Understand user-device relationship in multiscreen exercise activity

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Abstract: The emergence of a variety of different technical devices has changed the ways we manage things, live our lives, gain new knowledge, or maintain a healthy lifestyle. According to Manhattan Research (2012) multiscreen health activities are on the rise. More and more exercise related equipment or gadgets are being adopted for the purposes of tracking, enhancing or facilitating our physiological state. Research in this field have addressed issues in the type of interaction, usage pattern and information perspectives, to explore the mechanisms between intrinsic issues (individual differences, content and device), and extrinsic issues (environmental context and culture implications). Less attention has been paid to deal with the relationships between the users and their devices during exercise activities. Some reports have shown why and how people utilize multiple devices in their daily lives, as well as what those devices mean to them in general, but it may not be the same while applying to the context and purpose in the domain of physical health. Mobile devices like smartphone, tablet or exercise gadgets provide specific functions and convey different messages when used in the context of exercise. The goal of this study is to explore the kind of devices people use during exercise, the usage context, and the emotional reaction derived from multiple devices by understanding the role of each device and how it can affect users' perception to the content and the motivation to the goal from a user-centered point of view. The findings of my study ascribed roles to the investigated devices through in-depth interviews. This study is to propose a conceptual structure of the user-device relationships in exercise activities, and provide a basic understanding on how we could map out the content, strategies or different ways of interaction with the characteristics of devices to maximize the effectiveness of the outcome.

Keywords: exercise, user-device relationship, multiscreen, product attachment, motivation

1. RESEARCH BACKGROUND

Technology has gone through a number of technological advances driven by the innovation of new technical phenomena and/or influenced by the evolution of human lifestyle. The Internet phenomenon made activities and communications possible without geographical and timely constrains. Things that we encounter in our daily lives have turned from tangible to intangible online materials and people nowadays receive information mostly from online search engines, email, blogs or all kinds of electronic platforms. Internet has become the main source of information provider, and enables information synchronization in all kinds of devices that are able to access the Internet. As the Internet ecosystem converged, Internet penetrates into our daily lives and reaches users across all touch-points and devices. According to the 2013 survey conducted by the International Telecommunication Union, 40% of the world's population are online and the percentage is growing each year (ICT, 2013). Internet builds up the communications between two and up to several entities, and changed the ways of how a single individual to a large enterprise communicate, collaborate and innovate. The trends of multiscreen, crowdsourcing, e-learning, online medical consulting services are a few examples that demonstrate the impact of Internet phenomenon. Internet made it easier for people to connect with each other through various platforms, it also strengthen users' attachment toward multiple devices and result in different sets of relationship.

With the latest mobile technological advances in smartphone mobility, multimedia and ubiquitous computing, the mobile phenomenon has emerged rapidly with the mass adoption of smartphone. While the always-on connected devices increased, 90% of the media are consumed through variety of screens including smartphone, laptop, tablet and television as compared to 10% with non-screen interaction on radio and paper-based artifacts as according to Google's research on multiscreen (Google, 2012). The increase in device mobility enables people to access data anytime anywhere which have added more mobility into our lifestyle. From desktop computer to smartphone and tablet, the usage context has broken its boundaries and have been expanded everywhere. Mobile devices are not used only for the purposes of communication, but have also become the vehicle for interactive audiovisual contents that are always-on, context-aware, and are being viewed, transferred, retrieved and distributed on the go. People start to establish significant relationships with their devices, such as mobile phone, tablet or PDAs which contain private personal information and often employed with a more active attitude, and used as primary or secondary screens (Cesar, Knoche & Bulterman, 2009).

Before multiscreen phenomenon emerged in recent years, the user-device relationship have been referred to as how users interact with a single device, and research in this area have provided valuable insight into subjects like user emotion, human behavior, attitude and motivation mainly dealing with single device interaction. However, in the era of multiscreen world, people no longer interact with with only one device, instead they interact with multiple devices in sequence or in conjunction with one another to extend device possibilities within a broader context. More interactive experiences appeared as user behaviors get more complex, the role of technology becomes versatile, and there is a need of reassessment to explore the interplay between users and their multiscreen. This study proposes that the potential of Internet and device mobility have made devices integrate seamlessly with one another while users are no longer restricted to using a single device but are able to choose the right kind of devices that suit their current usage and needs.

