

INVESTIGATING SELF-TRACKING USE FOR MENTAL WELLNESS OF NEW PARENTS

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To my beloved family for their wholehearted love and support.

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TABLE OF CONTENTS

LIST OF TABLES	9
LIST OF FIGURES	10
ABSTRACT	11
CHAPTER 1. INTRODUCTION	12
1.1 Background of the problem	12
1.2 Significance of the study	13
1.3 Research questions	14
1.4 Scope	14
1.5 Assumptions	15
1.6 Definition of key terms	15
CHAPTER 2. REVIEW OF RELEVANT LITERATURE	16
2.1 Parent, Stress, and Wellness	16
2.1.1 Understanding wellness	16
2.1.2 Understanding stress	17
2.1.3 Parenting stress	19
2.2 Parent, Stress, Wellness, and HCI	22
2.2.1 HCI for wellness	22
2.2.2 HCI for parents	22
2.3 Personal Informatics	23
2.3.1 Introduction to personal informatics	24
2.3.2 Personal informatics for stress management.	25
2.3.3 Personal informatics for parents.	26
CHAPTER 3. METHODOLOGY	28
3.1 Research Design	28
3.1.1 Research approach	28
3.1.2 Study instruments	29
3.1.2.1 <i>OmniTrack</i>	29
3.1.2.2 Worksheets	29
3.2 Participants	31

3.3	Data Collection	32
3.3.1	Session I: co-creating a personal tracker	33
3.3.2	Session II: revising a tracker.....	34
3.3.3	Session III: co-reviewing tracking data	34
3.4	Data Analysis	35
3.5	Validity and Reliability	36
CHAPTER 4.	FINDINGS	37
4.1	Personal Informatics	37
4.1.1	Choosing tracking topics	37
4.1.1.1	Tracking topics and goals	38
4.1.1.2	Concerns about choosing tracking topics	40
4.1.2	Designing personal trackers.....	41
4.1.2.1	Time range	41
4.1.2.2	Text.....	42
4.1.2.3	Rating.....	43
4.1.2.4	Photos	45
4.1.2.5	Multiple choices	45
4.1.3	Revising personal trackers	46
4.1.3.1	Reasons for changing tracking topics	47
4.1.3.2	Reasons for revising data fields.....	48
4.1.4	Practices of self-tracking	49
4.1.4.1	Various criteria of subjective evaluation	49
4.1.4.2	Sharing with husband	50
4.1.4.3	Sharing with others	51
4.2	Stress Management	52
4.2.1	Parents under stress.....	52
4.2.1.1	Negative perceptions of life as a parent.....	52
4.2.1.2	The struggles of immigrant parents	53
4.2.2	Tracking topics and goals for stress management	55
4.2.3	The influential factors on stress management	57
4.2.3.1	Knowledge about stress	57

4.2.3.2	The importance of subjective perceptions	58
4.2.3.3	The role of the spouse in stress management	58
4.2.4	The impacts of self-tracking practices on stress management.....	60
4.2.4.1	Having a better understanding of one's life.....	60
4.2.4.2	Changing life in a positive way	61
4.2.4.3	Emotional satisfaction.	63
4.3	Participant Engagement in the Design Workshops.....	64
4.3.1	Sharing feedback with each other.....	64
4.3.2	Empathizing with each other	65
4.3.3	The role of humor	68
4.3.4	Comparing with others	69
CHAPTER 5.	DISCUSSION	71
5.1	Social Self-Tracking for Parents' Mental Wellness.....	71
5.1.1	Flexible self-tracking practices for developing self-knowledge.....	71
5.1.2	Family-centered tracking for supporting mental wellness.....	73
5.1.3	Benefits and hinderance of the social nature of the workshop	74
5.1.4	The need for onboarding experiences	75
5.2	The Opportunities and Challenges of Parenting Stress Management.....	77
5.2.1	Managing stress in the daily lives of parents.....	77
5.2.2	The role of the spouse in stress management	78
5.2.3	Fostering positivity through a journaling practice.....	79
5.3	Participant Engagement in the Design Workshops.....	80
5.3.1	Building a rapport between the researcher and participants	80
5.3.2	Participants' understanding of their participation.....	82
5.3.3	Group workshop as a socializing opportunity for parents	83
5.3.3.1	Opening up new opportunities for the social life of new parents	84
5.4	Ethical Considerations	85
5.5	Limitations	86
5.6	Conclusions.....	87
APPENDIX A.	WORKSHOP PROTOCOLS	88
APPENDIX B.	WORKSHEETS	98

APPENDIX C. TRACKING TOPICS.....	105
APPENDIX D. THEMES, CODES, AND EXAMPLE QUOTES	1
REFERENCES	116

LIST OF TABLES

Table 3.1 Participants Demographics	31
Table 3.2 Research Questions, Data Sources, and Data Analysis Methods	32
Table 4.1 Topics that The Participants Chose to Track	38
Table 4.2 Revisions of Tracking Topics	47
Table 4.3 Tracking Themes	55

LIST OF FIGURES

Figure 1 Participants filling out worksheets in the third workshop.	34
Figure 2 Screenshots of the participants' trackers created on <i>OmniTrack</i>	42

ABSTRACT

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New parents often experience significant stress as they take on new roles and responsibilities. Personal informatics practices have increasingly gained attention as they support various aspects of wellness of individuals by providing data-driven self-insights. While several PI systems have been proposed to support mental wellness of individuals not only by providing self-knowledge but also by helping individuals deal with negative emotions, few studies investigated how parenting stress can be managed through PI practices. In this paper, I set out to investigate how new parents make use of flexible self-tracking practices in the context of stress management. The findings of this study indicate that flexible self-tracking practices enable individuals to develop self-knowledge as well as to better communicate with their spouses through data. Based on the findings, I discuss how the self-tracking experiences for the mental wellness of parents can be better designed and provide some considerations for future research and design for parenting stress management.

CHAPTER 1. INTRODUCTION

1.1 Background of the problem

New parents face various challenges as they undergo radical physical, emotional, and social transitions. Taking on new roles and responsibilities, their routines are dramatically changed and their resources to socialize with others are significantly reduced, which contributes to feelings of stress, anxiety, depression, and loneliness. Moreover, individuals who are living far away from their family and friends are at greater risk of severe parenting stress while dealing with feelings of isolation and loneliness as being both transplants and new parents, which could diminish mental wellness of parents as well as the quality of life of the family (Yoon, 2013; Bornstein & Bohr, 2011; Nomaguchi & House, 2012; Fonseca, 1995).

The HCI research community has given much attention to promoting one's wellness. Especially, previous research suggests the potential of personal informatics in promoting one's wellness by providing data-driven self-insight into various aspects of one's daily life, such as managing diabetes (Webster et al., 2015) and physical activity (Gouveia, Karapanos, & Hassenzahl, 2015). Personal informatics systems have been suggested as ways to promote not only physical wellness but also mental wellness such as sleeping behavior (Kay et al., 2012) and emotions (Kelley, Lee, & Wilcox, 2017; Lee & Hong, 2017; Lee & Hong, 2018). Researchers have also proposed personal informatics systems to support serious mental health problems such as bipolar disorder (Frost, Doryab, Faurholt-Jepsen, Kessing & Bardram, 2013; Matthews et al., 2015). However, it has been pointed out by Lee et al. (2018) that there is limited research on how individuals can benefit from engaging in personal informatics practices within the context of coping with daily stress despite the different opportunities and challenges that it brings into the field of personal informatics.

The unique circumstances that new parents face, which often lead to feelings of social isolation and distress, show opportunities and challenges in this space in tackling parenting stress with personal informatics practices. Not only do PI practices provide new parents with data-driven self-insights, which often lead to positive behavioral changes (Webster et al., 2015; Gouveia et al., 2015; Kay et al., 2012), but they can also play a therapeutic role by allowing self-expression of

individuals (Lee et al., 2017, Lee et al., 2018) and help them regulate negative emotions (Webb, Miles, Sheeran & Hinshaw, 2012).

Therefore, in this work, I set out to investigate how new parents make use of flexible self-tracking practices in the context of stress management with the ultimate goal of informing the design of personal informatics systems to support stress management of new parents.

The key contributions of this work are fourfold:

- I discuss the benefits of flexible self-tracking practices to developing self-knowledge for better stress management of individuals,
- I argue for the potential of family-centered PI systems to support mental wellness of family members,
- I present the opportunities and challenges of parenting stress management, based on the results from rich descriptions of two weeks of self-tracking experiences as well as the daily lives of five new parents,
- And I provide practical suggestions to build a good rapport for participant engagement in the design workshops as well as the benefits of group workshops as socializing opportunities for new parents.

1.2 Significance of the study

This research expands knowledge in the field of personal informatics systems by providing rich descriptions of the lived self-tracking experiences of what kinds of topics new parents choose to track, how and with what goals they engage in self-tracking within the context of stress management, and opportunities and challenges of designing self-tracking experiences to support stress management of new parents. In addition, this study can provide insights or advice for researchers or organizers who conduct workshops for supporting mental wellness of individuals, which involve reflecting on one's daily life and sharing experiences in the group setting, also with specific consideration of the unique vulnerability of new parents. This knowledge will contribute to informing the design of self-tracking processes and tools for mental wellness for general populations. While this study is specifically focused on new parents and parental stress, findings of this study may be transferrable to other vulnerable populations.

1.3 Research questions

The research questions that this study aims to answer are:

- What topics do new parents choose to track, when presented with a flexible self-tracking tool in the context of stress management?
- What data about those topics do new parents choose to track, within the flexible self-tracking tool in the context of stress management?
- In what ways do new parents self-track, and reflect on self-tracking, when using a flexible self-tracking tool?

The first and second research questions will be answered mainly from the first workshop session and additionally from the second workshop session in which participants reflect on their lives as a parent, choose relevant tracking topics to their parenting stress, design personal trackers by defining data fields, and revise them after a week of tracking. The third research question will be answered from the two weeks of tracking data with their personal trackers, the second and the third workshop sessions through co-reviewing their tracking experiences with other participants, and the following one-on-one interviews by reflecting on their tracking experiences.

1.4 Scope

The study is aimed at understanding how parents make use of a flexible self-tracking technology in the context of stress management. Also, this study seeks to provide design insights to personal informatics systems for promoting mental health, focusing on stress management of new parents. To that end, I will not consider non-technological stress management techniques such as meditation, yoga, or aromatherapy. Also, since this study is focusing on mental wellness but not a physical aspect of wellness, I will not address self-tracking technologies using biosensors to track physical health-related data. Furthermore, the scope of this study is limited to the issue of daily stress, not including all the issues of mental health, which is defined “to include a variety of negative experiences and feelings that, while sometimes adaptive, could turn into severe mental health problems if not addressed” (Lee et al., 2018). In short, I will explore how new parents engage in PI practices through a flexible self-tracking technology within the context of managing daily stress.

1.5 Assumptions

This research was performed and draws conclusions based on the following assumptions:

- Participants will engage in interview sessions, workshop sessions, and self-tracking practices in an honest and candid manner.
- Participants will discuss actively with each other in the workshop sessions.
- Participants will commit to self-tracking practices consistently during the study period within a reasonable margin of error. A reasonable margin of error refers to an error that does not deviate from the purpose of self-tracking that a participant and the researcher agreed upon in the first workshop session. I will be checking data every day during the study period to make sure that they are on the right track.

1.6 Definition of key terms

- Self-tracking: the process of recording one's own behaviors, thoughts, and feelings (Kopp, 1988).
- Personal Informatics systems: "systems that help people collect personally relevant information for the purpose of self-reflection and gaining self-knowledge" (Li, Dey, & Forlizzi, 2010, p.558).
- Flexible tracking: In this study, flexible tracking refers to the customizable self-tracking practices that satisfy individuals' various tracking needs, preferences and goals (Kim, Jeon, Lee, Choe & Seo, 2017).
- Mental wellness: "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (WHO, 2017). In this work, I view mental wellness as positive attitudes and feelings towards of one's life that help individuals deal with their daily stressors.
- Stress: "a particular relationship between the person and the environment that is appraised by the person as taxing and exceeding his or her resources and endangering his or her well-being" (Lazarus and Folkman, 1984, p.19). In this work, I consider stress as negative feelings resulting from an individual's subjective appraisal of stressors and available resources.

CHAPTER 2. REVIEW OF RELEVANT LITERATURE

In this chapter, I will describe the relevant literature in the following way: (1) Parents, Stress, and Wellness, (2) Parent, Stress, Wellness, and HCI, and (3) Personal Informatics. In the first section, I examine some of the essential concepts of wellness, stress, and parenting stress as grounding blocks of this study. Then, in the following section, I briefly describe how researchers in the field of HCI have conducted research on wellness and parenting. In the last section, I introduce the concept of personal informatics and review the relevant literature on personal informatics for wellness, stress management, and parenting.

2.1 Parent, Stress, and Wellness

In this section, I describe the contexts where the concept of wellness was born and the multiple dimensions of wellness. Then, I examine the definitions of stress, the effects of stress, and different types of coping strategies. Lastly, I discuss the dynamics of the causes and effects of parenting stress.

2.1.1 Understanding wellness

Wellness is a commonly used word in our daily lives but not an easy concept to define. The term wellness suggests a paradigm shift from the traditional definition of health in Western culture toward a more holistic perspective that emphasizes interrelations of body and mind and focuses on promoting healthy human functioning (Westgate, 1996). It began to gain attention when the primary health concerns have been shifted from the threat of infectious diseases to chronic and lifestyle illnesses such as heart disease, diabetes, obesity, and cancer, which are closely related to stress (Exeter, 2009). Therefore, stress is one of the critical factors for wellness, which makes stress and wellness inseparable concepts in nature.

There are numerous definitions of wellness but many of the definitions draw on similar core elements. Larson (1999) notes that a holistic definition of health was first introduced by World Health Organization (WHO) as “a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity” (WHO, 2017) and most definitions of wellness are aligned with this definition. There are numerous definitions of wellness but

researchers have a consensus on that wellness is multi-dimensional, interrelated, holistic, and continuous rather than an end state (Exeter, 2009). There are eight main dimensions of wellness, which most researchers agree upon: physical, emotional, social, intellectual, spiritual, occupational, and environmental (Exeter, 2009).

While all eight dimensions are interrelated, the most relevant dimensions of wellness with stress management of parents would be emotional and social wellness. Emotional wellness is conceptualized as “awareness and control of feelings, as well as a realistic, positive, and developmental view of the self, conflict, and life circumstances, coping with stress, and the maintenance of fulfilling relationships with others” (Exeter, 2009, p.12). Aligned with the spirit of wellness, emotional wellness does not merely mean the absence of serious mental health issues but also includes maintaining positive self-concept and resilience as well as experiencing satisfaction, curiosity, enjoyment in life (Exeter, 2009). Social wellness is associated with having supportive and fulfilling relationships, and maintaining intimacy with others (Renger et al., 2000). Mental wellness and social wellness play a significant role in stress management for parents because they enable individuals to build resilience and coping strategies for daily stress. In this work, I collectively call both mental and social wellness as ‘mental wellness.’

2.1.2 Understanding stress

Stress is part of our life regardless of one’s age, gender, and circumstances. Stress has been a prominent topic in many disciplines because it affects our health, physically, mentally, and socially, and other critical parts of our life. There are three approaches to defining stress: “a stimulus-based definition, a response-based definition, and a dynamic process” (Butler, 1993, p.5). A stimulus-based approach focuses on external sources of stress, which suggests that external pressure leads to stress. This approach assumes that when the external stimulus becomes too great, internal collapse becomes inevitable (Butler, 1993). Therefore, the physiological aspect of stress is emphasized in this approach, which is how our physical body reacts when threatened. The physiological aspect of stress is typically measured through collecting saliva to measure individuals’ cortisol levels (Serva, Benamati, Blue, & Baroudi, 2011), measuring heart rate and respiratory sinus arrhythmia (Evans et al., 2013), and sleep patterns (Rodgers, Maloney, Ploderer & Brereton, 2016).

On the other hand, a response-based definition focuses on psychosocial responses to aversive stimuli. This definition concentrates on how individuals adapt to or cope with the stress depends on their characteristics, though the assumption is that if the stress persists, at some point, exhaustion or collapse becomes inevitable (Butler, 1993). This approach puts an emphasis on the psychosocial aspect of stress, which is how we perceive circumstances and choose to respond to that stimulus. The psychosocial aspect of stress is typically measured through self-reporting using a survey instrument methodology (Serva et al., 2011). The definition as a dynamic process combines both the stimulus-based and response-based definition. Recognizing the limitations of both approaches, in clinical practice, most clinicians now view stress as a dynamic process reflecting both internal and external factors: personal traits of an individual and his or her circumstances, as well as the interactions between them.

The importance of the subjective perceptions of stressors and the surrounding circumstances have been emphasized by several studies (Lazarus, DeLongis, Folkman, & Gruen, 1985; Telleen, Herzog, & Kilbane, 1989; Crnic & Greenburg, 1990; Fonseca, 1995; Tucker, 2011). According to Butler (1993), stress occurs when perceived demands upon individuals are greater than their perceived resources so that one does not feel capable of coping with the stressors (Tucker, 2011). In other words, stress is dependent upon one's subjective appraisal of the stressors and the perceived resources (Tucker, 2011). Thus, how individuals interpret the stressors and situation is more important than the stressors and situation itself. This approach to stress is clearly described in Lazarus et al. (1984)'s definition of stress: "a particular relationship between the person and the environment that is appraised by the person as taxing and exceeding his or her resources and endangering his or her well-being" (p.19).

Although everyday stress is a normal part of our life, untreated chronic stress can result in serious health conditions both physically and mentally. Not only when individuals are exposed to distressful or traumatic events but also when they are exposed to everyday stressors that are not ignored or poorly managed, chronic stress can occur, which results in negative consequences in many aspects of one's physical, mental, and social health. On the one hand, typical effects of stress on physical health include a migraine, muscle pain, chest pain, a weakened immune system, digestive problems, and sleep problems (The American Psychological Association, 2010). Also, chronic stress can contribute to serious health conditions including such as high blood sugar, high blood pressure, heart attack, and fertility problems (Baum & Posluszny, 1999).

On the other hand, prevalent effects of stress on mental health include anxiety, restlessness, forgetfulness, lack of motivation, irritability, or depression (The American Psychological Association, 2010). Chronic stress also can lead to serious mental issues such as major depression, anxiety disorder, bipolar disorder, cognitive problems, personality changes, and problem behaviors, if not appropriately addressed (Pearlin, 1999). Therefore, it is essential to manage before one's stress level properly is accumulated for an extended period to the point that it threatens one's physical and mental health.

