disappointed in themselves, a non-progress that jeopardized their capability of completing the change, or a product of chance, inducing a passive or reactive disposition. In all these cases, participants did not mention technology as a support, rather being seldom associated with effects going against the desired directionality of change.

4.3 Temporal synchronicity: Changing with and against others

Participants reported that, sometimes, the temporality of their changes could be connected with the temporality of other individuals' changes: some changes may be seen as occurring in synchrony, so that people may change together at the same velocity and toward the same direction. U4, for instance, recounts that when she decided to move in and start a new business with her partner, the changes in her life completely synchronized with those of her companion: not only their life changes pointed toward a common direction, but also their speed progressively adapted to each other. This synchronization strengthened both their relationship and the willingness of driving together the change.

Sharing the temporality of changes may also help to face transformations that are difficult to accept, as several participants highlighted. U13, for instance, reports that when his father died, he decided to give an acceleration to his whole life undertaking a variety of very quick changes. This also accelerated the temporality of his mothers' changes, who aligned to this velocity and speeded up the processing of grief, which resulted for her in the opportunity to begin a new life. Likewise, participants who changed their daily routines in sync with another person during the COVID-19 lockdown found a way to cope with the fear and the worries induced by this abrupt event by establishing a shared "new temporality" that made them feel less alone and bewildered in a world that was undergoing extremely rapid transformations.

Temporal synchronization, however, may occur even when people perceive that they are not changing despite the passage of time: in this case, it is stability that two or more individuals share, notwithstanding the other changes occurring in their lives. U12 and U6, for example, explain that

despite some “objective time” has passed and some transformations have taken place, the relationships with their strictest circle of friends remained substantially the same: *“There were some changes, but I did not perceive them as real changes, because our relationship did not change”* says U12, while U6 highlights that *“when my best friend had a daughter obviously our opportunities to see each other have changed. But we now try to find other moments for us, maybe we do not go out at night anymore, but we see at lunch or right after he finishes to work, the friendship did not change, I think that we are still the same when we see each other.”*

Sharing the time of change (or non-change), its velocity and direction, encourages participants to take control of the change, feeling part of a common journey where they can support each other, or makes them feel less alone, seeing that their changes (or non-changes) are shared with other individuals. Nevertheless, participants also report cases of misaligned changes, when they feel that they are changing at a certain velocity, or along a certain direction, whereas “others” are remaining stationary, or are changing at a different pace, or are pointing to a different aim.

Participants explained that the temporal desynchronization of changes may compromise a relationship, if it occurs between people who are strictly tied together, or may make the person feel lonely and out of place, even questioning the “legitimacy” of her own changes. U7, for instance, reminds a sentimental relationship that lasted more than 7 years explaining that *“Especially in the last two years of the relationship, I started working and I changed my interests, relationships, I was going out with new friends... and I started seeing my girlfriend as if she were anchored to a previous stage of our life, I was going one way while she was going another.”* U2 and U6 highlight that most of their friends recently underwent important transformations, getting married and having a child, so that they have begun to feel against the grain. *“Sometimes, it seems to me that I’m going upstream. I don’t know if this is right or wrong, I believe that this is right for me, but I feel a bit lonely, I mean, not only because almost all of my friend got married and had a child so now it is more difficult to see them, but also because I cannot share with any of them my way of living, what I’m doing, how I’m changing or how I plan to change in the future,”* says U6. Similarly, U16 recounts how he decided in the last few years to lock himself away in his own private world represented by his house and the antique objects that he has carefully collected over time, as a reaction against the changes happening “outside.” In this way, he

built a “straighter” temporality, more foreseeable and static, where to find a refuge, but, at the same time, where he found himself alone.

To summarize, changing synchronically with other people may strengthen the willingness to intentionally drive the change, as people may help each other and proceeds toward a common aim. It is also reassuring, as people feel less alone being aware that other persons are sharing their journey. By contrast, changing upstream may yield a sense of loneliness, even questioning the “rightness” of their own changes. With reference to this theme, participants did not mention technology as a means for supporting the synchronization (or desynchronization) of change.

5 DISCUSSION

The research question that drove this study was: How is the time that people experience during major changes in their lives configured and how does it impact on the process of change? The findings show that change time has different features which deeply affect how the participants perceive, make sense of, and manage the change they live.

Extremely slow changes risk going unnoticed, thus limiting the individual’s possibilities to act upon the change. Likewise, fast changes are likely to be followed mindlessly and engender temporal experiences that may be lived as anxious and worrisome. However, when participants are able to “see” the velocity of change, reflect upon it, or anticipate it, they can regain a certain degree of control over the change and its velocity, slowing down or even accelerating its flow.

The temporal direction of change also appears to influence people’s capabilities of taming the change. When its directionality is conceived as a progress or a back to basics, the participants see more opportunities to steer the change and may actively work for favoring the accomplishment of the transformative process. By contrast, when it is associated with negative meanings, the direction of change is perceived as either a decay or an involution, being lived as a “fate” that can only be accepted or endured. Similarly, perceiving the temporality of change as having oscillating or random directions may induce an experience of stasis or predispose the person to react against rather than proactively act upon the change.

Finally, connecting the temporality of change with that of changes lived by other individuals may strengthen the willingness to drive the process toward a certain direction, as people may feel less alone and can rely on the understanding of those that are sharing a similar transformation. Misaligned changes may instead jeopardize a relationship, or make the person feel lonely and out of place, even leading to question the rightness of the change.

A key contribution of this study, therefore, is to present rich descriptions of how people account for and experience “change time,” highlighting those temporal features that have an existential impact and may encourage or discourage individuals to manage and complete their life transformations. Obviously, the temporal features identified above may add or compensate their effects, so that extremely fast changes going backward and perceived as a decay may not only be seen as inexorable but also provoke more worrisome experiences, as highlighted e.g., by participants living health problems that worsened rapidly.

By and large, my study findings contribute, on the one hand, to HCI literature on time, by identifying several important characteristics of existential time, as it emerges from the experience of change. This kind of time has not received much attention in HCI (Rapp et al., 2022) and little we knew about its nature and characteristics. From this study, it emerges that this kind of time is completely subjective, so that the same temporal feature may be lived differently by different individuals. Moreover, it is heavily meaning-laden as people ascribe a variety of existential meanings to it. Finally, existential time is intrinsically inter-subjective, as it is open to others, despite its intimate and idiosyncratic nature. On the other hand, these findings contribute to HCI research on life changing events, emphasizing the importance of time when people have to reflect on and act upon change, an aspect that has been overlooked in previous HCI work on life transformations. While a few HCI studies emphasized the role that remembering and “past time” may play in dramatic life events (Sas & Whittaker, 2013; Herron et al., 2015), my study findings suggest novel ways through which the existential time of change may impact the change itself: this opens new opportunities for “designing” the specific features of change time, like its velocity, direction, and synchronicity, to help people manage the changes they experience.

This said, I will now unpack these contributions in the following, by pointing out more detailed insights on the implications of this study for HCI.