2. MULTISCREEN STUDIES

Multiscreen phenomenon has yielded research opportunities in various academic disciplines dealing with how we interact and connect with multiple devices, as they have gradually become a great part of our lives. Technological convergence led to media divergence, and resulted in different kind of devices and forms of content to serve users' various needs (Roscoe, 2004). For example, ESPN (Entertainment Sports Programming Network) fans are exposed to multiple devices everyday in various contexts. *"The ESPN fan who watches "SportsCenter" as he gets ready for work, listens to (radiocast of the television show) "Mike & Mike" on the way to work, uses ESPN.com to keep up with sports news during the day, and either watches ESPN on TV at home or goes out and uses ESPN mobile* (Assael, 2011). The adoption of several screens to perform related or unrelated tasks represent that every screen has its own benefits which people are able to use alone or together to create smarter and elevated user experience (Caras, EMEA & Microsoft Advertising, 2010). The technology has changed and so do other aspects that have been influenced by this kind of phenomenon: interaction goes from single to multiple, system usability goes from emphasizing on reliability to flexibility, services goes from linear to non-linear. Even information management takes into account the communication switching and mobility (Oulasvirta & Sumari, 2007). The multiscreen phenomenon has changed how we interact, think and learn; therefore, it is relevant to say that our relationship with screen is no longer limited to single screen interaction. According to Manhattan Research (2012) multiscreen health activity is on the rise. However, less attention has been paid to deal with the relationships between the users and their devices during exercise activities. Some reports have been showing why and how people utilize multiple devices in their daily lives, as well as what those devices meant to them in general (Matthews, Pierce & Tang, 2009), but it is not the same while applying to the domain of physical health.

People formed close relationship with mobile phone and PDAs, which are considered to be "personal accessories" (Wehmeyer, 2008), and described as an extension of one's self (Pertierra, 2005). Most of the researches in user-device attachment are done from mobile phone perspectives, and it is worth probing into such nature of relationship that it might shed light on the relationships with multiple devices that this study is going to investigate. This close relationship was defined as product attachment that illustrates the emotional experiences between product and its user (Schifferstein, Mugge & Hekkert, 2004). The relationship with modern technology has become tighter for the past decade, and the role of technology in human's lives has transformed from dominating, facilitating, and influencing to the extent of changing the perception and cognition aspects of human. Mobile device is considered hybrid with its voice and data features (Sarker and Wells, 2003). Devices are perceived with different meanings and functionalities according to the context and time of use, while the form size and lightweight make them possible to be carried around and thus the relationship between users and devices become even more complex and diversified. For example, tablet is interpreted as a multimedia station during leisure time, as an on-the-move professional assistant in formal business hours and as a entertainment device for socializing (Zamani, Giaglis & Nancy, 2012). The role of device is changing interchangeably, and perceived with various expressive meanings. People refer to device as their companion, which is reflected with personality and defined beyond its instrumental power (Turkle, 2007). Understand the relationship with multiscreen enables further prediction between multiscreen behavior and users' expectations.

Under this circumstance, the roles and functions of device is required to be redefined and generate with new sets of meanings. This study aims to explore the relationship people developed

with multiple devices during exercise activities. To explore the kind of devices people adopt during exercise, the activity types by device, and the user-device relationship by clarifying the role of each device, the emotional mapping and how its characteristic could affect users' reaction to the content and motivation to the goal from a user-centered point of view.

3. METHOD

The purpose of this study is to explore the user-device relationship in exercise context; therefore, it is important to know the kind of devices people adopt, and the emotional bond and insights that are elicited from the interaction with multiscreen. This study conducted in-depth interview with three participants (two males and one female; average age 28), whom are students and have been actively using multiple devices in exercise activities for approximately one to two years. Participants were selected to have been using those devices for a long period of time to avoid early adoption issues like technical or acceptance problems, and to make sure that their experiences are stable and reliable for research. The in-depth interview were conducted for approximately 1.5 hours each, and each participants were informed before the interview to bring the devices which they utilize during their exercise for demonstration. In these interviews, participants were asked about their exercise goals, types of exercise they perform, situations of where and how they used their devices, and also what kind of devices they use during exercise. They were also asked to describe their connections to those devices through usage patterns, and emotional bonds. Interviews were used as a way to elicit participants' emotions as to how they felt while using those devices and how they would give certain role for each device without the need to observe them in action or to ask them to fill out questionnaires. The results were analyzed and aggregated to create significant implication on users' relationship with multiscreen during exercise activities.

