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Use of health tracking devices by Digital Natives has drawn the attention of the health tracking technology industry. Despite that, it is not clear how those technologies really work for them in their life contexts, and more study is needed to understand how they interact with the large amount of information generated by these technologies. My study borrowed the Savolainen model of everyday information practice as a theoretical lens to focus on life contexts around the use of health tracking technologies. The data was collected qualitatively, through semi-structured interviews with nine college students. In the findings, information practices, personal life contextual factors, and technology enablement are identified. In evolving relationships among these factors, how information affordance was offered was discussed. Many information practices still relied on manual means, as reflected by life contexts.

Headings:

      Information science -- Research

      Information technology -- Health

      Information practice

      Information use

INFORMATION PRACTICES OF YOUNG USERS IN THE CONTEXT OF HEALTH
TRACKING TECHNOLOGIES

by
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Approved by

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In wrapping up my thesis, I can finally feel the fresh summer breeze and realize how many flowers have blossomed around my department building. They smell sweeter than ever.

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*"… it struck me as both magical and mundane that technology that had saved me was simply hands. **Of course, our technology is us**."*

— *Eula Biss, On Immunity: An Inoculation*

*".. **We are stuck with technology when what we really want is just stuff that works**."*

— *Douglas Adams, The Salmon of Doubt*

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## INTRODUCTION

### 1.1 Research Motivation

Health tracking technologies have rapidly gained popularity in recent years as such devices have become prevalent in our daily lives. According to Soreon Research in Switzerland (2014), the market for wearable healthcare devices is expected to grow 65% each year and over $40 billion by 2020. The technologies hold great promise for promoting health and physical performance by tracking users' health states and activities.

In most cases, these technologies come in the form of built-in mobile applications through personal digital devices, such as smartphones and tablets. The healthcare device industry is also keeping an eye on these changes. According to digital health philosopher John Nosta, in an interview in Real Business (2015), the young generation — individuals who have grown up with prolific digital technologies environment all their lives — will bring about a major shift in developing mobile health technology, because they use smart devices very skillfully and are used to ubiquitous computing.

Marc Prensky (2001) referred the generation born after 1980 as ~~to~~ 'Digital Natives (DNs)'. It is often called the 'Net Generation' (Tapscott, 1998, 2009), or more recently the 'Google Generation (Rowlands et al. 2008, JISC-Ciber 2008) or the i-Generation (Rosen 2010). Dingli, A. and Seychell, D (2015) narrowed down the scope of 'the second generation of Digital Natives (2DNs)' by referring to them as the 2DNs — those who were "born around the end of the first decade as a new breed of digital

citizens" (p.20).

Digital natives are expected to be more knowledgeable about their healthcare by taking advantage of the growing numbers of smart health monitoring devices. For example, some digital native parents use such health technologies to monitor their children (Shenolikar, 2015). The digital natives are gradually drawing attention from health industry as major users of smart health technologies in near future

However, despite their popularity and the rising number of prospective users among Digital Natives, it is still not clear whether smart health monitoring technologies really work to for young people as promised, and if so, how. Additionally, how they use health tracking technologies seems complicated. According to recent research by Flurry, a mobile analytics subsidiary company from Yahoo (Simon Khalaf , 2014), usage of over 6,800 health and fitness applications in 100,000 devices were sampled. The results showed that usage among the Digital Natives generation (18-24 ages) was actually under-index by 57% compared to the average. Unlike their general tendency toward technology use, Digital Natives don't necessarily prefer smart health tracking technologies in the context of managing their daily health care, such as tracking fitness and diet.

In this regard, research may need to go into detail for understanding how Digital Natives actually take advantage of health tracking technologies, particularly by looking at their daily life contexts. This is because, as Dingli and Seychell underline in their book, "we cannot understand the digital natives without also understand the context in which they live" (2015, 3p).

Given the fact that a lot of information is generated by health tracking technologies, a lot of attention needs to be paid to how DNs use these technologies in their daily lives.

This study was designed to explore research questions: (1) what kinds of information practices are implemented while using-health tracking technologies (2) how those technologies offer information affordances to digital natives, and (3) what usage looks like in their daily life context.

## 1.2 Literature Gaps

Research on the use of mobile technologies for use in tracking exercise or diet has been conducted widely in many disciplines, particularly, in the field of Human-computer interaction (HCI). Most research observed practices around interactions with health related technologies, while few studies took the approach of practice theories. Likewise, despite the fact that studies in the theory of practice have drawn on everyday life examples to support its perspectives, it's hard to find practice theory studies dealing with how people are informed by using health tracking technologies in everyday practices.

However, some fields such HCI, CSCW (Computer Supported Coop Work), information science and etc, recently called for research that uses "practices" as a tool of analysis. Some researchers of sustainable HCI have already adopted a practice approach by emphasizing its insightful perspective. In this regard, Entwistle et al (2015) noted that "what we should be focusing on is how people engage in the practices of everyday life, …, if we are to truly affect their behaviors through technology" (p.1125).

Furthermore, Kuutti and Bannon (2014) proposed that HCI researchers pay more attention to practice-based approaches as a methodological framework. In terms of researching the daily life uses of healthcare technology, practice theory was recommended by Grönvall and Verdezoto (2013). According to them, practices-based

approaches as a conceptual framework allow us to give rich description on how people bring healthcare technologies into their life contexts and use. Aligned with this view, specifically for researching healthcare technology, theoretical frameworks and models are needed in order to embrace uses of the technologies in non-clinical settings (Grönvall and Verdezoto2013; Fitzpatrick and Ellingsen, 2013).

In information science literature, many researchers, particularly Savolainen (2008), also have called for more research on information uses based on practice theories. He indicated that it could be done by looking at how certain types of information practice are used in the context of everyday life. In response to those research demands, this study borrowed the perspective of practice theory as theoretical lens to focus on everyday life context around using health tracking technologies, particularly in fitness and food intake. This practice-based approach would be useful in order to understand how information practices and the technologies are saturated with life contexts.

# LITERATURE REVIEW

## 2.1 Contextual Literature Review

Health and fitness technologies have gained increasing popularity in the recent years. Such technologies, including mobile applications and wearable technologies, allow users to track steps, calories, heart rate, sleep, etc. It's no longer unusual to see people using health and fitness technologies during their daily routines. As health and fitness technologies has spread, research on the topic of health and well-being has grown in academia, especially in personal informatics (Choe et al., 2014; Consolve, S et al., 2008 ; Rooksby et al., 2014; Li et al., 2010), HCI (Ahtinen, A et al., 2009; Klasnja, P et al., 2011; Meyer, J et al, 2014; Nylander, S et al.,2014; Fritz T et al., 2014) and healthcare informatics (Dalgaard, L et al., 2013; Fanning, J et al., 2012; Klasnja, P., & Pratt, W, 2012) sustainable design studies (Grönvall, E., & Verdezoto, N, 2013; Wakkary, R et al., 2013).

Self-tracking activities associated with health have become an integral part of our everyday lives. Regarding health and fitness technologies, many different practices are now implemented in real time and the process of generating and processing information is ubiquitous. However, within the health and fitness domain (Gittleson, 2013; Khalaf, 2014), there is little research showing what and how specific practices are implemented and how people perceive information in the context of tracking their health and wellness through technology. A focus on daily practices - what and how practices consist of using

information and technologies- has not been emphasized enough. Without considering user's practices and their contextual factors, those practices are likely to be outlined as general device usages.

Many researchers in health and wellness technologies have focused more on technology (Albinali et al., 2010; Gupta & Jilla, 2011) or users' aspect (Ahtinen, Isomursu, et al., 2008; Oh, J., & Lee, U, 2015). For example, they evaluate technologies in terms of their system design and usability or studied user's motivation for adapting or using technologies. In order to examine about how to promote user's health behavior with mediated technologies, some studies often borrow theories from diverse area, such as cognitive psychology (Yoganathan, D., & Kajanan, S, 2013; Short.C.E et al., 2014), social psychology (D. Yoganathan, et al, 2014)  and health behavior science etc, which often makes data analysis more complementary and manifest. Using theoretical frameworks is important because it illuminates what data tell us by drawing researcher's "attention to particular events or phenomena, and sheds light on relationships that might otherwise go unnoticed or misunderstood" (Maxwell, 2012, p.49).

The majority of research on health and wellness technology in HCI have evaluated particular devices or applications by recruiting participants who hadn't used those technologies before.(Rooksby et al., 2014) Those studies often missed how users' life contexts affected how they interacted with those technologies. Some studies on "Quantified-Selfers" (Q-Selfers) in the field of personal informatics have paid attention to how users incorporate smart health tracking technologies into their lives. However, Q-selfers, as it is defined, are users who diligently track and analyze many things about themselves (Shin, et al, 2015). They are different from common self-trackers who

adopted one or two devices and have used those in their daily life. In this regard, Fritz, Huang, Murphy, & Zimmermann (2014) is a rare exception.

Fritz, (2014) investigated users who have continually used activity tracking technologies over the long term to figure out how health technologies can continue to support users' values and practices as they change over time. By exploring users' experiences with feedback and reward from the devices, as well as motivation and sharing data, the study found design implications emphasizing social features of technologies and how the features may facilitate the long-term uses of health technologies. The research reflected users' real life contexts, such as considering their initial motivation on adoption of activity tracking technologies. However, by excluding participants who stopped using along the way, the research only focused on the merits and impact of technologies in long-term uses.

Similarly, the recent study by Rooksby, J., Rost, M., Morrison, A and Chalmers, M. C (2014) also stressed a range of users' life events and how those were closely connected to their uses of activity tracking technologies. Like the study by Fritz et al (2014), researchers recruited diverse activity trackers who had previously used such devices and individuals who would like to use the devices. With their findings, they introduced the term "lived informatics," which underlines the importance of our daily life contexts in the meaningful use of information. One of their major findings is that even though the same activities tracking device were used among different participants, each used the device in different ways. They categorized five types of personal tracking; directive tracking, documentary tracking, diagnostic tracking, collecting rewards, and fetishized tracking.

Different styles activity-tracking technology use were also found among individuals in another recent study by Tollmar, K., Bentley, F., Viedma, C (2013). Researchers combined a large amount of data from various devices, including mobile applications, activities tracking and sensors, and individual contextual factors. They investigated how integrated health information affected users' health behavior changes. As in previous studies, daily life contexts were stressed in the research. Researchers pointed out that proper approaches to logging and tracking should be different in order to get accurate results that reflected each user's wellness goals and individual contexts. However, records and data were the main focus of in this study, rather than how users use and implement the information obtained by the devices.