First, the study findings highlight the impact of the temporality of changes on the people's possibilities of reflection and agency upon the change itself. "Favorable" temporalities, e.g., having a velocity that can be "seen" by the individual and a direction that is positively appraised, as well as being sharable with others, may increase people's opportunities for making sense of the change and for proactively intervening on its course. By contrast, "unfavorable" temporalities, e.g., too fast or too slow, negatively appraised by the individual, and misaligned with the temporalities of significant others may hinder people's awareness of change or willingness to drive the change, making them passive or reactive actors who feel to follow a predetermined path. These findings contribute not only to the HCI literature on life changing events, but also on HCI research on *time-related reflective practices* which sees "time" as a prerequisite for reflection. This kind of research has mainly revolved around slow designs which promote reflection through artifacts that slow down people's perception of time. Traditionally, fast time promoted by contemporary society, and encouraged by fast technologies designed with efficiency in mind, is believed to hinder our opportunities for reflection (Hallnäs & Redström, 2001); while slow time, sustained by slow technologies, actively supports moments of reflection and mental rest (Odom et al., 2018; Odom et al., 2021). The findings recounted above, instead, suggest that it is the excess of both velocity and slowness that may undermine people's capabilities of reflection on changes; whereas it is the visibility of the velocity of time that encourages moments of reflection. In this sense, fast and slow times, rather than having absolute values, may both support reflection provided that they become visible. Moreover, my study findings point out that the reflection practices that people enact on the changes that they experience may occur at a later time and have their own temporality, so that a very slow change may be realized abruptly, while a fast change may be only slowly acknowledged. This may suggest that designs aiming at promoting reflection through time design may intervene not only during the event of change, but also when reflection occurs, by regulating the temporality of the reflective practices and "designing" how and when they should be enacted (e.g., by identifying the Kairos, the opportune moment for reflection).

Second, the "sociality" emerging from this study points to the fundamental "temporal openness" that characterizes our existence, emphasizing how individuals tend to compare to, synchronize with, or misalign from others' temporalities. This highlights that existential time, as it manifests itself in the

phenomenon of change, is often social, despite the apparently privateness of our existential concerns. This social nature of existential time relates to research on social memories (Petrelli & Whittaker, 2010; Jones & Ackerman, 2018), rituals (Uriu & Odom, 2016), and interpersonal synchronization (Rinott & Tractinsky, 2022), and widens opportunities for connecting the private time that we experience within our subjectivity to the time of the others: this may shift the focus of HCI research on “social time” from social structures and organizations (Pschetz & Bastian, 2018; Jackson et al., 2011), as well as cultural processes (Taylor et al., 2017; Chalot. et al., 2016), to the *intersubjectivity of time* as an existential matter.

Third, the fact that the existential time of change is completely subjective and meaning-laden, as it emerges from the study findings, entails that the temporality of the same kind of change may be experienced differently by different persons (or by the same person at different stages of her life), while the temporalities of different kinds of change may be similarly lived by the same person (or by different individuals). This leads to a variety of idiosyncratic temporal experiences, which, despite the communalities that I attempted to trace in the recounting of the study findings, remain quite unique. In this sense, designs that do not attempt to represent the diversity of temporal experiences risk being counterproductive rather than useful to the process of change (Bowler et al., 2022). Designers should then question their own assumptions about time, when it points to the time of our existence, and be open to ways to live and manage the temporality of the everyday life different from their owns.

Fourth, the study findings suggest that we go beyond a variety of simplistic oppositions that dominate much of the debate on time in HCI. For instance, since these findings point out that slow time and fast time are no “good” or “bad” per se, as it happens in slow technology rhetoric (Odom et al., 2022), temporal velocity becomes relative to the existential problems that people face in their everyday life: individuals may have the need to accelerate or decelerate time, or simply accept its velocity, depending on the specific life matters that they are facing. This opens new opportunities for designing for temporal slowness and speediness and reconfigures the opposition between slow time and fast time in a continuum grounded on people’s existence. Likewise, the meaning-laden nature of change time goes against the opposition between the objective and social nature of time, which informs much debate on the “origin” of time in HCI (Pschetz & Bastian, 2018). In the objective conceptualizations of time, time

is external to human practices and independent of the individuals' subjectivities: it is "given" by the objective characteristics of nature, so that it passes equally for everything everywhere (Bardon, 2020). By contrast, in the social and cultural approaches to time, time is built by communities, organizations, and societies, as we have noticed with reference to the HCI literature on the time-related organizational and cultural practices (e.g., Jagannath et al., 2019; Taylor et al., 2017). In both cases, however, it appears that the individual accepts a temporality that is already "made": on the one hand, the person cannot modify the objective time; on the other hand, she may contribute to the social construction of time as a collective endeavor, but as an individuality she has limited capabilities of acting upon time. In the existential time characterizing the phenomenon of change, instead, the person actively "shapes her own time," ascribing specific meanings to it: in this sense, apparently similar temporalities (e.g., directed forward) may be very different, because they are intertwined with different meanings. This process, however, is not solipsistic, as people are open to others' time and to intersubjectively constructing shared temporalities. In this sense, people "make time" (Lindley, 2015), rather than passively accepting the time already "made" by "nature" or by societies and communities. This opens new possibilities to conceptualize time in HCI, pointing to a "third way" that aligns with Bergson's (1913) seminal conceptualizations about the time of the consciousness, as well as with HCI studies on remembering practices that highlight the constructed nature of our past (van den Hoven & Eggen, 2008), without embracing a solipsistic perspective. In fact, it proposes a "malleable" notion of time, in which individuals can actively shape their own time with the help of the others and, possibly, with the support of technology.

I will now outline several design implications of this study. The study findings show that current technology plays a minor role in affecting the temporality of change. The participants mentioned technology only seldom, and in certain cases its use went against their intended goal (e.g., by preventing the change to move forward). This confirms HCI research emphasizing that current technologies are inattentive to the needs of people experiencing a change (Cherubini et al., 2020) and that they may even hinder the process of change (Herron et al., 2017; Sas & Whittaker, 2013). The following considerations could then provide insights on how to build better technologies for supporting people facing a life change.

6 IMPLICATIONS FOR DESIGN

6.1 Changing fast and slow: *Designing the velocity of time*

The study findings show that the time of changes can be invisible, and this may undermine people's possibilities of reflecting and acting upon the changes themselves. In particular, when changes are too slow or too fast the individual may be unable to "see" the change. "Seeing" or "feeling" the velocity of change time is thus important, in order to become aware of the change that is happening and consequently to open opportunities for intervening on the change itself. However, from the study findings, it also emerges that change time is not objective but subjective, so that it is not considered for the objective properties of the changes from which it originates, but for the kind of experience that it elicits. In this sense, what is important is the perceived velocity of changes rather than their intrinsic fastness: this opens opportunities for shaping such perceptions in order to help people better manage the change. Moreover, not only the "happening" of the change may be fast or slow, but also the act of reflecting upon it: people may realize suddenly a slow change, and possibly being bewildered by such an abrupt realization; or slowly become aware that a sudden change occurred, thus being unable to foresee "in time" the relevant consequences that the change will have.

These findings suggest that designers, on the one hand, could attempt to affect the subjective perception of the velocity of change time, instead of simply displaying its "objective" velocity; on the other hand, that they could design the timeliness and the velocity of the reflective process, carefully considering when and how fast it is useful to elicit moments of reflection.

