Jun 16th, 12:00 AM

# Qualitative Study of Smartphone use: Subjective Experience of Time through Personal Ubiquitous Technology

Yong-Ki Lee
*KAIST (Korea Advanced Institute of Science and Technology), Daejeon, Republic of Korea*

Kun-Pyo Lee
*KAIST (Korea Advanced Institute of Science and Technology), Daejeon, Republic of Korea*

# Qualitative Study of Smartphone use: Subjective Experience of Time through Personal Ubiquitous Technology

**Yong-Ki Lee**, KAIST (Korea Advanced Institute of Science and Technology), Daejeon, Republic of Korea
**Kun-Pyo Lee**, KAIST (Korea Advanced Institute of Science and Technology), Daejeon, Republic of Korea

## Abstract

We explore Smartphone use in Korea to develop a grounded theory on the experience with personal ubiquitous technologies. The preliminary theory that emerged during our data analysis centres on the role of changing time experiences in the use of Smartphones. Within this interpretation, we theorize that the Smartphones are used through tactics of accelerating, broadening and defragmenting time perceptions in order to control the experience of time. These tactics are. Finally, we support this notion of temporal qualities by proposing the three time-related factors for personal ubiquitous technologies of Speed and Acceleration, Incidental Interactions, and Intrinsic Technology Integration.

### Keywords

Smartphone, Time, User Experience, Personal Ubiquitous Technology, Grounded Theory.

Current research has confirmed the phenomenon that people are almost always with their Smartphones (Oulasvirta, Rattenbury, Ma, & Raita, 2011). Its usage is spread across the whole day, as people get on their devices the moment they wake up, and continue using them until late at night (Karlson, Meyers, Jacobs, Johns, & Kane, 2009). Most importantly, people perform these tasks within their own timeframe, whenever they feel like it and regardless of the context or activity. Against this backdrop, our study explored Smartphone interactions by Korean youths. We focused on how the Smartphone is appropriated by means of user tactics to gain notions of private time. Thus, this paper builds its argument, that Personal Ubiquitous Computing is a temporal technology, through three focal points: (1) the phenomenon of Smartphone use, (2) the appropriations of personal ubiquitous technologies by Korean youths, and (3) a qualitative study to assess these appropriations.

## Towards Personal Ubiquitous Computing

The scope of our qualitative study required us to understand the concept of the Smartphone in a broader sense. This meant we had to exceed its plain technical definition, which would be a handheld, wearable and mobile information appliance that involves a pervasive communications infrastructure supporting it to enable a continuous integration of technology and people. Instead, our focus in this section centres on how user experience and interaction design issues, as well as adaptation (context-awareness) and personalization technologies have evolved over the course of the past two decades into current Everyday Computing ideas, arising from two theories of at that time new computing paradigms: The current Smartphone can be seen as rooted in two technological mindsets, which are Calm Computing and Information Appliances.

## *Third Wave Computing – embedded and mobile*

In his 1996 article “The coming age of calm technology” (Weiser & Brown, 1996) Weiser introduced a three-wave model regarding the evolution of computing, with the first wave of computing, taking place from 1940 to about 1980, as being dominated by many people serving one computer, the second wave, in contrast having one person and one computer, however divided and not inhabiting each other's worlds, and finally, the third wave, having many computers serving each person everywhere. Weiser called this last wave “ubiquitous computing” or “UbiComp”. He characterized this paradigm through the two characteristics of being present at anytime and available anywhere. Accordingly, this led to a temporal dimension enabled by embedding invisible computer in all interactions with our environment, and a spatial dimension driven by mobilizing portable computer to accompany people on every movement.

Weiser characterized the third wave in computing with the words “invisible”, “calm”, and “connection”. Since computers already inhabited the most mundane things found in the domestic environment, Weiser stipulated that people must dwell with computers, rather than just interact with them. Dwelling with computers meant that both people and computers have their given places, and co-exist in “comfort”. Weiser lamented that existing computer metaphors of that time were inadequate to describe this “dwelling” relationship, and he especially despised the metaphor “smart” for its intrusive nature. He realized that for computers to be truly smart, they had to be ignorable for most of the time, while providing subtle yet “constant clues about surroundings, the loved ones, the own past, the objects around us, or even the world beyond the home.” (Weiser & Brown, 1996) With several more analogies to the natural context of the home, Weiser discussed the subtleties that turn a house into a home and that computers were to help bring about this turn. Weiser unmasked and criticized the metaphor of “smart” as an attempt to scale computing in performance, only making it bigger, better, faster, and therefore as unsuitable for meeting actual human needs. Instead, he envisioned the possibility to make machines that take care of humans’ unconscious details, by connecting them deeper with their environment. The house of the future thus was to become one “quiet and unobtrusive connection to the world”. Weiser concludes his thoughts on ubiquitous and calm computing by seeing its major role in freeing people’s minds from unnecessary work, and empowering them to “understand the patterns in the universe and ourselves within them” (Weiser & Brown, 1996).

Even though highly influential on the directions of the field of ubiquitous computing, the third wave, as envisioned by Weiser, has not come to pass. Yet, it has created the grounds for an agenda of ubiquitous computing research that would have a vast and sustaining impact on related studies of human-computer interaction. For our study, Weisers’s thoughts allow us to see the Smartphone in a different light, turning the focus away from what it is now. In this way it lets us imagine possibilities of what it could become instead, and what its underlying concept of transcending human limitations essentially stands for.