4. FINDINGS AND DISCUSSION

The participants used their devices mostly at the gym, school track and sidewalk. The differences in location impacted the kind of devices being used. The devices utilized by the participants include smartphone, laptop, television and other screens such as pedometer and weight scale.

4.1. The role of devices

Devices that were originally designed for one specific feature, now possesses more than one role. For instance, mobile phone transforms from merely a communication tool to what we considered a hybrid tool (Sarker & Wells, 2003), which can be used for navigation, data searching, socializing, entertaining and so on. Most often the roles of the devices in exercise activities can be categorized to indoor and outdoor settings. The influencing factors that determine how devices mean to users are exercise goals, activity types, motivation, and technological characteristics such as network capability, mobility and content design.

4.1.1. Smartphone

Participants described smartphone as a communicator, a recorder, an entertainer in indoor exercises, and a coach in outdoor exercises. It is the main device that is being utilized the most in exercise activities by participants. Smartphone's small size makes it easier to carry around, to manoeuvre with one hand and to fix on exercise equipment. This study analyzed smartphone usage in two phases: before exercise and during exercise, to demonstrate how the role of devices

shifted with user needs and changing context. Participants have stated that before exercise, smartphones were used as communication tools to contact exercise pals through phone calls and sending online or offline messages. As one participant said, "*I contacted my exercise buddies to make sure that everyone is going to the gym tonight*". Communication beforehand acts as a trigger for the activity to take place as several research studies have proved that social interaction in physical activities result in increased motivation (Biddle & Mutrie, 2001). The role of smartphone shifts with the change of contexts. During exercise, smartphone plays interchangeably different roles and establishes distinct connections and relationships with its owner, holding specific meanings for each participant. "*Smartphone is the best tool I can think of to record and store my personal data, I don't need to memorize the numerical data and then go home and key in onto my laptop*, it saves me time" Two participants described smartphone as a secretary that helped them to record their fitness data such as the kind of fitness equipment they used, exercise duration, and calories burnt, which are considered personal data. The use of smartphone made it easier for them to manage data digitally instead of paper-based recording. The management of personal information is part of what people need to pay attention to in the multiscreen world as to manage personal information across multiple devices. Also, since smartphone contains personal data, this result in people seeing smartphone as an extension of self (Zimmerman, 2009). This reveals the needs for users to store their private data in secured place while it is also reliable to manage data across multiple devices. The relationship between smartphone and exercise is intense and it is reflected through user's emotional attachment to their smartphones. "*I feel anxious if I forget to bring my smartphone because I might not be able to keep record*", stated one participant. The fear of losing data accurately showed the need of people to keep track of personal data and to synchronize data across devices. Other exercise-related smartphone usages that influenced participants' emotion were also discovered from the interview. Smartphone was also considered as an entertainer, providing recreational functions such as music, movies, e-newspaper or games, which may or may not be related to exercise itself, but serve personal enjoyment. "*When I felt low in physical strength and will power, I start to watch TV or use my smartphone to distract myself from paying attention to my sore muscle and bodyache*", "*You never feel bored with smartphone by your side, it possessed the powers of multi-sensory, vividness and richness that provides endless entertainments*". Such multifunctional features often bring extra motivation for the current task. The role of smartphone is diversified and can be assigned to meet user need and use context. In outdoor exercise situations like school track and sidewalk, the small and light-weightiness of smartphone possesses more advantages than any other devices with Internet access. "*I use a fitness application called RunKeeper on my smartphone to track my running distance, and this application provides me with instant feedback (through my headphone) on how far I have run and whether I have reached my goal. It is like having a coach by my side. I feel both motivated and inspired.*" This shows that users like to feel in control of their exercise progress while being given prompt feedback. These will help them reach their goal in an easier way with more pleasant experience.