Efforts to find contextual variables that may affect the usability of activity tracking devices were also shown in the research by Temir (2013). By evaluating two mobile applications for tracking outside running through user study, she tried to discover design implications for similar health and fitness applications. She found that users' previous experiences and motivation, such as running for hobby or for health, led different needs in using mobile applications. However, she accounted for a somewhat narrower scope of contextual factors, such as sunshine and the physical limitations of mobile phones, rather than general day-to-day life contexts.

In a similar vein, several contextual variables, such as types of activities to be tracked, activities, social features, and the devices' condition across a variety of tracking technologies, were found in the research. (Oh, J., & Lee, U, 2015). The study mainly focused on usability issues in terms of technological features rather than users' usage patterns and practices.

Recently, studies on activity-tracking device users have placed a greater emphasis on user' life contexts and their specific practices in using technologies. They have acknowledged that taking life practices and contexts into account helped to evaluate health-related technologies appropriately, which has led to promoting user's engagement in health and wellness technologies. Even though theoretical frameworks can manifest things that were missed in research process (Maxwell, 2012), most studies on health tracking technologies, particularly in HCI area, have tended to rely on empirical data. There have been few studies using both theory-based approaches and empirical data.

One recent study (D. Yoganathan, et al, 2014) used the Computers Are Social Actors (CASA) paradigm and cognitive load theory as theoretical frameworks to clarify the effects of humanized feedback on fitness applications in improving users' fitness performance. Based on CASA, researchers conceptualized mediators such as language style (formal or informal), modalities (visual or voice), and activity types (aerobic or anaerobic). Using cognitive load theory, relationships among mediators, user engagement, and cognitive load were effectively manifested in the research results.

Base on the Social Cognitive Theory (SCT) and persuasive technology design principles, the research (2013) by Yoganathan, D., & Kajanan, S evaluated current commercial fitness applications to figure out effective design guidelines. They found some components were drawn from SCT, such as self-efficacy, outcome expectation, self-regulation and social facilitation. They evaluated the effective of applications by combing this with data collected from online assessments.

Only recently has research (Cordeiro, F et al, 2015 a; Cordeiro, F et al, 2015 b) started to show interest by users in using mobile technology to journal food intake. In

studying technologies-based intervention for healthy eating, previous research commonly compared the paper diary to mobile applications for food journaling. Lee, G et al (2006), Duncan, M et al (2014) showed that there was no significant difference between those groups, although mobile-based interventions and applications had a slightly better score. (Lee, G et al, 2006)

It's hard to find research using theories as theoretical frameworks — most research has been based on user studies conducted to design new systems. A study by Short.C.E et al (2014) is the rare exception. It drew on social cognitive theory and self-regulation theory to design effective mobile application-delivered intervention for promoting physical activity and nutrition. Using intervention based on those two theories, they experimented with two groups; one given mobile application-delivered intervention and another with paper-based intervention. Researchers observed the groups using conceptual frameworks based on social cognitive theories, such as knowledge, self-efficacy, provided information, goal setting and self-monitoring.

So far, studies on emerging health tracking technologies have mostly concentrated on evaluating such technologies' usability, which often failed to consider user's life contexts. In terms of research methods, few studies borrowed theoretical frameworks. Through evaluation studies we know which technological features work or don't work, or how users are motivated to engage in using such technologies. However, we little know about influences of life contextual factors on using the technologies, particularly how users use information in practice created by the technologies. In this regard, Grönvall and Verdezoto (2013) recently stressed the importance of looking at 'practices' as units of analysis in researching how people bring healthcare technology into their daily lives.

Despite such requests for the practice-based research, there is a lack of studies using practice theories in studying information practices with health and wellness technologies.

## 2.2 Conceptual Literature Review

Practice theory has developed over time, with slightly different emphasized points depending on the scholar, from Heidegger, Wittgenstein, Foucault, Bourdieu and Giddens, who is considered as the first generation of theorists (Postill, 2010), to Schatzki and Reckwitz. More recent practice theory is concerned with 'material and contextual dimensions of practices.'(Entriw, 2015) Practice theory has also been debated in diverse disciplines, such as anthropology, philosophy, sociology, and science and technology studies. Scholars agree that practice theory provides noble ways to defy dualism between individuals and society, because it is equally dependent on the individual's mind and social structures.

From a practice theorist's perspective, our everyday life and its meaning is manifested in our specific activities and practices.  Feldman and Feldman (2011) summarized general agreement among various perspectives of the theory; "(1) that situated actions are consequential in the production of social life, (2)that dualisms are rejected as a way of theorizing, and (3) that relations are mutually constitutive. These principles cannot be taken singly, but implicate one another" (p.1241).

It's difficult to define what practice is in a few words, especially in science research (Savolainen, 2008). This is because of practice's elasticity. In the context of our daily lives, we all go through practices but each has different contexts and moments. Consider Warde's (2005) definition of practice as 'internally differentiated and dynamic' (p.131). According to Schatzki (2002), a practice is "bodily doings and sayings' (p.72).

He further elaborated that a practice "is a temporally evolving, open-ended set of doings and sayings linked by practical understandings, rules, teleo-affective structure and general understandings" (p.87).

Reckwitz (2002) described a practice in a way that stressed materiality or artifacts.

> "*A practice is a routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, knowhow, states of emotion and motivational knowledge.*" (p.249).

From this definition, Shove and Pantzar (2005) described a practice as the integration of three aspects; materials, meanings, and forms of competence. In different disciplines such as consumption studies, environmental studies, and HCI design studies, practice theory has been a useful lens to look closely at our practices in life in order to better understand it.

In one consumption study based practice theory, Shove and Pantzar (2005) offer a definition of practice by Schatzki (2001) and Reckwitz (2002) to emphasize the material aspects of practices. They point out how attention had not been paid to materiality in practices, even though practices evolve and reproduce with associated objects and meaning. Based on practice theory, they conceptualized products, techniques and constituent meanings, and how practice theory can clarify relationships between products and new practices as they evolve with new meaning and techniques.

Most environmental studies that use practice theory as a theoretical lens have been based in the sustainable HCI, design and consumption fields. Strengers, Y.A.A (2011) drew on a practice theory framework to emphasize the position of householders as those who practice, which allowed another view apart from their traditional roles as

consumers. During interviews, the researcher asked householders how their day to day practices related to energy and water consumption has changed by using an in-home display system. By focusing on practices in everyday life, the research demonstrated how eco-feedback systems could produce new practices in those contexts.

Shove et al's definitions and perspectives on practice theory have been used as frameworks particularly in HCI design studies. The recent study by Entwistle et al (2015) also explained two practices of cooking and laundry based on the practices perspectives. Through this study they developed a new frame model to support the practice theory called Contextual Wheel of Practice (COWOP), demonstrating how their practice model could be applied in diverse domains. They especially pointed out that practice theory could provide a rich understanding of self-monitoring technology and its practices. Aligned with this, Fitzpatrick and Ellingsen (2013) also called for theoretical frameworks that can articulate practices using healthcare technologies.

Practice theories also often have been applied in serious hobby fields. Hartel J (2006, 2010) demonstrated gourmet cooking as practices consisting of information activities and resources by showing how recipes and cookbooks had been documented and managed at home.

Using knowledge management literatures as a starting point, information science scholars have recently paid attention to practice theories. A few scholars, such as Savolainen, Talja and Lloyd, have drawn on practice theories in their work on information behavior studies (e.g. Cox, 2012; Huizing and Cavanagh, 2011; Lloyd, 2009, 2010; Savolainen, 2007, 2008). These authors adopted Schatzki's philosophical perspectives as the foundation for their work on practice theory (Cox, 2012).

Savolainen (2008), for example, introduced the concept of "information practice," which incorporated perspectives from practice theories and social phenomenology. The concept emphasizes our everyday practice and its socio-cultural contexts to better understand information seeking, use, and sharing.

Drawing on practice theory perspectives, a book, *Knowing in organizations: A practice-based approach,* edited by Nicolini D, Gherardi S and Yanow D (2003) described a variety of daily life practices, such as hammering, flute making, roof tiling, and cooking. Personal photographic works (Rose, 2010; Schwartz.D, 1986; Griggin M, 1986; Peterson SM, 2008; Cox and Blake, 2011) also have been illustrated from the perspective of practice theory. Cox (2013) used those works to discuss how information is implemented in daily life practices.

Despite so many studies on real life examples from the perspective of practice theory, the contexts of the use of health tracking technologies has not been covered based on practice theory, even though practice theory reflects life contexts and allows in-depth data analysis.

## 2.3 Information Practice

The concept of information practice has recently been discussed by Savolainen in his book *Everyday Information Practices* (2008). According to Savolainen, information practice is "a set of socially and culturally established ways to identify, seek, use, and share the information available in various sources such as television, newspapers, and the Internet' (p. 2)

Information practice is not a new term. Its concept has been discussed since the early 2000s, even though the term was were referred to often in the 1960s and 1970s.

Since Savolainen's works on information practice came out, a few studies tried to gain insights from it.

Pamlea McKenzie developed a model of information practice in the context of everyday life information seeking. The model consists of four seeking activities; active seeking, active scanning, non-directed monitoring, and obtaining info by proxy.

Unlike McKenzie, Sanna Talja and Preben Hamsen (Talja, S, 2002; Talja, S., & Hansen, P, 2006, Hansen, P., & Järvelin, K, 2005) have focused on the social aspects of practice, such as work contexts. They described information practice as "practices of info seeking, retrieval, filtering, and synthesis" (Savolainen, 2008).

However, the concept of information practices has been understood as having very broad meaning, about which there is still no consensus among scholars. Scholars of information practice do commonly acknowledge its social and cultural factors in information seeking, use, and sharing. In addition, information practice can be habitual and can be applied to diverse settings, not just work contexts (Savolainen, 2008).

The concept of information practices could be unclear when compared to similar concepts, such as information behavior and information action. Those concepts all explain "the ways in which people deal with information". Information practice differentiates itself from information behavior and information action by emphasizing social and contextual meanings. Information behaviors are usually explained by individual needs and motivation. Similarly, information action is understood mainly by individual intention, such as one's goals and interests (Savolainen, 2008).