In this study, I view stress as a dynamic process between an individual and external environment, which results from the subjective appraisal of the stressors and available resources. This study focuses on the psychosocial aspect rather than the physiological aspect of stress. Therefore, this investigation is approached by qualitative methodology to explore how new parents engage in self-tracking practices within the context of stress management with the ultimate aim of better supporting parents to deal with stress in their daily lives.

2.1.3 Parenting stress

The transition to parenthood can be exciting but stressful for every parent and family. This is because the transition often requires parents to change their lifestyle radically (Deater-Deckard, 2004). Parenting stress is a normal part of new parents, but it becomes a significant issue when raised to the extent that it negatively affects parent functioning and the parent-child relationship (Abidin, 1992).

The Parenting Stress Index was developed by Abidin (1995) and has been widely used to measure parenting stress. The PSI consists of the three subscales: 1) parental distress, 2) dysfunctional parent-child interaction, and 3) difficult child. According to Abidin (1995), parental distress indicates the psychological distress of an individual regarding one's role as a parent, while dysfunctional parent-child interaction refers to a state where parents feel disappointed by their child's reaction or rejected by the child in the interaction between a parent and child, and difficult child denotes the difficulty due to the child's difficult temperament or behavioral problems. Several studies examined what is the most influential factor on parenting stress among the three categories. While some reported that child behavioral problems or difficult temperaments have the closest relationship with parenting stress level (King, King, Rosenbaum, & Goffin, 1999; Ramos, Guerin, Gottfried, Bathurst, & Oliver, 2005), others found that parents' personal psychological

distress is the most strongly related area to the feelings of parenting stress (Webster-Stratton, 1988; Koeske & Koeske, 1990; You, Lee, & Kwon, 2018). Despite the seemingly opposing claims, the common ground of the studies is that parenting stress stems from an interaction between both parent and child factors (Berry & Jones, 1995), which is aligned with the perspective that views stress as a dynamic process as mentioned above.

On top of the potential stressors in transition into parenthood presented above, recent immigrant parents in the U.S. may be exposed to more stressors related to their parenting experiences due to separation from family and friends, language barriers, lack of social support network, cultural differences, and struggles with adjustment (Yoon, 2013). Specifically, many researchers have reported that acculturation process can aggravate the immigrant parents' caregiving burdens, which in turn may cause increased parenting stress of them (Bornstein et al., 2011; Nomaguchi et al., 2012). Therefore, immigrant parents may experience more parenting stress than domestic parents due to the potential impact of acculturation stress (Nomaguchi et al., 2012).

In addition, international students and their spouses with young children are likely to confront even more potential disadvantages as being immigrants, students or trailing spouses, and new parents. Since being a graduate student is often psychologically and physically taxing due to high demands and competitive atmosphere, graduate students with children often find it challenging to juggle multiple roles. Gilbert (1982) and Scheinkman (1988) reported that graduate student marriages were vulnerable and at high risk for divorce. Scheinkman (1988) found out in her study at a university mental health clinic that spouses of students often suffer from loneliness, isolation, feelings of disorientation because the students often become emotionally unstable and obsessed with school work. Furthermore, individuals who gave up their previous job before their spouses started graduate school tend to suffer from lack of goals and meaninglessness (Gilbert, 1982; Scheinkman, 1988).

Caregiver psychological well-being and social support are the most frequently mentioned factors that mediate parenting stressors, and both have ample empirical evidence. Researchers who emphasized caregiver psychological well-being factors focus on intrapersonal resources that counterbalance the negative impact of maternal distress (Fonseca, 1995; Speraw, 2010; Tomlin, 2014; You et al., 2018; Louie, Cromer & Berry, 2017) such as mother's personality traits (Vermaes, Janssens, Mullaar, Vinck & Gerris, 2008), positive views (Hwang, Ko & Yong, 2010; Jang &

Chong, 2011), and religious belief (Tomlin, 2014; Louie et al., 2017; You et al., 2018). On the other hand, researchers who highlighted the role of social support in buffering parenting stress (Koeske et al., 1990; Cottornell, 1986; Crnic et al., 1990; Tucker, 2011) placed emphasis on the perceived availability of support (Seagull, 1987; Moncher, 1995; Tucker, 2011), relational quality (Corse, Schmid & Trickett, 1990) and different types of support (Cohen & Mermelstein, 1985) (i.e., emotional, tangible, or informational). There is evidence that parents experience an increased level of stress partially due to feelings of isolation (Jackson, 1999; Lennon, Blome & English, 2002). Therefore, several studies have validated that the appropriate social support contributes to moderate the impact of parenting stress (Fonseca, 1995; Moncher, 1995; Cohen & Willis, 1985) while most of the studies focus on the impact of social support on the relation between parental stress and child abuse (Fonseca, 1995; Tucker, 2011; Yoon, 2013) instead of parental psychological well-being itself.

The importance of the subjective perceptions associated with parenting experiences rather than the potential stressors and mediators themselves has also been highlighted by many researchers (Telleen et al., 1989; Fonseca, 1995; Tucker, 2011; Yoon, 2013). Black, Heyman & Smith-Slep (2001) and Milner (1993, 1994) found that abusive parents tend to subjectively rate life stressors as more frustrating than non-abusive parents so that they are easily overwhelmed by stressors related to their parenting experiences. Also, when it comes to the role of social support as a mediator of parental stress, the importance of the perceived availability rather than more objective aspects such as the number of relationships is emphasized (Cohen et al., 1985).

Most of the studies on parenting stress focus on the impact of parenting stress on negative parenting behaviors such as child maltreatment or abuse. Research has repeatedly determined that abusive mothers experience greater stress than non-abusive mothers (Holden, Willis & Foltz, 1989; Whipple & Webster-Stratton, 1991; Benedict, Wulff & White, 1992; Black et al., 2001; eTucker, 2011) and parenting stress is significantly associated with child abuse (Schaeffer, Alexander, Bethke & Kretz, 2005; Holden & Banez, 1996).

Such complexities of parenting stress that involve multiple and compounding factors bring unique challenges in supporting stress management of parents with technology. Thus, the understanding of how parents make use of a flexible self-tracking tool within the context of stress management is needed as a foundation of the design of self-tracking processes and tools to support mental wellness of new parents.

2.2 Parent, Stress, Wellness, and HCI

This section is introductory, providing an overview of what has been the focus of HCI for wellness, and what kinds of research has been conducted in HCI for parenting.

2.2.1 HCI for wellness

Wellness has received a lot of research attention in the HCI community along with the recent trend of an explosion of wellness interventions and technology applications in the market. Therefore, various wellness interventions have been suggested or created using a wide range of technology. As mentioned above, wellness is focused on promoting or maintaining of positive status in various aspects of health whereas the traditional health interventions are focused on correcting poor health conditions by treatment or management of a disease. Therefore, works in HCI have aimed to keep individuals healthy by monitoring the personal health state.

Personal informatics systems have been found beneficial for monitoring individuals' health state and improving one's wellness in various aspects, such as managing diabetes (Webster et al., 2015) and physical activity (Gouveia et al., 2015). Personal informatics systems have been suggested as ways to promote not only physical wellness but also mental wellness such as sleeping behavior (Kay et al., 2012) and emotions (Lee et al., 2017). Researchers have also proposed personal informatics systems to support serious mental health problems such as bipolar disorder (Frost et al., 2013; Matthews et al., 2015). However, it has been pointed out by Lee et al. (2018) that there is limited research on how individuals can benefit from engaging in personal informatics practices within the context of coping with daily stress despite the different opportunities and challenges that it brings into the field of personal informatics.

2.2.2 HCI for parents

Considerable research attention has been paid in HCI to how digital technologies can support parenting. Toombs et al. (2018) provided the landscape of the HCI literature for supporting parenting, which includes a broad spectrum: how to enhance the pregnancy experience using mobile technology (Gao, Li, Lin, Liu, Pang, 2014), how to support the transition from the neonatal intensive care unit to home using a mobile application (Lee, Garfield, Massey, Chaysinh, Hassan, 2011), how breast pumps or a breastfeeding system can be better designed (D'Ignazio, Hope, Michelson, Churchill, & Zuckerman, 2016; Balaam, Comber, Jenkins, Sutton,

& Garbett, 2015; Simpson, Garbett, Comber, Balaam, 2016), how to design an infant monitoring system to reduce everyday burdens of parents (Hayes et al., 2011), and how to design a system that better supports record-keeping of young children (Kientz, Arriaga, Abowd, 2009).

The landscape of the HCI literature on parents includes several studies that examine existing practices or design a new system for providing social support with parents: a social network which is aimed at encouraging physical interactions between single parents (Arkonac, Frazer, Horgan, Kracewicz, & Al-Naimi, 2017); a system that helps expectant mothers share their experiences in their intimate social groups (Hui, Ly, & Neustaedter, 2012); and a system that helps parents reflect on their social media practices (Trujillo-Pisantry, Durrant, Martindale, James, & Collomosse, 2014). Aligned with these studies, Toombs et al. (2018) suggest some interesting findings to inform the design of technologies for supporting social lives of parents; recognizing the fact that new parents are under vulnerabilities, the personal vulnerabilities and interpersonal care should be considered in designing sociotechnical systems for new parents. To that end, one of their suggestions is that providing safe spaces for sharing of their parenting experiences, promoting empathy among groups as a grounding block for a new friendship in parenthood.

However, to the best of my knowledge, there is no research that tackles the mental wellness of parents with PI practices. As PI practices are proven to gain data-driven self-insights regarding stress (Lee et al., 2018), help individuals regulate negative feelings (Webb et al., 2012), and foster healthy behaviors through self-intervention (Webster et al., 2015; Gouveia et al., 2015; Kay et al., 2012), I set out to engage parents in flexible PI practices with the purpose of parenting stress management.

2.3 Personal Informatics

In this section, I will first introduce the concept of personal informatics by its definition, a stage-based model of PI systems established by Li et al. (2010), the necessity of flexible PI system, and the two categories of self-tracking, documentary and diagnostic tracking by Rooksby, Rost, Morrison & Chalmers (2014). Second, I will briefly describe how research on personal informatics for wellness has relied primarily on quantitative approach using biosensors, how most studies have focused on patients with serious mental health problems rather than

individuals faced by daily stress. Lastly, I will look into the research gap where few studies have explored stress management of parents through a PI practice.

2.3.1 Introduction to personal informatics

Li et al. (2010, p.558) have defined personal informatics as a system that “helps people collect personally relevant information for the purpose of self-reflection and gaining self-knowledge.” PI systems have been proven effective for both self-understanding and self-improvement (Ayobi, Sonne, Marshall, Cox, & Centre, 2018; Choe, Lee, Lee, Pratt, & Kientz, 2014; Yamashita et al., 2017) in various aspects of daily lives, such as physical activity (Gouveia et al., 2015), sleeping behavior (Kay et al., 2012), menstrual cycles (Epstein et al., 2017), mental wellness (Kelley et al., 2017), and caregiving (Yamashita et al., 2017; Yamashita et al., 2018).

Li et al. (2010) established a stage-based model of PI systems composed of five stages: “preparation, collection, integration, reflection, and action” (p.560). In the preparation stage, people decide what they will record and how they will record before they start data collection. In the collection stage, people collect information about themselves while observing their inner thoughts, behaviors, interactions with others, and the surrounding environment. In the integration stage, people gather the data collected and prepare for the next stage, reflection. The efforts that people need to put into this stage varies depend on how they tracked their data. If the data were automatically tracked using digital technologies, they might not need further action to prepare for the reflection stage. However, if the information was gathered with different mediums and the data is all over, people might need to spend a fair amount of time to bring it all together and organize the data. In the reflection stage, people reflect on the data they collected. The reflection might be mediated by just looking at lists of collected data or exploring information visualizations. This stage involves both a short-term reflection, which is conducted immediately after recording the data, and a long-term reflection, which takes place after several days or weeks, are valuable in different ways. Short-term reflection allows users to be aware of their current status and long-term reflection have users to see trends and patterns over time. In the action stage, people choose what they are going to do with the new self-knowledge. People often want to tailor their behaviors to better-pursue their goals for the tracking based on the new understanding about themselves.

According to Rooksby et al. (2014), self-tracking can be categorized into two types: diagnostic tracking and documentary tracking. Diagnostic tracking stands for a goal-driven tracking to identify causal relationships, which focuses on problem-solving. On the other hand, documentary tracking is characterized by documentation of daily experiences driven by curiosity toward oneself and mindfulness. In contrast to many studies focusing on the diagnostic aspect of PI systems that requires quantifiable health goals such as managing blood sugar-rate for diabetes (Crosby et al., 2017; Panzera et al., 2013; Webster et al., 2015), recent studies have also investigated the explorative nature of documentary tracking to support one's emotional needs (Kim et al., 2017; Kelley et al., 2017; Yamashita et al., 2017; Yamashita et al., 2018). Since many social and environmental factors affect mental health (Kelley et al., 2017), PI systems for mental wellness should be approached from both the problem-solving aspect of diagnostic tracking and the explorative aspect of documentary tracking.

2.3.2 Personal informatics for stress management.

There is a significant body of work in HCI that informs the design of PI systems to better support one's stress management. Most of the work predominantly relies on a quantitative assessment approach utilizing biosensors. Some investigated ways to detect the root causes of stress using biosensors (Caponaro et al., 2013; Gjoreski, Gjoreski, Lusterk & Gams, 2016; Sarker et al., 2016), ways to visualize an individual's biosensor data for stress intervention (Snyder et al., 2015; Yu, Funk, Hu, Feijs, 2017; Sharmin et al., 2015), and the influence of biosensor feedback on an individual's reaction, interpretation, or reflection (Kye et al., 2017; Hollis; Pekurovsky, Wu, Whittaker, 2018).

Additionally, the majority of studies on wellness-related PI systems focus on a physical wellness such as diabetes (Webster et al., 2015), physical activity (Gouveia et al., 2015), and sleeping behavior (Kay et al., 2012). On the other hand, ways for PI systems to support one's mental wellness have recently gained the attention of HCI researchers as well. It has been pointed out by Lee et al. (2018) that previous studies that aim to promote one's mental wellness through PI system have relied primarily on a quantitative assessment approach using biosensors, while only a limited number of studies have tackled wellness from a qualitative approach to gain an in-depth understanding of the context and underlying issues of an individual's mental wellness (Ayobi et al., 2018; Lee et al., 2018).

Also, researchers have argued that coping with daily stress deserves more research attention in the field of PI (Kelly et al., 2017; Lee et al., 2018) due to the unique challenges it brings to PI practice such as a difficulty in figuring out what to track to improve one's mental wellness and potential harms of close monitoring in mental health management (Kelley et al., 2017). Lee et al. (2018) has argued that previous research on PI practice to support mental wellness has predominantly focused on serious mental health problems such as bipolar disorder by having them keep tracking of their extreme mood swings (Frost et al., 2013; Matthews et al., 2015). However, there is a limited number of studies that deal with PI practices to cope with daily stress (Kelley et al., 2017; Lee et al., 2018) which fits better to the definition of mental wellness that emphasizes promoting or maintaining positive status rather than focusing on correcting poor mental health conditions. Therefore, there is a need for a qualitative investigation on how individuals make use of a PI system and how a PI system can better support how individuals deal with daily stress.

2.3.3 Personal informatics for parents.

There have been many attempts to support parenting with personal informatics systems. Most work is related to how to support parents tracking data related to the general development or health of a baby. Hayes et al. (2011) explored a system for parents to monitor and track health-related data of preterm infants and Wang, O'Kane, Newhouse, Sethu-Jones, & De Barbaro (2017) investigated how baby wearable technologies are adopted and used in parenting. These studies show that employing a PI system for tracking data related to children impacts not only parents' knowledge about their babies but also the perceived physicality and social factors of parenting.

Some studies considered the communication between parents and healthcare professionals in the use of PI for collecting data related to children. Ben-Sasson, Ben-Sasson, Jacobs, & Saig (2017) suggested a crowd-based and expert-curated system for tracking child development and Kollenburg et al. (2018) explored the potential value of developmental data tracked by parents in communication between parents and healthcare professionals. Furthermore, a family-centered health informatics approach has been suggested to address family health in a unified way (Pina et al., 2017). However, despite the potential benefits of PI practices on parenting stress management based on prior works, few studies consider the mental wellness of

parents with PI systems, which reveals opportunities to investigate ways to support the mental wellness of parents with PI practices.

To summarize this chapter, the unique contexts of parenting stress bring both opportunities and challenges into the field of PI for supporting stress management of individuals. While stress occurs as a result of an individual's subjective appraisal of the stressors and available resources, mental wellness provides individuals with both intrapersonal and interpersonal resources to cope with daily stressors. Both parent and child factors can cause parenting stress; however, additional circumstances such as living as immigrants, students, or trailing spouses may expose parents to more potential stressors. Caregiver psychological well-being and social support are the most frequently mentioned factors that mediate parenting stressors in the field, but most of the works on parenting stress focuses on the impact on negative parenting behaviors such as child abuse. Research has determined that the subjective appraisal of both the stressors and mediators is critical for the level of perceived parenting stress. Thus, such complexities of parenting stress that involve multiple and compounding factors need to be considered in supporting stress management of parents.

PI practices have gained research attention from HCI researchers for supporting both physical and mental wellness of individuals by providing data-driven self-insights and expressive therapy experiences. Parenting stress brings opportunities and challenges in PI practices for stress management. However, despite the potential opportunities and challenges, there is limited research on dealing with daily stress or parenting stress in this space. Therefore, in this study, I set out to explore how new parents engage in PI practices in the context of stress management.

CHAPTER 3. METHODOLOGY

In this chapter, I introduce the research design by providing a methodological literature review on the everyday design, descriptions of study instruments and the participants who engaged in this study. I illustrate the data collection process which involved a series of workshop sessions and interviews, data analysis methods, and the methods I used to ensure the validity and reliability of this study.

3.1 Research Design

This study is aimed at understanding how new parents make use of a flexible self-tracking technology in the context of stress management. To that end, I recruited five new parents and engaged them in a two-week self-tracking usage study which involves a series of interviews and participatory workshops. This chapter explains in detail about the rationale for the choice of research methods, how data was collected, and how it was analyzed.

3.1.1 Research approach

This study is built on the everyday design approach (Wakkary, 2005; Wakkary & Leah, 2007; Wakkary & Leah, 2008) which considers every individual as an everyday designer who incrementally and creatively appropriates artifacts and surroundings in daily life. In this approach, design activity is thought of as “an everyday cycle of interaction and adaptation that occurs over time and evolves design systems, artifacts, and routines (Wakkary et al., 2007, p.164),” in which individuals design for themselves or their family to accommodate their daily needs. The hallmark of everyday design is the belief in the creativity of individuals. As everyday designers, individuals are creative and resourceful in continually appropriating artifacts and surroundings in everyday lives (Wakkary et al., 2007).