4.1.2. Laptop

Laptop is less mobile than other hand-held devices. Its medium size and weight make it not as easy to operate in motion; therefore, it is often used in stable locations such as coffee shops, offices or at home. In the context of exercise, laptop usage occurred most often both before and after exercise for various purposes as opposed to during exercise. Participants in the interview portrayed laptop as their long-term partner. Laptop acted as a gateway toward knowledge, insight, sharing and self-reflection. Some quotes from participants stated that: "*I used laptop a lot for*

exercise-related information seeking. I found the right kind of fitness equipment for muscle building as well as how to prevent myself from exercise injuries", "*I searched for opinions and experiences online from people whom have the same problem or exercise goals with me, and see how I can learn from them*". Laptop serves as a quick and convenient first priority tool for information gaining. The knowledge absorbed through searching process also affects later decision-making and how people accomplish their goals. As one participant said "*It was until I knew that cardio exercise worked best with weight training for losing fat, did I start to change my exercise plan.*" Exercise evaluation was conducted through fitness service websites (participants used RunKeeper in this case), which participants synchronized their exercise data from their smartphones to their laptops. "*I checked the website on a weekly basis to see my exercise records, and evaluated whether I have achieved my weekly goal. Seeing the number of running miles increasing was the greatest motivation to me.*" Users employed laptop to manage their scattered exercise data, evaluate exercise performances, display history exercise record or share with friends their goal achievements. The results from the interaction with laptop show that a great amount of time are spend on self-reflection and awareness in relation to the exercise performances, which are indicate to be crucial factors to increase motivation (Ronda & Brug, 2001).

4.1.3. Television

The relationship with television in domestic contexts is like being with an old friend, it is casual, laid-back, and just like being with a friend (Microsoft, IPSOS & BBDO, 2011). Televisions in the gym may not have a direct influence to exercise itself, but they do have emotional and motivational attributes to the participants. As they mentioned, "*TV is like an companion which accompanied me throughout the exercise, it made me feel less bored and let me forget how hard I am working right now*", "*If there is a chance, I often choose the fitness equipment with embedded TV in them*". Sometimes exercise requires repetitive physical and emotional commitment and watching television is a way to distract people from paying attention to the exercise itself and put mind at ease. Interestingly, as participant said, "*I am not always paying attention to the television program content, instead I play games, check some social networking websites or read my email at the same time.*" Smartphones thus can be used like a secondary screen while watching television, and this multiscreen behavior was found in other research studies as to enrich TV watching experience (Cesar, Bulterman & Jansen, 2008). However, in the context of exercise, TV watching is not the primary task, but as an aid to help people complete their exercise routine. It is believed that the complementary use of smartphone as the second screen experience is perhaps inherited from people's daily interaction with television.

4.1.4. Other screens

Pedometer and weight scale are part of the devices participants adopted during their exercise activities. Pedometer is used during ambulatory activities like walking and running for counting the number of steps and the distance travelled. "*I carried my pedometer in my pocket everyday with me to almost anywhere. My pedometer have an internal 7-day memory, so I usually checked the number of steps I have walked at the end of the day, and adjusted whether I need to walk more tomorrow*" as stated by one participant. Its hardware and software design make pedometer simple and easy to use without any set up beforehand; therefore, it is accessible to a wild range of population (Bravata et al., 2007). Participants refer to pedometer as simple, invisible and friendly, and described it as a soundless friend who stays by their side everyday. Weight scale is more like a ruler that participants used as a device to measure whether they have achieved their desired weight. However, participants did not feel any connection or emotional reaction with the weight scale mostly due to the short interaction time and limited content provided. Screens without

Internet access functions like pedometer and weight scale usually operate alone and have less interactions with other devices, but they have been proven to be easily adopted and utilized as self-monitoring tools (Lubans, Morgan & Tudor-Locke, 2009) as well as motivational tools (Kang et al., 2009) for promoting physical health.