By introducing the concept of “Information Appliances” (IA), researchers have made a step towards a personal ubiquitous computing from another point of view, different from that of Weiser’s. In many ways foreshadowing the idea of Smartphones, Jef Raskin coined this term around 1979 (Allan, 2001). Norman later explained the term in more detail describing IA as movable devices designed and pre-configured for a single purpose, and becoming unnoticeable for untrained people, due to their high ease of use. Norman promotes this effect as the device becoming “invisible” leading to an “Invisible Computer”. Another important feature of IA is their ability to share information automatically with any other IA (Norman, 1999). IA can be seen as a milestone to the advancement of ubiquitous computing and to current Smart Devices. Yet, although smart devices partially overlap in definition with specific types of appliances such as Information appliances, Smart Devices differ in several key ways. Firstly, Smart Devices in general can take a much wider range of form-factors than appliances. Secondly, Smart Devices support more of the ubiquitous

computing properties. Thirdly, information appliances focus on remote interaction with computing environments that tend to be personalized whereas Smart Devices can also focus heavily on impersonal physical world interaction. Finally, the term appliance generally implies that devices are task specific and under the control of some embedded system or application with a specific operating system, whereas Smart Devices may support multiple tasks, e.g., a mobile phone can act as a phone but also as a games console, music player, camera, etc.
Norman's argument that appliances with single-function technologies would take over and replace complicated, multi-functional devices has been disproved, considering the success of iPhones, Blackberrys, etc., opening up new possibilities for the future of a personal ubiquitous computing to another direction.

## *Everyday Computing - anytime and anywhere*

The unpredictability of everyday life is reflected in the variability of the context basically comprising people's actions, times and places in which those actions occur, and motivations that drive the same. Rogers clarifies that specifics of this context have proven to be subtle in difference, fluid in experience and highly idiosyncratic in meaning, making it very difficult to build truly smart systems that naturally support people in their daily practices (Yvonne Rogers, 2006).
To overcome this issue Bell and Dourish present their notion of Ubiquitous Computing as inherently messy. Their idea is to have a significant aspect of Ubiquitous Computing's research agenda dealing with the ways heterogeneity is currently manifested and managed in real-world systems and everyday ecologies. This then shifts the question to how people manage as well as benefit from this messiness in current interactions (Bell & Dourish, 2007).
Tolmie et al. suggest some kind of Bricolage of ordinary technologies, which, instead of becoming invisible or inconspicuous, are supposed to show clear presence and visibility, while still remaining "unremarkable" and thus, invisible in use (Tolmie et al., 2002). Tolmie notes that especially, recognizing the minutiae of multifaceted, yet unremarkable aspects that surround our everyday routines provides potent requirements on any technology that might become embedded in such activities. Here routines are identified as the very "glue of domestic life" by providing the grounds whereby the business of home life gets done. Thus, routines stand for people being able to get out the door, do chores, put the children to bed, and so on, without constantly having to account for what they are doing.
Another approach towards a more realistic vision of Ubiquitous Computing is presented by Chalmers et al. Their concept describes 'seamfulness' as an answer to the many ways a user shapes her activity to fit new technologies into an existing ecology of products and tools Thus, 'seamfulness' explains the "process of experiencing and understanding how to weave a new system into one's everyday life" (Barkhuus & Polichar, 2010; Chalmers & Galani, 2004), as this happens while taking advantage of the unintended seams in technology.
Both Tolmie and Chalmers deal with the fact that in actuality, Ubiquitous Computing has turned out to be characterized by activities of improvisation, tinkering and appropriation. For example, many current technologies found in homes are likely to be tied together rather casually and kept in sync with significant efforts. Furthermore, these technologies reveal surprising appropriations for purposes barely imagined by their designers, sometimes even directly opposing them. There is an obvious divide between the various social, cultural interpretations of what technology should be used for.
Despite this heterogeneity of understandings, Abowd and Mynatt have identified a key concern that is common to all approaches in that "(…) motivations for everyday computing stem from wanting to support the informal and unstructured activities typical of much of our everyday lives." To support these activities Abowd and Mynatt demand a continuous interaction that changes computing from a localized tool to a "constant presence" (Abowd & Mynatt, 2000). They propose five key features of casual activities to inform the design of

everyday computing. Those are that daily activities (1) rarely have a clear beginning or end, (2) are expected to be interrupted, (3) have multiple activities operate concurrently, (4) have time as an important discriminator and finally (5) need associative models of information to resume an activity. In summary, these five points characterize the temporal experience of the unstoppable flow of life in which we can merely dip in and out opportunistically.
Additionally, Abowd and Mynatt offer four research directions in everyday computing that range from (1) designing a continuously present computer interface, to (2) presenting information at different levels of the periphery of human attention, to (3) Connecting events in the physical and virtual world, to (4) designing for informal, peripheral, and opportunistic behavior. In summary, these directions roughly reflect the challenge of enabling personal, ubiquitous computing as we already can witness with current Smartphones.

# Research design

## *Research Goal*

The research goal is twofold. On the one hand, we aim at utilizing both research foci of ‘Smartphone use’ and ‘Korean youths’ to understand the phenomena of Personal Ubiquitous Computing among technologically skilled young Koreans. On the other, we aim at developing a theory that addresses the interrelationship between humans and personal ubiquitous technologies.