Aligned with this approach, I believe new parents are creative everyday designers who are capable of designing personal trackers to support their own stress management and appropriate them as they engage in self-tracking practices with the aid of a flexible self-tracking tool and a facilitator. Accordingly, in this work, I am interested in (1) what kinds of tracking topics new parents put on the table within the context of stress management, (2) what kinds of data new parents

are interested in tracking about those topics and (3) how new parents adapt to self-tracking practices as they appropriate their personal trackers with a flexible self-tracking tool. Therefore, through a series of design workshops, I had our participants brainstorm and choose tracking topics, define different data entries as they desired, and revise their personal trackers based on the reflections on a week of self-tracking.

3.1.2 Study instruments

The study instruments that I used for the study include *OmniTrack*, a mobile self-tracking application that enables a customization of personal trackers, and worksheets designed to help participants reflect on their daily lives focusing on parenting stress, choose tracking topics, present trackers to others, and reflect on their tracking experiences.

3.1.2.1 OmniTrack

To investigate how new parents utilize a flexible self-tracking technology for stress management, I conducted technology probes by using a smartphone application, *OmniTrack* (Kim et al., 2017). *OmniTrack* is a mobile self-tracking application that enables a customization of personal trackers to meet individuals' various tracking needs. I chose this application because it not only enables users to create a flexible self-tracker for daily activities but also it provides researchers with an experimental toolkit to manage experiments and analyze the collected data. Because all our participants were iPhone users, but the application only supported Android, I lent each participant an Android phone with *OmniTrack* installed for the research purpose only. In the first workshop, after handing out the mobile phones for the research purpose, I introduced them how to create a new tracker, how to make a new tracking item with trackers, and how to check accumulated data. The data entries were uploaded to a web server every time participants created a new one in real time, if they were connected to Wi-Fi. For the potential loss of tracking data, I checked the *OmniTrack* experiment server every day and texted participants if they do not track for two consecutive days.

3.1.2.2 Worksheets

The study procedure included three design workshop sessions: 1) co-creating a personal tracker, 2) revising the tracker, and 3) co-reviewing tracking data. For the first and the third workshop,

worksheets specifically designed to help participants engage in activities to reflect on their daily lives, choose tracking topics, present trackers to others, and reflect on their tracking experiences.

In the first workshop session, I handed out worksheets for three activities: 1) reflecting on daily lives with scaffolded questions focusing on relevant factors to parenting stress, 2) choosing tracking topics, and 3) presenting personal trackers to others.

For the first activity, fifteen scaffolded questions related to basic needs (e.g., sleep and meals), parenting stress (e.g., how often and what situations they felt tired, overburdened, impatient, frustrated, or incapable as a parent), social support (e.g., meaningful conversation with spouse or others), and time for themselves (e.g., existing stress management strategies). Those questions are built on some of the concepts in the relevant literature presented above such as bidirectional interactions between parents and children, caregiver psychological well-being and social support, and the importance of subjective perceptions associated with parenting experiences. These were not example tracking topics, but rather scaffolded questions to help individuals reflect on their lives and brainstorm possible tracking topics of their interests. I informed participants that they do not need to answer all the questions due to time constraints.

In the second activity, based on what they reflected on their daily lives through the first activity, participants brainstormed and wrote down three tracking topics that they would track for two weeks. When choosing tracking topics, I asked them to choose 1) the most relevant topics to their parenting stress, 2) what they can record almost every day in the weekdays (weekends were optional), and 3) what they are interested in. Participants were also asked to write down the reasons for choosing such topics and what kind of data they would like to know regarding those topics referring to the different types of data fields that *OmniTrack* offers.

After the second activity, participants created their personal trackers with *OmniTrack*. I worked with each participant to help them create trackers, define data entries, give their trackers and data fields proper names, and set reminders. The following activity was presenting each individual's personal trackers to other participants about tracking topics and data fields they chose, the reasons for choosing the topics, and what they felt while designing trackers.

In the third workshop, I handed out worksheets to participants as well to assist them in an activity to look back on their tracking experiences, which includes what they learned through the tracking experiences and the impacts of the self-tracking on parenting stress management.

3.2 Participants

Since social isolation is a significant factor that contributes to compounding experiences of parenting stress as presented in Toombs et al. (2018) and Butcher, Wind & Bouma (2008), I decided to focus on a specific population of parents who were living far away from family and friends, which was an ideal context to understand the isolation and vulnerabilities of parenthood. Therefore, I recruited five Korean mothers living in Lafayette, Indiana- a small college town in the US- who have a child younger than 36 months. All of them came to the US as a trailing spouse as their spouses decided to study or work in the US. Most of the participants had one child whereas Jina had three children, whose ages ranging from 18 months to 6 years. The participant demographics are summarized in Table 3.1.

Table 3.1 Participants Demographics

Name¹	Age	Child's age	The length of time in the U.S.	Spouse's job
Dayoung	32	35 months	4 years	Graduate student
Jina	35	6 years 4 years 18 months	7 years	Working for a local company
Miyoung	35	17 months	2.5 years	Graduate student
Soojin	35	8 months	2.5 years	Postdoc researcher
Yumi	30	22 months	3 years	Graduate student

The purpose of this study was neither to verify the effect of self-tracking intervention on stress management nor to form generalizable theory about how new parents engage in self-tracking practices within the context of stress management. Instead, I aimed to investigate the viability of using a self-tracking technology for stress management through an in-depth understanding of the self-tracking experiences of a focused set of parents who were physically isolated from family and friends. Thus, enrolling a small number of participants was intentional to foster effective interaction among participants and a researcher as design partners as presented in other similar studies (i.e., Ferrario et al., 2017).

¹ Names are pseudonyms.

I solicited participants through a snowball sampling method (Goodman, 1961) and leaflets handed out at a local Korean church in Lafayette, Indiana. I used this sampling strategy to recruit participants who already know each other because I wanted to create a comfortable atmosphere where parents can talk about their parenting experiences in a candid manner. In turn, all our participants were recruited through a local Korean church. The workshop was advertised as a research activity that could provide parents with opportunities to engage in self-tracking practices for better stress management as well as to socialize with other parents.

3.3 Data Collection

The study procedure consists of a series of interviews and design workshop sessions. Throughout two weeks, three design workshop sessions were conducted: (1) co-creating a personal tracker, (2) revising the tracker, and (3) co-reviewing tracking data. The workshop protocols for each workshop session is in Appendix A. In the first workshop, participants co-designed a custom tracker in a group setting with the purpose of stress management during the study period. Participants had a chance to revise their trackers in the second workshop. After they were given one more week to use the revised tracker, participants were invited to the last workshop, where they shared their tracking experience reflected on the results both in a group setting and one-on-one interviews. Table 3.1. shows what data sources were used to answer each research question and what analysis methods were used for the specific data sources. Note that the entire process of data collection was conducted in Korean to create a more comfortable atmosphere for participants to speak in their native language.

Table 3.2 Research Questions, Data Sources, and Data Analysis Methods

Research Questions	Data Sources	Data Analysis Methods
(1) What topics do new parents choose to track, when presented with a flexible self-tracking tool in the context of stress management?	Transcripts, observational field notes, and worksheets from the first and second workshop session	Thematic analysis Content analysis

(2) What data about those topics do new parents choose to track, within the flexible self-tracking tool in the context of stress management?	Screenshots of individual tracker on <i>Omnitrack</i> from the first and the second workshop session	Content analysis
(3) In what ways do new parents self-track, and reflect on self-tracking, when using a flexible self-tracking tool?	Transcripts and observational field notes from the second and third workshop session and following one-on-one interviews	Thematic analysis
	<i>Omnitrack</i> tracking data and usage logs	Content analysis

3.3.1 Session I: co-creating a personal tracker

On the first phase of the study, participants engaged in an instruction and activity session to create their personal self-trackers. This session began by introducing the concept of self-tracking and the self-tracking tool. Then, participants took part in the first activity to reflect on one's life focusing on daily experiences related to parenting stress to identify their daily stressors and relievers. Through the second activity, having a discussion with other participants as well as with a researcher, each participant wrote down two to four tracking topics that they would like to address through the study period. When choosing tracking topics, I asked them to choose 1) the most relevant topics to their parenting stress, 2) what they can record almost every day in the weekdays (weekends were optional), and 3) what they are interested in. Participants were also asked to write down the reasons for choosing such topics and what kind of data they would like to know regarding those topics referring to the different types of data fields that *OmniTrack* offers. Then, they created personal trackers with *OmniTrack* by naming a tracker, defining data entries, and setting reminders for recording. Lastly, each participant presented one's tracker to other participants.

3.3.2 Session II: revising a tracker

After a one-week trial, small group interviews were conducted in a pair or trio to revise their trackers based on the first week of tracking experiences. Walking through the data collected during the first week, each participant was asked if there were any issues regarding the use of the tracker or if there were changes that they wanted to make to their trackers. After revising the trackers, participants took part in another week of self-tracking.

3.3.3 Session III: co-reviewing tracking data



Figure 1 Participants filling out worksheets in the third workshop.

After the two weeks of the study period, a group interview was conducted to reflect on and review their tracking experiences. The participants shared some of the interesting findings through the tracking experiences with each other. Then, one-on-one interviews were followed to gain more detailed information about each individual's tracking experience, assuming participants might feel more comfortable to share their experiences in a one-on-one setting, especially if they are introverted persons. The participants were asked to reflect on their tracking experiences including in what ways they engaged in self-tracking and what they felt during the study period in the one-on-one interviews.

3.4 Data Analysis

All the interviews and workshop sessions were audio-recorded and transcribed for analysis. I created observational field notes for each workshop session as well. The worksheets that participants filled out in the workshop sessions and the tracking data collected through *OmniTrack* during the two-week study were also included for analysis. As all data was originally in Korean, they were translated into English during the process of analysis.

Content analysis and thematic analysis were used as qualitative methods to analyze the data. Content analysis is defined by Berelson (1952) as “a research technique for the objective, systematic and quantitative description of the manifest content of communication” (p.18). In this work, structured data such as the worksheets from workshops and tracking data were analyzed through content analysis as it is suitable for describing the characteristics of textual information (Vaismoradi, Turunen & Bondas, 2013).

On the other hand, thematic analysis, which is defined as “a method for identifying, analyzing, and reporting patterns within data (Braun & Clarke, 2006, p.79),” was used to find overarching themes across the loosely structured data such as transcripts and observational field notes from workshops and interviews. I chose thematic analysis because it provides a flexible method of data analysis and allows researchers to use various theoretical frameworks. Braun et al. (2006) proposed the six steps of conducting thematic analysis:

- (1) “becoming familiar with the data by writing transcripts (p.89)”,
- (2) “generating initial codes (p.89)”,
- (3) “searching for themes (p.89)”,
- (4) “reviewing themes (p.91)”,
- (5) “defining and naming themes (p.92)”,
- (6) and “producing the report (p.93)”.

Following Braun et al. (2006)’s approach, I went through the six phases of thematic analysis. First, to become familiar with the data, I transcribed all the audio recordings from workshops and interviews. Then, I organized (1) what participants wrote down on worksheets (Appendix B), (2) what kinds of tracking topics our participants chose, how those topics have changed over time, rationales of the changes (Appendix C), (3) and each participant’s tracking data into tables. Second, examining all the data mentioned in the first phase of data analysis, I highlighted interesting ones and gave them initial codes. In this phase, I translated the interesting

data from Korean to English. Third, I created a mind-map using a web application to search for overarching themes (Appendix D). I placed example instances or quotes for each code and categorized different codes into broader themes. Because the findings seemed to have contributions to the three subareas, personal informatics, stress management, and design engagement, I organized the themes into the three subareas. Fourth, by reviewing the themes and codes, I went through iterative cycles of revisions. Fifth, I defined and named the themes. For example, in the Personal Informatics section, I named the themes based on the stages of PI—choosing tracking topics, designing personal trackers, revising personal trackers, and practices of self-tracking—to present the findings chronologically. Lastly, when producing the report, I went through some revisions to the themes and codes again. For example, the impacts of self-tracking practices were initially in the 4.1 Personal Informatics, but I chose to move it to the 4.2. Stress Management because I realized the impacts were closely related to stress management.

3.5 Validity and Reliability

As of one of the strategies to ensure the credibility and validity of the study, I meticulously kept all the materials such as transcripts, observational field notes, worksheets, and usage logs and data from *OmniTrack* during the data collection and analysis process. I also used three approaches to increase the validity and reliability of the results:

- (1) methodological triangulation using interviews, observational field notes, worksheets for workshop sessions, and usage logs and data from *OmniTrack*,
- (2) peer-debriefing to check possible biases in attention and vocabulary,
- (3) member checking, having participants review the findings to verify if I have reflected their perspective properly (Carspecken, 1994; Patton, 2001).

CHAPTER 4. FINDINGS

In this chapter, I will present some of the interesting findings of this study in the following way: (1) Personal Informatics, (2) Stress Management, and (3) Participant Engagement in the Design Workshops. In the first section, I will introduce how our participants chose their tracking topics, designed and revised personal trackers, and in what ways they engaged in self-tracking practices. In the following section, I will describe what kinds of parenting stressors and relievers our participants mentioned, the role of spouse, and the meaning of family to our participants. In the last section, I will report how our participants gained insights from each other, exchanged feedback, empathized, made jokes, and compared with each other.

4.1 Personal Informatics

In this section, I will first introduce how our participants chose their tracking topics, focusing on what kinds of topics they chose to track and what kind of concerns they had. Then, I will describe how our participants designed their personal tracker by utilizing different data fields in creative ways and how and why the participants wanted to revise their trackers. Lastly, I will discuss in what ways our participants engaged in self-tracking practices, including having various criteria of subjective evaluation, sharing tracking experiences with husband and others, and when they wanted to record with different trackers.

4.1.1 Choosing tracking topics

In the first workshop for co-designing personal trackers, our participants had a chance to reflect on their daily lives as a parent with the given worksheets. Based on the reflections, they brainstormed possible tracking topics and chose two to four tracking topics per individual (Table 4.1). There were various kinds of tracking topics that participants chose and different tracking goals that they pursued. I also found some of the interesting concerns that the participants had when choosing tracking topics. In this section, I will illustrate some of the interesting findings related to different tracking topics and goals and the concerns of the participants about choosing tracking topics.

4.1.1.1 Tracking topics and goals

Our participants wanted to track various topics with a flexible self-tracking tool within the context of stress management. Table 4.1 shows what kinds of topics the participants were interested in tracking. The most frequent topics include husband's involvement in parenting, time for oneself, going out, and sleep. It is noteworthy that four of our participants chose to track topics related to their husbands such as 'Husband's involvement in parenting' and 'Fun conversation with my husband,' even though there was only one question related to one's spouse in the worksheet among twenty-one questions. Miyoung, the only participant who did not choose to track her husband, was in an unusual situation during the study period when her husband was extremely busy at work that he was not able to involve in parenting, and her parents were visiting her helping with watching her baby instead of her husband. She said she would definitely have chosen to track her husband if she was under usual circumstances.

On the other hand, all our participants wanted to track what they think were stress relievers. While Dayoung and Jina wanted to track 'Time for myself' because they thought they needed to be alone to relieve stress, Soojin chose to track a broader topic, 'Stress reduction strategies.' Meanwhile, Miyoung and Yumi chose to track more specific activity such as 'Exercise' and 'Going out.' In addition, Soojin and Yumi wanted to track their 'Sleep' because they thought they tend to be stressed out when they are sleep-deprived. Other topics include 'Quiet time' and 'Frustration toward my baby.'

Table 4.1 Topics that The Participants Chose to Track

Participant	Initial Tracking Topics
Dayoung	Husband's involvement in parenting (남편의 육아참여) Time for myself (혼자 있는 시간)
Jina	Fun conversation with my husband (신랑과 즐거운 대화) Time for myself (나만을 위한 시간) Quiet time (말씀 묵상)
Miyoung	Going out (외출: 운동 제외한 사회 활동) Exercise (운동)

Soojin	Husband's involvement in parenting (남편의 육아참여) Stress reduction strategies (하루 스트레스 해소 방법) Sleep (수면) Frustration toward my baby (아기에게 짜증내는 횟수와 강도)
Yumi	Husband's involvement in parenting (남편의 육아 참여) Going out (외출) Sleep (수면)

Our participants pursued various tracking goals throughout the study period. In the first workshop for co-design, I intentionally stayed neutral and asked them to choose ‘the most relevant topics to one’s parenting stress management’ in order to avoid leading participants either only to pursue self-improvement or self-knowledge. Therefore, some of the participants focused more on having a better understanding of themselves while others focused more on improving one’s life. The goal that Dayoung had in mind when she chose to track ‘Time for myself’ and ‘Husband’s involvement in parenting’ was to measure how she and her husband were doing objectively. With this goal in mind, Dayoung did not let her husband know that she was tracking him because she wanted to record him as he had been, without him being affected by being aware of being tracked. Soojin and Yumi wanted to understand how much they were stressed out, what made them stressed out, and if existing stress relieving strategies were effective through ‘Sleep,’ ‘Frustration toward my baby,’ ‘Stress reduction strategies,’ ‘Husband’s involvement in parenting’ and ‘Going out’ tracker. On the contrary, Jina and Miyoung aimed to reinforce existing stress relieving strategies, such as ‘Time for myself,’ ‘Quite time,’ ‘Going out,’ ‘Exercise,’ and ‘Baby naps.’

The tracking goals that were related to participants’ husbands were surprising and similarly varied. Dayoung and Jina wanted to have a better relationship with their husbands through tracking ‘Time spent with my husband,’ ‘Fun conversation with my husband,’ and ‘Communication with my husband.’ Furthermore, Soojin hoped that she could split parenting duties with her husband through tracking ‘Husband’s involvement in parenting.’

4.1.1.2 Concerns about choosing tracking topics

The participants had several concerns when choosing tracking topics. Some of the concerns resulted from a perceived burden of commitment to self-tracking practices every day. Dayoung and Jina raised concern in the second workshop that they wanted to track meaningful conversation or having fun with husband, but they thought they would not be able to have meaningful conversation or fun with their husband every single day. I recommended naming trackers in a neutral way if they were pressuring to them, so they renamed their trackers as ‘Communication with husband’ and ‘Time spent with my husband.’ In addition, Miyoung and Yumi were worried about their trackers ‘Going out’ and ‘Exercise’ because they could not guarantee that they would be able to go out or exercise every day. Especially, after three days since the study had started, Miyoung’s baby caught a cold, so she had to stay home with him not being able to engage in ‘Going out’ or ‘Exercise.’ I recommended to Yumi either recording why she was not able to go out or exercise or having alternatives that are easier to do such as taking a walk if circumstances do not allow. To Miyoung, I suggested adding a new tracker which she can record every day even though she had to stay with her baby at home in the second workshop.