**Table 1:** Overall usage and device role by activities

Activity	Device	Usage	Device Role
Indoor Activity (Gym, Home)	Smartphone	• Used for social connection, which acts like a trigger. • Easy and convenient for users to carry around and used as a main device to connect with their other devices. • Used for personal purposes such as managing personal exercise data, or dealing with unfinished works. • Most of the time, it is utilized to kill time or serves for personal enjoyment, which also adds motivation and increases exercise sustainability.	Communicator Recorder Entertainer
	Laptop	• Quick and convenient first priority tool for exercise information gaining. • May affect later decision-making and ways to accomplish the goals. • A better device to manage scattered exercise data, evaluate performances, and display history records. • A great amount of time are spend on self-reflection and awareness in relation to the exercise performances.	Long-term partner
	TV	• Provide additional emotional and motivational influences to the users. • Used to distract users from paying attention to their sore muscle and bodyache while also sustain their exercise behavior. • Usually used in conjunction with smartphone as a secondary screen.	Old friend
	Other screens	• Pedometer is accessible to a wild range of population since it is easy to use, lightweight and no pre-set up is required. • Weight scale and pedometer are easily adopted and utilized as self-monitoring tools as well as motivational tools for promoting physical health.	--
Outdoor Activity (Track, Street)	Smartphone	• Small and light-weightiness of smartphone possesses more advantages than any other devices for outdoor locomotor activities. • Users like to feel in control of their exercise progress while being given prompt feedback.	Coach
	Other screens	• An easy and immediate tool to grab for tracking outdoor activities.	--

4.2. Usage based on time

This study analyzed usage of multiscreen devices through time intervals: before, during and after exercises. Exercise setting (indoor and outdoor), behavior path, and usage modes (sequential and simultaneous usage) and considered in relation to the utilized devices. The result revealed how multiscreen are utilized the second screen effect and specific usage in relation to the exercise context. These results provide a basic understanding on how people react to the multiscreen phenomenon.

Result from indoors setting in Figure 1 showed that before exercise, laptop and smartphone are used simultaneously: communication and searching for exercise-related information are both done prior to going to the gym, but communication takes a more important role at this stage. In behavior path, contacting friends from smartphone acts like a trigger for the exercise activities to take place, and the presence of trigger often indicates motivation. Previous research has stated various strategies for motivation, such as social support, feedback and rewards (Fogg, 2002). Therefore, it is important to know how people use their multiple devices in different stages as a basic standpoint for motivational strategies or other services to be added on. Participant used smartphone, pedometer and TV all together during exercise for different tasks but at the same time complementing with each other. Television and smartphone are used like secondary screens to enrich exercise experience and to distract attention on physical and psychological tiredness, while

it is also noticeable that complementary usage of television and smartphone indicate users' multitasking behavior and the nature of being engaged at all time (Microsoft, Flamingo & OTX, 2013). The emotion derived from using devices has an influential factor to its users on the kind of devices they choose to be used with one another to enhance exercise experience. Participants tend to select TV programs that suit their exercise type in the gym. "*Part of my purposes of going to the gym is to relax, so I will choose to watch movies with more positive mood and avoid watching tense movies which will affect my emotion*", "*When I am using the elliptical machine, I like to watch sport competitions like NBA since they have similar pace and motivates me to work harder*" Therefore, content and emotion are two influential factors when devices are chosen to be used solely or in conjunction with one another to meet user needs or completing a task. Smartphone, in particular, is used sequentially throughout the whole exercise process, showing that its technical capability and content availability are both mature enough to conform to all kinds of contexts.
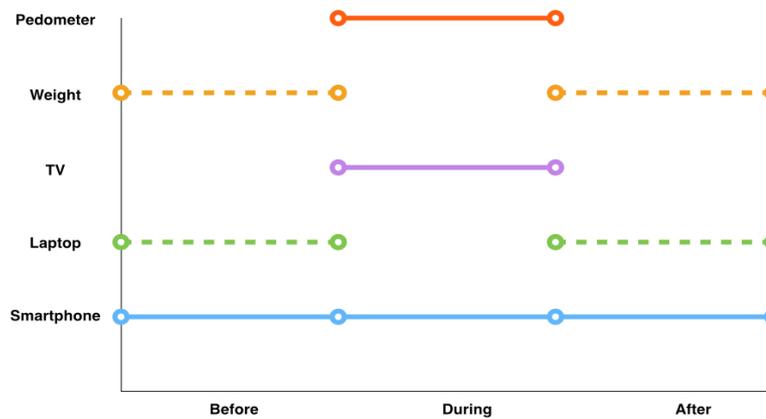
Figure 1: Indoor exercise (The adoption span of different devices before, during and after exercise)