I will take advantage of the concept of information practice posited by

Savolainen. He combined practice theories and social phenomenology to conceptualize

information practice in everyday contexts. According to Savolainen's model of everyday

information practices, information seeking, use, and sharing are shaped in social and

dialogical ways. Contextual factors around information practices play significant roles by

giving rich description on how practices are embedded in everyday life. Practices shape

our information activities, from how information is defined to how it is managed.

According to Savolainen, focusing on practices gives details of "how our desire for

routine makes us rather conservative in our information use." (2012)

Even though witnessing information practices is common, there is lack of studies

on "exactly how information is used" (Savolainen, 2008). Information can be meaningful

when it is used. In this regard, he called for more qualitative research, since it can offer a

rich discourse on how certain information practices and its daily life context intertwine

with each other to produce meaning. My general approach will proceed from the

perspective of everyday information practice. With my qualitative data, I also will

elaborate on conceptual research questions concerning how health tracking technologies

allow information affordances and how personal life contexts are interwoven with both.

This paper attempt to substantiate information practices in the uses of fitness and

wellness technologies among young individuals by drawing on practice theories. I will

use Savolainen's model of everyday information practice as my theoretical lens. Shove

and Pantzar (2005)'s definition of practices will complement this model, in order to

manifest the material dimension of practices. Material, one of the three components of

practice, will help to clarify how information practices are interwoven with the uses of

technologies in daily life contexts.

**RESEARCH METHODS**

The study was designed as a qualitative research. Among the qualitative methods, semi-structured interviews were the most commonly conducted, with the intention of obtaining a rich and holistic understanding of fundamental behaviors, motivations, and needs (Gillham, 2005). This method relies open and exploratory research questions analyzed as meaning-based (Elliott, 1999)

In-depth, face-to-face interviews were conducted to understand information practices and their real-life contexts while young people interact with technologies for journaling their fitness and foods intake. Also, photographs were taken of participants' notebook logs and of their data recorded by mobile application and physical-activity tracking devices. Those photographs also were closely treated as research data. (Silverman, 2006). They complemented the interview data by giving more detail and comprehensive contexts of participant's experiences regarding using technologies for journaling fitness and food. The interviews were transcribed and carefully reviewed for major themes. This process was repeated to refine research themes (Boyatzis, 1998; Hayes, 2000).

**3.1 Study Participants**

Nine study Participants were recruited through flyers on the bulletin boards at the gyms, libraries, and student union centers on the University of North Carolina, Chapel Hill campus.

The participants had to meet the following criteria: be an enrolled student of the university, at least 18 years of age, and currently using or have ever used technology for logging their exercise records or food intake. Technology was defined broadly, and included notebooks, mobile applications, and physical activity tracking devices. Those usages had to be at least for two weeks to ensure that participants had enough interaction with the technology for the purpose of tracking fitness or food intake. They were compensated with a $10 Starbucks gift cards for participating in a short survey and semi-constructed interview.

Seven females and two males participated, ranging in age from 18 to 23 years old (the mean age was 19.8 years). They self-identified as Digital Natives. To track running and diet, five participants used technologies such as mobile applications, physical activity tracking devices, laptops, and smartphones. They were all users of mobile applications for running and two occasionally used wearable devices such as a Fitbit or Jawbone Up. Three participants didn't use digital technologies for logging their exercise or diet, using instead notebooks or papers, even though they carried smartphones to listen to music, watch cable TV, text, and use social media. *Table 1* displays participant demographics and key information.

| N | Age | Sex | Technologies for tracking fitness and diet in the past | Technologies for tracking fitness and diet in the present | Fitness to log | Diet to log |
|---|---|---|---|---|---|---|
| **P1** | 19 | M | • Notebooks (paper) | • Notebooks(paper) | o Strength training<br>o Running | N/A |
| **P2** | 23 | F | • Mobile phone & apps, Excel worksheet<br>• wearable devices | • Mobile phone & apps, laptop (spreadsheet) | o Running,<br>o Yoga or Pilates | List of foods intake |

| | | | | | | |
|---|---|---|---|---|---|---|
| **P3** | 19 | F | • Notebooks (paper), Mobile phone & apps | • Notebooks(paper), Mobile phone & apps | o Strength training<br>o Running<br>o Yoga or Pilates<br>o Boxing | N/A |
| **P4** | 21 | M | • Notebooks (paper) | • Notebooks(paper) | o Strength training | N/A |
| **P5** | 19 | F | • Notebooks (paper),<br>• Mobile phone & apps | • Notebooks(paper) | o Strength training<br>  Running | N/A |
| **P6** | 18 | F | • Notebooks (paper),<br>• Mobile phone & apps | • Mobile phone & apps | o Strength training<br>o Running,<br>o Yoga or Pilates | List of foods intake |
| **P7** | 20 | F | • Wearable device (jawbone up)<br>• Mobile phone & apps | • Mobile phone & apps | o Strength training<br>o Running | N/A |
| **P8** | 20 | F | • Mobile phone (including mobile apps) | • Mobile phone (including mobile apps) | o Strength training<br>o Running | List of foods intake |
| **P9** | 19 | F | • Wearable device (Fitbit)<br>• Mobile phone & apps | • Wearable device (Fitbit)<br>• Mobile phone & apps | o Running<br>o Yoga or Pilates<br>o Cycling<br>o Zumba<br>o Volleyball | List of foods intake |

Table 1. Study Participants' demographic information and their technologies for tracking fitness or diet

## 3.2 Data Collection

### Procedure

Prior to collecting data in earnest, a pilot study was conducted by randomly selecting four individuals who were using fitness applications for monitoring and logging their exercise in the campus gym. Throughout brief interviews, questions regarding general patterns and motivations of using such technologies were asked. Based on the

pilot study, interview questions for the main study could be guided and completed.

The main user study consisted of two data collection phases for each participant:

1. Online short survey

2. Semi-structured interview

**Online short survey**

      All participants were required to register a time slot for interviews, and to complete a short questionnaire to provide demographic information, (i.e. gender, age), the exercise they were keeping track of, technologies that they had used in the past and were currently using, what kinds health related information that they recorded through the technologies, and the period of using the device. They were asked to provide not only their devices but also past and current records logged through the devices. The survey form is attached in Appendix B.

**Semi-structured interviews**

      Before the interviews, the researcher explained the goals of the research and ensured participants that all data collected would keep confidential. An informed consent form was given to each participants and was acknowledged. The interview was conducted semi-structurally and lasted 50-70 minutes. During the interviews, with participants' consent, handwritten logs and data created by technologies were photographed. This helped participants describe specific contexts and processes involved with recording their data based.

      As introduction questions, participants were asked regarding their general fitness and diet. Questions included the patterns and level of current exercises, how long and

how often they exercise per week, and their motivation.

Following those question were main questions under four themes:

1) Technology adoption (e.g.: How and why you start using a certain technology for logging fitness or diets?)

2) Information representation (e.g.: Describe your process of logging information.)

3) Technology affordance and constraints (e.g.: If allowed, are you willing to share your data on social media?)

4) Reflection from data (e.g.: How do you feel while tracking data, or how does data matter to you?)

## 3.3 Data Analysis

**Thematic Analysis**

Thematic analysis (Braun & Clarke, 2006) was implemented as a coding technique for analyzing collected data. Thematic analysis is defined as "a method for identifying, analyzing, and reporting patterns (themes) within data" (Braun & Clarke, 2006, p.79) In the thematic analysis, researcher generated initial codes based mainly on interesting features and repeated words. Potential codes were searched, and key concepts or themes were developed. In center of those themes, data was reviewed, categorized, and reduced to main ideas.

In the coding process with the key concepts, all transcripts were manually categorized. The computer software ATLAS.ti was used to complement the manual

coding by searching for alternative analyses. This rigorous thematic approach helped the researcher develop "insightful analysis that answers particular research questions" (Braun & Clarke, 2006, p.97)

**Using photographs of participant's log data for complementing interviews**

Participants were asked to share their data by capturing them as screen shots or pictures with researcher during interviews. Some of photographs are attached in Appendix A. Those images provided contextual information on participants' logging activities in daily life. Those data were explained in detail by participants during the interviews, which helped trigger their memories regarding specific situations and feelings. Carter and Mankoff's (2005) have also pointed out the useful role of photography in research.

**FINDINGS**

**4.1 Summary of Findings Identified Based on the Model of Everyday Information Practice**

The model of everyday information practice introduced by Savolainen (2008) describes how everyday projects are related to three components of information practices—information seeking, use, and sharing—through contextual factors and teleo-affective structures. Figure 1 presents his model. In the model, 'everyday project' generally was meant as human activities that offer a meaningful context of action that reflected traditional social phenomenology perspectives. 'Everyday information practices' are composed of information seeking, information use, and information sharing. In the center of the model, there are the contextual factors that mediate information practices and everyday projects. For example, the urgency of projects and lack of time to do the project belong to contextual factors. Teleo-affective structure incorporates values, goals, and interests by making information practices understandable. It relates to ends, beliefs, hopes, expectations, and emotions/mood.
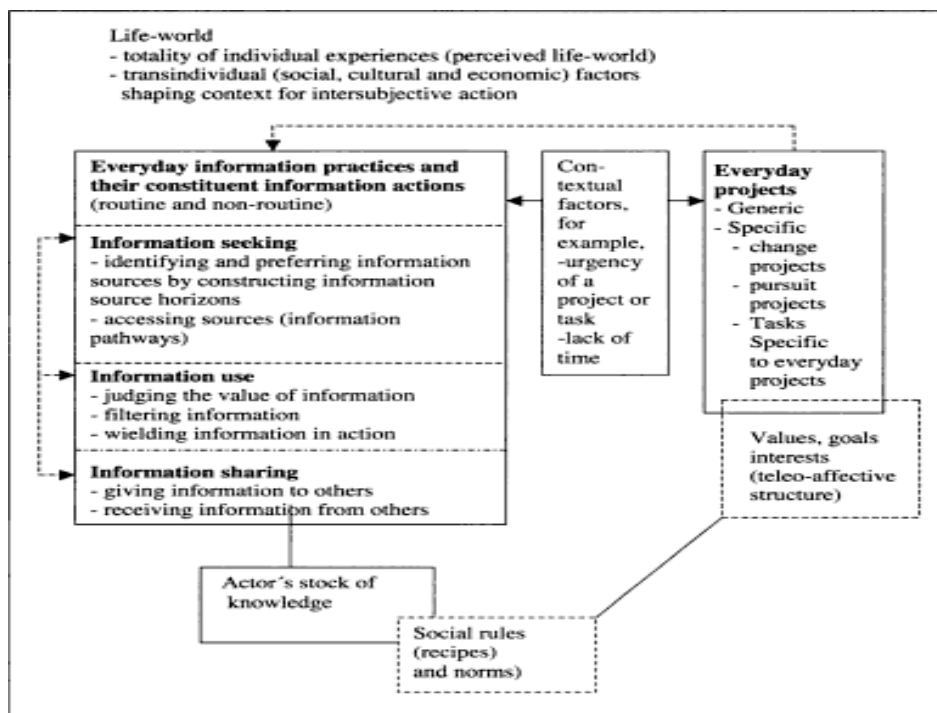
Figure1. Model of Everyday Information Practice (Savolainen, 2008, p.65)

Journaling fitness and food is influenced not merely by individual motivation or technological affordance, but by "socially and culturally shaped value and interests," such as wellbeing. Practice-focused analysis based on this Savolainen model explains the findings in this research, and is useful for understanding how information practices are transformed and evolved along with journaling fitness and food as an everyday life project.