As four of our participants chose to track the topics related to their husbands, our participants talked a lot about their husbands in the group workshops. They seemed to find it fun and hilarious to track their husbands and make jokes about their husbands. Jina thought it was going to be very funny when she tracks ‘Fun conversation with my husband.’ When Jina talked about what it would look like if she tracked ‘Fun conversation with my husband,’ she and other participants laughed out loud: *“I’m gonna try the ‘Fun conversation with my husband’ this evening, like, why did you come this late, honey? It’s time for fun conversation” (Jina).* (“오늘 저녁에 남편한테 막, 여보, 왜 이렇게 늦게 왔어? 우리 즐거운 대화할 시간이야.”) When I asked them if it would be okay for them to share their data with others in the last workshop, Soojin and Yumi said yes and joked that they do not care about criticizing and ranking their husbands with others.

However, although other participants were laughing when making jokes about their husbands as well, I noticed some of the participants felt that the idea of rating other individuals including their husbands is a little uncomfortable. Miyoung joked that *“If I rate Soojin is 4 stars and Yumi is 1 star after meeting you guys, it would be very shameful for you. This should be anonymous.”* (“외출하고 와서 Soojin 은 4 점, Yumi 은 1 점... 그러면 진짜 수치스럽겠다. 이거 꼭 익명이어야겠네.”) She also made jokes that their husbands might contact the researcher and say *“I’m having a*

really hard time since my wife is tracking me... When does the study end?” (“남편들이 조용히 연락하는 거 아니야? 연구인지 뭔지 때문에 너무 힘들어요... 대체 언제 끝나나요?”) Both remarks seemed to show her concerns that the subjects of tracking might feel uncomfortable or offended. Moreover, Dayoung said that one of the reasons that she did not let her husband know that she was tracking his involvement in parenting was that she thought he might be offended.

4.1.2 Designing personal trackers

In this section, I will introduce some of the interesting findings related to what kinds of data fields our participants used, how our participants utilized different data fields with their personal trackers, and what our participants gained from different data fields.

4.1.2.1 Time range

Most of our participants, except Jina, added a time range field to their trackers to record from when to when a certain event lasted. Both Soojin and Yumi tracked from when to when they slept and from when to when their husband took care of their babies. Through tracking from when to when their husbands took care of their babies, Soojin and Yumi realized that the length of time that their husbands could spend for their babies was very short, which made them feel that they were taking care of their children almost on their own, at first. Through tracking from when to when they slept, Soojin and Yumi learned that they were sleep-deprived, and their sleep patterns were irregular. Lastly, Miyoung realized that she spent very little time for herself while spending most of the time taking care of her baby through tracking from when to when she went out to hang out and from when to when she exercised.

The figure displays three distinct tracker interfaces side-by-side, each with a dark purple header bar containing a close button (X) and the title 'New [Tracker Name] Item'.

- Left Tracker:** Titled 'New [남편의 육아 돌봄시간과 어떤 도움을 줬는지] Item'. It features a green dot icon and the text '남편이 아가 돌본 시간' with 'Just now' to its right. Below this is a time selection interface with two circular pickers, each showing '03:04 PM, Feb 21, 2019'. Between the pickers is a 'Same time' label and up/down arrow buttons. Below the pickers are three buttons: '+ 30 mins', '+ 1 hour', and 'To Now'. At the bottom, there is a green dot icon and the text '어떻게 돌봤는지' above a text input field labeled 'Type in short text here'.
- Middle Tracker:** Titled 'New [운동] Item'. It features a green dot icon and the text '만족도' above a five-star rating system. Below this is another green dot icon and the text '운동 전후 심신 컨디션' above a text input field labeled 'Write text here'. At the bottom center is a large teal button labeled 'SAVE ITEM'.
- Right Tracker:** Titled 'New [나를 위한 시간] Item'. It features a green dot icon and the text 'Multiple Choices' above four unchecked checkboxes with labels: '간식(커피,스낵)', '침 시간(낮잠, 휴식,티비)', '활동(지인과만남,쇼핑 외)', and '내관리(피부팩,네일 외)'. At the bottom, there is a green dot icon and the text 'Photo' above a photo upload area indicated by diagonal lines.

Figure 2 Screenshots of the participants' trackers created on *OmniTrack*.

Soojin's 'Husband's involvement in parenting' tracker which includes time range and text field (left), Miyoung's 'Exercise' tracker which includes rating and text field (middle), and Jina's 'Time for myself' tracker which includes multiple choices and photo field (right).

4.1.2.2 Text

All participants included a text field to their trackers to describe something in detail. Text fields allowed participants to record what they did, what they felt, and why they felt that way. The average length of text varied from individual to individual. Jina said that she did not like writing long sentences, so she often wrote just a few words or a short sentence whereas Dayoung wanted to describe what happened, what she felt, and why she felt comprehensively in relatively long sentences, sometimes more than seventy words.

With the detailed descriptions, Dayoung said she learned about herself that she never knew before, including what was most important in her evaluation of her husband's involvement in parenting:

I thought how much my husband was engaged in taking care of our child was the most important factor for me because then I can take some rest. But, writing down the reasons for the rating, I realized I wasn't that satisfied even when my husband took really good

care of our child for a long time because of other things such as I didn't like him going out to drink with his friends on Saturday evening. (Dayoung) (저는 남편이 육아 도와주는 시간이 중요하다고 생각했었어요, 그러면 전 할 수 있으니까. 근데 별점 준 이유를 쓰다 보니까, 제가 남편이 육아를 얼마나 잘했는지에 대해서 별점을 주지 않더라구요. 육아 잘 했어도 남편이 저녁에 술 마시러 간 날에는 내 기분이 안 좋으니까 낮게 주고.)

Soojin also gained a better understanding of her life by tracking why she got frustrated toward her baby and what disturbed her sleep with text fields. With the two of her trackers combined, 'Sleep' and 'Frustration toward my baby,' she discovered a correlation that her baby often woke up in the middle of the night, which made her frustrated and decreased the quality of her sleep. Then, she came to wonder why her baby often woke up in the middle of the night, searched on the internet, and came to know that her baby was going through a growing pain.

Meanwhile, through listing what their husbands did while taking care of their babies with text fields, Soojin and Yumi came to think that their husbands were doing their best at the given time, contrary to what they felt through tracking the time range:

When I first started tracking my husband, I almost felt I was taking care of our baby on my own because he only can spend a very short time with our baby. However, as I saw him also feeling sad about not being able to spend more time with our baby because of work, I realized he has given 100% of his efforts at the given time for us and felt grateful for him. (Yumi) (처음에 트래킹 시작할 때는 나도 아 남편이 아기 볼 수 있는 시간이 거의 없구나, 내가 거의 독박 육아를 하고 있구나 느껴서 좀 억울할 뻔했어요. 근데 우리 남편도 아기랑 보낼 수 있는 절대적인 시간이 적다는 것에 대해서 서운해 하는 걸 보니까, 주어진 시간에는 자기가 할 수 있는 한 정말 100을 하고 있는 걸 알게 됐어요. 그걸 알게 된 이후로는 되게 감사하게 느껴졌고.)

4.1.2.3 Rating

All our participants utilized a rating field for different purposes: evaluating the satisfaction of quality time, satisfaction of one's husband's involvement in parenting, the intensity of emotion,

and quality of sleep. Dayoung, Jina, Miyoung, and Yumi added a rating field to evaluate the satisfaction of quality time such as ‘Time for myself,’ ‘Time spent with my husband,’ ‘Fun conversation with my husband,’ ‘Going out’ and ‘Exercise.’ Evaluating satisfaction of quality time had different meanings to our participants. Dayoung realized that she preferred spending time with family over spending time on her own unlike what she thought before:

Through rating the ‘Time for myself,’ I came to learn that I feel the happiest when I am with my family rather than on my own. I thought I really appreciate spending time on my own, but it wasn’t that satisfying than I expected. (Dayoung) (혼자만의 시간 트래킹하면서, 가족과 보내는 시간에 사실 제가 제일 행복하다는 걸 알게 됐어요. 저는 스트레스를 해소하기 위해서는 혼자만의 시간이 제일 중요하다고 생각했는데, 막상 트래킹하다 보니 그렇게 좋지 않더라고요.)

Jina found out that her daily life was not that depressing than she thought even at the worst moment of the week by rating ‘Fun conversation with my husband’: *“It was surprising that I gave 3 out of 5 stars even when I had a really serious argument with my husband. I thought I have been under a lot of stress, but I wasn’t.”* (“난 신랑이랑 제일 크게 싸웠을 때도 별점이 3 점이었어, 나도 보고 놀랐다니깐.”) Miyoung also discovered that hanging out with a certain group of friends in the same age was the most therapeutic to her through rating ‘Going out’:

I learned what is most helpful for reducing stress. Hanging out with some of my friends really helps me relieve stress and soothe loneliness. I wasn’t really aware of it, but I came to realize it through rating satisfaction of going out. (Miyoung) (트래킹하면서 스트레스 해소에 뭐가 제일 도움이 되는지 알게 된 것 같아요. 마음 맞는 사람들이랑 편하게 얘기하는 시간이 내 스트레스나 외로움을 치유해준다는 걸 느꼈어요. 그런 것에 대해서 크게 생각하지 않았는데, 만족도를 이렇게 점수 매겨보니까 알게 된 것 같아요.)

Dayoung and Yumi used a rating field to evaluate their satisfaction level of their husbands’ involvement in parenting. What was different between them was that Dayoung had two text fields to describe what her husband did and to explain the reasons for rating whereas Yumi only had one text field to describe what her husband did with their baby. The difference

resulted from their different attitudes towards tracking their husbands. Dayoung came to learn that she did not rate her husband's involvement in parenting objectively based on how much help he gave to her or how long he spent time with their baby. Rather, she tried to be true to her feelings at the moment which were often affected by other circumstances, and rated her husband's parenting very subjectively, as she evaluated 'Time for myself' and 'Time spent with my husband.' Therefore, she wanted to explain the reasons why she gave such ratings in detail so that she can remember in the future. Meanwhile, Yumi said she tried to stay objective while rating her husband's parenting, although she acknowledged it might have been somewhat under the influence of her feelings.

4.1.2.4 Photos

Jina was the only person who chose to add a photo field to her trackers. She added a photo field to her 'Time for myself' tracker to keep records of what she did in her free time. In the first workshop, she expected that it would be easier for her to record what she did with photos than with texts. In the last workshop, she reflected on her experiences and said that she enjoyed the act of taking pictures itself: *"It was really fun to take pictures of what I did for myself today after my kids went asleep even though they are just small things."* ("나를 위한 시간도 소소한 것이라도 저녁에 애들 다 재우고 찍고 하는 기쁨이 있었어요, 그런 것들이 재밌더라고요.") It is not clear why other participants did not add a photo field to their trackers, but Yumi also said that it would have been great records if she added photos to record her 'Going out' tracker so that she can bring back memories in the future.

4.1.2.5 Multiple choices

Jina and Miyoung used multiple choices field in creative ways. Jina used a multiple choices field in two of her trackers as a way to understand what she appreciates the most. For her 'Time for myself' tracker, she made use of multiple choices as her own way of classifying what she did in her free time based on her preferences and feasibility. Specifically, the most preferred way of her but the most difficult one to do was 'shopping or hanging out with friends,' the second preferred way was 'taking naps or watching TV shows,' and the least preferred way but the easiest one to do was 'having snacks.' Therefore, when checking the accumulated data, she was able to see how many times she was able to do the most preferred activity and how many times she just had

to be satisfied with the least preferred but easiest activity. In the second workshop, Jina was not happy with the findings through the categories:

I think I came to face my daily life. I knew what my life was like but seeing that all things that I recorded for 'Time for myself' were watching TV or having snacks was a bit frustrating. I wanted to go shopping this week, but I didn't have a chance, not even once.

(Jina) (좀 내 일상을 직면하는 시간이었던 것 같아요. 알고는 있었지만 이렇게 기록하다 보니까, 맨날 하는게

티비 본거, 간식 먹은 거밖에 없어. 이번주에 쇼핑도 좀 가고 싶었는데, 한번도 못가고...)

However, interestingly, after one more week, she came to realize that she did not necessarily prefer 'shopping or hanging out with friends' over 'taking naps or watching TV shows' and 'having snacks' because she found herself choosing to watch TV and have snacks even when she had a chance to go shopping.

When Jina revised her 'Fun conversation with husband,' she also added a multiple choices field to her 'Communication with my husband' tracker to categorize what she gained through it, such as 'Understanding my husband better,' 'Understanding my weaknesses,' 'Learning new information about neighbors,' 'Nothing but a waste of emotion,' 'Feeling connected to each other and grateful.' In the exit interview, she noted that she came to know what she hoped to gain through communication with her husband, which was feelings of connection and appreciation. In addition, Miyoung used a multiple choices option in her 'Going out' tracker to check what kind of people she met such as 'small group bible study,' 'born-in-1983,' and 'play date.'

4.1.3 Revising personal trackers

After one week of tracking with the trackers designed in the first workshop, participants had a chance to revise their trackers either by changing their tracking topics or altering data fields. Three of our participants wanted to change existing tracking topics or add a new tracker as presented in Table 4.2. Also, three of our participants wanted to make some tweaks to their data fields while the other two participants added a new data field to their trackers according to the researcher's suggestion. In this section, I will describe what kind of changes the participants wanted to make to their trackers and why they wanted to make such changes.

Table 4.2 Revisions of Tracking Topics

Participant	Initial Tracking Topics	Revisions of Topics
Dayoung	Husband's involvement in parenting (남편의 육아참여) Time for myself (혼자만의 시간)	Time for myself (혼자만의 시간) → Time spent with my husband (남편과 둘만의 시간)
Jina	Fun conversation with my husband (신랑과 즐거운 대화) Time for myself (나만을 위한 시간) Quite time (말씀 묵상)	Fun conversation with my husband (신랑과 즐거운 대화)→ Communication with my husband (신랑과 소통)
Miyoung	Going out (외출: 운동 제외한 사회활동) Exercise (운동)	Added 'Baby naps' (아기 낮잠)
Soojin	Husband's involvement in parenting (남편의 육아 참여) Stress reduction strategies (하루 스트레스 해소 방법) Sleep (수면) Frustration toward my baby (아기에게 짜증)	N/A
Yumi	Husband's involvement in parenting (남편의 육아 참여) Going out (외출) Sleep (수면)	N/A

4.1.3.1 Reasons for changing tracking topics

As presented in Table 4.2, three of our participants wanted to make some revisions to their existing trackers after a week of tracking. Each participant had a different reason for the change. Most of the changes resulted from the new understanding about themselves while one was due to circumstantial reasons.

Jina wanted to change ‘Fun conversation with my husband’ because she and her husband felt a pressure that their conversation had to be fun. Therefore, she chose a more neutral word and named the tracker as ‘Communication with my husband.’ Not only renaming the tracker, but she also added different data fields from the previous one such as what she gained through the communication as a multiple choices field. Dayoung changed her ‘Time for myself’ tracker to ‘Time spent with my husband’ because she realized that she actually preferred spending time with her husband over on her own, and spending time with her husband was the most influential in her mental well-being.

Unlike other participants, Miyoung made changes to her tracker because of circumstantial reasons. After a few days after the study period started, her baby caught a cold, so she had to stay at home with him all the time, which made her not able to hang out with friends or exercise. Therefore, she and I talked to think about something she could do at home. As a result, she added a new tracker, ‘Baby naps,’ because she thought she could take some break when her baby was taking a nap.

4.1.3.2 Reasons for revising data fields

Three of our participants wanted to make some tweaks to their data fields while the other two participants added a new data field to their trackers according to my suggestion.

The motivation of the three participants for making some changes to their data fields was that they came to have a better understanding of what kinds of data fields were more appropriate to know more about their topics of interests. Dayoung wanted to add a text field to describe the reasons for the rating for her husband’s parenting. In her initial trackers, she did not have a text field for the reasons for the rating, but she wanted to add one more because she thought she needed it to find meaningful patterns about herself and her husband. Jina wanted to add more option, ‘applying nail polish or skin care,’ to the multiple choices in her ‘Time for myself’ tracker because it is something she enjoyed as well. Miyoung wanted to change a time field to a time range both in her ‘Going out’ and ‘Exercise’ tracker because she felt a time range field made more sense to track from when to when she spent time outside home or exercises.

Meanwhile, Soojin and Yumi added a text field to record what disturbed their sleep in their sleep trackers according to the researcher’s suggestion with the purpose of finding the reasons for negative patterns of sleep.

4.1.4 Practices of self-tracking

There were some interesting findings while our participants engaged in self-tracking practices for two weeks. In this section, I will describe the various criteria of evaluation of the target activity, event, or behavior in a subjective manner, the motivation of sharing or not sharing tracking experiences with the participants' spouses and other people and what our participants felt about sharing the tracking experiences with their husbands or other people.

4.1.4.1 Various criteria of subjective evaluation

As presented in the 4.1.2.3. Rating, all our participants included a rating field to one or more of their trackers. In terms of rating quality time for oneself such as 'Fun conversation with my husband,' 'Time for myself,' 'Exercise,' 'Going out,' the participants focused on their feelings at the moment. For instance, Miyoung said she rated 'Exercise' regarding how much she felt better compared to before exercising, how relaxed she felt, and how satisfied she was, and Yumi said she rated 'Going out' according to how much she felt her stress level was reduced. However, the participants engaged in rating not only related to the target activity, event, or behavior but also based on other factors that did not have a lot to do with the tracking topics such as how satisfied their family time was. For instance, Dayoung indicated that she tended to evaluate her 'Time for myself' related to how she spent time with family:

I thought the longer the break is, the more satisfied I am, but I realized the length of time doesn't really matter to me. I tended to view and rate 'Time for myself' associated with how I spent time with my family as well. (Dayoung) (혼자 보내는 시간이 길면 좋고 짧으면 안 좋은 거 그렇게 생각했는데, 그게 전혀 아니더라고요. 가족들이랑 어떻게 시간을 보냈느냐에 따라서 혼자만의 시간에 대한 평가가 달라져요.)