### How do young Koreans use their Smartphone?

The initial research question prior to any data collection was deliberately kept broad to avoid any bias and to have further questions emerge during the data collection and analysis phase. Subsequently, various more questions arose such as: when, where, and how often do people use their Smartphone? What is the context of Smartphone use? What are peripheral activities during Smartphone use? When does Smartphone use itself become peripheral and when does the device become second nature? What are the effects of the Smartphone's multi-functionality? How many functions are actually used? What functions are used simultaneously? What is the average duration of Smartphone use? What makes Smartphone use difficult? How do people cope with interruptions? etc. Most of the questions initially remained unanswered, as their true purpose was not to produce solutions, but to inspire new thought processes in the course of building a new theory.

## *Participants*

We aimed at subjective insights about real use situations of the Smartphone among Korean youths. To that propose, we focused on a small sample of that part of the Korean society, which currently accounts for the highest rate of mobile internet usage (KCC, 2011). This part is comprised of university students aged 20 to 25. Following a qualitative approach, we focused on a small number of participants. The selection of a specific age group kept the sample group homogenous resulting in higher data validity. Finally, the chosen age group showed a limited involvement and overlap of activities with other Korean social or demographic groups, meaning that the age group preferred to keep to themselves, within their social circles.
The recruitment process was enabled by announcements on public notice boards at cafeterias, dormitories and online forums, as well as through recommendations of students and professors. Eventually, we recruited 13 participants of which all were university students with a mean age of M=23,5 (SD=1,5). Seven participants were female, 6 were male. Six participants owned an Android OS Device, five an iPhone. In addition, one participant used a Blackberry and the final remaining one a Nokia device (Symbian

OS). All participants signed a consent formed that ensured their free will to participate and their neutrality and autonomy towards the research and the researchers.

## *Data Collection*

We chose a qualitative approach based on the Grounded Theory Study proposed by Strauss and Corbin (Corbin & Strauss, 2008) for four reasons. Firstly, we wanted to focus on a new phenomenon for which only little information existed. Secondly, we wanted to study this phenomenon as it occurred in its natural setting. Thirdly, we wanted to preserve complexity to avoid oversimplifications. Finally, we hoped to develop a "wild theory" (Y. Rogers, 2011) grounded in our primary data.

As it is typical with Grounded Theory, our study began with an open qualitative data collection, rather than specific hypotheses about what was to be found, so as not to unnecessarily constrain the emergent framework by precisely identifying variables. The study was framed with the broad research question of how young Koreans use their Smartphone. Further sub-questions arose during the collection and the simultaneously conducted analysis of data.

We collected three data types. The primary source was photos taken by the participants in the process of making an informal photo diary. The participants were asked to record their Smartphone use indirectly, by taking an unaimed and effortless snapshot immediately after each time they turned on their Smartphone. Over a period of three weeks, the 13 participants took a unified amount of 1033 pictures averaging to a mean of M=80 (SD=41,9) per person. As the photos were taken with the Smartphone, we had a secondary data source through automatic tags that provided the photograph with a time, date and GPS location stamp. Next to this quantitative data, the third source for our analysis was gained in three weekly debriefing sessions in which the participants annotated their photographs in regard to the activity on the Smartphone (Q1: What did you do on your Smartphone?), the context activity (Q2: During what situation did you turn on your Smartphone?), as well as the duration (Q3: How long did you use your Smartphone? a moment – a minute – more than three minutes?).

With this method, we intended to collect in situ data, while minimizing obtrusiveness, so that the Smartphone itself became our research tool. Thus, the Smartphone not only served as the object of study, but also as a recording device to collect and document contextual data about the use of Smartphones. As users were already familiar with their devices there was no need for detailed instructions, nor were there any necessities for having researchers follow and shadow the participants. We realized that the Smartphone's nature as a primary communication tool was of great advantage for any in-the-wild study, as people carry their phones around naturally and use them in everyday social relationships (Katz & Aakhus, 2002; Kopomaa, 2000; Ling, 2004). Smartphones thus differ from related technologies, such as personal digital assistants, PDAs (Barrett & Barrett, 2001), not so much technologically as psychologically: mobile phones are an accepted and integrated part of the people's lives and Smartphones are becoming increasingly common.

## *Data Analysis*

Again, following the guidelines for inductive research within Grounded Theory (Corbin & Strauss, 2008), data were read and re-read until major themes emerged. Phenomena were clustered into larger conceptual categories. Simultaneously, pertinent literature was researched to understand existing theory and to uncover related phenomena. Initial data analysis began with data collection so that the remaining time of the study could be used to gather more data pertaining to emergent themes, until we reached a degree of saturation.