A first step toward this goal is certainly represented by the need to identify the changes experienced by the person and make their velocity visible. This could be achieved by collecting a variety of personal data through automated instruments. As we have seen in the Background Section, HCI research on time-related remembering practices was traditionally inspired by lifelogging technologies, which continuously collect a variety of data about people's life, seeing the individual's past as a sort of repository of "objective memories" from which retrieve all the events occurred in her life (van den Hoven et al., 2012). Self-tracking and lifelogging devices (Rapp & Tirassa, 2017; Elsdén et al., 2016), therefore, could be certainly useful in helping people collect personal data that could then be used to

detect the changes occurring in their life. Systems could then identify those imperceptible transformations in the user's information to identify extremely slow changes (such as body changes, or ageing), or abrupt modifications in data trends to detect extremely fast changes. Users could then be made first aware of such transformations by designs that "materialize" the change time: for instance, designs embedded in the user's environment, like digital paintings, or digital mirrors that superimpose a digital layer on the user's reflected image, could constantly highlight the changes that the person is undergoing and their velocity.

Then, designers could start intervening on the subjective perception of the velocity of such changes. For instance, technology could allow the user to experiment different velocities of change: for example, they could use digital representations that simulate how changes may evolve at different paces. This could encourage the user to actively pursue the process of change, making visible how very small changes could produce bigger impacts in a more or less distant future. Moreover, as some of the study participants emphasized, understanding how changes will evolve in the future may prepare individuals for the change ahead, allowing them to better manage its temporality, especially if its velocity will increase or decrease as the change unfolds. Furthermore, very fast changes could be "slowed down" by making more evident the intermediate "stages" that led to the change, albeit they occurred in a very short time span. Alternatively, a system could anchor the user to her past for a while, showing the connection between the ongoing transformation with previous aspects of herself, so to decelerate the perceived velocity of the change that she is experiencing.

Finally, designs could also intervene on the when and how fast reflection on changes should be enacted. For instance, a fast realization of all the consequences of a sudden change could be counterproductive in certain cases, as the "blindness" to change could be a coping strategy that positively shields the person from an excessive amount of stress (e.g., in the case of the loss of a significant other). In this sense, speeding up the reflective process in order to make the person aware of the change that she is experiencing should be done only by taking into account the conditions in which the person is at that particular moment and by adjusting the reflection "cues" accordingly: for instance, designs should avoid making the change visible in the immediacy of the happening of the event, but

slowly elicit processes of self-reflection after a while, in a way that may be faster than the “natural” process of realization, but not so fast as to produce stress in the individual.

6.2 Changing forward and backward: *Designing the direction of time*

We have seen that the same temporal direction (e.g., a change directed forward) can be perceived either as positively or negatively, depending on the meanings that people ascribe to it. When the participants understood the direction of change in a positive way, as progress or back to basics, they felt to be the main actor of their process of change and were comfortable with the transformations that were occurring. By contrast, when they ascribed a negative meaning to the direction of change, seeing it as decay, oscillation, or random movement, they felt to be worthless and unable to drive the change itself.

For HCI, these findings entail the need to recognize the plurality of time experiences and their intrinsic intertwining with meaning. Moreover, they highlight the need to better consider how temporal experiences may impact on how people manage and live their existential matters. In this perspective, acting upon how the direction of time is appraised by the person may become a means for improving her wellbeing. In other words, design may not only favor reflection and sense-making *per se*, which may result even in rumination and sense of worthlessness when the direction of change is seen in negative terms, but elicit “positive” meanings, which may modify how the direction of time is experienced and lead the person to a greater wellbeing.

In this perspective, temporal technologies for change could enable people to “annotate the direction of their time” to better allow the expression of the plurality of the temporal experiences, as well as encourage processes of “positive” sense-making that may support people in seeing the direction of time in more favorable terms. While calendars and timelines have been traditionally conceived as objectifications of time by HCI research dealing with time management practices (Di Bartolomeo et al., 2020), new designs supporting life changes could prompt “malleable” representations of time that can be enriched by the user reporting her subjective experiences about the temporal direction of a given change. This is in line with those time management designs that favor the expression of the user’s idiosyncratic needs rather than her adaptation to an external and unique temporality (Janböcke et al.,

2020; Bowler et al., 2022). For instance, users could be invited to draw a picture of time periods when they experienced a change, even only in the form of a sketch, or by providing them with predefined shapes like arrows, circles, or spirals, representing “typical” temporal directions, which can be then adjusted by them. Then, the user could be encouraged to “tag” these shapes with the meanings that she considers more appropriate for that particular temporal shape. Automatically-generated questions on the basis of the tags provided could also be prompted regularly, in order to elicit further moments of sense-making (e.g., why do you see the time of this change as a circle? Does it seem to you that you cannot proceed? What could you do to change its direction?).

Moreover, these systems could attempt to revert the understanding of the temporal direction of a particular change, which may be associated with negative meanings and thus be seen as, e.g., an involution or decay. To this aim, designs could employ automatically-created stories using AI techniques (Hendrikx et al., 2013), displaying alternative “versions” of the user’s temporal experience of change. For example, a person that is thinking that her relocation is a step back in her “life story,” could be prompted with a narrative in which her alternate self sees this change as a progress, highlighting the consequences of this change of perspective: these stories could be developed on the basis of what the user has previously reported, as well as on the personal data that have been automatically collected by the devices and tools that she uses (wearables, calendars, etc.).

Alternatively, systems could prompt “counterexamples” retrieved from the user’s personal history that may disconfirm the meanings associated with the temporal direction of certain changes. For instance, if the person appraises her chronic illness as an unavoidable and uniform involution toward a worse state, the system could highlight those periods in which the situation improved, and what kind of behavior she enacted at those time. This could work toward changing the idea that the worsening is constant and relentless. Furthermore, designers could think of providing a sort of “false memories” overrepresenting or amplifying certain improvements. This clearly goes against the idea encompassed by several reminiscing technologies supporting the total recall of the “objective” memories of the individual (van den Hoven et al., 2012; Sellen & Whittaker, 2010), but is in line with approaches that see our memory as constructed (van den Hoven & Eggen, 2008), opening opportunities for designing for “benevolent deception” (Adar et al., 2013) in time-related remembering technologies. In this

perspective, false memories can be created if they can positively change the meanings ascribed to the temporal direction of a certain change and increase people's sense of agency upon the change itself and their overall wellbeing. Likewise, temporarily inhibiting certain memories (e.g., the past failures in changing a specific habit), as suggested by research on life changes promoting the idea of designing for forgetting (Sas & Whittaker, 2013), may modify the perception that the change is oscillating without a direction.

In this sense, the system may become a sort of temporal coach that attempts to steer the understanding of a certain change time, by actively selecting and shaping memories, or by proposing alternative meanings.

6.3 Changing with and against others: *Designing the synchronicity of time*

We have noticed that the existential time of life changes is fundamentally open to others, as people often compare the temporality of their own changes with those of others. Sharing the temporality of a change may make people feel less alone and more willing to drive the process of change.