Likewise, some of our participants rated their husbands' parenting based on their subjective feelings while others tried to stay objective in evaluating their husbands' parenting. Dayoung learned that she was quite a moody person by finding herself rating her 'Husband's involvement in parenting' not based on how well her husband was with their baby or how long he spent time with their baby, but how her husband was nice to her and if she was feeling well both emotionally and physically: *"I rated him a few days ago low even though he spent quite a*

long time with our son because I got mad to him when he and my son looked kind of allied against me.” (“아빠랑 애랑 너무 사이가 좋고 저는 좀 소외시킨다고 느낄 때가 있어요. 그럴 땐 남편이 육아한 시간이 길어도 고맙다고 느껴지지 않아서 점수를 낮게 줬어요.”) On the other hand, Yumi said she tried to stay objective while rating her husband’s parenting, although she acknowledged it might have been somewhat under the influence of what she felt at the moment.

4.1.4.2 Sharing with husband

As one’s spouse is the primary parenting partner in most cases, some of our participants were interested in sharing their tracking experiences with their husbands while the others were not concerned much about sharing their experiences with their husbands. Especially, since four of our participants chose to track topics related to their husbands, some of them let their husbands know about their tracking experiences to ask for their cooperation. However, not all the participants decided to let their husbands know in the first place. I asked participants twice if they let their husbands know about their tracking experiences, in the second workshop and the last workshop. From the beginning, Jina and Yumi told her husband that they were tracking ‘Fun conversation with my husband’ and ‘Husband’s involvement in parenting,’ respectively. Jina said her intention of asking him for cooperation, but Yumi said she did not have a specific intention of letting her husband know. On the contrary, Dayoung, Miyoung, and Soojin did not let their husbands know until the second workshop. They had their own reasons for not letting their husbands aware of their tracking experiences. Dayoung wanted to record him as exactly as he had been and thought he might be affected if he realized that he was being tracked. Miyoung did not feel that she needed to let her husband know because her tracking topics were irrelevant to him. Soojin thought her husband was too busy to engage more in parenting, so it was of no use to let him know.

Nonetheless, after one week, Dayoung and Soojin changed their minds and decided to tell their husbands. After changing one of her tracking topics from ‘Time for myself’ to ‘Time spent with my husband,’ Dayoung wanted her husband to cooperate with having quality time together. Interestingly, Soojin used her tracking data as a medium of communication with her husband. She showed her tracking data to her husband and renegotiated how to split parenting duties:

I showed both my ‘Sleep’ and ‘Husband’s involvement in parenting’ tracking data to my husband and he was shocked and felt sorry to me. He came to understand that I have

lacked sleep and he didn't spend much time at home this week, so we discussed what kind of help I need and how he can help better. Therefore, he decided to stay home in the evening before our son goes to sleep and go to work a bit later to take care of him in the morning. He also helped me with dishes this week as well. (Soojin) (남편한테 수면 시간이라든
질 기록한 표를 보여주고, 남편의 육아참여도 보여줬어요. 보면서 제가 잠이 되게 모자란다는 걸 알고 남편이
되게 미안해하고, 또 육아 참여 별로 없는 것도 보고. 그래서 서로 힘든 게 뭔지, 어떤 도움이 필요한지 나누면서
육아 계획을 짰어요. 그래서 남편이 최대한 밤에는 아기 봐주고, 출근도 좀 늦게 해서 아침 시간 같이 할 수
있도록 하기로 그렇게 얘기했어요.)

Inspired by Soojin's story, Miyoung said it would have been helpful for her husband to empathize better with her if she tracked how tough her daily life was and shared the data with him. Similarly, Yumi noted that she was going to show the data to her husband after the last workshop because she felt they could have had a meaningful conversation with each other based on the data.

4.1.4.3 Sharing with others

Most of our participants did not choose to share their tracking experiences with others except for one participant, Jina. She had been telling others that she was participating in a study and tracking regarding her parenting stress: *"I wanted to tell my friends that I am managing myself in a fun and novel way. It's basically a really new and fun experience, so I wanted to share with everybody."* ("뭔가 내가 재밌는 경험을 하고 있다, 나는 내 관리를 이런 식으로 하고 있다는 걸 주변 친한 사람들에게 말하고 싶었어요. 굉장히 신선한 경험이지 않아요.")

On the contrary, other participants were reluctant to share their tracking experiences or not interested in sharing with others. Dayoung and Miyoung were concerned about sharing too much about husband and wife matters with others outside the group: *"Hmm, wives may come to argue with their husbands more often if they share data about their husbands with each other as they compare each other's husband."* ("남편과의 일을 다른 부인들이랑 나누면 남편과의 부부싸움이 잦아지지

않을까요? 괜히 다른 남편들이랑 비교하게 되고.”) Yumi thought the self-tracking experience was a very personal activity, so she did not feel the need to share with others.

4.2 Stress Management

In this section, I will first describe the stress experienced by our participants related to what kind of stressors they perceived in their lives as a parent and what kind of struggles they experienced as immigrant parents. Then, I will discuss what kind of tracking topics the participants chose to track and what kind of goals they pursued through self-tracking. Furthermore, I will examine the influential factors on stress management perceived by our participants. Lastly, I will look into the impacts of self-tracking practices on stress management.

4.2.1 Parents under stress

The two weeks of the study provided a glimpse into the stress experienced by our participants being both as a parent and immigrants living in the US. In this section, I will talk about how our participants perceived stress in their daily lives being both as parents and immigrants.

4.2.1.1 Negative perceptions of life as a parent

Like many other parents with young children, our participants were struggling with stress in their everyday lives. Some of our participants, Jina and Miyoung, perceived their mundane routines of daily life as stressful. Jina stated that she was frustrated that all she was able to do in her free time was just watching TV and having snacks. Similarly, Miyoung stated that *“I realized my everyday life is really monotonous and repetitive, and I spend very little time for myself, especially, because my child has been sick recently; I have been tied to him all day long.”* (“이걸 하다 보니까, 나 되게 별거 없이 단조롭게 사는구나, 그리고 나를 위한 시간이 진짜 없구나 하는걸 느꼈어요. 최근에는 애가 아프니까 하루 종일 애한테 매여 있어서 더 그랬고.”)

Some of our participants were also unsatisfied with their husbands’ involvement in parenting, which contributed to their perceived stress. Soojin’s husband had been too busy, so he often got back home late at night and could not engage in parenting much. In the second workshop, she told that she felt tracking her ‘Husband’s involvement in parenting’ made the problems more prominent: *“I sometimes got mad looking at the data. I said to my husband, ‘Honey, you only spent an hour and a half with our son today!’, showing him the data.”*

(“트래킹한거 보다가 남편한테, 여보! 오늘 애기랑 한시간 반 밖에 안 놀아줬다! 보여주면서 그러기도 하고.”) Yumi also realized that the length of time that her husband engaged in parenting was too short because he often got back home late, which made her feel she was taking care of her baby almost on her own.

Due to the severe stress, some of our participants, Miyoung and Soojin, said they had worried if they had depression since they often experienced severe mental distress in their everyday life:

I sometimes felt like I was going crazy when I had to take care of my baby all by myself for hours and hours even without a few minutes to have a cup of coffee. The feeling that nobody but I'm the only one who can take care of him sometimes really suffocates me.

When my baby first arrived, I was amazed by him, and I didn't feel that way, but it's been more than a year and a half, so the stress has been accumulating since then. (Miyoung)

(애기랑 단둘이 있는 시간이 제일 힘들죠. 몇시간 동안 스트레이트로 혼자서 아기를 보는게... 어쩔 때는 차분히 앉아서 커피 한 잔 마실 시간이 허락이 안될 때, 되게 미치는 순간이 있어서... 나 말고는 아무도 이 아이를 봐줄 수 없다. 오로지 나한테 달려있는 존재라는 생각을 하면 숨이 막힐 때가 있어요. 처음에는 아기를 키우는 게 신기한 경험이기도 하니까 그렇게 힘들게 느껴지지 않았는데, 그 생활도 벌써 1년 반이 되었으니까... 축적이 된 것 같아요.)

4.2.1.2 The struggles of immigrant parents

On top of the struggles of being a parent of a young child, our participants were exposed to more disadvantages as a recent immigrant and a trailing spouse, which is in line with prior works (Yoon, 2013; Gilbert, 1982; Scheinkman, 1988). As all the participants were trailing spouses who came to the US due to their husbands' study or work, they had to take a leave of absence from work or quit their jobs before coming to the US. Our participants found the financial and emotional dependence on their husbands challenging. Jina had to quit her job right after she married her husband because her husband was working in New Zealand and then moved to the US a few years later as her husband came to have a new job.

Life of a stay-at-home wife is really in one's husband's hands in every aspect, especially in a financial aspect. I sometimes get anxious about being a stay-at-home wife without pursuing any career while comparing with my peers who are successful in their careers back in my home country. I think I often seek compensation for all of that from my husband. (Jina) (엄마의 삶이라는 게 남편에게 좌지우지되는게 너무 크니까, 경제적인 측면에서 특히.

나랑 같이 일하던 사람들 벌써 과장 달고 팀장 달고 했는데 나만 아무 커리어 없이 이렇게 애들만 키우면서 사는게 어쩔 때는 불안하기도 하고... 그 보상을 아무래도 신랑한테 다 바라게 되는 것 같아요.)

As feelings of isolation and loneliness have been proven to contribute to the increased level of parenting stress (Jackson, 1999; Lennon et al., 2002), Dayoung and Miyoung were concerned about feelings of loneliness as well as emotional dependence on their husbands. Dayoung noted that she came to realize she was more emotionally dependent on her husband than she thought, and she attributed the reason to live as an immigrant: “*Maybe, because I often feel lonely as I am an immigrant here apart from my family and friends, I got more dependent on my husband. He is my best friend as well as my husband.*” (“아무래도 외국 생활하면서 가족이랑 친구 다 떨어져 있으니까 외롭다 보니 남편한테 더 의존하게 되는 것 같아요. 남편이 제일 친한 친구이기도 하고...”) Miyoung also talked about the challenges of the life of an immigrant parent:

I really wished that I could ask my mom to watch my baby for a few hours and have a day off to hang out with my old friends, but I don't have my mom or my old friends here. I needed to talk to someone who would not judge me or misunderstand me, but I felt there was no one, so I often isolated myself. (Miyoung) (너무 힘들면 엄마한테 아기 몇 시간 맡기고 친한 친구들이라도 만나러 가고 그러면 좋겠는데, 그런 것도 완전히 단절된 상태에서 오롯이 아이랑 나랑 처음부터 끝까지 있는 게 참 힘들어요. 여긴 친한 친구가 없잖아요. 내가 무슨 말을 해도 오해하지 않고 편하게 얘기할 수 있는 그런 친구랑 얘기할 수 있는 게 여긴 없으니까, 그냥 집에 혼자 고립되어 있기도 하고...)

4.2.2 Tracking topics and goals for stress management

When presented with a flexible self-tracking tool within the context of stress management, our participants chose to track different topics in pursuit of different goals. In this section, I will examine what kinds of tracking topics our participants chose and what kinds of goals they sought within the context of stress management.

Table 4.3 shows what kinds of themes emerged through the topics which our participants chose to track, including husband's involvement in parenting, time for oneself, quality time with husband, social activity, basic needs, and negative emotion. The most frequent themes were one's husband's involvement in parenting, time for oneself, and social activity. There were some topics that were not clear which theme it belonged because the topics themselves sometimes did not represent what the participants really wanted to capture. In those cases, I categorized them based on their intentions and what they ended up tracking. For example, when Miyoung decided to track 'Baby naps,' her intention was to record what she did in her free time because baby nap time meant her free time. Therefore, I categorized her 'Baby naps' tracker into 'Time for oneself.' Also, for Soojin's 'Stress Reduction Strategies,' all the tracking items that she ended up tracking were about hanging out with friends. Therefore, I categorized it into 'Social Activity.'

Table 4.3 Tracking Themes

Participant	Husband's involvement in parenting	Time for oneself	Quality time with husband	Social activity	Basic needs	Negative emotion
Dayoung	Husband's involvement in parenting (남편의 육아 참여)	Time for myself (혼자만의 시간)	Time spent with my husband (남편과 둘만의 시간)			
Jina		Time for myself (나만을 위한 시간) Quite time (말씀 묵상)	Fun conversation with my husband (신랑과 즐거운 대화) → Communication with my			

			husband (신랑과 소통)			
Miyoung		Exercise (운동) Baby naps (아기 낮잠)		Going out (외출)		
Soojin	Husband's involvement in parenting (남편의 육아 참여)			Stress reduction strategies (하루 스트레스 해소 방법)	Sleep (수면)	Frustration toward my baby (아기에게 짜증내는 횟수와 강도)
Yumi	Husband's involvement in parenting (남편의 육아 참여)			Going out (외출)	Sleep (수면)	

As presented in 4.1.1.1. Tracking topics and goals, our participants sought different tracking goals. While some aimed to have a better understanding of their lives, others explicitly pursued improving their lives. For example, Dayoung, Soojin, and Yumi pursued understanding how much they were stressed out, what made them stressed out, and if existing stress relieving strategies were effective through ‘Time for myself,’ ‘Sleep,’ ‘Frustration toward my baby,’ ‘Stress reduction strategies,’ and ‘Going out.’ In contrast, Jina and Miyoung sought to reinforce existing stress relieving strategies, such as ‘Time for myself,’ ‘Quite time,’ ‘Going out,’ ‘Exercise,’ and ‘Baby naps.’

Interestingly, some of our participants wanted to affect other people through tracking as well, specifically their husbands. Dayoung and Jina wanted to have a better relationship with their husbands through tracking ‘Time spent with my husband,’ ‘Fun conversation with my husband,’ and ‘Communication with my husband.’ Furthermore, Soojin hoped that she could split parenting duties with her husband through tracking ‘Husband’s involvement in parenting.’

4.2.3 The influential factors on stress management

The two weeks of the study revealed some interesting findings of what kind of factors affected parents' stress management. In this section, I will describe how one's knowledge about stress, subjective perceptions, and one's spouse's emotional support affected stress management.

4.2.3.1 Knowledge about stress

The two weeks of the study revealed what kind of knowledge about the stress our participants had, how the knowledge affected stress management, and how it changed over time. The participants had their own thoughts about what kind of strategies worked best for them for reducing stress. For example, in the first workshop, Dayoung and Jina said spending time on their own was most helpful for reducing stress whereas Soojin and Yumi said hanging out with friends was most helpful for them. Also, Miyoung was not sure about which strategy worked best for her. These thoughts were reflected in the tracking topics that the participants chose to track in the first workshop.

However, as they engaged in the tracking experiences, some of the participants realized there were other strategies that work better for them. Dayoung came to know that she was not that satisfied with spending time alone than she thought and actually preferred spending time with family after the first week of tracking. Thus, she decided to change the tracking topic from 'Time for myself' to 'Time spent with my husband.' Likewise, Jina learned that her preferences on what she did in free time were different from what she thought. In the second workshop, she said:

I thought going shopping or meeting friends were the most enjoyable activities for me, but I found myself choosing just to watch TV and relax. Maybe going outside is not always the best option for me. I found I actually enjoyed spending time at home, watching TV, and having some snacks. (Jina) (나는 꼭 쇼핑을 가거나 나가서 친구를 만나는 게 제일 나한테 스트레스 풀리는 일이라고 생각했는데, 한번 쇼핑 갈 기회가 있었는데도 내가 쇼핑을 안하고 티비를 보는 거예요. 그래서 꼭 쇼핑 가는게 나한테 제일 좋은 건 아니구나 깨달았어요. 집에서 티비 보면서 간식먹는 게 나한테는 더 편하고 좋기도 하더라구요.)

4.2.3.2 The importance of subjective perceptions

The importance of the subjective perceptions of the stressors as well as the surrounding situations has been highlighted by several studies (Lazarus et al., 1985; Telleen et al., 1989; Crnic et al., 1990; Fonseca, 1995; Tucker, 2011). The results of the study also uncovered the importance of one's subjective appraisal of the stressors and the perceived resources in stress management.

Through recording and checking their daily lives, some of our participants came to perceive their lives more positively, even though there was no difference in their circumstances. In contrast to what Jina thought of what she did in her free time on the first week of tracking, watching TV shows and having some snacks, she came to appreciate the small things that she was able to do for herself because she realized she actually chose to watch TV and have some snacks instead of going shopping. On top of that, Jina discovered that she and her husband had an argument less frequently than she thought before the tracking, which made her feel relieved. Jina explained how the self-tracking practices helped her with mood management: *“Because of the repetitive routines of our lives and daily challenges, many parents are surrounded by vague negative feelings. Recording my daily life made me view my life more objectively.”* (“육아가 힘들고, 항상 똑같은 일상이 반복되니까, 엄마들은 보통 막연한 부정적인 느낌 속에서 살잖아요. 그런데 트래킹하면서 내 삶을 좀 객관적으로 볼 수 있었던 것 같아요.”) Similarly, despite her initial thought that she was almost the only one who took care of her son, after the two weeks of tracking, Yumi came to give more credits to her husband's involvement in parenting by listing what kind of things he did for their son. In sum, recording their lives changed the way how our participants perceived their daily lives despite any changes in their circumstances.

4.2.3.3 The role of the spouse in stress management

All our participants highlighted the role of the spouse in stress management throughout the study. Four of the participants, Dayoung, Jina, Soojin, and Yumi, chose to track either their ‘Husband's involvement in parenting’ or ‘Communication with my husband,’ which shows that they considered their husband's role in their stress management significant. On top of that, the only participants who did not choose any tracking topic related to one's husband, Miyoung, said the reason that she did not choose to track topics related to her husband was because her husband was extremely busy during the study period so that he was not able to spend any time for

parenting at the time. She said she would have tracked how her husband helped as well if he could be involved in parenting during the study period.

Furthermore, Dayoung and Jina stressed the importance of their husbands in their mental wellness. Dayoung wanted to track ‘Time spent with my husband’ because she was spending much time with him since they started to send their child to preschool, which made their relationship even more important to her mental wellness. Therefore, she noted that the relationship with her husband affected how she perceived the other times that she spent alone or with her child: *“I think the relationship between my husband and me affects both the time that I spend alone and the time that I spend with my child.”* (“남편과의 관계가 혼자 있는 시간에도 영향을 미치고 육아에도 영향을 미치는 것 같아요.”)