Based on this framework, specific information practices and personal contextual factors, in the context of fitness and food journaling, could be clearly identified from the research data. In terms of everyday information practices, six information practices were found; *capturing information, reviewing information* (Information seeking); *manipulating information, representing information, interpreting information* (Information use); *sharing information* (Information sharing). Based on the findings, contextual factors and

teleo-affective structures frequently overlap each other. I combined these into a group of personal contextual factors, and revised the model based on that. To highlight the role of materiality in information practices (which was ignored in the model), 'technology enablement' was added to the reframed model. It is given to figure 2
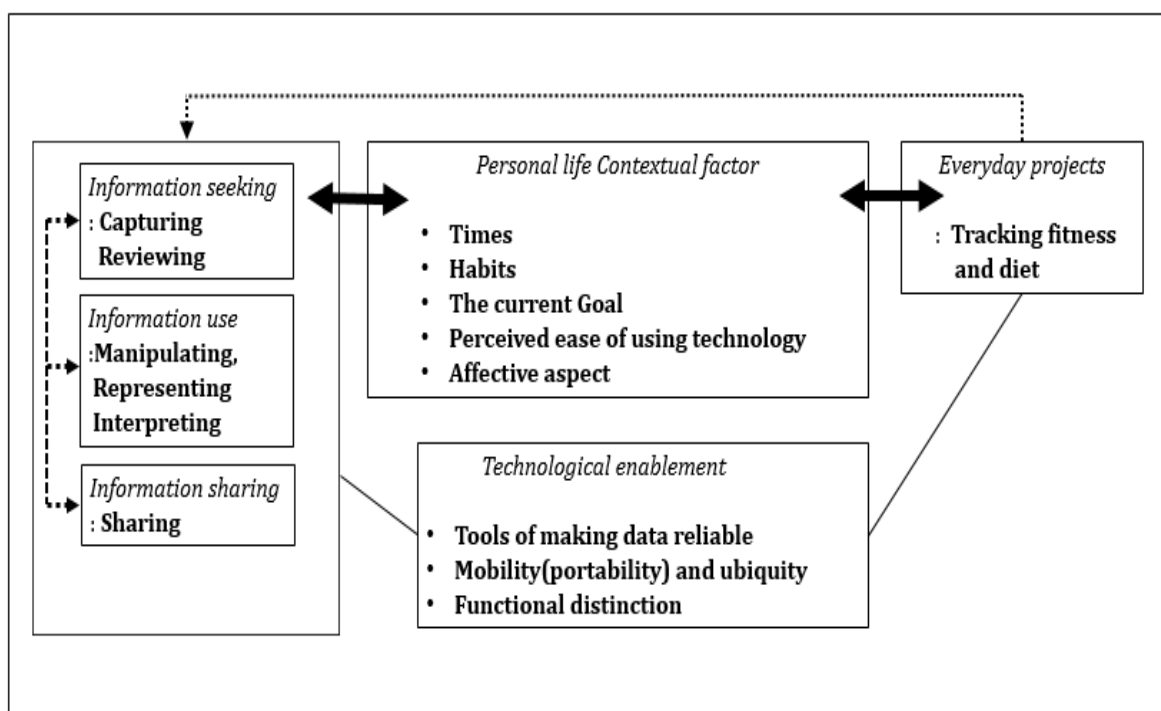


*Figure 2 Summary of findings identified based on the model of everyday information practice*

By focusing on information practices, personal life context factors, and technology enablement, the interactions among them clarify how health tracking technologies and life contexts enable users to achieve certain information practices, and how information affordance flows from those interactions.

**4.2 Information Practices**

**Information Seeking;** *capturing information, reviewing information*

*Capturing information* and *Reviewing information* are categorized in the practice

of information seeking, since identifying and selecting information source are included in

the process of capturing information. In that information sources are determined by

information needs, the practice of *reviewing information,* which is often implemented in

support of the user's memory, could be considered information seeking.

**Capturing Information**

Capturing information describes the practice of acquiring data/records or useful

tips related to their physical activities or food intake. Captured information from this

practice often becomes a source for monitoring or logging information. Participants could

capture information either through technologies or by acquiring it from other people.

Participants usually obtained information about workout performance records, such as

distance running, duration, calories burned, or nutrition information from technology. In

terms of information from others, usually people close to them, participants gained useful

tips or advice when trying new exercises or starting to log physical activities.

The capturing of information from fitness machines such as elliptical bikes or

treadmills using technology such mobile applications, while or after working out or

having food, was identified. For example, participant 2 took a picture of the data on an

elliptical bike with her smartphone once she has finished working out, then brought her

data home and logs her record.

> *I just **take a picture and then bring it home** and then like before I go to bed or whenever I don't feel like studying **I just log all my workout, diet, and finances.** (P2)*
>
> *.. after workout **whenever it pops up on the treadmill or elliptical I take a picture of it.** I take a picture of it and then when I go back home like whenever, even when I forget it I can do it later. (P2)*

Some participants said that they frequently check miles and speed from their

mobile application while or after running to get some sense of their ongoing workouts. In

the context of food intake, participants have found nutrition information provided by

mobile food bank database applications.

> ..*it will like* **give me like the calorie amounts because it's just like in the information bank** *and so if something does change, like if for some reason like I can't eat oatmeal because I'm out of it and I have cereal, like I can just look for the cereal and just put it in and I won't have to like go and* **it will come up with the calorie information** *and I won't have to go look up the calorie information* (P8)

The practice of capturing information was also identified through human relationships.

Participant 1 got some general ideas from his baseball trainer regarding how to log

exercise information.

> *I mean I used to do like in my sophomore year of high school I used to have a personal trainer for baseball and* **he kind of had like a notebook where he logged workouts and he kind of had like he printed it out and then he'd have a set amount of workouts of what we were going to do for the day** *and that kind of, I don't know, I guess* **that would be the inspiration for this [way to log workout]**. (P1)

**Reviewing Information**

*Reviewing information* incorporated overall activity tracking or keeping what an

individual logged. Reviewing information presumed that keeping information preceded

doing so, or was in progress. Whether or not participants reviewed information had a

tendency to depend on whether their past logs were informative or useful.

Participants who rarely tracked what they had logged said that they only took

advantage of the logs when it became necessity. They also pointed that this was because

they hadn't thought about how the logs would be useful. Those participants seemed rarely

to care about their past fitness or diet logs.

> *Like this just now looking back at the very first day was probably one of the first times I did that.* **Like I just don't need to know about it anymore.** (P4)
> **How often do I go back and look at it … not often at all.** *I usually just kind of let*

*it go*.  (P9)


The only time they had gone back to the past logs and reviewed them was when

they were seeking some answers to solve certain problems, such as suffering from injury

or feeling fatigued for no reason.

> *I really don't **unless I'm like trying to figure something out like why I might have gotten injured** or **why I feel like my fitness level is higher or something like that.***  (P7)

On the other hand, there were participants who kept and reviewed their fitness or food

intake logs frequently.

The majority of participants said memory was an issue. Participants wanted to

remember how much physical activity they did and what specific food they ate. There

were various reasons for this, but the major reason was the desire to track progress in

their physical activity or to be more careful about their diet.

> *I think it was because **I was worried I was going to forget it** and like I would go to the gym without like a clear intension and then I wouldn't follow through **because now that I have it like written down, like I said before I can look at it and I know I'm halfway through**, two thirds of the way through, but if I don't have anything **like really written down and like solidified like planned** (P6)

> *Because **when I was doing it [logging foods] in my L-fit I realized like it makes me pay attention to what I'm eating and how much I'm eating and if I'm eating healthy or not**, and so I thought it was a good idea to be able to know if I am eating healthy or not and **it makes me more conscious of things like that**.*  (P6)

In a similar vein, they pointed out that while reviewing their logs they checked what they

had done and tried to keep their workout pattern consistent. They considered their past

logs informative and useful, and seemed to expect that the logs could be used in some

ways, such as to guide what exercise they needed to do next.

*I look at it whenever I'm recording it* and probably that's about really it, cause it's kind of a notebook and I just record it. I mean occasionally like I said a couple days *I just look at it to just see what workout I need to do that day and then also like when I'm kind of struggling to remember the workout*, like just looking at it kind of helps motivate me just to go to the gym and figure it out on the way there instead of being like well I'm not going to go because I can't figure out what I'm supposed to do. (P1)

*Because I think* **it was important for me to be able to remember what the workout was**, like **if I really wanted to do it again it would be easier for me to go back and find it** than if I had to think about a whole new workout. (P3)

**Information Use:** *manipulating information, representing information, interpreting information*

The practices of manipulating, representing, and interpreting information belong to the field of information use. *Manipulating and Representing information* are in the category of filtering information. *Interpreting information* is aligned with the activity of judging the value of information content, in that through the information practice individuals valued information for future action.

**Manipulating Information**

Manipulating information could be defined as the activity of editing. It embraces the related practices such as updating, deleting, integrating information, or separating information into different categories. The practice often decides how much amount information will be saved. For example, through manipulating information, records are simplified or specified. The practice also made individual differences in ways in which people created their own logs.