Future designs could employ social matching systems, namely, systems that build user profiles, compute the matches, and then recommend people to one another (Terveen & McDonald, 2005), to allow people find similar others on the basis of the temporal experience of the change they are living. Instead of creating large communities for publicly sharing personal time experiences, systems could create cozy social environments aimed at encouraging mutual understanding, because network size is negatively associated with self-disclosure (Wang et al., 2016). Ren et al. (2012) suggested that familiarity and friendliness between individuals may be increased, for example, by providing personal profiles, making activities repeatedly visible to each other, and providing private communication channels. In this vein, "temporal" social matching system could provide dyadic, rather than public, forms of communication, in which pairs of users may disclose their profiles and own temporal experiences of change to each other. For instance, if the user is undergoing a very fast change implying a sort of decay, the system could select comparison targets that are similar to her on these dimensions, and then allow them to communicate and share their experience. Comparisons with people that ascribed

different meanings to the same temporal configurations could be also prompted, in order to provide an alternative perspective that may elicit processes of reflection. In other words, these systems could allow users to find “a match,” meant as a person in the same temporal situation, with whom sharing opinions, worries and eventual solutions on how to better manage the change time.

Alternatively, designers could design conversational agents to make people interact with “artificial others” reporting similar or different experiences that are automatically created on the basis of the temporal experience of the user. These agents could foster the user’s empathy and self-disclosure, inspired by HCI research on empathic chatbots (e.g., Lee et al., 2019) and agents that simulate active listening (Lim et al., 2019). Even though current technology has limitations with reference to the capability of tackling conversational topics that fall outside the specific domain of expertise of the agent, advancements in this field seem to be proceeding rapidly (Rapp et al., 2021).

Alternatively, these interactions could take place within interactive games, in which the “other” is represented by a Non-Player Character (NPC), in line with previous designs in the field of interactive dramas, like *Façade* (Mateas & Stern, 2005). These interactions could be aimed at making the user expose how she subjectively lived the temporal experience of change, as well as her emotions, doubts, and existential concerns that she associated with the change and its time. Similarly, the NPC could express its “experience,” also exploiting its embodied nature and the fact that the interaction occurs in a fictional game world (for instance, referring to objects, environments, and other NPCs that populate the game world when recounting its experience): this would possibly encourage users who are reluctant to open to others to self-disclose. Finally, these interactive games could also provide simulation tools to explore how specific changes (for example, a sudden change backward) could have different impacts if experienced alone or with other NPCs, taking inspiration from real-life simulation games like *The Sims*, a game that allows the player to experience the simulated lives of “Sims”.

7 CONCLUSION

In this article, I explored how people account for and experience the temporalities of their daily life changes. The first contribution of this study is to offer rich descriptions of how the temporal features of

change may impact on how individuals perceive and manage the changes themselves. Temporalities that have a visible velocity, are characterized by a “positive” direction, and are sharable with others may increase people’s opportunities to make sense of and drive the process of change. By contrast, temporalities that are too fast or too slow, are negatively appraised, and are misaligned with the temporalities of significant others may hinder people’s awareness and their willingness to steer the change. These findings highlight the importance of the existential time of change in people’s everyday life and the minor role that current technologies play, which may open a new design space for temporal technologies in HCI. The second contribution of this article is to highlight several theoretical insights and design considerations that may make HCI research on time and life changes move forward. On the one hand, the existential time emerging from the study moves the HCI debate on time beyond the dichotomies between slowness and speediness, as well as between objective and social times, putting in the foreground multiple temporalities that are relative to the existential problems that people face in their daily life, can be shaped by the individuals themselves, and are often open to others despite their fundamental subjectivity. On the other hand, suggestions for designing temporal technologies that make the velocity of change malleable, support the ascription of meaning to the direction of time, and encourage people to share their temporal experiences with “others,” whether real or artificial, may contribute to develop better systems for supporting life changes, focusing on their temporal aspects rather than on their effects.

REFERENCES

- Adar, E., Tan, D. S., & Teevan, J. (2013, April). Benevolent deception in human computer interaction. In Proceedings of the SIGCHI conference on human factors in computing systems, Association for Computing Machinery, New York, NY, USA, (pp. 1863-1872). DOI: <https://doi.org/10.1145/2470654.2466246>
- Agapie, E., Avrahami, D., & Marlow, J. (2016, May). Staying the course: System-driven lapse management for supporting behavior change. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems Association for Computing Machinery, New York, NY, USA, (pp.

1072-1083). DOI: <https://doi.org/10.1145/2858036.2858142>

Bardon, A. (2013). *A brief history of the philosophy of time*. Oxford University Press.

Bellotti, V., Dalal, B., Good, N., Flynn, P., Bobrow, D., & Ducheneaut, N. (2004). What a to-do: Studies of task management towards the design of a personal task list manager. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '04)*. Association for Computing Machinery, New York, NY, USA, 735–742. DOI: <https://doi.org/10.1145/985692.985785>

Bergson, H. (1913). *Time and free will. An essay on the immediate data of consciousness*. London: George Allen & Company.

Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative research*, 8(1), 137-152. DOI: <https://doi.org/10.1177/1468794107085301>

Bowler, R. D., Bach, B., & Pschetz, L. (2022). Exploring Uncertainty in Digital Scheduling, and The Wider Implications of Unrepresented Temporalities in HCI. In *CHI Conference on Human Factors in Computing Systems (CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 140, 1–12. DOI: <https://doi.org/10.1145/3491102.3502107>

Bowler, R. D., Bach, B., & Pschetz, L. (2022). Exploring Uncertainty in Digital Scheduling, and The Wider Implications of Unrepresented Temporalities in HCI. In *CHI Conference on Human Factors in Computing Systems*, Association for Computing Machinery, New York, NY, USA, 1-12. DOI: <https://doi.org/10.1145/3491102.3502107>

Breger, L. (1974). *From Instinct to Identity: The Development of Personality*. Prentice-Hall, Englewood Cliffs, NJ.

Brubaker, J. R., & Callison-Burch, V. (2016). Legacy contact: Designing and implementing post-mortem stewardship at Facebook. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. Association for Computing Machinery, New York, NY, USA, 2908–2919 DOI: <https://doi.org/10.1145/2858036.2858254>

Card, S. K., Moran, T. P., & Newell, A. (1980). The keystroke-level model for user performance time with interactive systems. *Communications of the ACM*, 23(7), 396-410. DOI: <https://doi.org/10.1145/358886.358895>

Chalot, H., Cheng, C., Yu, C., Rau, P. L. P., & Gao, Q. (2016, February). Time Management Application: Insights on French and Chinese Collaboration. In *Proceedings of the 19th ACM Conference on Computer Supported Cooperative Work and Social Computing Companion*, Association for Computing Machinery, New York, NY, USA, (pp. 241-244). DOI: <https://doi.org/10.1145/2818052.2869085>

Chen A. Y. S., Odom, W., Zhong, C., Lin, H., & Amram, T. (2019). Chronoscope: Designing Temporally Diverse Interactions with Personal Digital Photo Collections. In *Proceedings of the DIS 2019 Conference on Designing Interactive Systems*. Association for Computing Machinery, New York, NY, USA, 799–812. DOI: 10.1145/3322276.3322301