Jina, Miyoung, and Yumi also described how their husbands’ emotional support had been helpful for their mental wellness. Jina stated that she realized that they were communicating a lot about their children and she was receiving much help from it through tracking ‘Communication with my husband.’ Miyoung mentioned how her husband’s emotional support was helpful for her to recover from hard times when she was at the risk of depression:

There was a time that I thought I need to take care of my son all by myself because my husband was busy. However, once I became too depressed and realized it might affect my son and my husband as well, I talked to my husband about how I was feeling. He totally understood me, and he has been doing everything to help me out since then; it helped me turn a corner. Sometimes he can’t help me because he gets too busy, like last week, but I understand it because I know that he does his best at other times. (Miyoung) (처음에는 육아는 내가 다 해야 한다고 생각했거든요. 나는 집에 있고, 신랑은 바쁘니까. 근데 내가 되게 우울증같이 오고 한동안 굉장히 힘들었던 적이 있는데, 그러면 그 영향이 우리 가족한테 다 가서 가족에게도 안 좋다는 걸 느끼고 부터는, 힘들면 남편한테 바로 얘기해요. 그러면 남편이 제 말을 다 수용해주고, 정말 최선을 다해서 도와줘요. 지난주같이 특수하게 바쁜 상황에서는 신랑이 도와줄 여건이 도저히 안된다는 걸 나도 아니까 감수하는 거죠. 다른 때에는 최선을 다하는 걸 아니까.)

4.2.4 The impacts of self-tracking practices on stress management

Throughout the two weeks of the study, our participants discussed the impacts of the self-tracking practices on stress management. In this section, I will report the impacts of self-tracking practices perceived by our participants including having a better understanding of one's life, changing life in a positive way, and emotional satisfaction.

4.2.4.1 Having a better understanding of one's life

Through the two weeks of tracking, our participants gained better understandings about their lives. First, they found something new about what kind of persons they were that they never knew. Dayoung came to know that she was quite a moody person as she found herself rating 'Time for myself' or 'Husband's involvement in parenting' not based on the length of time spent or what kind of activities she or her husband did but based on other factors such as her physical and emotional state, the satisfaction level of family time, and the relationship with her husband. Also, she came to understand that spending quality time with family was far more helpful for her stress management than spending time alone.

Second, the participants learned if their existing stress reduction strategies were effective. Miyoung realized her existing strategies, exercise or meeting friends, were very helpful for her reducing stress, especially meeting friends whom she felt the most comfortable. Soojin found that she had been spending too much time on meeting friends outside so that she often felt tired.

Third, the self-tracking practices allowed participants to gain better knowledge about their children as well. Soojin noted that she was able to identify correlations through the captured data with her 'Sleep' and 'Frustration toward my baby' trackers:

My baby has gotten up in the middle of the night for almost three weeks. Without the tracking data, I would have just wondered why. However, through the data, I found that he always woke up in the middle of the night, then he woke me up, too, and I got frustrated toward him. So, I searched on the internet why he did that and came to know that it was due to growing pains. (Soojin) (한 삼 주 전부터 아기가 새벽에 늘 깨요. 그 데이터가 없었으면 왜인지 몰랐을 텐데, 기록을 해보니까, (아기가) 새벽에 깨는 거, 그래서 저도 깨고, 아기에게

짜증내는 시간도 다 새벽이고, 그게 다 연결되어 있더라고요. 그걸 보고 검색해보니까 그게 다 성장통 때문이라는 걸 알게 되었어요.)

The self-tracking practices also let our participants recognize some of the negative patterns in their lives such as irregular sleep patterns (Yumi), lack of sleep (Soojin and Yumi), lack of time for oneself (Miyong), and lack of outdoor time (Miyong), which could be detrimental to stress management. These discoveries had the individuals make a resolution to improve the patterns. Soojin and Yumi decided to take a nap when their babies are asleep or to go to bed early not to get too tired during the day. Miyong resolved that she would go to the gym or take a walk more often.

4.2.4.2 Changing life in a positive way

Even though our participants engaged in self-tracking practices for stress management for a short period, some positive changes happened in their lives as one of the impacts of self-tracking practices. For Yumi, the act of self-tracking supported increased mindfulness in everyday life: *“I came to be more conscious about my daily routines, thinking if doing these things would help parenting stress management.”* (“트래킹하면서 나의 일상을 의식하면서 지내게 되고, 내가 이런 행동을 하는게 육아 스트레스 해소에 도움이 되는 건가 한번 더 생각해보게 되고, 좋았어요.”)

Furthermore, the self-tracking practices gave our participants a chance to perceive their lives in a more positive way, which is one of the vital intrapersonal resources that mediate parenting stress (Hwang et al., 2010; Jang et al., 2011). Most of our participants indicated that they realized they were in better situations through data compared to what they thought before. Yumi and Jina found that her level was not that high compared to what she thought before:

I gave three stars out of five stars for the ‘Communication with my husband,’ even though I had a serious argument with my husband and it was the worst moment of the two weeks, isn’t it surprising? I thought I argue with my husband more often, almost every day, but it was just one time in two weeks! (Jina) (나 신랑이랑 싸우고 이래도 별이 제일 적은 게 3 개였어요. 그날 오후까지 울고불고 싸웠는데도. 나는 싸움도 더 자주 하는 줄 알았어요. 근데 2 주 동안 한번밖에 안 싸웠더라고요. 난 맨날 싸우는 줄 알았는데.)

Jina also came to appreciate small things that she did for herself:

Even though I've had snacks almost every day, I didn't think I was doing something for myself. I just consumed snacks because I was stressed out without thinking carefully.

However, recording it as one of the categories of 'Time for myself,' I came to realize this was also a precious thing to me, something has a good influence on me. (Jina)

(매일 간식을 먹어도, 그게 나를 위한 것이라고 생각하지 않았어요. 그냥 스트레스 받으니까 어떤 의식 없이 섭취한 거지.

근데 이걸 나를 위한 시간이라는 카테고리 안에서 선택하니까, 간식 먹는 시간도 나에게 소중한 거구나, 나에게 좋은 영향력을 주는 거구나 하고 인식하게 된 것 같아요.)

Soojin and Dayoung said they realized they were spending a lot of time for themselves as well as for their babies on meeting friends or spending quality time with her husband.

Not only did they become positive about themselves, but they also came to appreciate their husbands through the self-tracking. Jina, Soojin, and Yumi shared the same feeling that they had felt they were the only ones who sacrificed for their families, but they realized their husbands were doing their best for family as well: *"Even though he spends very little time with our son due to his busy work, I realized he has been doing his best at the given time through the tracking experiences"* (Yumi). (“트래킹하면서 남편이 바빠서 아기 볼 수 있는 시간은 정말 적지만, 주어진 시간에는 정말 최선을 다하고 있다는 걸 느끼게 됐어요.”)

The self-tracking practices also contributed to some behavioral changes. One of the benefits of self-tracking practices which Jina and Miyoung found was promoting positive behaviors, exercise and meditation:

I have not been good at going to the gym because I often got lazy. But while tracking exercise, I felt I had to go to the gym to have something to write down. After a few visits, now I feel it became a lot easier for me to go to the gym. (Miyoung)

(평소에 귀찮아서

미루다가 운동 잘 안 가고 그랬었는데, 트래킹 하면서는 한 줄이라도 써야 하니까 귀찮아도 가게 되고. 요새는 훨씬 운동 가는 게 수월해진 것 같아요.)

Meanwhile, Soojin found the self-tracking practices helpful for her to reduce negative behaviors because she felt her frustration towards her baby had decreased after she started tracking it.

Interestingly, one of our participants also elicited behavioral changes from others, specifically one's husband. For Soojin, the self-tracking practices was an opportunity to collect data to facilitate communication with her husband to split parenting duties based on empirical data. Sharing the data with her husband, she was able to discuss renegotiating parenting duties with her husband, which was expected to help her relieve the burden of parenting and manage parenting stress.

Even though there were different kinds of benefits of the self-tracking practices on parenting stress management, because the study lasted for only two weeks, it is hard to tell whether the impacts lasted after the study. Thus, further research is needed to identify the long-term impacts of the self-tracking practices on parenting stress management.

4.2.4.3 Emotional satisfaction.

The act of self-tracking was perceived as satisfying and therapeutic by our participants. Most of our participants enjoyed the act of self-tracking itself, both the process of recording and checking data, which is in line with Matthew, Murnane & Snyder (2017). Jina and Yumi noted that the act of recording was enjoyable and meaningful whereas Soojin and Dayoung appreciated checking the accumulated data more. Jina considered participating in this study as a special opportunity for her to manage her stress and enjoyed the feeling of taking care of herself. The records of her everyday life made Soojin view her life full of special moments and the visualizations of tracking data from 'Time spent with my husband' made Dayoung feel satisfied:

When I was tracking 'Time for myself,' it wasn't that satisfying to see the charts because there wasn't much time that I can be on my own. After changing the topic, it is a lot more pleasing to check the charts and see how much time I spent with my husband. (Dayoung)

(혼자만의 시간 트래킹할 때는 혼자만의 시간이 너무 적어서 좀 그랬는데, 남편과 둘만의 시간으로 바꾸고 나니까 쓸 게 많아지기도 했고, 시간을 수치화해서 내가 얼마나 누리고 있는지 볼 수 있어서 좋았어요.)

4.3 Participant Engagement in the Design Workshops

In this section, I will present some of the interesting findings of how the participants interacted with each other, how they perceived the interactions between them, and how the researcher interacted with them throughout the design workshop sessions. I will first describe how our participants shared feedback, empathized with each other, and compared with each other in the workshop sessions. Then, I will talk about the role that humor played in the workshop sessions.

4.3.1 Sharing feedback with each other

I found out that the group setting of the workshop sessions facilitated the entire process of the study where our participants choose tracking topics, design personal trackers, revise trackers, and reflect on their tracking experiences. Most of the participants expressed interests in what others chose to track and how they designed their trackers. By observing what others have written down on their worksheets and listening to others' conversation during the workshop sessions, they often gained insights regarding figuring out new tracking topics and appropriate data fields. Dayoung reflected on the workshop sessions:

At the beginning of the study, I wasn't sure what to track, but I got a lot of hints from others. It was helpful to see how other people figured out their tracking topics and

systematize their trackers by adding different fields. (Dayoung) (처음에는 사실 뭘 해야 할지 잘

몰랐는데, 다른 사람들에게 힌트를 많이 얻은 것 같아요. 다른 사람들이 어떤 주제를 고르고, 어떻게 트래커를

체계화하는지 볼 수 있는 게 좋았던 것 같아요.)

While choosing tracking topics in the first workshop, Miyoung glimpsed Yumi's worksheet and said, *"I think Yumi's topics are great, 'Going out,' 'Sleep,' and 'Husband's involvement in parenting'!"* ("네 주제들 너무 좋은데! 외출, 수면, 남편의 육아참여.") She admitted later that her 'Going out' tracker is *"copied"* from Yumi's.

In addition, the participants sometimes suggested possible tracking topics or data fields to each other. When Jina was thinking about ways to design her 'Time for myself' tracker, Soojin recommended adding a photo field to record what kind of snacks she had. Likewise, when Miyoung was worried about her unusual situation that her parents were visiting her and her husband was too busy to engage in parenting at the time, Yumi suggested recording her parents'

involvement in parenting, named ‘Others’ involvement in parenting.’ As similarly in the second workshop, our participants gave some suggestions to each other. Seeing that Dayoung was thinking about how she could revise her trackers for a while, Jina suggested changing her ‘Time for myself’ to ‘Today’s pleasure’ and making a multiple choices field that can record different kinds of activities. Conversely, when Jina said that recording ‘Fun conversation with my husband’ was pressuring, Dayoung recommended changing it to ‘Candid conversation.’ Likewise, when Miyoung was having a hard time to come up with a new tracking topic because she was not able to continue tracking her original ones, Soojin proposed tracking her baby’s cold or baking, which are the things that one can do at home as well even though her baby was sick.

4.3.2 Empathizing with each other

Since our participants shared many similarities in their life circumstances as being a trailing spouse living in a small college town, a Korean immigrant, and a parent who has a child or children in a similar age, they often found it easy to empathize with each other.

Among the three workshop sessions, our participants brought their children to some of the workshop sessions. In the first workshop, most of the parents participated with their children except Dayoung, who sent her child to a preschool, because they could not find someone to watch them instead. In the second workshop, which comprised of the two groups according to the participants’ schedules, Soojin and Yumi brought their children whereas others did not. In the third workshop, none of the participants brought their children as it was conducted in the evening so that their husbands were able to watch their child.

Therefore, in the first workshop session when most of the participants brought their child, they had more chances to empathize with the struggles of a parent with young children as they participated in the activities struggling with their child. The workshop sessions were often interrupted by children as they cried, whined, asked their mom to hold them, and fell on the ground. When Yumi said to the researcher, “*It’s chaotic, isn’t it? It’s normal for us in the small group bible study*” (“정신없지? 우리 성경공부할 때 늘 이래.”), Soojin immediately elaborated on what she said, “*Sometimes the leader was talking to just one person because everyone else was breastfeeding or changing a diaper.*” (“어쩔 때는 리더랑 한 사람만 얘기하고 있어. 누구는 젖 먹이러 가고, 누구는 기저귀 갈러 가고...”)

Not only the struggles related to the social life of mothers of young children, but our participants also shared the same feelings about the life of a parent. Dayoung and Jina shared the ambivalent feelings toward parenting and family with each other. I found an interesting conversation between Dayoung and Jina in the second workshop, talking about how they felt about parenting and identifying with each other.

There is a love-hate relationship because parenting is sometimes fun but always physically taxing. [...] I thought I preferred spending time alone, but I realized I actually felt more comfortable and happier when spending time with family, even though it was physically taxing. (Dayoung) (애증의 관계죠. 육아는 즐겁기도 하지만, 무조건 힘드니까. [...] 저는 혼자 있는 시간이 중요한 사람이라고 생각했는데, 사실 가족들이랑 있을 때 몸은 힘들더라도 마음은 더 편하고 더 즐겁다는 걸 느꼈어요.)

Same here. I don't just feel comfortable to spend time alone without family. I often worry if my husband will feed our child healthy food or if he got too tired from work to take good care of our children. [...] While I was preparing for my husband's birthday party with my kids, I found myself really happy, even happier than the time that I spent by myself, even though I had a serious argument with my husband and made up just a few minutes earlier. I thought spending time alone was critical in stress management, but maybe it's not all about it. (Jina) (맞아. 혼자 나간다고 마음이 마냥 즐겁고 편하지만도 않아. 남편이 애들 밥은 제대로 줄지, 일하고 와서 피곤해 보이는데 애들은 잘 볼지... [...] 우리 남편 생일 때 생일 파티 준비 애들이랑 같이 하면서 굉장히 즐거운 거야, 혼자 있을 때보다도. 그 직전까지 남편이랑 울고불고 되게 싸우고 겨우 화해했는데도. 나는 스트레스 해소를 위해서는 혼자 보내는 시간이 되게 중요하다고 생각했었는데, 그게 다는 아니었나봐.)

As well as Dayoung and Jina, Soojin also reflected on the workshop sessions and said “I felt we all shared the same feelings as parents. Especially, Yumi and I feel the same way that our

husbands were trying their best even though they were able to spend only a short time for parenting.” (“다 비슷한 마음인 것 같아요. 특히 Yumi 이랑 저는 남편이 짧은 시간에 최대한 하려고 노력하는 모습이 보였다는게.”)

Our participants also empathized with each other about the challenges of a trailing spouse and an immigrant as presented in 4.2.1. The struggles of immigrant parents. When Jina talked about the challenges of being dependent on her husband in many aspects and expressed the anxiety of living as a stay-at-home wife after quitting her job, Dayoung identified with her. Also, Dayoung and Miyoung share the same concerns of emotional dependence on their husbands associated with the loneliness of being an immigrant.

As they shared the same feelings about many aspects of the life of a parent, they became close and developed bonds with each other in such a short time. Even though all our participants were attending the same church, some of them have never had a chance to have a conversation with each other. Miyoung and Soojin, and Miyoung and Yumi were the only participants who said that they were close friends before the study. Nevertheless, the other participants stated that they felt they became close quickly as well.

I haven't really had a chance to talk to the other participants even though we go to the same church. But I felt as if we were old friends. Maybe because we are all in similar situations as a parent, trying out best for our husband and children. We are like-minded people. (Jina) (같은 교회에 다니지만, 다들 여기서 이번에 그룹으로 처음 만나서 얘기 나눠보거든요. 근데 꼭 10 년지기 친구처럼 얘기한 것 같아요. 다들 애 엄마들이고, 남편이랑 애들 위해서 최선을 다하고 있고, 다들 같은 마음이었던 것 같아요.)

We all have children who are similar in age and we are all in similar situations, so we were able to sympathize with each other and had a lot of fun, even though I've barely talked with Dayoung and Jina before. I felt comfortable as if I were chatting with my old friends. (Miyoung) (다들 비슷한 또래 아이 키우는 엄마들이고, 환경도 다 비슷하고, 그러니까

공감대도 잘 형성되고, 재밌었던 것 같아. Dayoung 나 Jina 는 거의 왕래가 없었는데, 두 번 봤는데도 되게 가까워진 것 같아요. 그냥 친구들이랑 수다 떠는 시간이라 생각했어요.)

I have met a lot of moms in play dates, but it's been a bit difficult to have deep conversations there because they might think I'm grumbling too much. It was great to talk with other moms openly and frankly. (Dayoung) (플레이 데이트 같은 건 많이 하지만, 아무래도 거기서는 내가 지금 어떻게 그런 깊은 대화를 하기가 사실 어렵잖아요. 개인적인 투정처럼 비취질 수도 있고... 여기서 허심탄회하게 얘기할 수 있어서 좋았던 것 같아요.)

When reflecting on the group workshops, Jina stated that she thought it might have helped the candid conversations between the participants that they were trained to open themselves up through the small group bible study.

4.3.3 The role of humor

Our participants often told funny jokes to each other in the group workshops, which made others laugh much. I found the humor beneficial for candid conversations and developing a rapport among the participants. Notably, Jina was great at being honest and humorous about negative feelings. For example, when the participants were reflecting on her life through the worksheets in the first workshop, she talked to herself, *"How often do I get frustrated? Maybe fifty or sixty times a day? 7 hours in 24 hours?"* ("얼마나 자주 짜증이 나시나요? 하루에 한 50 번, 60 번? 24 시간 중에 7 시간?"), which helped break the ice among the group. When she said she was going to track 'Fun conversation with my husband,' Dayoung said to her, *"So, you are tracking 'happy time' with your husband"* ("아 남편과의 Happy time...") and Jina replied, *"Hmm, happy and a husband doesn't really go well together."* ("Happy 랑 husband 는 너무 안 어울린다.") In addition, when designing her trackers, she joked, *"If I record a snack tracker with a photo field, I might eat something looking nice in a pretty plate,"* ("사진 찍으려면 간식을 더 맛있어 보이는 걸로 예쁘게 먹겠는데?") which made other participants joke as well.