Manipulating information reflected participants' fitness or diet patterns. Whenever participants increased their workout levels or tried to do new exercises, they needed to update their logs. Updating information sometimes meant deleting old

information for mobile application users.

> ***I update it sometimes***, *so like the number of times* ***I've increased so it didn't used to be 40 walking lunges total, like it started out I think as 30*** *and then I ended up I could up it to 40 and so I increased the number of squats, actually I need to update that because now it's 36 instead of 30 which means it also increased the number of wide leg squats from 30 to 36 and so the backward lunges increased recently and so did the wall sit, it went from a minute to two minutes.* ***So as I get stronger I'll update it on my phone and like increase it***. (P8)

> *If I do increase the weight then* ***I erase it and then I put my new weight that I'm doing.*** (P6)

Participants used different methods for logging information depending on the types or roles of information they needed, such as dates or names of workout. For example, they might organize information by putting it in different places.

> *It's either this type of format or it's just a calendar, but the calendar would be just it's basically reversed whereas* ***here I'm logging the dates, whereas the calendar I'd be logging the workouts.*** *(P1)*

> *because it's easier to do that on notes* ***because I already have everything and I just have to erase my weight, whereas if I do it on this I have to individually put in each exercise*** *and how many reps I did and how many sets, and I think I can only put in sets, I can only put in reps separately then sets, so I might have to put in one exercise three times if I did it for that many sets. (P6)*

A majority of the participants tended to categorize information as binary (dichotomous). For example, rather than logging specific fitness class names, they were only concerned with the information regarding dates or whether they attended the class or not. For food journals, only the names of foods were logged, rather than specific time or nutrition information. In this way, manipulating information was done among participants for simplification purposes.

> *Pilates I can't really log,* ***I mean I measure like whether I did it or not*** *(P2)*
> *Yeah and I* ***just measure the day Monday, Wednesday, Thursday or something*** *like that just to see like which day works best for me.* ***(P2)***

*I like to keep **everything as simple and organized as possible,** so a device that gives me things that I don't need to know or care about, it's just extra stuff to have to think about. (P4)*

*I'll still **generalize it** as good bad, satisfactory or not satisfactory kind of day. (P9)*

## Representing information

Representing information involves the practice of visualizing acquired

information. The information was represented in various forms of texts, numbers, marks,

color or matrices for each participant. Some participants drew circles or others did

checkmarks to mark the exercise they had completed.

*…like if I don't run for an hour I would **probably put like a circle** on it or something, but it's just this is kind of something else I kind of just did like an extra step to kind of just see how much I'm running. (P1)*

For each person, a checkmark had a different meaning, such as a completed workout or

pointing out that something had changed in their workout or diet.

***The checkmark**, that was because that was a good weight because **this squat machine changed** on this date. (P4)*

By using different colors or shapes of marks, information was separated for different

meanings.

*All the **black stuff** doesn't matter time I get it done but it's required to do that day and anything in **blue means** it's related to my business (P4)*

Some participants created formats to present their logs in a broader view or format.

*Even the apps like they have different systems and it was really hard for me to like live through it after I log all my workout I didn't really check it, so **I felt like maybe I have to have a big picture of it, in Excel I can have a big picture** and then you **can go in detail if you want to**. (P2)*

**Interpreting information**

Interpreting information includes the practice of assessing the value, usefulness, or importance of information. Specifically, interpreting information was deeply related to perceived accuracy, reliability, and future usefulness. How participants interpreted information revealed how much they valued information.

> ***Looking back on like the whole time I've been doing it, that's the only time that I really do care about it really,*** *because it's kind of like I feel like* ***once I complete a month it's like I'm starting over again***. *So I just kind of, it's more also just like if I complete a month that's fine.* (P1)

> ***I don't mind losing it*** *but for February and* ***this month I don't want to lose it kind of but if it's a little bit more in detail***, *so I can't really memorize all of them.* (P2)

**Information Sharing:** *sharing information*

Sharing information is the practice of giving information to or receiving information from others.

**Sharing Information**

In the context of logging fitness or food intake, the information was related to physical activities or diet in daily activities. Few participants shared their fitness or diet logs with others. Even though most participants were sharing or willing to share only with their close friends or family by texting or meeting face to face, they were very negative about sharing their records on social media such as Facebook or Twitter. They were concerned about privacy and how others would respond. They also pointed out that their successful physical activities or diets were just their "personal agenda" and it would not be helpful to others.

> *I* ***share my running data with my friends all the time and with my family back home***, *like oh if I'm proud of something I'll take a screen shot and look I did this, but I* ***don't really share this with anyone just because it's in my agenda and it's***

*not very detailed.  **I don't think it would be like really helpful for anyone**.  (P3)*

*Because **I feel like that's annoying for people to see every run I do.  Like I don't want then to think I'm bragging or anything like that because I'm not, you know**.  So yeah I just don't post much on social media as it is so I don't want the only thing I post to be like I ran today or something like that. (P7)*

## 4.3 Personal Contextual Factor

: Time, Habits, Current goal, Perceived ease of using technology, Affective aspects

## Time

Time made a difference in the ways participants implemented information

practices, such as logging, manipulating, and representing information. Most participants

felt under time pressure in their lives and managed their logging practices accordingly.

*No, definitely not, cause you can see like a block this big can get covered up by your little flyer, that's a whole day's log.  **So it takes my like maybe two seconds of a set to write down a number.  So not a long time at all, plus I have to stand there for two minutes anyway, so it doesn't waste time.**  (P4)*

*But yeah it works pretty well and I don't mind, like it doesn't take that long to like type if out and so I normally get to class early so I'll get to my first class and I'll just like write this all down or **I'll like write it down like on my way to the gym or like a lot of times I'll be filling up my water bottle at the gym so it doesn't really take that long**. (P8)*

Whenever participants felt a lack of time to log their records, they manipulated

and represented them with minimal effort. For example, some participants logged less

meticulously.

*I think it's like **that's maybe part of the reason why I keep it so short** is because it's just like … (P3)*

Time also affected the preferred tools for logging; notebooks, mobile application,

activity tracking devices. Because of the time required to enter each number into an

application, one participant said that she/he preferred using paper to write down the

records of her/his strength training rather than using a mobile application.

> *…You have to figure it [using mobile application] out and I find that's such a waste of time. That [Logging weight training] is a lot more detail to have to write down reps and stuff like that.* **Like it only takes a minute to write down like times and stuff like that** (P7)

Participant 8, by contrast, said she felt no time constraints about using mobile

applications for typing out what food she ate.

> *So* **it never really feels like a big time commitment** *because this is a pretty convenient app and it doesn't take that long.* (P8)

**Habit**

As participants engaged in logging and tracking practices over time, they said it

became a matter of habit. They found that they logged their exercise information without

reflecting on how they did it or what they logged. For example, for participant 9, she said

that wearing activity tracking devices became a part of her routine.

> **I guess it's just habit now**, *like I set it next to my mirror when I'm getting ready and I have, I wear a hair band every day, so it's just like wearing a hair band, slap it on and it's my watch and it goes with me everywhere.* (P9)

Habitual logging made participants stick whatever logging method they had experienced

in the past.

> **I think it just turns logging into a habit** *so like I like write down the exercises and I just do (P8)*

> *Yeah I guess, like I didn't have a Smart Phone* **when I started logging things, so like back in high school** *I didn't get an iPhone until I think my junior year of high school, so I think I just you know the old flip phones didn't have calendars so I* **think it was just part of habit and routine.** **(P7)**

Logging fitness records have been done by following the same note-taking habits used in

classes.

*I checked them off as I went along and so like the gym was three different parts, so just like indent it because I just like the way it looks better cause that's also* **how I take my notes so it's kind of just habit.** *(P8)*

Participant 3 used paper for logging her exercises. She also said her current method of logging workout information followed her prior experience using a card.

*I think it may have started because* **when I started working out a long time ago I did used to write down the workout plan, like on a little card** *and I would bring it to the gym with my friends and ⋯ So that would be a much more detailed, like that would be a specific like your sets and your reps for each exercise that we do and I have it all planned out on a card and I bring it so we could use it when we worked out.* **Then I would keep the cards and I'd file them away but I wouldn't ever really look at them and so I think that's how it started.** *(P3)*

**Current Goal**

Setting goals was identified as an effective motivator to promote physical activity. Goal setting is often built into wearable health devices as a default function (Munson, S. A., & Consolvo, S, 2012).

The findings showed that whether participants have a goal or not affected how they logged and represented information. Participants who didn't have goals didn't log in a specific way. For these participants, the main reasons to log were to maintain their current patterns of exercise or to keep consistency in their daily lives.

*I think I have, I want to keep my running logging the same because I really like it. I think in the future* **it might be important for me to keep more detailed written records but I don't have any active plans to change the way I record.** *(P3)*

**I mostly use it to make sure that I'm around the goal** *and then because I'm watching it throughout (P6)*

*I've seen other people at the gym keep like really* **rigorous journals of how they log and I never completely understood. Like I get it like writing it all down so you have it but I'm also not motivated enough to do that because I'm not searching for like a specific goal,** *because I feel like people who log like that are like I want to be able to bench like 180 by this point, then I want to be able to*

*bench 250 by this point and I'm like I'm happy if I can bench the bar eventually.
So like it's not, I don't have a set goal for like weight lifting, (P8)*

**Perceived Ease of Using Technology**

How comfortable participants feel about manually entering their activity records

on mobile application or laptop had little effect on participant's preferred method for

logging and tracking activities. Subjective factors divided users who felt more

comfortable writing by hand and those more comfortable with typing. Even though

typing was the preferred way to record information, some participants strongly preferred

hand writing to log exercise records.

> *Any time I write anything down like even letters in the mail I type them out
> because it's faster. **I can type so much faster than I can write.** I'm left handed
> so I don't smear anything when I'm typing. …. it would be **so annoying to have to
> like get all these fractions and dates and everything put in the way that I want to**
> and there's like what, there's like 30 characters down here in a little box and it
> would take me more time to power on a computer and get that all put in, I waste a
> lot of time, (P4)*

> *I feel **perfectly comfortable using them [technologies], I just when logging
> workouts I prefer using paper**. (P5)*

**Affective Aspects**

Affective aspects, such as feeling and reflection, were identified around each

information practice. Positive feelings such as happiness, pride, and a sense of reward

were related to using technologies for journaling fitness and nutrition. Those feelings

made participants consider the information practices meaningful, which contributed to

them incorporating these practices into their daily lives.  Interestingly, participants

overall estimated their information practices as positive and satisfying experiences. They

reported that they felt happy, took pride in themselves, and felt a sense of fulfillment

through all forms of information practices.