Chen, A. Y. S., Odom, W., Zhong, C., Lin, H., & Amram, T. (2019, June). Chronoscope: designing temporally diverse interactions with personal digital photo collections. In *Proceedings of the 2019 on Designing Interactive Systems Conference*, Association for Computing Machinery, New York, NY, USA, (pp. 799-812). DOI: <https://doi.org/10.1145/3322276.3322301>

Cherubini, M., Reut, L., Tyler, J., & Ortlieb, M. (2021). Inattentive, imprudent and inapt: discovering inadequacies of ICT during life-changing events through the lens of non-users. *Behaviour & Information Technology*, 40(15), 1643-1670. DOI: 10.1080/0144929X.2020.1772879

Dabrowski, J., & Munson, E. V. (2011). 40 years of searching for the best computer system response time. *Interacting with Computers*, 23(5), 555-564. DOI: <https://doi.org/10.1016/j.intcom.2011.05.008>

Di Bartolomeo, S., Pandey, A., Leventidis, A., Saffo, D., Syeda, U. H., Carstensdottir, E., El-Nasr, M. S., Borkin, M. A., & Dunne, C. (2020). Evaluating the effect of timeline shape on visualization task performance. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, Association for Computing Machinery, New York, NY, USA, (pp. 1-12). DOI:

<https://doi.org/10.1145/3313831.3376237>

Dourish, P. (2001). *Where the Action Is: The Foundations of Embodied Interaction*. MIT Press, Cambridge, MA.

Durrant, A. C., Kirk, D. S., Trujillo-Pisanty, D., & Martindale, S. (2018). Admixed portrait: Design to understand facebook portrayals in new parenthood. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, Association for Computing Machinery, New York, NY, USA, (pp. 1-14). DOI: <https://doi.org/10.1145/3173574.3173586>

Ehn, P. (1988). *Work-Oriented Design of Computer Artifacts*. Arbetlivscentrum, Stockholm

Elsden, C., Kirk, D. S., & Durrant, A. C. (2016). A quantified past: Toward design for remembering with personal informatics. *Human-Computer Interaction*, 31(6), 518-557. DOI: <http://dx.doi.org/10.1080/07370024.2015.1093422>.

Erikson, E. H. (1963). *Childhood and Society*. Norton, New York, NY.

Fabian, J. (1983). *Time and the Other: How Anthropology Makes its Object*. New York: Columbia University Press.

Fallman, D. (2003). In *Romance with the Materials of Mobile Interaction: A Phenomenological Approach to the Design of Mobile Information Technology*. Doctoral thesis. Larsson & Co:s Tryckeri, Umea University, Sweden

Fischler, M. A., & Bolles, R. C. (1981). Random sample consensus: a paradigm for model fitting with applications to image analysis and automated cartography. *Communications of the ACM*, 24(6), 381-395. DOI: <https://doi.org/10.1145/358669.358692>

Glaser, B. G., and Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Aldine Publishing Company, Chicago, IL.

Gordon, S. (2012). Existential time and the meaning of human development. *The Humanistic*

Psychologist, 40(1), 79–86. DOI: <https://doi.org/10.1080/08873267.2012.643691>

Gulotta, R., Gerritsen, D. B., Kelliher, A., & Forlizzi, J. (2016). Engaging with death online: An analysis of systems that support legacy-making, bereavement, and remembrance. In Proceedings of the 2016 ACM Conference on Designing Interactive Systems, Association for Computing Machinery, New York, NY, USA, (pp. 736-748). DOI: <https://doi.org/10.1145/2901790.2901802>

Gulotta, R., Kelliher, A., & Forlizzi, J. (2017). Digital systems and the experience of legacy. In Proceedings of the 2017 Conference on Designing Interactive Systems, Association for Computing Machinery, New York, NY, USA, (pp. 663-674). DOI: <https://doi.org/10.1145/3064663.3064731>

Gulotta, R., Odom, W., Faste, H., & Forlizzi, J. (2014). Legacy in the age of the internet: reflections on how interactive systems shape how we are remembered. In Proceedings of the 2014 conference on Designing interactive systems, Association for Computing Machinery, New York, NY, USA, (pp. 975-984). DOI: <https://doi.org/10.1145/2598510.2598579>

Gulotta, R., Odom, W., Faste, H., & Forlizzi, J. (2014). Legacy in the age of the internet: reflections on how interactive systems shape how we are remembered. In Proceedings of the 2014 conference on Designing interactive systems. Association for Computing Machinery, New York, NY, USA, 975-984. DOI: <https://doi.org/10.1145/2598510.2598579>

Gulotta, R., Odom, W., Forlizzi, J., & Faste, H. (2013). Digital artifacts as legacy: exploring the lifespan and value of digital data. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Association for Computing Machinery, New York, NY, USA, (pp. 1813-1822). DOI: <https://doi.org/10.1145/2470654.2466240>

Hallnäs, L., & Redström, J. (2001). Slow technology—designing for reflection. *Personal and ubiquitous computing*, 5(3), 201-212. DOI:<https://doi.org/10.1007/PL00000019>

Hangal, S., Lam, M. S., & Heer, J. (2011). MUSE: Reviving Memories Using Email Archives. In Proceedings of the UIST 2011 Symposium on User Interface Software and Technology (pp. 75–84).

New York, NY, USA: ACM. doi: 10.1145/2047196.2047206

Harrison, D., & Cecchinato, M. E. (2015). " Give me five minutes!" feeling time slip by. In Adjunct Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers, Association for Computing Machinery, New York, NY, USA, (pp. 45-48). DOI: <https://doi.org/10.1145/2800835.2800858>

Heidegger, M. (1982). *The Basic Problems of Phenomenology*. Indiana University Press, Bloomington, IN.

Hendrikx, M., Meijer, S., Van der Velden, J., & Iosup, A. (2013). Procedural content generation for games: A survey. *ACM Transactions on Multimedia Computing, Communications and Applications*, 9(1), 1–22. DOI: <https://doi.org/10.1145/2422956.2422957>

Herron, D., Moncur, W., & Van Den Hoven, E. (2017). Digital decoupling and disentangling: towards design for romantic break up. In *Proceedings of the 2017 conference on designing interactive systems*, Association for Computing Machinery, New York, NY, USA, 1175-1185. DOI: <https://doi.org/10.1145/3064663.3064765>

Hildebrandt, M., & Rantanen, E. M. (2004). Time Design: Organizers and Panel Co-Chairs. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 48, No. 3, pp. 703-707)*. Sage CA: Los Angeles, CA: SAGE Publications. DOI: <https://doi.org/10.1145/985921.986208>

Homewood, S., & Vallgård, A. (2020). Putting Phenomenological Theories to Work in the Design of Self-Tracking Technologies. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference*, Association for Computing Machinery, New York, NY, USA, (pp. 1833-1846). DOI: <https://doi.org/10.1145/3357236.3395550>

Hunter, E. G., & Rowles, G. D. (2005). Leaving a legacy: Toward a typology. *Journal of Aging Studies*, 19(3), 327–347. DOI: <https://doi.org/10.1016/j.jaging.2004.08.002>

Husserl, E. (1962). *Phenomenological Psychology: Lectures from the Summer Semester, 1925*. Martinus Nijhoff, The Hague, The Netherlands.