After initial data collection, patterns emerged. The most interesting and promising patterns were pursued and first theories were sketched.

| | | Coder 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Speed** | **Face-to-face** | **Multi-tasking** | **On the way** | **In Bed** | **Idle time** | **During class** | **Study pal** | **Just Checking** | **Marginal total** |
| Coder 1 | Speed | .09 (.017) | .01 | .02 | .01 | - | - | - | - | .01 | .14 |
| | Face-to-face | - | .03 (.002) | - | - | - | - | .01 | - | - | .04 |
| | Multitasking | .02 | - | .04 (.004) | .01 | - | - | - | - | - | .07 |
| | On the way | .01 | - | - | .09 (.011) | - | - | - | - | - | .10 |
| | In Bed | - | - | - | - | .15 (.026) | - | - | - | - | .15 |
| | Idle time | - | - | - | - | .02 | .13 (.034) | .03 | .01 | - | .19 |
| | During class | - | .02 | - | - | - | - | .05 (.008) | .01 | - | .08 |
| | Study pal | - | - | - | - | - | - | .01 | .08 (.009) | - | .09 |
| | Just Checking | - | - | - | - | - | .05 | - | - | .09 (.014) | .14 |
| | Marginal Total | .12 | .06 | .06 | .11 | .17 | .18 | .10 | .10 | .10 | 1.00 |

Table 1: Agreement Matrix.

## Open coding

We divided the data (Photos and Annotations) into segments and scrutinized for commonalities that reflect properties of a theme. In this process we converted the visual data of photographs into descriptive codes that characterized our phenomenon of Smartphone use from different angles. Open coding yielded a large number of different items regarding use patterns. Many unique items, however, went astray in the process of conceptualization. They reflected isolated idiosyncrasies of behavior that could not be grouped content wise but under the more generic concept of 'idle time'. Examples include Smartphone use 'on the toilet', 'in the shower', 'while brushing teeth', 'while clipping toenails', 'alone in bed', 'in changing rooms of department stores', 'when using earphones, 'closing eyes, daydreaming', etc. Most of these examples are not directly represented in the following concepts, however, they all underscore the deep level of momentary privacy and glimpses of complete seclusion found throughout our study.

## Axial Coding and development of concepts

In a second step we reduced the numerous codes by looking for logic relationships and similarities of meaning. Thereby, we formulated more general codes that led to nine more generic concepts of Smartphone use of Korean youths. These initial concepts are: (1) Speed, which subsumes instances of momentary Smartphone activities, micro-actions, and fast thought-processes like chatting or twittering (2) Face-to-face encounters, which subsumes Smartphone uses when with or among people (3) Media Multitasking, which subsumes Smartphone uses in situations like watching TV, surfing the web, reading a print magazine, etc. (4) On the way, which subsumes use situations during transit, like riding the bus, walking, etc. (5) In Bed, which subsumes Smartphone uses on the bed (6) Idle time, which subsumes uses while waiting (7) During class, which subsumes use cases while attending classes (8) Study pal, which subsumes cases during private, solitary study (9) Just Checking, which subsumes habitual and repetitive behavior patterns during Smartphone use.

Table 1 shows how we ensured reliability of these concepts, as we went into another coding cycle with two individual coders, and subsequently adopted Cohen's Kappa as an interrater reliability measure:

$$K = (P_a - P_c) / (1 - P_c)$$

where $P_a$ represents the percentage of cases on which the coders agree and $P_c$ represents the percentage of agreed cases when the data is coded by chance. From

Table 1 the sum of the diagonal values result in $P_a = 0.75$ and $P_c = 0.125$ leading to the result of:

$$K = (0.75 – 0.125) / (1 - 0.125) = \mathbf{0.71}$$

After an initial low score we updated some concept definitions to its current state and repeated the coding session until reaching a satisfactory score. The highest agreement on a concept was found with time spent ‘in bed’ as those situations occurred regularly and were easy to identify. The marginal totals show the most frequently coded concepts, which are ‘idle time’, time spent ‘in bed’ and the concept of ‘speed’.

### Selective Coding and grouping concepts into categories

The nine concepts have been reviewed according to their suitability for our initial theory of human tactics relating to time, resulting in their synthesis to three main categories of time experience:
“Accelerating the speed of thought” relates to the variability of the time experience and involves the codes “Speed”, “On the way”, and “Checking Habits”.
“Broadening awareness” relates to the continuity of the time experience and involves the codes “Speed”, “Media Multitasking”, and “Checking Habit”
“Defragmenting the temporal self” relates to the non-linearity of the time experience and involves the concepts of “Idle time” and “Checking Habits”

### Formation of a theory

Our initial theory of temporal experience was validated against the data by reviewing all relevant material, compiling evidence and evaluating its strength. Following Strauss and Corbin’s guidelines, we began developing an evidence-supported theory of the interrelationship between humans and personal ubiquitous technologies. More specifically we focused on user tactics aimed at creating self-identity. In the process of research we identified temporal aspects in user behavior, and interpreted that users had temporally fragmented self-identities, which were numerous moments of self-reflective activities aimed at creating glimpses of private time in a public context. Building our theory around this thought, we arrived at more general issues of time and society in view of an ever accelerating pace of life, where technology is not only the cause of speeding up but can also be the means to solve it. We realized that although, a personal ubiquitous computing technology such as the mobile phone might have affected people negatively, as it heightened their busyness, aggravated the effects of interruption and fragmentation on their lived experience, and generally deprived them of the control over their time, we also found a positive aspect that revealed Smartphone use as an enabler of reclaiming control over one's time.