*I think both, **I feel proud that I did continuously write down** all my food for the past however long and then **I'd feel proud that my numbers do increase for the strength training**. (P6)*

*Like **while logging … most of the time I'm like generally satisfied with myself** cause I'm like I remembered to do something today, so it is satisfying to see that like to enter so .. So it's nice to see and I like to just like seeing it written out. (P8)*

Participants said that looking back their records and reflecting on them was fun and interesting, since the records and logs represented their dynamic lives.

***It is kind of fun to look back and see how it continues to change over time, so I do flip back on occasion but it's nothing I do regularly.** (P3)*
*I think I work out regularly, but I always mix up what I'm doing so I think like I'll go to different classes different days, so I think like **it's interesting to look back and see what I was doing mostly at one time and stuff like that…** I think it's kind of like **a motivating factor to like look back and see how often I've been running or how infrequently I've been running and I don't know, I just like that sort of stuff interests me.** (P7)*

Logging information seems to be associated with affective feelings, such as motivation and self-assurance. Participants overall wanted to be aware of their health related activities by logging their fitness activities or diets. The fact that they had been doing well in their physical activity or healthy diet became good motivators.

***I like logging cause it reminds me if I worked out that day and that how much I worked out the day before** and I should probably workout more the next day. **It keeps you like motivated** (P5)*

Simply continuing to log activity seemed to motivate some participants. For them, logging meant reporting what they did and this played a role in self-management and self-discipline.

*…. because my own workouts since I don't get a grade for it I can skip it [workouts] if I really wanted to, **but by writing it I don't skip it. (P5)***
In a similar vein, self-assurance among participants played a big part in logging

information. They wanted not only maintain their fitness and diet patterns, but also make

sure that they kept up a healthy lifestyle throughout their logging.

> ***My motivation [for food logging]*** *was to, well one was my doctor as well and just* ***making sure that I was eating right and still continuing to exercise and of*** ***course keeping up*** *kind of I wanted to keep up with appearances throughout the last part of my senior year so it was about staying fit, staying slim and eating and being nutritionally healthy.* (P9)

> ***This [logging] helps me see like if I've really done a lot that week*** *like I should probably chill out because I worked out this day and this day. It also kind of, sometimes I do feel like I haven't done enough even though I know I have and* ***so*** ***this is a good way to remind myself like you've been active, you don't have to*** ***worry about it. So it's also kind of self -assurance.*** (P3)


**4.4 Technology Enablement**

**Reliable Tool to Keep Data in either Systematical or Physical Ways**

In the context of fitness and healthy diets, health and wellness technologies was a

reliable tool in keeping a systemic or physical record of one's health activities. Whether

using mobile applications for tracking running and steps, or through notebooks for

strength training, participants believed that their records should be stored reliably.

> *No, so how I used the steps is at the end of the day like* ***it [step data] is always there*** ***like it doesn't get removed, it's always there*** (P2)

Some participant pointed out that all past records could be accessed through not

only mobile application but also through websites associated with their personal

accounts. For example, they said that even if they might lose the device, their data would

not be lost. This is because, according to them, their data had been stored in their

personal account system, which is expected to be accessible any time through any

internet-enabled device or route. The system connecting mobile applications and websites

allowed participants to believe that their data would be kept reliably.

> *Because it's an app* ***I have an account with Nike and so my data doesn't go anywhere it's still there it's posted with them.*** *(P3)*

Also, they generally thought that their movements have been tracked accurately as well. A notebook for logging exercises also was considered a reliable tool for some participants, particularly when they were logging rather than tracking. According to participant 4, a piece of paper and a pen were reliable methods to log fitness records, especially in terms of the time required.

> ***Technology is not going to make it faster or easier and be as reliable as me writing it down***, *you know what I mean.* ***Reliability is 100% and time spent is one second***, *technology can't beat that with anything else.* (P4)

Non-digital tools like a notebook were perceived to be reliable because there was no risk of data errors or system crashes. According to participants, they didn't have to worry about losing records in their notebook.

> *I guess I'm very like old school, I like even like books more than electronic books. I guess it's like easier on the eyes too when you're looking at it. I like like the feel when you write on it, you know, cause when you write on the tablet you have a different feel.* ***Then also like it's you won't lose that paper. When online there's that chance you could crash and lose it or you have to find it in a folder.*** (P5)

**Mobility and Ubiquity**

Mobility and ubiquity of mobile application and wearable tracking devices allowed participants to multitask. Doing other work right in the middle of logging was allowable as well, due to its automatic logging system built into the technology and the device's portability. For example, while running, participants were informed about their speed at each mile in the voice of the application, even while listening to music. Participants didn't find it necessary to take time or to make space for logging or tracking their records. Technology's mobility and ubiquity lessened their burden for fitness and

food logging activities.

> ***I think I just do it on my phone more [comfortable] because I'll write my to do***
> ***lists while I'm on the go because I multitask, so as I'm walking somewhere I'll***
> ***be like typing it up*** *or like I'm in class and I actually don't have to bring my*
> *computer to my class this semester, just by chance, it makes my backpack so much*
> *lighter, so I don't bring it so I don't have it, so I'll just type it up on my phone.* ***So***
> ***most of, a lot of it is out of sheer convenience because I always have my phone***
> ***on me all the time.*** (P8)

The portability of wearable devices facilitated logging activity by offering more

convenience than using a smartphone or notebook.

> *They pretty similar as far as the information they give you except that the Garmin*
> *includes heart rate and your phone doesn't. It's just the* ***Garmin is more***
> ***comfortable because you don't have to carry anything.*** (P7)

**Particular Functional Features Built into Different Technologies**

Whether particular functions were provided by mobile applications or wearable

tracking devices affected participants' decision whether or not they journaled their fitness

results and diets. Some applications for tracking nutrition and fitness count only certain

physical activities and foods. For example, how many calories were burned from weight

training usually was not included when the application calculated total calories consumed

a day. For this reason, participant 6 said that she didn't log.

> *There's an option for strength training but see if I do cardio and I put in say*
> *zumba for 60 minutes then it will add my calories, but if I put in exercise if I put in*
> *strength and then* ***I put in sit ups then it doesn't change my calorie count at all.***
> ***So I didn't feel like it was necessary to put in because I didn't see like a physical***
> ***change.*** (P6)

A large amount of nutrition database information enabled participants to log food

in specific ways. Since the application *MyFitnessPal* allowed them to look up all sorts of

food calories easily, they said it made them more engaged in tracking their activities than

other applications.

*..good thing about My Fitness Pal I think is that **it's database is so gi-normous that I can say I ate a Quaker oatmeal packet with skimmed milk and it can give me the brand and everything like that** whereas in outfit class we had to use the government, I don't know what that website is called but the government like My Plate kind of thing and you have to go in and enter like one cucumber and then it would ask you like sliced, raw, those kind of things whereas **on here I can just kind of scroll, click and it all goes in.** This was the website was way more time consuming than My Fitness Pal, so relatively I kept that in mind. It was like this is actually the fastest way to do it, so just go ahead and do it.* (P9)

Similarly, a sync function connecting smartphone and laptop gave participants an

alternative place to log. If smartphone was not in their hands, they could log easily by

using a laptop. This sync function helped to free participants from depending on one

device.

> ***It's just an app that came on my phone and it's super easy to use and it also saves over onto my computer too cause like they synch with each other.*** *So like if I'm on my computer and my phone is like out of my grasp I can just like type it down and it will synch eventually. So it's just mostly ease because it came with the phone. ... I'll copy and past it into my note section on my phone so I'll have it **and I don't have to like retype it on my phone I can just copy and paste it from my computer** and so it's just ease.* (P8)

Additionally, sync functions between technologies, such as laptops and mobile

applications, the data could be considered ubiquitous**.**

Logging to an exhaustive degree was also enabled by some mobile application.

For example, the Nike Run application that most participants used created data about

running total miles, speed per minute, a running map. Real-time data capturing and

meticulous recording, which a manual logging could hardly replace, greatly supported

participants' fitness activities. From data collected by the device, participants were able

to learn about their daily physical activity patterns in detail.

## DISCUSSION

Practice is deeply ingrained in materiality aspects of life, so they are often identified by how we use technology or tools. For example, when we pay attention to the technological affordances of activity-tracking technologies, they unfold vividly how devices play a role in generating data and how users are informed by the data. Based on identified information practices and contextual factors in our findings, material aspects of practices will be considered throughout the discussion. Specifically, it will show how technologies enable young users to perform certain information practices and how those practices reshape how technology is used for fitness and food intake.

### *Relationship between Technological Affordance and Human Intervention in Practices*

One of ways to focus on the materiality aspect of practice would be looking at how technological affordance contributes to shaping or reshaping a certain practice. This perspective underlines the point that technology actually influences practices as much as human agency (Leonardi, 2011). Aligned with this, some scholars (Fayard and Weeks 2007; Leonardi, 2011) describe affordances as somewhat relational by being based somewhere between people and artifacts, so the concept of affordances can be either used or exert an influence on works in multidimensional ways (Fayard and Weeks 2007; Leonardi, 2011).

In this study, a different tension was seen in each practice depending on the relationship between technological affordance and human intervention. Specifically, each

tension's aspect was changed by who took the role of main agent in practices.

When technological affordance assumed the greatest role in achieving an information practice, there's not much room for human intervention. Technology affordances wield control over practice by providing convenience. For example, automatic logging and keeping large amounts of data were applied to this case. With human intervention, those practices might be difficult, or rather human intervention would take more time and effort than when the technology does the same practices.

In certain practices, human intervention was considered more important than technology. Such practices were often based on own health-related goals or contextual factors. For examples, when it came to practices concerned with managing, representing, and interpreting information, human intervention was perceived as a better way to work. Study participants also favored taking an active part in such information practices without using technological affordances.

In the practice of manipulating information, little technological affordance was noticed among participants. Even though all participants were heavy users of smart devices, technologies seemed not to be capable of customizing or organizing information in ways they wanted. Participant 4 clearly referred to this.