J Loup, J., Subasi, Ö., & Fitzpatrick, G. (2017, May). Aging, HCI, & personal perceptions of time. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)*. Association for Computing Machinery, New York, NY, USA, 1853–1860. DOI: <https://doi.org/10.1145/3027063.3053079>

Jackson, S. J., Ribes, D., Buyuktur, A., & Bowker, G. C. (2011). Collaborative rhythm: temporal dissonance and alignment in collaborative scientific work. In *Proceedings of the ACM 2011 conference on Computer supported cooperative work*, Association for Computing Machinery, New York, NY, USA, (pp. 245-254). DOI: <https://doi.org/10.1145/1958824.1958861>

Jackson, S. J., Ribes, D., Buyuktur, A., & Bowker, G. C. (2011). Collaborative rhythm: temporal dissonance and alignment in collaborative scientific work. In *Proceedings of the ACM 2011 conference on Computer supported cooperative work (CSCW '11)*. Association for Computing Machinery, New York, NY, USA, 245–254. DOI: <https://doi.org/10.1145/1958824.1958861>

Jagannath, S., Sarcevic, A., Young, V., & Myers, S. (2019). Temporal rhythms and patterns of electronic documentation in time-critical medical work. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, Association for Computing Machinery, New York, NY, USA, (pp. 1-13). DOI: <https://doi.org/10.1145/3290605.3300564>

Janböcke, S., Gawlitta, A., Dörrenbächer, J., & Hassenzahl, M. (2020). Finding the Inner Clock: A Chronobiology-based Calendar. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, Association for Computing Machinery, New York, NY, USA, 1-7. DOI: <https://doi.org/10.1145/3334480.3382830>

Jones, J., & Ackerman, M. S. (2018). Co-constructing family memory: understanding the intergenerational practices of passing on family stories. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. Association for Computing Machinery, New York,

NY, USA, Paper 424, 1–13. DOI: <https://doi.org/10.1145/3173574.3173998>

Kaptelinin, V. (2016). Making the case for an existential perspective in HCI research on mortality and death. In *Proceeding of the SIGCHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI EA '16)*, 352-364. DOI: [10.1145/2851581.2892585](https://doi.org/10.1145/2851581.2892585)

Kaptelinin, V. (2018). Technology and the Givens of Existence: Toward an Existential Inquiry Framework in HCI Research. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. Association for Computing Machinery, New York, NY, USA, Paper 270, 1–14. DOI:<https://doi.org/10.1145/3173574.3173844>

Kitson, A., Schiphorst, T., & Riecke, B. E. (2018, April). Are you dreaming? a phenomenological study on understanding lucid dreams as a tool for introspection in virtual reality. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI'18)*. ACM, New York, NY, Article 343, 12. DOI: <https://doi.org/10.1145/3173574.3173917>

Labouvie-Vief, G., Chiodo, L. M., Goguen, L. A., & Diehl, M. (1995). Representations of self across the life span. *Psychology and Aging*, 10(3), 404.

LeCompte, M. D., & Goetz, J. P. (1982). Problems of reliability and validity in ethnographic research. *Review of educational research*, 52(1), 31-60.

Lee, J., Walker, E., Burlison, W., Kay, M., Buman, M., & Hekler, E. B. (2017, May). Self-experimentation for behavior change: Design and formative evaluation of two approaches. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI'17)*. ACM, New York, NY, 6837–6849. DOI:<https://doi.org/10.1145/3025453.3026038>

Lee, M., Ackermans, S., van As, N., Chang, H., Lucas, E., IJsselsteijn, W., 2019. Caring for Vincent: A Chatbot for Self-Compassion. In: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, New York, pp. 1–13. <https://doi.org/10.1145/3290605.3300932>.

Leshed, G., & Sengers, P. (2011). “I lie to myself that i have freedom in my own schedule” productivity

tools and experiences of busyness. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Association for Computing Machinery, New York, NY, USA, 905-914. DOI: <https://doi.org/10.1145/1978942.1979077>

Lim, C. Y., Berry, A. B., Hartzler, A. L., Hirsch, T., Carrell, D. S., Bermet, Z. A., & Ralston, J. D. (2019). Facilitating self-reflection about values and self-care among individuals with chronic conditions. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-12). doi: 10.1145/3290605.3300885

Lindley, S. E. (2015). Making Time. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15). Association for Computing Machinery, New York, NY, USA, 1442–1452. DOI: <https://doi.org/10.1145/2675133.2675157>

Lindley, S., & Wallace, J. (2015). Placing in age: Transitioning to a new home in later life. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 22(4), 1-39. DOI: <https://doi.org/10.1145/2755562>

Liu, L. S., Inkpen, K. M., & Pratt, W. (2015, February). "I'm Not Like My Friends" Understanding How Children with a Chronic Illness Use Technology to Maintain Normalcy. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15). Association for Computing Machinery, New York, NY, USA, 1527–1539. DOI: <https://doi.org/10.1145/2675133.2675201>

Luo, Y., Lee, B., Wohn, D. Y., Rebar, A. L., Conroy, D. E., & Choe, E. K. (2018). Time for break: Understanding information workers' sedentary behavior through a break prompting system. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI'18). ACM, New York, NY, Article 127, 14. DOI: <https://doi.org/10.1145/3173574.3173701>

Martin, R., & Holtzman, H. (2011). Kairoscope: managing time perception and scheduling through social event coordination. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11). Association for Computing Machinery, New York, NY, USA, 1969–1978. DOI:

<https://doi.org/10.1145/1978942.1979227>

Massimi, M., Odom, W., Banks, R., & Kirk, D. (2011). Matters of life and death: locating the end of life in lifespan-oriented HCI research. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11). Association for Computing Machinery, New York, NY, USA, 987–996. DOI: <https://doi.org/10.1145/1978942.1979090>

Massimi, M., Odom, W., Banks, R., & Kirk, D. (2011). Matters of life and death: locating the end of life in lifespan-oriented HCI research. In Proceedings of the SIGCHI conference on Human Factors in Computing Systems (CHI '99). Association for Computing Machinery, New York, NY, USA, 17–24. DOI: <https://doi.org/10.1145/302979.302982>.

Mateas, M., & Stern, A. (2005). Façade: architecture and authorial idioms for believable agents in interactive drama. In Proceedings of the 6th international conference on Intelligent Virtual Agents (IVA'06). Springer-Verlag, Berlin, Heidelberg, 446–448. https://doi.org/10.1007/11821830_37

Mazmanian, M., Erickson, I., & Harmon, E. (2015). Circumscribed time and porous time: Logics as a way of studying temporality. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15). Association for Computing Machinery, New York, NY, USA, 1453–1464. DOI:<https://doi.org/10.1145/2675133.2675231>

Mazmanian, M., Erickson, I., & Harmon, E. (2015). Circumscribed Time and Porous Time: Logics as a Way of Studying Temporality. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15). Association for Computing Machinery, New York, NY, USA, 1453–1464. DOI: <https://doi.org/10.1145/2675133.2675231>

McAdams, D. P. (2001). The psychology of life stories. *Review of General Psychology* 5(2), 100–122. DOI: <http://dx.doi.org/10.1037/1089-2680.5.2.100>

McDonald, N., Schoenebeck, S., & Forte, A. (2019). Reliability and inter-rater reliability in qualitative research: Norms and guidelines for CSCW and HCI practice. *Proceedings of the ACM on Human-*

Computer Interaction, 3(CSCW), 1-23. DOI:<https://doi.org/10.1145/3359174>

McGrath, J. E. (1988). *The social psychology of time*. Newbury Park, CA: Sage.