## Findings

On the basis of our qualitative analysis, the preliminary theory explains that Korean youths have developed tactics for reclaiming time-control. They achieve this by changing their subjective time experience with the help of the Smartphone. This is a new finding since previous studies instead have focused on objective measures of changing people’s performance in regard to, busyness (Leshed & Sengers, 2011; Sullivan, 2008), scheduling (Crabtree, Hemmings, Rodden, & Mariani, 2003; Neustaedter & Bernheim Brush, 2006; Taylor & Swan, 2005), time-shifting (Harboe, Massey, Metcalf, Wheatley, & Romano, 2008), or interruptions (Czerwinski, Cutrell, & Horvitz, 2000; Fogarty et al., 2005; González & Mark, 2004).

## *Tactics of regaining control over one's time*

Based on the categories that resulted from the selective coding session we discovered three user tactics involving the Smartphone that change the experience of time and help in shaping a self-identity within a social context.

### Accelerating the speed of thought

This tactic is about exploiting the variability of the time experience. Based on our data extensive instant- and real-time communication sustained the strong and direct bonds within the homogenous social groups of similar age. Instant Messengers, preferably the Korean service 'KakaoTalk' turned out to be the social glue that was widely used in situations on the go and surprisingly also during face-to-face meetings to speed up slow real-world conversations by mixing in a remote person through her online presence. Figure 1 shows the context of conversations that made people think slower. In a debriefing the participant mentioned a feeling of depression that, however, quickly disappeared after picking up the Smartphone and chatting to a remote friend, which sped up thought processes.

Figure 1: Speeding thoughts through chats.

### Broadening awareness

This tactic is about exploiting the continuity of the time experience. Broadening awareness represents the desire not to miss anything and shifting the focus from fetching data in real time to being updated with information all-the-time. Checking behavior and peripheral attention play a key role in achieving this continuous awareness. Media Multitasking among Koreans is a common practice not to be more productive, but to be aware of what is happing around. During debriefing participants noted that the additional media for parallel processing were not actually helping to get more done, as those were time-wasting rather than time-saving technologies, but they implied that having all that sensual noise around had something soothing and that the unpleasant time spent studying felt less like work. In our data we found several instances that indicated time pressure due to an overall accelerated pace of life as a Korean student. We frequently found the participants during their studies. Yet this was done in a way that seemed to have them rather distracted than focused. Figure 2 shows study situations that include multiple media and unconventional settings such as the bed.

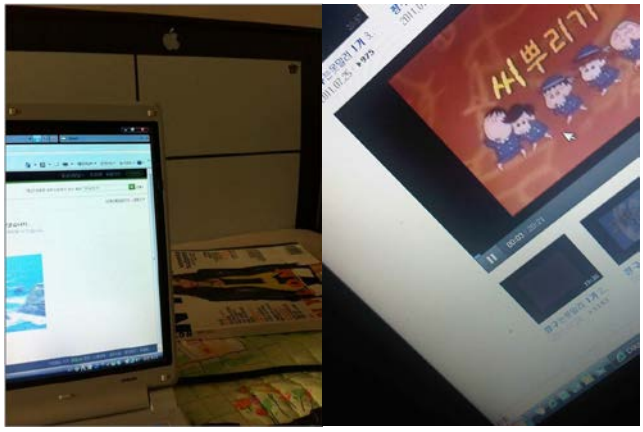

Figure 2: Distracting media running in the background during times of study.

### Filling fragments of Empty Time

This tactic is about exploiting the non-linearity of the time experience. It emphasizes the idea of empty time fragments by describing how the participants experience moments and periods of aimless Smartphone use. The fragments represent uses that happen habitually without the participants' direct intention. In their explanations they expressed how they felt empty and disconnected when being alone, and that their devices enabled emotional feelings to fill the emptiness. Figure 3 shows how a participant habitually picked up the smartphone several times during private moments of solitude, in which she was preoccupied with herself and told about how she felt lonely.

Figure 3: Feeling lonely during the private activity of personal hygiene.

## Discussion

Based on the research findings, which yielded the three categories in form of human tactics to reclaim control over one's time, we discuss three corresponding technological quality factors that respond to the tactics. In addition, we validate our interpretations by holding them up against independent literature sources to find commonalities or patterns. Finally, we develop a theory that addresses the interrelationship between humans and personal ubiquitous technologies.

### *Temporal Quality factors of Personal Ubiquitous Computing*

A preliminary theory that has emerged from our data is the discovery of Personal Ubiquitous Computing essentially being a temporal technology and that human tactics about exploiting properties of time experience impact how people collect and construct their self-identity with their Smartphone. In this section we present temporal quality factors

for Personal Ubiquitous Computing that corresponds to the three previously discovered tactics of *accelerating*, *broadening* and *defragmenting*.

## Speed and Acceleration

This quality factor responds to the variability of the time experience in terms of speed. Our data has shown that Korean youths prefer to speed up everyday's practices such as short bursts of interactions experienced during chats or instant messaging sessions with their Smartphone and link those with a feeling of achievement. In the context of an accelerated pace of life there is evidence that, contrary to a current paradigm of supporting *Slowness* (Hallnäs & Redström, 2001) and reconsidering values in *Busyness* (Leshed & Sengers, 2011), Fast thought processes actually bring about happiness. Pronin et al. studied a link between the speed of thought and mood concluding that paced thought processes, which they coined *Manic Thinking* positively affected the mood and induced feelings of power and creativity, and even a heightened sense of energy and "grandiosity" (Pronin & Wegner, 2006) Killingsworth et al. took an approach from the opposite direction and argue that a slowly *wandering mind is an unhappy mind.* Similar to Pronin et al. the authors draw an indirect link between happiness and speed of thought (Killingsworth & Gilbert, 2010) Both studies support the notion of Speed and acceleration as something desirable and support our findings of Korean students' behavior, which frequently presented bursts of paced thinking and a short but speedy 'Twitter Mentality'.