> *My to do's is all by hand, you know, and I could do all that through Google calendar and stuff, there's so many electronic things that I can do but I like to not be on this as much as possible because I like to visually see how it is, **I like to format things the way that I want to do it. I like it to be organized a certain way and electronics you only can usually do it a couple ways, you know you have to do it a different way and I just didn't want to, I like to visually see it all here, I don't want pages to scroll through, different data to put in**, I don't want to be in the gym like this, I just want to write a number down and keep going you know*. (P4)

Also, he described how technological affordance from smart technologies didn't work

well for manipulating information.

> So **it [using technologies] slows you down, it's confusing, it could get deleted, I
> can't flip through it.** *I don't know just I'm a by hand kind of guy, so both how I
> plan my day and how I plan my workouts.* (P4)

Figure 3 represents where each information practice is based in relationships between

technological affordance and human intervention.

| | Strong Technological Affordance | Weak Technological Affordance |
|---|---|---|
| **More Human Intervention** | | Interpreting information<br>Representing information<br>Manipulating information<br><br>Sharing information |
| **Less Human Intervention** | Reviewing information<br>Capturing information | |

Figure 3 Position of information practices in relationship between technological
affordance and Influence of Life contexts

Technological affordance and human intervention could be seemed to exert their

influences almost equally. In terms cases when human intervention worked better, human

intervention was favored no matter what kinds of technology, be it mobile application or

physical activity tracking device, was used, and no matter what level of technical

affordances were provided. This suggest how human finally and ultimately mediate

tensions over technologies (Leonardi, 2011). This was clearly represented by Cooren,

who said that "To say that nonhumans do things does not mean that human contributions

are passed over…**humans can appropriate what nonhumans do**" (2004, p. 377).

Therefore, relations between human and technological affordance are in flux, and

they both are active and evolving things rather than static. Also, within these relationships, information practices were observed as things reshaped by each person's daily-life context and individual goals. The diversity of this fabric was demonstrated and reconfirmed by empirical findings throughout this research.

### *Strong Technological Affordance and Weak Influences of Life Contexts*

Technological affordances and the life contexts were found to be relevant to an important degree. In this regard, Markus and Silver (2008) explained technological affordances as the features of technology users perceived as useful, depending on their goals and what the technology allowed them to do. Affordances can be considered a contextual and subjective concept influenced by users' intended purposes and interpretations. Even though the same technology was available, each person perceived the technological affordances differently.

In the research, how deeply life contexts were reflected depended on whether technological enablement were perceived, and how deeply that enablement was related to the fulfillment of information practices. In other words, how a certain technological enablement was implemented in order to achieve a certain practice was closely based on individual daily life contexts, such as daily routines, skills, or temporal and spatial factors around the practices.

As technological affordances became more incorporated in fulfilling information practices, user's life contexts were less involved. Physical activity tracking technology logged every movement in real time without time and space constraints. Despite that, the data collected by the device was just numerical value per se as a result of quantifying physical activities, such as distance based on GPS. It didn't embrace contextual factors.

For example, data didn't take into account users' physical condition, weather, or how steep the route was, even though those factors considerably affected the performance of physical activities. Participant 8 demonstrated that the mobile application for tracking running sometimes made her feel frustrated because the recorded data pressured her to perform better all the time regardless of those contextual factors.

> *Well yeah like the Nike one it would like stress me out because I'm not running fast enough, like I was faster last time, why am I not, and like I just wouldn't even take into account like **I'm running a different route, there's more hills here or it's hotter today so it's like going to slow me down cause it always like drove me to like be, like I wanted to be faster*** (P8)

Life context factors, such as individual goals, skill, and habit, were rarely reflected when technological affordances took a big portion in implementing a certain information practice. In terms of carrying on the practices of capturing or tracking information, the practices were highly supported by technological affordances offered by mobile applications or physical activity tracking devices. Their automatic systems for counting steps or measuring run distance, for storing real-time data, required little user engagement and control. Those information practices rarely involved participants and were unable to contribute to the creation of habitual behavior. Because users has less control, they should shift away or quietly stop using the technologies when they didn't like a device, instead of correcting technologies.

### *Weak Technological Affordance and Strong Influences of Life Contexts*

For other information practices, participants perceived few technological affordances from their smart devices. Participants didn't need the help of technology enablement to implement information practices. The information practices were identified and reshaped by whether participants took advantage of technologies for

achieving a certain information practice, and how effective it was. Life context density was deepened when information practices were under human control.

Participants recognized that they might want to use Excel sheets or mobile applications for visualizing their data generated by the device. But they thought doing so was somewhat time-consuming and unnecessary considering the effort required to find the appropriate technology and use it. This was evidence that time-constraints were a factor in the decision to implement information practices with smart technologies. Some participants clearly favored recording their fitness records or foods intake manually, because they thought that it would be easier to customize a log formats that comported with their preferences or fitness-related goals. For such participants, keeping a log in different colors or with a particular shape of check mark was not perceived as a technological affordance. Minor technology affordances in the practice of representing information embraced life-contexts. The format, colors, markings, or orders of logs were determined by contextual factors, such as having time to log between different types of weight trainings, kinds of exercise, the number or types of information to log, etc.

In terms of the practice of interpreting information, there was also little room for technological enablement and technology couldn't directly support the practice. Instead, it considerably reflected daily life contexts by depending on individual's prior experiences or own health or fitness-related goals. Additionally, whether individual has a goal related to their fitness and diet or not affected if they will change technology or not and how they incorporate information practices in it. Participants pointed out that if they set the new goal, they were willing to try or change their current technologies and ways of logging practice. It implies that depending on individual's goals, they interpreted a

technological affordances in different ways (Leonardi, 2013).

With emerging smartphone applications and the growing use of social media, sharing information has been easier than ever. Most health monitoring technologies offer a sharing function, which is widely accepted as a major motivator for users to engage in the monitoring of their health (Munson, S. A., & Consolvo, S, 2012). But many study participants were reluctant to share their data, and this technological affordance was rarely utilized. In terms of sharing information, participants preferred to use non-technologically mediated ways, such as face-to-face communication. Concerns over life-contexts, such as privacy considerations and expectations about other people's response to fitness information, were overriding factors.

In short, information practices, such as manipulating, representing, interpreting, and sharing information require a lot of life context factors from users. Technological affordances were less identified, or at least less preferred, among participants, who preferred to enter data manually. Those choices Stemmed from a combination of users' technical ability given time-constraints, habits, and goals, which gave users more control over their technological practices. Therefore, when it comes to achieving each information practice, the process was one of balancing or negotiating between technological affordance and life-context density.

Table2 summarizes how technological affordances and human intervention play a role in each information practice. The table vividly presents which practice is more or less involved in either technological affordance or human intervention by listing specific functions and factors.

| Information Practice | Materiality | Technological Affordances | Human Intervention | Life Contextual factor |
|---|---|---|---|---|
| **Capturing** | Notebook Camera Mobile application Activity-tracking device | • Real-time logging<br>• Meticulous logging (time, seconds, miles, speeds, map GPS)<br>• Multitasking (Auto-logging, Fitness& Registering at the same time)<br>• Portability (Wearable, carry around) | | |
| **Reviewing** | Notebook Mobile App Activity-tracking device Laptop | • Keep data reliable (Memory supports)<br>• Accessibility to DB (Making data ubiquitous) | | |
| **Manipulating** | Notebook Application (Note app) Laptop (Excel) | | • On preference, habit<br>• Customizing data manually (Organizing, controlling data) | • Time-constraint<br>• Technical skill<br>• Fitness goal<br>• Logging habits |
| **Representing** | Notebook App (graph, charts) | | • Reflecting personal needs or goals<br>• Make visualize manually | |
| **Interpreting** | | | • On experience (judging accuracy)<br>• On Fitness goal (accessing its value) | |
| **Sharing** | Smart phone | • Texting, capture shot | • Face-to-face sharing | |

Table 2. Technological affordance, human intervention, life contextual factors for each information practice in the context of using health tracking devices for fitness and diet

***Inertia or Evolving Information Practices in the Center of 'Habit'.***

Information practices observed in the study were sometime quite dynamic and evolving. Those dynamic aspects were closely related to the theme of "habit": routinized life contexts and habitual uses of technologies. Orlikowski (2000) also described how practice could be altered into one of three degrees of changes, depending on how routinized it is in life. In the context of journaling fitness and food using technologies, individual habits affected not only the adoption of technologies but also the ways in information practices were conducted.

Through a combination of evolution and inertia, information practices were continually weaving together technologies and life routines, making new fabrics of relationship. Technologies seemed to have inertia in that when they have been involved in the routine of exercise and nutrition for a long time. Once a certain technology was established in a routine, the same or similar technology tended to be adopted when participants needed new devices. For example, participants who had used workout cards in a gym chose to use a notebook at the gym instead of a smart device. Similarly, who used to a calendar adopted notebook or paper as new devices for journaling fitness or food intake. However, those used to using a mobile phone for health-related activity logging preferred to continuing using smart devices.

Such habitual uses of technologies might be differentiated from the concept of familiarity with certain technologies, since all participants considered themselves heavy-smart device users in everyday life. Whether or not habitual uses of technologies have been established, technological affordances were perceived differently in completing information practices.

Besides routinized uses of technologies, routinized patterns of diet or fitness also affected how information affordance are imbricated in the technologies. For example, participants who used a campus cafeteria for every meal noted that because of having a nearly identical daily diet, they felt it was fairly easy for them to type nutrition information manually in their mobile application, which might be very time-consuming for others with having variable daily diets. In this regard, technological affordance could be understood as a result of "reconciling own goals with materiality of a technology" (Leonardi, 2013, p.154).

### *Interconnectivity of Information Practices*

A major perspective in practice-based theory is that "practices are interconnected," in which practices are conducted recurrently and collectively (Rivera, G., & Cox, A, 2014), and within that, technologies and their affordance are closely intertwined with life-contexts. On this point, information practices were not clearly distinguished in our finding. Information practices were linked to each another by reshaping each other. For example, if their data regarding fitness or diet were logged and represented in simplified forms or formats, most participants were reluctant to share it (manipulating information ←→ sharing information). As another example, if the data was interpreted as not useful by participants, they often didn't implement further practices to capture, keep, or share that information with others (interpreting information ←→ capturing, tracing and sharing information).

In the process of fulfilling each information practice, technologies and information affordances were understood not in one defined way but in several possible

ways. The arenas of information practices were partially overlapped by different

technologies and information affordances.