Mynatt, E. and Tullio, J. (2001). Inferring Calendar Event Attendance. In Proceedings of the 6th International Conference on Intelligent User Interfaces (Santa Fe, New Mexico, USA) (IUI '01). Association for Computing Machinery, New York, NY, USA, 121–128. <https://doi.org/10.1145/359784.360310>

Newton, I. (1687). *Philosophiae Naturadynlis Principia Mathematica* (1st ed.). See also the modern English translation, A. Motte (1934), *Sir Isaac Newton's Mathematical Principles of Natural Philosophy*. Berkeley and Los Angeles: University of California Press. Streater.

Nowotny, H. (1992). Time and Social Theory: Towards a Social Theory of Time. *Time & Society*, 1(3), 421–454. Doi: <https://doi.org/10.1177/0961463X92001003006>

O'Connor, M., Conboy, K., and Dennehy, D. (2017). Temporality in Information Systems Development (ISD) Research: A Systematic Literature Review. In Proceedings of the 12th International Research Workshop on Information Technology Project Management (IRWITPM), 1-13. <https://aisel.aisnet.org/irwitpm2017/5>

O'Riordan, N., Conboy, K., and Acton, T. (2013). How Soon is Now? Theorizing Temporality in Information Systems. In Proceedings of the International Conference on Information Systems (ICIS) 2013: Reshaping Society Through Information Systems Design, 1-15.

Odom, W., Banks, R., Durrant, A., Kirk, D., & Pierce, J. (2012). Slow technology: critical reflection and future directions. In Proceedings of the Designing Interactive Systems Conference (DIS '12). Association for Computing Machinery, New York, NY, USA, 816–817. DOI: <https://doi.org/10.1145/2317956.2318088>

Odom, W., Stolterman, E., & Chen, A. Y. S. (2022). Extending a Theory of Slow Technology for Design through Artifact Analysis. *Human-Computer Interaction*, 37(2), 150-179. DOI:

<https://doi.org/10.1080/07370024.2021.1913416>

Odom, W., Wakkary, R., Bertran, I., Harkness, M., Hertz, G., Hol, J., Lin, H., Naus, B., Tan, P. & Verburg, P. (2018, April). Attending to slowness and temporality with olly and slow game: A design inquiry into supporting longer-term relations with everyday computational objects. In Proceedings of the 2018 CHI conference on human factors in computing systems (pp. 1-13). DOI:<https://doi.org/10.1145/3173574.3173651>

Palen, L. (1999). Social, individual and technological issues for groupware calendar systems. In Proceedings of the SIGCHI conference on Human Factors in Computing Systems (CHI '99). Association for Computing Machinery, New York, NY, USA, 17-24. <https://doi.org/10.1145/302979.302982>

Peesapati, T., Schwanda, V., Schultz, J., Lepage, M., Jeong, S., & Cosley, D. (2010). Pensieve: Supporting Everyday Reminiscence. In Proceedings of the CHI 2010 Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 2027-2036. DOI: 10.1145/1753326.1753635

Petrelli, D., & Light, A. (2014). Family rituals and the potential for interaction design: a study of Christmas. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 21(3), 1-29. DOI: <https://doi.org/10.1145/2617571>.

Petrelli, D., & Whittaker, S. (2010). Family memories in the home: contrasting physical and digital mementos. *Personal and Ubiquitous Computing*, 14(2), 153-169. DOI: <https://doi.org/10.1007/s00779-009-0279-7>

Petrelli, D., Whittaker, S., & Brockmeier, J. (2008). AutoTopography: What can physical mementos tell us about digital memories? In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '08). Association for Computing Machinery, New York, NY, USA, 53-62. DOI: <https://doi.org/10.1145/1357054.1357065>

Pschetz, L. (2015). Isn't it time to change the way we think about time?. *Interactions*, 22, 5 (September-October 2015), 58–61. DOI: <https://doi.org/10.1145/2809502>

Pschetz, L., & Bastian, M. (2018). Temporal Design: Rethinking time in design. *Design Studies*, 56, 169-184. DOI: <https://doi.org/10.1016/j.destud.2017.10.007>

Rapp, A. (2022). Time, engagement and video games: How game design elements shape the temporalities of play in massively multiplayer online role-playing games. *Information Systems Journal*, 32(1), 5-32. DOI: <https://doi.org/10.1111/isj.12328>

Rapp, A. and Tirassa, M. (2017). Know thyself: A theory of the self for personal informatics. *Human-Computer Interaction* 32, 5–6 (2017), 335–380. DOI: <https://doi.org/10.1080/07370024.2017.1285704>

Rapp, A., Curti, L., Boldi, A. (2021). The human side of human-chatbot interaction: A systematic literature review of ten years of research on text-based chatbots. *International Journal of Human-Computer Studies*, 151, 102630. doi: 10.1016/j.ijhcs.2021.102630

Rapp, A., Odom, W., Pschetz, L., & Petrelli, D. (2022). Introduction to the special issue on time and HCI. *Human-Computer Interaction*, 37(1), 1-14. DOI: <https://doi.org/10.1080/07370024.2021.1955681>

Rapp, A., Tirassa, M., & Tirabeni, L. (2019). Rethinking technologies for behavior change: A view from the inside of Human change. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 26(4), 1-30. DOI: <https://doi.org/10.1145/3318142>

Ren, Y., Harper, F. M., Drenner, S., Terveen, L., Kiesler, S., Riedl, J., & Kraut, R. E. (2012). Building member attachment in online communities: Applying theories of group identity and interpersonal bonds. *MIS Quarterly*, 36, 841–864. <https://doi.org/10.2307/41703483>

Rinott, M., & Tractinsky, N. (2022). Designing for interpersonal motor synchronization. *Human-Computer Interaction*, 37(1), 69-116. DOI: 10.1080/07370024.2021.1912608