The relationship with multiscreen in outdoor situations shown in Figure 2, occurred mostly after exercise, and this is due to Internet availability, form size and device mobility. Participants often transfer exercise data such as step counts and distance travelled onto their other laptop or smartphone for later retrieval and evaluation after exercise. Data synchronization is a critical issue since it saves time for data transferring and participants feel more motivated if their devices are able to sync with their other devices easily. During outdoor exercise, participants used pedometer and smartphone for keeping track of their exercises, while smartphone is sometimes used as secondary devices for listening to music.
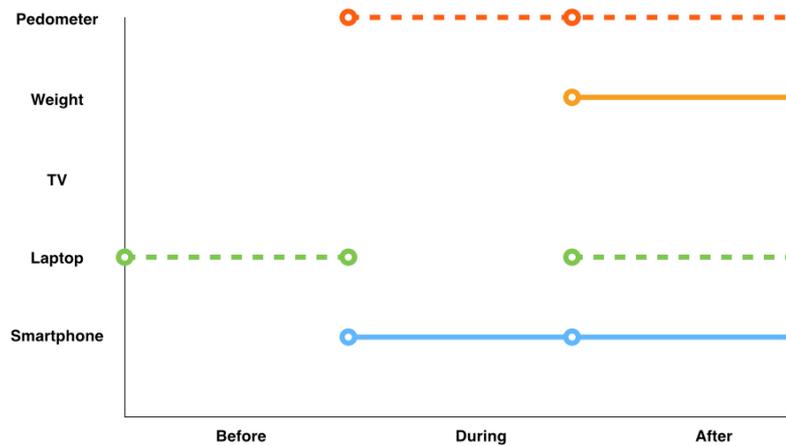
Figure 2: Outdoor exercise (The adoption span of different devices before, during and after exercise)

Defining the devices through time interval clearly demonstrated what device are suitable for current stage of use and how the interplay between content and emotion come to affect the sequential and simultaneous usages that may reflect in users' decision making.

4.3.   Goal setting

From the interview we also found that goal setting plays an important determinant in revealing participants' action pattern, behavior path and emotional reaction. People exercise for the purposes of fulfilling their goals or hoping to accomplish certain results. No matter it is to maintain a healthy lifestyle, improve performance or for relaxation, users take different approaches to fulfill their desires, and the actions they take may determine the kind of devices being adopted and their relationship with those devices.

One participant reported having set up specific goals for losing weight on a periodic basis (weekly and monthly goals) and before an important event like travel. He mentioned that goal setting encouraged him to keep exercising, and act as an indicator for him to reflect back from time to time on how far left he had to work on to accomplished his goals. He used both the smartphone and laptop to keep track of his goals. He mentioned in the interview that setting exercise goals have two effects: in short term, goals motivated him to continue pursuing exercise and keeping track of the numbers (weight, calorie intake, calories burnt, body fat) that helped him compare exercise results on daily basis and reminded him on whether more exercises were needed. In the long term, the overall goal records portrayed as an inspiring milestone that increased his self-image as he proudly said *"In the past two years, the distance I have ran by foot is equal to the distance of circling the earth once."*

On the contrary, the other two participants did not set up any specific goal but are hoping to get "in shape" and to increase muscle strength. One participant reported that in the beginning, he actively kept exercise records using his smartphone, but after a while he does not exercise as frequent as before. The participant mentioned that the lack of a clear definition of "in shape" made him less motivated to go exercise. Moreover, keeping exercise record became boring and troublesome for him after a while as he said "*I think the application needs more variation such as adding some group competition function or other features that motivates me*". In addition, he felt exercise did not interest him as much as before and he did not know when he could achieve his

desire of being "in shape". There is a decline in positive emotion with the number of exercise taken, as participants start to feel bored. At the time of Interview, both participants said that even though they didn't set up any specific exercise goals, they still went for exercises now and then because they believed that they would slowly get closer to getting "in shape" and increased muscle strength.