Miyoung: *"With makeup on..."* ("화장하고 먹고...")

Soojin: *"With nail polish on your fingers..."* ("손에 매니큐어 바르고 손까지 나오게...")

Jina: “*That’s so funny and sounds totally irrelevant to parenting.*” (“아 너무 웃겨. 육아랑은 전혀 상관이 없네.”)

When choosing tracking topics, she made a vulgar joke as well, “*I might have chosen a vulgar tracking topic if I have met you (the researcher) before, you all know what kind of person I am.*” (“내가 초면이라서 지금 야한 거 안 한거야. 구면이었으면... 언니 18 번 알지?”), and Yumi responded, “*You mean, how often I have sex with my husband?*” (“부부생활 횟수 트래킹?”), which made the other participants laugh much.

Our participants made jokes when they gave comments to each other’s trackers as well. When the other participants were talking about adding a rating field to their trackers, Miyoung expressed her concern about rating others through making jokes: “*I may rate Soojin is four stars, and Yumi is one star after meeting you two... It would be very shameful for you. This should be anonymous.*” (“외출하고 와서 Soojin 은 4 점, Yumi 은 1 점... 그러면 진짜 수치스럽겠다. 이거 꼭 익명이어야겠네.”) Soojin commented on Jina’s ‘Quiet time’ tracker by saying “*You can think about such a decent topic because you are NOT under a lot of stress!*” (“그런 주제를 생각할 수 있다는 거 자체가 여유가 있다는 거다!”)

4.3.4 Comparing with others

As the participants had many similarities, it was natural for them to compare themselves to each other. In the one-on-one interviews, some of the participants talked about what they felt through the comparison with others. It was interesting that our participants noted that they came to view their lives more positively by comparing with others as opposed to the common thoughts that comparing oneself to others makes people feel unhappy. Dayoung and Jina came to think that they were relatively in good situations while listening to others’ stories. Dayoung said:

I came to reflect on my situations objectively, and realized I was in relatively good situations because my husband spared a lot more time for our baby than the other husbands, but I have still complained a lot. Having conversations with other moms made me be reflective and think more positively. (Dayoung) (제 상황에 대해서 좀 객관적으로

들여다보면서, 제가 다른 사람들에 비해서 사실 편한 상황에 있다는 걸 깨달았어요. 저희 남편이 다른

남편들보다 시간을 많이 내는데도 계속 제가 불만이 많고 그랬던걸 좀 반성하기도 했어요. 다른 엄마들이랑 대화하니까 저를 돌아보게 되고 좋은 쪽으로 나아가게 되는 것 같아요.)

Moreover, as a mother who has the youngest baby in the group, Soojin was inspired by other mothers' stories who have gone through the rough period as she was going through at the time:

Sometimes I get very depressed so that I wonder if I have depression, but, listening to what Yumi said that she found she was not under a lot of stress, I came to think that I'm gonna feel a lot better soon. Maybe I am just turning around the corner. (Soojin) (한번씩은 육아 우울증이 있나 싶을 정도로 힘들기도 해요. 근데 아까 Yumi 이 지금은 별로 육아로 스트레스 받는 것 같지 않다 얘기하는 거 들었을 때 나도 그 때가 곧 오겠구나 그런 생각이 들었어요. 저는 지금이 딱 힘든 고비를 넘어가고 있는 찰나인 것 같아요.)

CHAPTER 5. DISCUSSION

In this final chapter, I discuss the opportunities and challenges of an everyday design approach of self-tracking experiences for stress management of new parents. In the first section, Personal informatics, I first emphasize how flexible self-tracking practices can benefit developing self-knowledge of individuals. Next, I argue for the need for family-centered tracking for supporting mental wellness of family members. Then, I examine how the social nature of the workshop both benefit and hinder self-tracking for parenting stress management. Lastly, I discuss the need for onboarding experiences for beginners in flexible self-tracking practices.

In the second section, Stress Management, I first talk about ways to manage stress in the daily lives of parents. Next, I discuss how one's spouse is related to one's parenting stress management and what role one's spouse needs to play in it. Lastly, I tackle how the PI practices can foster reflections that may change one's attitude to become more positive in life.

In the final section, I discuss the rapport-building between the researcher and the participants. Next, I examine some of the challenges related to the participants' understanding of their own participation in the study. Finally, I propose that group workshops that can provide new parents with socializing opportunities.

5.1 Social Self-Tracking for Parents' Mental Wellness

Based on the findings of this study, I first highlight how flexible self-tracking practices can benefit developing self-knowledge of individuals. Next, I argue for the need for family-centered tracking for supporting the mental wellness of family members. Then, I examine how the social nature of the workshop both benefits and hinders self-tracking for parenting stress management. I conclude this section by discussing the need for onboarding experiences for beginners in flexible self-tracking practices.

5.1.1 Flexible self-tracking practices for developing self-knowledge

As prior works on PI indicate (Matthews, Murnane & Snyder, 2017; Li et al., 2010), finding meaningful patterns about oneself is an important motive of individuals engaging in self-tracking practices. In the journey of pursuing self-knowledge through self-tracking, the subjective

evaluation of the influential factors on an individual's stress management played a considerable role as several studies on stress have emphasized (Lazarus et al., 1985; Telleen et al., 1989; Crnic et al., 1990; Fonseca, 1995; Tucker, 2011). Drawing from the rationales for the evaluation of daily activities and even others' behaviors, our participants were able to discover one's own criteria to evaluate potential stressors, relievers, and surrounding circumstances, which contributed to the expansion of self-knowledge of themselves. Such self-knowledge assisted each individual in answering some vital questions for stress management such as the following:

- 'Am I really stressed out now?'
- 'What made me stressed-out?'
- 'Are existing stress management strategies effective enough? Or, are there more effective ones?'
- 'What kind of support do I need for relieving parenting stress?'

The new self-knowledge let individuals revise their personal trackers as well as change their attitudes toward their daily routines, their husbands, and daily stress itself more positively, which is consistent with the findings from Lee et al. (2018)'s work. Moreover, recognizing negative life patterns that are detrimental to one's mental wellness let individuals make a resolution to improve the patterns for promoting one's mental wellness.

Therefore, in line with the analytic framework of PI for mental wellness presented in Lee et al. (2018)'s work, PI practices can be leveraged as useful means of supporting one's lifelong journey of finding oneself by allowing individuals to go through iterative cycles of developing self-knowledge for better stress management. The self-knowledge gained through the PI practices can be valuable by itself, but it also can enable individuals to change their attitudes towards their lives and everyday behaviors.

Specifically, there was a benefit for providing participants with a chance to reflect on their tracking experiences and appropriate their tracking practices as they revised their trackers with a flexible self-tracking platform. Throughout the two weeks of the study, our participants were able to investigate what kinds of tracking topics were more relevant to their contexts of stress and learn the complementary combinations of multiple data fields in a single tracker or multiple tracking topics through a week of tracking. The complementary combinations of multiple data fields, as well as multiple tracking topics, allowed our participants to gain a comprehensive understanding of their daily stress that they would not have been able to gain

through a single data field or a single tracker. Therefore, when they were given a chance to revise their trackers in the second workshop, most of the participants were able to appropriate their trackers based on the “meta-self-knowledge,” the knowledge about how to gain more insightful and useful self-knowledge.

To support developing “meta-self-knowledge” as well as self-knowledge through PI practices, individuals need to be provided with opportunities to reflect on, monitor and revise their personal trackers. In order to investigate more relevant topics, complementary combinations of data fields and multiple trackers, one should be given enough time to reflect on one’s daily life, appropriate their self-tracking practices, and learn about how the tracking experiences can better suit one’s personal needs. On top of that, in the process of the exploration and revisions, a facilitator should provide appropriate scaffolding for each individual throughout the learning process about oneself as well as foster constructive interactions between participants.

5.1.2 Family-centered tracking for supporting mental wellness

Our participants actively engaged others outside the group, specifically their spouses, in their tracking experiences in various ways. The interconnectedness of the lives of family members let our participants choose to track their spouses’ behaviors. When choosing their tracking topics, most of our participants chose topics related to their husbands such as their involvement in parenting or quality time spent with them. Also, three of our participants let their spouses know that they were tracking topics related to their husbands to ask their cooperation.

Notably, there were interesting perceptions about tracking their spouses among our participants. They thought that revealing that they were documenting their husbands’ behaviors could change the social dynamic between them either in positive or negative ways. Even though our participants perceived that tracking their spouses’ behaviors was something that could be blamed in the first place, it turned out that their husbands did not feel offended by the fact that they had been tracked and even became more cooperative with their spouses.

Furthermore, PI practices can be utilized as an effective medium to facilitate communication between family members (Pina et al., 2017), as one of our participants, Soojin, indicated. The data collected regarding one’s daily parenting life helped open up the conversation to renegotiate parenting duties with one’s spouse, which in turn elicited positive behavioral changes of one’s spouse.

Expanding the call for expanding the design lens from self-tracking to family-centered health tracking (Pina et al., 2017), I argue for the need for involving family members, specifically between spouses, in the PI practices for supporting mental wellness of family members. The PI practices can be leveraged to effective means of opening up better communication between spouses. Therefore, the design implications of this work on the family-centered tracking include: (1) family members can be involved in PI practices on different levels of engagement based on their needs and interests, ranging from being aware of what their spouse is tracking, to making meanings of data together, to collaboratively tracking; (2) the family-centered informatics need to be designed to facilitate communication between spouses by fostering empathy towards each other's daily life rather than proving one is right or wrong, or spying on each other; (3) ways for better-expressing emotional support to each other need to be considered. Future studies could explore how PI can fit in to make parenting less stressful and the relationships between spouses more equal through a feminist participatory approach.

5.1.3 Benefits and hinderance of the social nature of the workshop

Consistent with prior works (Lee et al., 2017; Lee et al., 2018, Pina et al., 2017), the small group discussion was considered beneficial for most of our participants in various ways. They found value in sharing feedback, empathizing, making jokes, and comparing with each other in the journey of exploring better ways to personalize one's self-tracking experiences for stress management.

Nonetheless, some of the participants, Miyoung and Yumi, did not find the small group setting very helpful for making better self-tracking experiences for parenting stress management even though they did enjoy the interactions in the workshop sessions. The reason was that they considered the tracking experiences had unique and personal meanings to them rather than common and social meanings. In the one-on-one interview right after the last workshop session, Yumi said that:

I think the meanings that the self-tracking experiences would be different from individual to individual because all of us are in different contexts. I considered the self-tracking practices as a very personal activity because I've been interested in something that others wouldn't. It's significantly different from Instagram because I upload something

that others would be interested in there. (Yumi) (나는 이 트래킹 작업이 개인에게 주는 의미가 되게 다르다고 생각했어요. 각자마다 상황이 다르니까. 이건 지극히 개인적인 기록이었던 것 같아요. 나에겐 의미있지만 다른 사람들은 그렇게 관심가지지 않을 만한 것들이었기 때문에. 인스타에는 남들이 관심있을 만한 걸 올리는 거니까, 완전히 결이 다르다고 생각해요.)

Similarly, Miyoung noted that “*Listening to others’ tracking experiences was interesting, but I didn’t feel the things what others considered important was as important to me because all of us were tracking different topics, anyway.*” (“다른 사람들 얘기 듣는 게 재밌긴 했지만, 남들한테 중요한 게 나한테는 중요하다고 생각이 안 드는 것들이 있었어요. 그래서 그냥 아 저 사람은 그렇구나 했던 것 같아요. 트래킹 주제가 다 달랐으니까.”)

On top of that, the social nature could have led our participants to choose or not even to verbalize some tracking topics that they would have tracked on their own. For example, one of our participants, Jina, mentioned that she could have tracked her sexual habits, which I believe was due to self-regulation of sharing private and sensitive matters with others.

To sum up, the social nature of the workshop helped facilitate the process of self-tracking experiences of individuals, but it could have put some constraints on choosing tracking topics because of the personal and the self-regulating nature of individuals. I argue that the small group environment could work as an onboarding stop on the journey of self-tracking experiences for stress management as it facilitates the process of designing self-tracking experiences. Following the self-tracking practices in a group setting for two to four weeks, individuals may engage in self-tracking respectively, without any concerns about privacy or social reputation. In this way, our participants might move on from “social self-tracking” to more traditional, individual self-tracking. This transition from social to individual self-tracking could provide precisely the kind of onboarding experience that is required for flexible self-tracking systems.

5.1.4 The need for onboarding experiences

As none of our participants had prior experiences with self-tracking technologies other than automatic sleep tracking feature with their mobile phones, some participants expressed concerns about engagement in the study with a self-tracking technology at the beginning of the study. Nevertheless, despite the expected burdens of participants, our participants found the self-

tracking practices far less burdening and more enjoyable than they thought. One of our participants, Jina, stated that:

I was a bit afraid of engaging in new practices with technology every day. However, once I started, I realized it only took like five minutes a day, so it wasn't a burden for me at all. Also, I really enjoyed the tracking experiences, so I've been telling my friends it's a really fun activity. They said it's a shame that they didn't participate in the study. (Jina)

(사실 연구 참여하기 전에는 매일 이렇게 컴퓨터로 뭔가를 한다는 게 되게 두려웠어요. 근데 막상 하고 보니까, 하루에 5 분도 안 걸리고, 전혀 부담 안되더라구요. 주변 친구들한테도 나 이렇게 재밌는 거 하고 있다고 얘기도 하고. 그 친구들도 연구 참여할 걸 그랬다고 아쉽다고 그러더라구요.)

Her remarks show both the concerns of the beginners who are just about to engage in self-tracking practices and the opportunity of involving such beginners even with a short trial.

Based on the claims above, I argue for the need for onboarding experiences for beginners to self-tracking practices which could help lower the perceived entry barrier to self-tracking services as well as provide support to personalize one's tracking experiences for mental wellness. Participation in a self-tracking study, like our participants did in this study, could be one of the great ways to lower the perceived entry barrier to self-tracking practices. Even though our participants started to engage in self-tracking practices because they were required to do in the first place, they came to realize that the self-tracking practices can be easy to do, help find meaningful patterns, and provide novel and fun experiences. On top of that, as I argued in the previous section, the small group environment could benefit the onboarding experiences for self-tracking by providing opportunities to share feedback, empathize with each other. Further ways to lower the perceived entry barrier of beginners in self-tracking practices will need to be investigated in future studies, but it could include: presenting the self-tracking practices as an undemanding and casual activity; a short trial program with a simple personal tracker followed by a formal participation with more in-depth personal trackers; or reviews from existing users which involve concrete examples and lived experiences.

5.2 The Opportunities and Challenges of Parenting Stress Management

In this section, I discuss implications for supporting stress management of new parents. First, I tackle what the results of this study revealed regarding managing stress in the daily lives of parents. Second, I highlight the role of the spouse in stress management. Lastly, I deal with how the PI practices contributed to fostering positivity in the daily lives of our participants.

5.2.1 Managing stress in the daily lives of parents

The two weeks of the study unveiled the lived experiences of new parents related to daily stress. The tracking themes emerged from the tracking topics of our participants' choice—time for oneself, quality time with husband, social activity, and husband's involvement in parenting—indicate some of the stress relievers that are considered important by new parents.

Most of our participants chose to track the perceived satisfaction level of target activities and the rationale for the assessment. The perceived satisfaction assessment allowed our participants to learn that effective stress management strategies are not necessarily doing something special, spending time on one's own, or having a long break. Instead, doing small and simple things, spending quality time with family, or having a short break could be great stress relievers for parents. The results indicate that parenting stress could be managed with just simple strategies that even busy parents can easily implement in their daily lives. Accordingly, when designing a parenting stress management program for new parents, it can be helpful if a facilitator introduces some simple but effective stress management strategies that are readily available to them.

In addition, it is notable that the rationale for the subjective appraisal of our participants was not necessarily based on the target activities or behaviors but also often affected by other irrelevant factors to the target activities or behaviors (i.e., one's physical or emotional state or the satisfaction level of the family time). The results suggest that daily stress cannot be fully understood without considering the complex dynamics of one's daily life. Therefore, the complexity that influences daily stress perceived by individuals should be considered in designing stress management programs or tools.

5.2.2 The role of the spouse in stress management

In designing this study, based on the relevant literature, I assumed that the most prominent stressors in parenting stress would include child behavioral problems or difficult temperament (King et al., 1999; Ramos et al., 2005), social isolation (Scheinkman, 1988; Jackson, 1999; Lennon et al., 2002), and feelings of meaninglessness (Gilbert, 1982; Scheinkman, 1988) and the most effective mediators of parenting stressors would include intrapersonal resources of parents (Vermaes et al., 2008; Hwang et al., 2010; Jang et al., 2011; Tomlin et al., 2014; Louie et al., 2017; You et al., 2018) and social support (Koeske et al., 1990; Cottornell, 1986; Crnic et al., 1990; Tucker, 2011).

However, the role of one's spouse unexpectedly turned out to be significant in parenting stress management. In choosing personal tracking topics, most of our participants, except Miyoun, chose to track topics related to their husbands, either one's husband's involvement in parenting or quality time with one's husband. The sample size of this study is relatively small, so the results cannot be statistically validated. However, the number of participants who chose to track their husbands indicates that it is not a singular event, which shows the significance of the role of the spouse in parenting stress management. Meanwhile, only a few participants mentioned their children when it comes to parenting stress. I reckon the reason could be because the overwhelmed and stressed mothers found it more comfortable and less guilty to talk about their husbands compared to talk about their children. In other words, because mothers felt uncomfortable or guilty to talk about negative aspects of their children, they could have chosen their husband as a scapegoat to express negative emotions.

Spouses were one of the most influential factors in parenting stress management, both as a potential stressor or an effective mediator of parenting stress. For some of our participants, perceived dissatisfaction with one's husband's involvement in parenting contributed to their increased level of stress which is consistent with Nedleman (1991)'s study with married graduate students. One of our participants, Soojin, explicitly dealt with this problem by sharing her tracking data with her husband during the study to renegotiate parenting duties, which turned out to be a successful approach for fostering her husband's empathy with her. On the other hand, as father involvement in parenting has been proven to lower parenting stress of mothers (Nomaguchi, Brown & Leyman, 2012), our participants also emphasized how their spouses'

involvement in parenting helped them when they were overwhelmed and exhausted by parenting duties

In addition, spouses' emotional support played a big role in parents' mental wellness (Giles, 1983). Two of our participants aimed to promote their marital relationship by having better quality time with one's spouse, so they asked for the cooperation of their spouses during the study. Other participants who did not choose to track quality time with one's husband also emphasized the role of their husbands' emotional support in their mental wellness as it had helped them overcome the most difficult time after they became a parent. Interestingly, emotional support from one's spouse was considered more important than the length of the time that their husbands spent in parenting by our participants.