- Salovaara, A., Lehmuskallio, A., Hedman, L., Valkonen, P., & Näsänen, J. (2010). Information technologies and transitions in the lives of 55–65-year-olds: The case of colliding life interests. *International journal of human-computer studies*, 68(11), 803-821. DOI: 10.1016/J.IJHCS.2010.06.007
- Sarker, S. and Sahay, S. (2004). Implications of space and time for distributed work: an interpretive study of US– Norwegian systems development teams. *European Journal of Information Systems*, 13(1), 3-20. DOI: <https://doi.org/10.1057/palgrave.ejis.3000485>
- Sas, C., & Whittaker, S. (2013). Design for forgetting: disposing of digital possessions after a breakup. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'13)*. ACM, New York, NY, 1823–1832. DOI: <https://doi.org/10.1145/2470654.2466241>
- Sas, C., Whittaker, S., & Zimmerman, J. (2016). Design for rituals of letting go: An embodiment perspective on disposal practices informed by grief therapy. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 23(4), 1-37. DOI: <https://doi.org/10.1145/2926714>
- Sas, C., Whittaker, S., & Zimmerman, J. (2016). Design for rituals of letting go: An embodiment perspective on disposal practices informed by grief therapy. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 23(4), 1-37. DOI: <https://doi.org/10.1145/2926714>
- Schutz, A. (1970). *On Phenomenology and Social Relations: Selected Writings of Alfred Schutz*. University of Chicago Press, Chicago, IL.
- Sellen A., & Whittaker, S. (2010). Beyond total capture: A constructive critique of lifelogging. *Communications of the ACM*, 53(5), 70–77. DOI: <https://doi.org/10.1145/1735223.1735243>
- Shen, Z., Lyytinen, K., & Yoo, Y. (2015). Time and information technology in teams: a review of empirical research and future research directions. *European Journal of Information Systems*, 24(5), 492-518. DOI: <https://doi.org/10.1057/ejis.2014.8>
- Shklovski, I., Kraut, R., & Cummings, J. (2008). Keeping in touch by technology: Maintaining friendships after a residential move. In *Proceedings of the SIGCHI Conference on Human Factors in*

Computing Systems (CHI '08). Association for Computing Machinery, New York, NY, USA, 807–816.

DOI: <https://doi.org/10.1145/1357054.1357182>

Smith, J., Flowers, P., and Larkin, M. (2009). *Interpretative Phenomenological Analysis: Theory, Method and Research*. Sage, London, UK.

Starkey, K. (1989). Time and work: A psychological perspective. In P. Blyton, J. Hassard, S. Hill, and K. Starkey (eds). *Time, Work and Organization*. London: Routledge, 35–56.

Suh, M., & Hsieh, G. (2016). Designing for future behaviors: Understanding the effect of temporal distance on planned behaviors. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI'16)*. ACM, New York, NY, 1084–1096. DOI: <https://doi.org/10.1145/2858036.2858591>

Svanæs, D., & Barkhuus, L. (2020, April). The designer's body as resource in design: Exploring combinations of point-of-view and tense. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. DOI: <https://doi.org/10.1145/3313831.3376430>

Taylor, J. L., Soro, A., Roe, P., Lee Hong, A., & Brereton, M. (2017, May). Situational when: Designing for time across cultures. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. Association for Computing Machinery, New York, NY, USA, 6461–6474. DOI: <https://doi.org/10.1145/3025453.3025936>

Taylor, J. L., Soro, A., Roe, P., Lee Hong, A., & Brereton, M. (2017). Situational When: Designing for time across cultures. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. Association for Computing Machinery, New York, NY, USA, 6461–6474. DOI: <https://doi.org/10.1145/3025453.3025936>

Terveen, L., & McDonald, D. W. (2005). Social matching: A framework and research agenda. *ACM transactions on computer-human interaction (TOCHI)*, 12(3), 401-434. DOI:

<https://doi.org/10.1145/1096737.1096740>

Uhde, A., Schlicker, N., Wallach, D. P., & Hassenzahl, M. (2020). Fairness and Decision-making in Collaborative Shift Scheduling Systems. Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–13. <https://doi.org/10.1145/3313831.3376656>

Uriu, D., & Odom, W. (2016, May). Designing for domestic memorialization and remembrance: a field study of fenestra in Japan. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). Association for Computing Machinery, New York, NY, USA, 5945–5957. DOI: <https://doi.org/10.1145/2858036.2858069>

Uriu, D., & Okude, N. (2010). ThanatoFenestra: photographic family altar supporting a ritual to pray for the deceased. In Proceedings of the 8th ACM Conference on Designing Interactive Systems (DIS '10). Association for Computing Machinery, New York, NY, USA, 422–425. DOI: <https://doi.org/10.1145/1858171.1858253>

van den Hoven, E., & Eggen, B. (2008). Informing augmented memory system design through autobiographical memory theory. *Personal and Ubiquitous Computing*, 12, 433–443. doi:10.1007/s00779-007-0177-9

van den Hoven, E., Sas, C., & Whittaker, S. (2012). Introduction to this Special Issue on designing for personal memories: Past, present, and future. *Human-Computer Interaction*, 27(1–2), 1–12. DOI: <https://doi.org/10.1080/07370024.2012.673451>

Van Gennip, D., Van Den Hoven, E., & Markopoulos, P. (2015). Things that make us reminisce: Everyday memory cues as opportunities for interaction design. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15). Association for Computing Machinery, New York, NY, USA, 3443–3452. DOI: <https://doi.org/10.1145/2702123.2702460>

Vecchione, M., Döring, A. K., Alessandri, G., Marsicano, G., & Bardi, A. (2016). Reciprocal relations

across time between basic values and value-expressive behaviors: A longitudinal study among children. *Social Development*, 25(3), 528-547. DOI: <https://doi.org/10.1111/sode.1215>

Wang, Y.-C., Burke, M., & Kraut, R. (2016). Modeling self-disclosure in social networking sites. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16)*. Association for Computing Machinery, New York, NY, USA, 74–85. <https://doi.org/10.1145/2818048.2820010>

Whittaker, S., & Schwarz, H. (1995). Back to the future: Pen and paper technology supports complex group coordination. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '95)*. ACM Press/Addison-Wesley Publishing Co., USA, 495–502. DOI: <https://doi.org/10.1145/223904.223971>

Whittaker, S., & Schwarz, H. (1999). Meetings of the Board: The Impact of Scheduling Medium on Long Term Group Coordination in Software Development. *Computer Supported Cooperative Work CSCW* 8(3), 175–205. DOI: <https://doi.org/10.1023/A:1008603001894>

Wiberg, M., & Stolterman, E. (2021). Time and Temporality in HCI Research. *Interacting with Computers*, 33(3), 250-270. DOI: <https://doi.org/10.1093/iwc/iwab025>

William T. Odom, Abigail J. Sellen, Richard Banks, David S. Kirk, Tim Regan, Mark Selby, Jodi L. Forlizzi, and John Zimmerman. 2014. Designing for slowness, anticipation and re-visitation: a long term field study of the photobox. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. Association for Computing Machinery, New York, NY, USA, 1961–1970. DOI: <https://doi.org/10.1145/2556288.2557178>

Wrosch, C., & Freund, M. A. (2001). Self-regulation of normative and non-normative developmental challenges. *Human Development*, 44(5), 264–283.

Wrzus, C., Hänel, M., Wagner, J., & Neyer, F. J. (2013). Social network changes and life events across the life span: a meta-analysis. *Psychological bulletin*, 139(1), 53.

Wyche, S. P., Smyth, T. N., Chetty, M., Aoki, P. M., & Grinter, R. E. (2010). Deliberate interactions: characterizing technology use in Nairobi, Kenya. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10). Association for Computing Machinery, New York, NY, USA, 2593–2602. <https://doi.org/10.1145/1753326.1753719>

Zahavi, D. (2012). The time of the self. *Grazer Philosophische Studien*, 84, 143–159. Doi: https://doi.org/10.1163/9789401207904_008