## Incidental Interactions

This quality factor responds to the continuity of the time experience and describes the importance from the view of technology to be continuously present and remaining in an always-on mode. From the human perspective this means to consider the periphery of attention as it becomes equally important to Personal Ubiquitous Computing as the already broadly discussed focal attention.

There are some approaches in HCI and Ubiquitous Computing research that make periphery a subject of discussion and support our theory of Incidental Interaction. However, much more work in this direction seems to be needed.

Schmidt defined the term *Implicit Interaction to* describe how processing power and sensing technologies can facilitate a wearable context-aware component and a sensor board for indirect communications (Schmidt, 2000). Cowan et al. have explored the mobile peripheral design space with their concept of *Emotipix,* an application that turns the background display into a space for visual communication (Cowan, Griswold, Barkhuus, & Hollan, 2010). Price et al. noted that while studying the role of attention in discovery-learning they encountered instances of time completely off task, which served as essential space for explorations and which they described with *tangential activity* (Price & Falcão, 2011). Williamson's prototype called Shoogle that facilitate excitory multimodal interaction with mobile devices, meaning that they allow eyes-free interactions (Williamson, Murray-Smith, & Hughes, 2007). Finally, Hudson presented his concept of *Whack Gestures* to address inexact and inattentive interaction with mobile devices (Hudson, Harrison, Harrison, & LaMarca, 2010). All the above mentioned examples have in common that they address the periphery of attention to allow interactions of a more incidental nature.

## Intrinsic Technology Integration

This quality factor responds to the non-linearity of the time experience and describes the process of the Smartphone enabling the creation of a self-identity through a deep and intrinsic integration of technology in everyday life.

Existing studies on identity and the mobile phone usually focus on the self-expression through its ownership and use as a material object (Carroll, Howard, Peck, & Murphy, 2003; Srivastava, 2005; Walsh & White, 2007). These approaches are about externally directed self-expressions of people. In contrast, we focus on the internally directed impressions that people experience. More specifically, we focus on how some Korean

youths in our study subjectively experienced personal time as fragments of undesired empty time.
The discomfort with personal time might be particularly typical in Korea. Four relevant cultural factors by Hofstede, Hall and Nisbett respectively (Hall, 1973; Hofstede, Hofstede, & Minkov, 2010; Nisbett, 2004), clarify why Koreans are prone to perceive personal time as empty time fragments. Hofstede claims that social life in Korea is strongly influenced by hierarchy, so that Korean culture shows a high “power distance”. Secondly, Koreans are very collectivistic, as they emphasize the importance of loyalty and unity for the group. Thirdly, Hall points out Korea's high context culture, in which each expression has to be related to the situation. Here, the context rather than the communication delivers the message. Finally, Nisbett indicates that East Asians have a richer understanding of the situations and relations between people than Westerners, but a lower ability to verbalize this knowledge. To compensate for this, Koreans rely on “nunchi” (van Rijn, Bahk, Stappers, & Lee, 2006), a term for high social awareness and empathy towards one's peers that obviates any verbalization. Thus, in a country focused on (1) hierarchy, (2) collectivism, (3) contextuality, and (4) empathy, the individual person defines herself in terms of others around her making social time preferable over personal time.

In this context, we found that the Smartphone as a communicative technology offered a way to fill the scattered moments of empty time with emotional feelings of stimulation and relatedness. The very intimate relationship between our participants and their Smartphones shows that there are aspects beyond pragmatism that explain the deep integration of the phone into people's everyday practices. This practice of how the user is filling empty time fragments during private moments finds support through the concept of ‘plastic time’ (Irani, Jeffries, & Knight, 2010; Rattenbury, Nafus, & Anderson, 2008). According to Rattenbury ‘plastic time’ features the five characteristics of (1) being unplanned and opportunistic (2) shrinking and expanding until it is interrupted, (3) passing by subconsciously, (4) often being non-immersive, and (5) being highly contextual. For our purpose the characteristics of ‘plastic time’ offers clear directions to implement our theory of a Personal Ubiquitous Computing as a temporal technology.

# Conclusion and Future Work

In this paper We explored the subjective quality of smartphone use in Korea, in regard to the phenomena of people's changed time experience with personal ubiquitous technologies. Furthermore, we described the general technological background of smartphone use, which explained the paradigm shift in Experience Design towards Personal Ubiquitous Computing.
On this background, we outlined our qualitative study of the smartphone experience among Korean youths. This study found three user tactics of regaining control over one’s time through the use of the smartphone, which are (1) Accelerating the speed of thought, (2) Broadening awareness, and (3) Filling fragments of Empty Time.
Finally, we formulated the three temporal quality factors for Personal Ubiquitous Technologies. (1) speed of thought, (2) incidental interactions, and (3) intrinsic integrations.