The above situation is similar to Hassenzahl's research in usage situation, which he defined into goal mode and action mode. Goal mode means goal fulfillment is the key to all actions, while individual describes themselves with terms like "serious" and "planning", but in action mode, taking action is the key while users feel playful and spontaneous (Hassenzahl, 2005). Drawing from this point of view, we can argue that having specific goal or having volatile goal plays vital role in exercise activities since it influences users' behavior, and the adoption of the devices and thus reshaping the relationship between user and the multiple devices.

5. CONCLUSION

The emergence of multiscreen, which has been a prominent phenomenon for the past few years, has changed people's lives and how they interact with their devices. This study explored the user-device relationship in exercise activities. It mapped out the changing relationships between user, context, usage modes and the roles of device. Knowing these relationships could help explain how multiple devices are adopted during exercise activities and how can they be utilized to achieve desired goals or enhance exercise experiences. Device constraint, mobility of device and users' body movements split exercise into two categories: outdoor and indoor exercises. The differences in context also resulted in the kind of devices people choose to adopt.

Based on in-depth interviews with three participants, this study showed that smartphone, laptop, television, pedometer and weight scale are used interchangeably throughout exercise processes. Among all of the devices, users developed a stronger sense of attachment with their smartphone, which is often being adopted as the primary device. The role of smartphone transformed from communicator, secretary, coach to entertainer through different stages of exercise. The personal physiological data being recorded is viewed as private assets, so much that users refer to smartphones as an extension of self. Therefore, the feelings of security and reliability are what users look for in the relationship with smartphone. Moreover, the multifunctional feature of smartphone broadens the user-device interaction and is being perceived by the users as a device with multi-sensory features, vividness and rich characteristics. The role of laptop in indoor context is like a device for investigation and knowledge seeking. It is used the same way in exercise context as it is being described as a long-term partner. However, in the context of exercise, users employed laptop to manage their scattered exercise data, evaluate exercise performances, display history exercise record or share with friends their goal achievements. Therefore, the relationship with laptop is mainly based on self-reflection and awareness that have significant influences for motivation. Television is one of the devices that users refer to as companion during indoor exercise. Even though using television may not have a direct influence to the exercise itself, but it does have emotional and motivational influences to its owners such as decreasing tensions derived from exercises and sustaining exercise behavior. TV watching is often being complimented by the use of smartphone for dealing with personal tasks such as checking email or playing games, which demonstrates that users like to multitasking even during exercise because they want to keep one single device for their personal use (Oulasvirta & Sumari, 2007). Other devices like pedometer and weight scale do not show prominent attachment with the users and it is due to their hardware characteristics that promote minimum interactions. However, it is found that the low technical

barrier made them easy and simple to adopt, especially pedometer that is often being implemented as a motivational tool to improve physical health for the general population (Mansi et al., 2013; Bravata et al., 2007). This paper also discusses the user-device relationship in time intervals. The complementary usage of smartphone and television shows how users like to be engaged at all time, and emphasizes on the importance of the interplay between content and emotion to enhance positive mood. The technical constraint and content availability of the devices and the contexts and types of exercise also direct how users define each of the devices and adopt them for sequential or simultaneous usages. Moreover, through exploring the relationship between users and devices, we found that the differences between having specific goal and having volatile goal determine the action approach users' take, their behavior path as well as the adoption of the devices.

This paper investigated the user-device relationship from multiple perspectives: how users characterize the role of each device as well as through exercise context and user behavior, to get a holistic understanding of how use-device relationship is constructed. This study stands at the beginning of possible discussion and further research on the concept of user-device relationship in the multiscreen world. The concepts raised in this study will have further development while more empirical studies will be conducted.

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BIOGRAPHY

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Yi-Shin Deng received his Ph.D. and M.Sc. in Industrial Engineering from Department of Industrial Engineering, University of Pittsburgh, Pennsylvania, United States. He is an associate professor in National Taiwan University, Taiwan. He is an active researcher and instructor on topics including human-computer interaction, user experience design, social informatics, design theory and methodology and computational design. Other research and practice on applying user research approach and exploration design processes to ICT device design, social software platform development, and service design are also his research interest.