**CONCLUSION**

In this paper, I elaborate on and evaluate "everyday life information practices" by looking at how health tracking technologies in daily life allowed young people to obtain information affordances. Depending on technological affordance and human intervention embedded in life contexts, each information practice was shaped or reshaped in different ways.

A practice-based approach fit this research, which studied the uses of health tracking technologies in non-clinical settings. The information practice model was appropriate to describe how health tracking technologies were actually utilized among young people, by being interwoven with their daily life contexts. For each information practice, technological affordance and human intervention functioned differently, which created different information affordances. This could be clarified in this paper by using practice theory perspectives. For example, the practices of capturing and keeping information were enabled mostly by technological affordances, while other practices were conducted mainly by human intervention and with little technological affordances.

This could not be discovered without highlighting each unit in the information practices model. This is because complicated interactions are easily generalized, so that one possible practice from which young people may benefit using smart technologies, in terms of tracking their daily physical activities and diet, may mean as much as any other such practice. It is an easy assumption for Digital Natives, who live closely with, and deeply rely on, technology.

Additionally, with the lens of practice theory, the main technological affordances such as generating data and informing users, could be emphasized. To be specific, a practice-based approach helped identify and differentiate information practices from one another throughout the empirical data. With those conceptualized information practices, the study was able to look at how and when health tracking technologies were involved in life contexts, and how information affordance were formed.

Practice theory may be differently applied to other contexts, and depending on contexts, different information practices would be observed. Therefore, giving "more details with the changing materiality of each relevant practice" (Christine, 2010, p.16) was evitable in order to figure out how the materiality offers information affordance in context. In this approach, this study tried to answer whether everyday information practice has become increasingly materialized in the context of using smart technologies for tracking fitness and diet.

Technology has increasingly pervaded our daily health-promoted practices by providing more variety of functions and technological affordances than ever. In this regard, it has been easier for people to obtain data generated by the devices and manage their health/life information across many mobile applications or smart tracking devices. Despite that, this study discovered that many information practices still relied on manual ways of logging. In other words, technologies weren't much involved in information practice in terms of daily activities for health care, such as tracking fitness and diet.

Considering all participants in this study belong to the Digital Native generation, young people who have grown up with a smartphone in their hands, it is noteworthy that smart health technologies and applications often were not preferred. Those technologies

couldn't reflect personal daily life contexts and didn't support well fitness performance or

diet management. For this reason, according to participants, they often felt that such

technologies were a white elephant, even though smart technologies were indispensable

in other parts of their lives.

Old technology, such as paper and pen, often worked better for certain information

practices depending on life context factors. Participant 5 reflected this clearly.

> *I like technology it's just **the technology isn't always like the best for everything.**
> ⋯ It is and like just because it's like easier in a way doesn't mean that it's
> always like the best option. **Like sometimes it's better to go old fashioned and
> like writing on a piece of paper** and maybe sometimes doing all the things like
> researching something it's better to use a laptop.* (P5)

## Research Contributions and Limitations

This study offers a few contribution in terms of practice theory literature and

methodology. The research brought new empirical studies into practice theory literature,

which illustrated how practice theories could apply to the use of smart health tracking

technologies in daily life.  Also, the study contributed to the recent movement toward

practice-based research in information science studies. Several information practices in

uses of health tracking technologies were identified and categorized based on the model

of everyday information practices.

Methodologically, the research was designed as an exploratory study and

performed close to field experimental studies. For the purpose of reflecting participants'

real life uses and experience, I recruited individuals who had ever used technology

supporting their fitness or food tracking for a minimum of one month. This was different

from the approach of most research in health tracking technologies, which have for the

most part been conducted in laboratories by researchers who supplied the technologies to participants and made them use them for certain periods. This method hardly reflected participant's initial motivation and preferences to use certain methods of tracking health behavior. Therefore, this exploratory study suggests a related method, by highlighting life contexts in health tracking technology literature.

This study couldn't give analysis in depth even though the study tried to bring the insightful perspectives of practice theory into the examination of empirical data. Aligned with this, Christensen and Røpke (2010) pointed out what issues should be more elaborated in related works: considering social interactions in practice as well as individual's practice; opening the possibility of delimiting the boundaries of practice and how a practice is defined; and examining the meaningful scope of practice per se and how it is related to surroundings. Such research limitations could be made up for by dealing with these suggestions in a future study.

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Appendix A: Photographs of participant's log data for complementing interviews
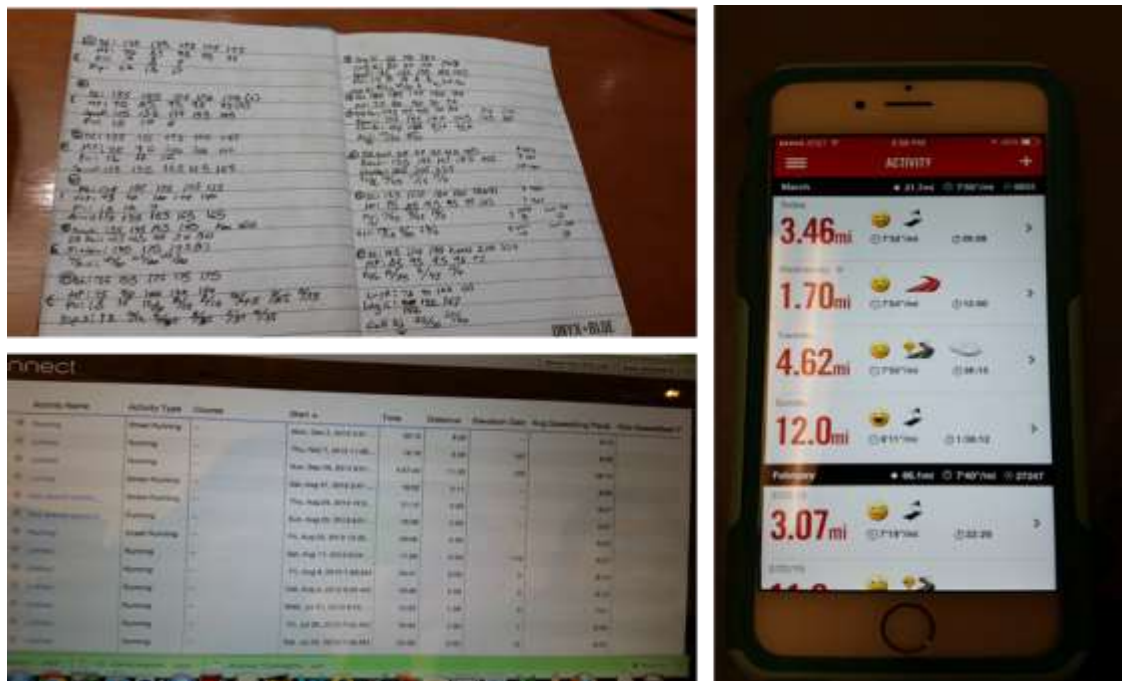


Picture 1. Photographs were taken of participants' notebook logs and of their data recorded by mobile application and physical-activity tracking devices. (Clockwise from top left)
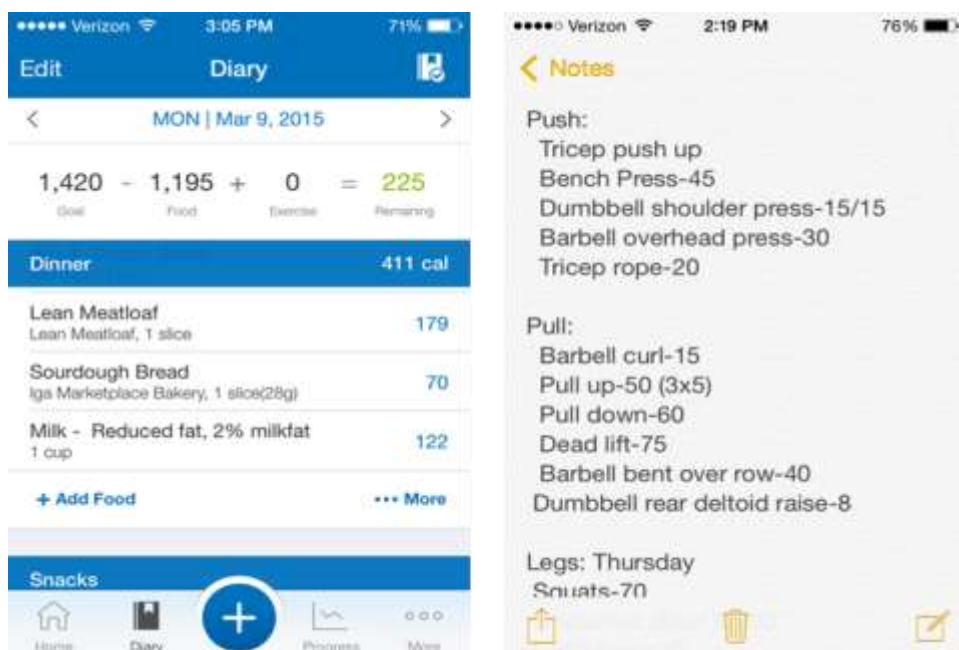


Picture 2. Screenshots of participants' diet and fitness logs from their mobile applications

Appendix B: Online survey form


Name (or Nick name ) *

[ ]

Age *

[ ]

Gender

- ☐ Female

- ☐ Male

1. What means have you ever used for logging or tracking your activities? (Select all that apply) *

- ☐ Notebooks(paper)

- ☐ Wearable device (Fitbit, jawbone up, etc)

- ☐ Mobile phone (including mobile apps)

- ☐ In your head

- ☐ Other: [ ]

2. Are you still constantly logging your workout? *

- ☐ Yes

- ☐ No

2-1. If so, what the current means? (Select all that apply)

- ☐ Notebooks(paper)

- ☐ Wearable device (Fitbit, jawbone up, etc)

- ☐ Mobile phone (including mobile apps)

- ☐ laptop (spreedsheet, etc)

- ☐ in your head

○ ☐ Other: [        ]

3. How long have you logged and tracked your workout? * When you started to log your workout? (Since Year/ month)

[        ]

4. What kinds of exercises that you have logged ? (Select all that apply) *

○ ☐ Strength training (e.g. weight lifting)

○ ☐ Running or Jogging

○ ☐ Yoga or Pilates

○ ☐ Cycling

○ ☐ Walking

○ ☐ Other: [        ]