In this study we have taken the approach of opening a different perspective on Personal Ubiquitous Computing, by arguing that it essentially is a temporal technology and that the psychology of time regarding the appropriation and reinterpretation of personal technologies, such as the Smartphone, requires more research.
Our approach to Smartphone use was of an interpretative nature calling for further validations, evaluations, and possibly quantitative studies on a larger scale.
Our future research on Smartphone use will continue with qualitative study approaches and will involve methods of Experience Sampling and evaluations of long-term user experiences. We hope that the key issues presented here will advance the discussion

towards the role of subjective time perception with future personalized and ubiquitous systems.

## References


Abowd, G. D., & Mynatt, E. D. (2000). Charting past, present, and future research in ubiquitous computing. ACM Trans. Comput.-Hum. Interact., 7(1), 29–58. doi:10.1145/344949.344988

Allan, R. A. (2001). A history of the personal computer: the people and the technology. Allan Publishing.

Barkhuus, L., & Polichar, V. E. (2010). Empowerment through seamfulness: smart phones in everyday life. Personal and Ubiquitous Computing, 1–11.

Barrett, L. F., & Barrett, D. J. (2001). An introduction to computerized experience sampling in psychology. Social Science Computer Review, 19(2), 175–185.

Bell, G., & Dourish, P. (2007). Yesterday’s tomorrows: notes on ubiquitous computing’s dominant vision. Personal Ubiquitous Comput., 11(2), 133–143. doi:10.1007/s00779-006-0071-x

Carroll, J., Howard, S., Peck, J., & Murphy, J. (2003). From Adoption to Use: the process of appropriating a mobile phone. Australasian Journal of Information Systems, 10(2). doi:10.3127/ajis.v10i2.151

Chalmers, M., & Galani, A. (2004). Seamful interweaving: heterogeneity in the theory and design of interactive systems. In Proceedings of the 5th conference on Designing interactive systems: processes, practices, methods, and techniques (pp. 243–252). New York, NY, USA: ACM. doi:10.1145/1013115.1013149

Corbin, J., & Strauss, A. (2008). Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory (Third.). Sage Publications.

Cowan, L., Griswold, W. G., Barkhuus, L., & Hollan, J. D. (2010). Engaging the Periphery for Visual Communication on Mobile Phones. In Proceedings of the 2010 43rd Hawaii International Conference on System Sciences (pp. 1–10). Washington, DC, USA: IEEE Computer Society. doi:10.1109/HICSS.2010.184

Crabtree, A., Hemmings, T., Rodden, T., & Mariani, J. (2003). Informing the development of calendar systems for domestic use. In Proceedings of the eighth conference on European Conference on Computer Supported Cooperative Work (pp. 119–138). Norwell, MA, USA: Kluwer Academic Publishers. Retrieved from http://dl.acm.org/citation.cfm?id=1241889.1241896

Czerwinski, M., Cutrell, E., & Horvitz, E. (2000). Instant messaging and interruption: Influence of task type on performance. In Proceedings of OZCHI (Vol. 2000, pp. 356–361).

Fogarty, J., Hudson, S. E., Atkeson, C. G., Avrahami, D., Forlizzi, J., Kiesler, S., … Yang, J. (2005). Predicting human interruptibility with sensors. ACM Trans. Comput.-Hum. Interact., 12(1), 119–146. doi:10.1145/1057237.1057243

González, V. M., & Mark, G. (2004). “Constant, constant, multi-tasking craziness”: managing multiple working spheres. In Proceedings of the SIGCHI conference on Human

factors in computing systems (pp. 113–120). New York, NY, USA: ACM. doi:10.1145/985692.985707

Hall, E. T. (1973). The silent language. Anchor.

Hallnäs, L., & Redström, J. (2001). Slow Technology – Designing for Reflection. Personal Ubiquitous Comput., 5(3), 201–212. doi:10.1007/PL00000019

Harboe, G., Massey, N., Metcalf, C., Wheatley, D., & Romano, G. (2008). The uses of social television. Comput. Entertain., 6(1), 8:1–8:15. doi:10.1145/1350843.1350851

Hofstede, G. H., Hofstede, G. J., & Minkov, M. (2010). Cultures and organizations: software of the mind: intercultural cooperation and its importance for survival. McGraw-Hill Professional.

Hudson, S. E., Harrison, C., Harrison, B. L., & LaMarca, A. (2010). Whack gestures: inexact and inattentive interaction with mobile devices. In Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction (pp. 109–112). New York, NY, USA: ACM. doi:10.1145/1709886.1709906

Irani, L., Jeffries, R., & Knight, A. (2010). Rhythms and plasticity: television temporality at home. Personal Ubiquitous Comput., 14(7), 621–632. doi:10.1007/s00779-009-0280-1

Karlson, A., Meyers, B., Jacobs, A., Johns, P., & Kane, S. (2009). Working overtime: Patterns of smartphone and PC usage in the day of an information worker. Pervasive Computing, 398–405.

Katz, J. E., & Aakhus, M. A. (2002). Perpetual contact: Mobile communication, private talk, public performance. Cambridge Univ Pr.

KCC. (2011). Korea Communications Commission. Survey Report on smartphone usage in the second half of 2011 (in Korean). Retrieved January 19, 2012, from http://www.kcc.go.kr/download.do?fileSeq=33279

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. Science, 330(6006), 932.

Kopomaa, T. (2000). The city in your pocket: Birth of the mobile information society. Gaudeamus.

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 2011 annual conference on Human factors in computing systems (pp. 905–914).
Ling, R. S. (2004). The mobile connection: The cell phone's impact on society. Morgan Kaufmann Pub.

Neustaedter, C., & Bernheim Brush, A. J. (2006). "LINC-ing" the family: the participatory design of an inkable family calendar. In Proceedings of the SIGCHI conference on Human Factors in computing systems (pp. 141–150). New York, NY, USA: ACM. doi:10.1145/1124772.1124796

Nisbett, R. E. (2004). The geography of thought: how Asians and Westerners think differently–and why. Free Pr.

Norman, D. A. (1999). The invisible computer: why good products can fail, the personal computer is so complex, and information appliances are the solution. The MIT Press.

Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2011). Habits make smartphone use more pervasive. Personal and Ubiquitous Computing, 1–10.

Price, S., & Falcão, T. P. (2011). Where the attention is: Discovery learning in novel tangible environments. Interacting with Computers.

Pronin, E., & Wegner, D. M. (2006). Manic Thinking. Psychological Science, 17(9), 807.

Rattenbury, T., Nafus, D., & Anderson, K. (2008). Plastic: a metaphor for integrated technologies. In Proceedings of the 10th international conference on Ubiquitous computing (pp. 232–241). New York, NY, USA: ACM. doi:10.1145/1409635.1409667

Rogers, Y. (2011). Interaction design gone wild: striving for wild theory. interactions, 18(4), 58–62.

Rogers, Yvonne. (2006). Moving on from Weiser's Vision of Calm Computing: Engaging UbiComp Experiences. In P. Dourish & A. Friday (Eds.), UbiComp 2006: Ubiquitous Computing (Vol. 4206, pp. 404–421). Berlin, Heidelberg: Springer Berlin Heidelberg. Retrieved from http://www.springerlink.com/content/x60w551565354377/

Schmidt, A. (2000). Implicit human computer interaction through context. Personal and Ubiquitous Computing, 4(2), 191–199.

Srivastava, L. (2005). Mobile phones and the evolution of social behaviour. Behaviour & Information Technology, 24(2), 111–129. doi:10.1080/01449290512331321910

Sullivan, O. (2008). Busyness, Status Distinction and Consumption Strategies of the Income Rich, Time Poor. Time & Society, 17(1), 5 –26. doi:10.1177/0961463X07086307

Taylor, A. S., & Swan, L. (2005). Artful systems in the home. In Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 641–650). New York, NY, USA: ACM. doi:10.1145/1054972.1055060

Tolmie, P., Pycock, J., Diggins, T., Maclean, A., Karsenty, A., & Ab, C. (2002). Unremarkable computing. In IN PROCEEDINGS OF CHI 2002 (pp. 399–406). Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.115.4870

Turkle, S. (2011). Alone Together: Why We Expect More from Technology and Less from Each Other. Basic Books.

Van Rijn, H., Bahk, Y., Stappers, P. J., & Lee, K.-P. (2006). Three factors for contextmapping in East Asia: Trust, control and nunchi. CoDesign, 2(3), 157–177. doi:10.1080/15710880600900561

Walsh, S. P., & White, K. M. (2007). Me, My Mobile, and I: The Role of Self‐ and Prototypical Identity Influences in the Prediction of Mobile Phone Behavior. Journal of Applied Social Psychology, 37(10), 2405‐2434. doi:10.1111/j.1559-1816.2007.00264.x

Weiser, M., & Brown, J. S. (1996). The coming age of calm Technology. Xerox PARC. Retrieved July, 8, 2007.

Williamson, J., Murray-Smith, R., & Hughes, S. (2007). Shoogle: excitatory multimodal interaction on mobile devices. In Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 121–124).

## Yong-Ki Lee

Yong-Ki Lee presently is a Ph.D. Candidate in the Human-centered Interaction Design Lab within the Department of Industrial Design at KAIST (Korea Advanced Institute of Science & Technology). After gaining diverse knowledge through undergraduate studies in architecture and urban planning at the University of Dortmund and Darmstadt University of Technology, as well as through five years of professional experience in advertising and communication design, he graduated summa cum laude at Köln International School of Design in Germany. In his studies he focused on the Theory of Design and on qualitative Design Research methodologies. He is currently studying research methods related to understanding the User Experience (UX) with Information & Communication Technology. In specific, he focuses on the Diary-Study methodology to understand long-term smart phone use, and to identify and analyze people's subjective experience of time with technology.

## Kun-Pyo Lee:

Kun-Pyo Lee is professor at Department of Industrial Design at KAIST and director of the Human-centered Interaction Design Lab. He is also serving as president for the International Association of Societies of Design Research IASDR. He was the Executive Vice President and Head of Corporate Design Center of LG Electronics. He studied design at Joong Ang University (BFA) Korea, IIT Institute of Design (MS. Design) US, and University of Tsukuba (Ph.D. Design) Japan respectively. His research interests include design methodology, design planning, user-centered design, user-interface design, user-experience design and crowd-sourced design. In addition to teaching and conducting research, Dr. Lee has worked on research projects with the world’s leading companies and organizations, such as LG Electronics, Samsung Electronics, Johnson and Johnson, Volkswagen and various governmental organizations. He has served on advisory boards of several organizations and journals in Korea and abroad and has worked for various professional design organizations.