The results of the study demonstrate the need for considering the impacts of the spouse factors in parenting stress management. While many studies on parenting stress focus on the effects of parenting stress on child abuse, more studies should deal with how spouses' involvement in parenting or emotional support can support parents' mental wellness.

5.2.3 Fostering positivity through a journaling practice

Prior studies have shown that journaling practices support people to deal with negative thoughts and shift to a positive mindset about oneself (Webb et al., 2012; Ullrich & Lutgendorf, 2002; Lee et al., 2018). Through the two weeks of tracking one's daily life as a parent within the context of stress management, our participants' attitudes towards their lives have changed in positive ways even without any changes of the circumstances. The self-knowledge gained through the subjective evaluations of daily activities and others' behaviors enabled such positive changes. Learning about what kinds of resources and support are available to them, what kind of strategies work better for them, and what kind of person they are, they came to perceive their daily lives more positively. Moreover, the PI practices were helpful for detecting negative patterns in one's thoughts and behaviors, which let our participants improve or resolve to improve.

However, the effects of writing about the causes and the implications of negative feelings are controversial (Webb et al., 2012). Some studies suggest it is beneficial for mental health (Lepore & Russell, 1997; Pennebaker, 1997; Spera, Buhrfiend & Pennebaker, 1994), but others argue that concentrating on causes and implications of negative feelings results in higher levels of depressed mood (Watkins, 2004, Watkins, Moberly, Moulds & Phelps, 2008). Our

participants also mentioned how the tracking experiences negatively impacted their moods in the first place by making their daily struggles (e.g., mundane daily routines, one's husband's less involvement in parenting) look more prominent, even though they came to change their minds and perceive their daily lives more positively after the two weeks of tracking. Accordingly, the potential negative impacts of the tracking negative feelings should be considered when designing PI systems for supporting mental wellness of the vulnerable populations such as new parents. It may be beneficial to provide individuals with some guidance to focus on problem-solving strategies in a concrete way instead of evaluating the emotions on an abstract level (Watkins et al., 2008).

In conclusion, PI practices are well-suited to support individuals who are subject to negative emotions such as feelings of isolation and loneliness to shift to a positive mindset through a life journaling. However, the potential negative effects of concentrating on the causes and the implications of negative feelings should be carefully considered. To that end, future research could investigate incorporating ways to help increase positivity and cultivate gratitude in designing stress management tools for parents, not by forcing positive thinking but by helping individuals find available resources and support and identify strategies that work better for them.

5.3 Participant Engagement in the Design Workshops

In this last section, I highlight the importance of building a rapport between the researcher and participants in the design workshops for parenting stress management. Next, I tackle some interesting challenges regarding our participants' understanding of their participation. Lastly, I call attention to the benefits of group workshop as a socializing opportunity for parents.

5.3.1 Building a rapport between the researcher and participants

In qualitative research, building a rapport between the researcher and participants is considered crucial for having participants open themselves up (Guillemin & Heggen, 2009; Prior, 2018). Reflecting on the journey of the study, the rapport between the researcher and the participants benefited both participant compliance with the study and eliciting candid conversations in the workshops and interviews.

Our participants were highly engaged during the entire period of the study, and the high compliance of our participants to the study is one of the evidence of such high engagement. At

the beginning of the study, I asked our participants to record every day in the weekdays whereas the weekends were optional. Nonetheless, all our participants recorded ten or more items in total, ranging from ten to thirteen items, which exceeded the requirements that I asked them. Moreover, our participants seemed to stay candid and honest during the workshops that they were able to talk about somewhat sensitive matters such as negative feelings towards their husbands.

I reckon the reason for such candid participation, as well as high compliance, was partially due to the relationship not as the researcher and the participants but as friends (Guillemin et al., 2009; Prior, 2018). I had prior relationships with two of the participants, Miyoung and Yumi, through a local Korean church, whereas I did not have any prior relationships with the other three participants. Below are the reasons that I think of why I was able to establish such good rapport during the study.

First of all, as participants and I shared the same cultural backgrounds and native language, it was easier for me to develop a rapport with them. Some participants mentioned that they felt grateful for an opportunity to participate in a study speaking their native language in a foreign country.

Next, I tried to create a friendly and comfortable atmosphere for our participants as much as I could. As I assumed parents of a young child would find it difficult to attend meetings with their children, I chose the meeting places after I asked our participants what kinds of places and the time that they would find most comfortable. Based on the participants' opinions, the first workshop was held in one of the participants' (Jina) house as she kindly opened her house for the workshop because she thought parents with a young child would find it much easier to handle their child at someone's house where a young child lives in as well. Even though I brought some food and beverages for the participants, Jina prepared a lot of food for us as if she was a host at a party. Because of our participants' busy schedule, the second workshop was conducted in two groups, one group was Dayoung and Jina, and the other group was the other three participants. The first group met in a café, and the other group met in a nursery room at church. The last workshop venue was the researcher's house because Jina was not able to offer her house for the workshop because one of her children was sick. I prepared some food and beverages for them as if I were a host at a party as Jina did before. To sum up, having workshops at casual places such

as house or café as well as sharing some food with participants helped create a friendly and comfortable atmosphere in the workshop.

In addition, expressing genuine interests in their lives and empathy towards their struggles also helped develop a rapport with participants. As one of our participants, Dayoung, has mentioned, parents are often reluctant to talk about their struggles with others because of the fear of judgment (Toombs et al., 2018). Therefore, they appreciated the opportunities to talk to someone interested in their struggles and willing to listen to them without judgments.

5.3.2 Participants' understanding of their participation

There were some interesting challenges regarding participants' understanding of their own participation. In the first workshop, presenting the criteria of selecting personal tracking topics as 'the most relevant topics to one's parenting stress management' was an intentional choice of the researcher to stay neutral not to lead participants to a certain way, pursuing either self-knowledge or self-improvement. In turn, our participants ended up pursuing both ways as they wanted, which contributed to one of the meaningful findings of the study.

However, most of our participants found it challenging to grasp the expectations towards them in this study. During the study, all participants asked the researcher at least once if they should behave as they have been or try something new to improve their behaviors consciously. I gave them an answer that it depends on their tracking goals. If they were to examine their current state related to daily stress, they might choose to behave as they have been. On the other hand, if they were to improve their lives for better stress management, they might try to improve their behaviors. Nonetheless, it seemed the answer did not clearly resolve the confusion. Not until the last workshop did one of our participants, Miyoung, understand that she could have chosen to track topics not only related to stress relievers but also about her daily struggles as a parent. She said she would have tracked how tough her daily parenting life was if she had understood that she had the option.

In short, the neutral stance of presenting the criteria of selecting personal tracking topics enabled participants to pursue both self-knowledge and self-improvement through their self-tracking experiences, but the ambiguity made our participants confused about what attitude they should bring into the study. To avoid such confusion while remaining open to both purposes of the self-tracking practices, future studies might consider explicitly presenting that participants

can choose either to examine their current state without changing their behaviors or aim to actively change their behaviors through the study.

5.3.3 Group workshop as a socializing opportunity for parents

As a previous study on parents indicated (Hobfoll, 1986; Telleen et al., 1989; Prins, Toso & Schafft, 2009; Lipman et al., 2010; Toombs et al., 2018), the group workshops provided great opportunities for our participants to socialize with other parents while sharing advice, having fun, and escaping from a monotonous daily routine. Throughout the series of the workshop sessions, our participants found it enjoyable and fun to interact with each other. Particularly, unlike the first two workshop sessions, the last workshop was in the evening when the participants were able to let their husbands watch their child, so all our participants were able to participate in the workshop without their child. They were very excited to have an evening out without their child, especially Soojin, who had the first evening out after she gave birth to her son. Therefore, they brought some food to the workshop to share with everybody, chatted for hours while I had one-on-one interviews at a different room, made jokes, and laughed much. I noticed how thirsty they had been for such socializing opportunity and how beneficial such an opportunity was for relieving parenting stress.

The findings of the study shed light on what kind of things need to be considered in designing a study or a group program to support mental wellness of new parents. First, the purpose of the meeting should be for parents, not for their children. Many parents with young children engage in play dates, the purpose of which is for their children. However, even though such meetings for children provide socializing opportunities for parents as well, parents may find it difficult to engage in candid conversation to freely talk about their struggles as a parent in such meetings if their purposes are not for parents, as one of our participants, Dayoung, noted. Accordingly, when designing a study or group program for the mental wellness of parents, the purpose of the meeting should be explicitly advertised as ‘for parents’ instead of ‘for children’ to let parents be aware that talking about their parenting struggles will be accepted and welcomed.

Second, it is crucial to create a casual and friendly atmosphere for helping participants discover the common grounds between each other. I reckon part of the reasons that our participants were able to become close to each other in such a short time was that they had many things in common, such as nationality, child’s age, religion, status as immigrants and trailing

spouses, and even spouses' jobs. Therefore, they found it easier to find the source of conversation, open themselves up, and empathize with each other. For new parents, despite many differences in cultural or social backgrounds, there is an opportunity for discovering the common ground easily based on the age of one's child, which makes it easier to begin a new friendship. This common ground helps open up a new opportunity for the social life of new parents, which will be discussed below in detail.

Third, researchers who are planning to engage parents in their studies or individuals who organize a group program for parents need to approach the potential concerns about the comparison to others carefully. Some of our participants expressed discomfort of talking about their marital relationship in detail with others because they were afraid of comparing oneself or one's spouse to others. Nonetheless, contrary to common belief, comparing oneself to others is not necessarily detrimental to one's mental wellness. Rather, it can benefit individuals by providing opportunities to think about positive aspects of one's life with reference to others going through similar struggles. Moreover, comparing with parents who have recently gone through similar rough times can give positive insights to individuals (Tomlin, 2014) like one of our participants, Soojin, stated. Therefore, future research could investigate the group dynamics of parents with older children and younger children and how they can better support each other in a group setting.

5.3.3.1 Opening up new opportunities for the social life of new parents

Becoming a parent is likely to entail the significant changes in friendships either by providing a new challenge or opportunities to build new friendships (Toombs et al., 2018). It was interesting that the participants were able to develop bonds with each other in a short time by sharing their lives as a parent and empathizing with each other, even though only a few of them had prior friendships. I reckon part of the reasons is because they share similar life circumstances: all participants were Korean immigrant parents so that they were able to speak freely in their native language with each other; all participants attended the same local Korean church, so they had basic information about each other even though they have never talked in person; all participants lived in the same city, a small college town in the US, and their spouses had similar jobs such as doctoral student or postdoc researcher; all participants had a child in similar age.

Specifically, the results were even more surprising considering the age hierarchy in Korean culture. Unlike in Western culture, relative age greatly affects the way individuals should speak to each other and how one should behave in the relationship in Korean society due to the influence of Confucianism (Ryu & Cervero, 2011). Therefore, Koreans tend to avoid speaking up or expressing their opinions in front of older people not to be considered rude by others. On top of that, it is common that people find it easier to become close to people of the same age whereas they may find it more challenging to become close to older people or younger people. One of our participants, Miyoung, mentioned that the group of friends she found the most comfortable was “born-in-1983”, who are friends of the same age as her.

This is because, technically, people of different ages cannot be a ‘*Chingu*’ with each other in Korean culture, which is loosely translated into ‘friend,’ even though they can still be friendly to older people or younger people. In other words, the age hierarchy could potentially hinder friendship between people of different ages.

Considering the cultural background, it is notable that our participants were able to engage in candid conversation equally and develop bonds with each other in a short time despite their age differences as presented in Table 3.1. When Yumi, one of our participants, talked about how her social life had changed after she gave birth to her son, she provided a great insight to presume what enabled such equal conversation and friendships: “*Once you become a parent, you become ‘friends’ with moms who have a child in a similar age.*” (“*아기 낳고 나면, 아기 나이에 따라서 친구가 돼요.*”) In other words, the age of one’s child becomes more important than the age of oneself in the parents’ social life. Therefore, even in some Asian countries which are under the influence of Confucianism, becoming a parent could open up a new opportunity for social life based on the age of children, despite the potential hindrances to friendships between individuals of different ages due to the cultural influences.

5.4 Ethical Considerations

The study was reviewed and approved by Purdue Institutional Review Board (Protocol # 1812021477). I required informed consent for participation in this study from all participants. I informed our participants that their participation is completely voluntary, and they can pause or quit the study at any time without any disadvantages. Participants were also informed that the

workshop and *OmniTrack* is not a clinically validated toolkit. They were strongly encouraged to create and customize their trackers as they desired for their own sake.

It was unexpected that our participants' spouses were mentioned much in the group workshop sessions. Our participants could have felt uncomfortable when listening to others talking about their husbands by comparing one's own spouse to others' spouses. Also, as some of our participants were worried, tracking one's spouse could lead to arguments between spouses, though it did not during the study.

5.5 Limitations

This research is limited by the following:

- This study was conducted with a relatively small number of participants, which will not represent the entire population of parents. However, since the nature of qualitative research is to provide an in-depth understanding of a specific individual's life, group, process, or an event but not to generate generalizable findings, this study did not aim for the representativeness of the entire population of parents.
- This study took place in a single city, Lafayette, IN in the United States. Therefore, the findings of this study may not be able to be generalized to parents from other cities in the United States or other countries.
- The two-week deployment period might have been too short to confirm the effectiveness of the self-tracking practices on stress management. This period also included the time needed for participants to adapt to the *OmniTrack* application. To mitigate this limitation, I had a training activity session to ensure if they understood how to use the application.
- The researcher may have cultural bias or assumptions that might have affected the data collection or analysis. To mitigate this limitation, I had my peers from multiple cultural backgrounds check possible cultural biases in attention.
- There were some constraints in choosing tracking topics because our participants were required to choose topics that they can record every day. The requirement affected the topics that our participants chose because they gave up some topics because they thought they would not be able to record the topics every day. If the study period were longer so that the participants were allowed to choose tracking topics that affect them once a week or once a month, the results could have been significantly different.

5.6 Conclusions

This study explored how new parents make use of flexible self-tracking practices through an everyday design approach within the context of stress management. This work provides insights into the field of personal informatics including how flexible self-tracking practices can support developing self-knowledge, how PI practices can facilitate communication and negotiations for supporting mental wellness of family members, the benefits and hindrance of the social nature of the workshops, and the need for onboarding experiences for beginners in self-tracking practices.

Next, in the area of stress management, the findings of the study showed some of the simple but effective stress management strategies that can be readily employed in the daily lives of parents as well the complex dynamics of daily stress. Spouses play a significant role in parenting stress management either by providing potential stressors or effective mediators; thus, more studies on the impacts of spouses' involvement in parenting or emotional support on parenting stress management are needed. The journaling style of self-tracking practices can foster positivity of individuals, but there are also potential negative impacts in writing about negative feelings.

Lastly, in terms of the participant engagement in the design workshops, building a rapport between the researcher and participants helped elicit participants' high compliance to the study and candid conversations in the study. Establishing friendly relationships with participants was key to building a good rapport. To avoid confusion while remaining open to both self-knowledge and self-improvement through the self-tracking practices, future studies might consider explicitly informing the participants regarding the expectations towards them. Group workshops can provide great socializing opportunities for parents. When designing the group workshops for promoting mental wellness of parents, it would be beneficial to explicitly set the purpose of the meeting 'for parents' instead of for children. While creating a friendly and comfortable atmosphere to promote interactions among participants, researchers or organizers of a group program should consider some of the complex group dynamics among parents as well.

Through this study, I have demonstrated how flexible self-tracking tools can provide a novel way to better-support the mental wellness of new parents. I argue that more work in this area, particularly with regards to how flexible self-tracking tools are onboard for new parents and how they are demonstrated through social workshops, can greatly benefit the abilities for parents to manage their own stress and mental wellbeing.

APPENDIX A. WORKSHOP PROTOCOLS

THE FIRST WORKSHOP PROTOCOL (FEB 13TH, 2019)

1) Introduction (25 mins in total)

(1) Introduction of myself (1 min)

Hi, I am Eunkyung Jo. I am a master's student in Computer Graphics Technology Department at Purdue University. Thank you for taking part in my study.

(2) The purpose of this study (3 mins)

I will make a powerpoint for (2) the purpose of the study and (3) the study procedure, and (5) OmniTrack for visual support.

Stress is an inevitable aspect of parenting. Since parenting stress involves highly subjective, social, and environmental factors, which means how individuals experience parenting stress can vary greatly from person to person.

Self-tracking is the process of recording one's own behaviors, thoughts, and feelings. It is not a special activity, but rather it is a casual experience that enables exploration of various aspects of one's daily life through data relevant to oneself.

In this study, from a researcher's side, the purpose of the study is to investigate how new parents make use of flexible self-tracking practices in the context of stress management. On the other hand, from participants' side, the purpose of collecting data is to understand what causes parenting stress and gain insights to better manage it.

Through this study, I aim to gain insights to better inform the design of personal informatics systems to support stress management of new parents.

(3) The study procedure (5 mins)

This study consists of three parts: 1) group workshops to co-create (2 hours) and co-review personal trackers (1.5 hour); 2) two weeks of self-tracking with a mobile app (more than one time during the weekdays, approximately 5-10 minutes per day); and 3) individual interviews to revise a tracker (0.5 hour) and reflect on tracking experiences during the study period (0.5 hour). In the first workshop (co-creation), which you are participating now, first, I will briefly introduce the self-tracking tool that you are using for this study. Second, you will take part in activities to reflect on your life focusing on daily experiences related to parenting stress to identify your daily stressors and relievers. Third, you will brainstorm and select up to three tracking topics that you would like to explore during the study period. Fourth, you will create your personal tracker on

OmniTrack, define data entries, and set a reminder for recording. Lastly, you will present your personal tracker and receive feedback from each other.

Then, you are asked to engage in self-tracking with your personal tracker for one week.

After one week, you and the researcher will meet and conduct a one-on-one interview. In this interview, I will ask you if there were any issues or challenges while you are tracking. If you would like to change your tracking topics or revise your tracker, you can modify it after discussion in this meeting. You will be asked to engage in self-tracking for one more week with the revised tracker.

After the two weeks of study period, you will be invited to a group workshop to co-review the collected data. The participants will be encouraged to share the insights through the tracking experiences.

At the end of the study, I will ask you to share your tracking experiences focusing on what you learned through the study and what you felt during the study period in an individual interview. Please feel free to ask any questions you have so far.

(4) IRB (5 mins)

- Provide participants with information regarding confidentiality and rights highlighting below:
 - Your identity will be made anonymous in reports of the study.
 - Audio recordings will be audio-recorded, transcribed, anonymized, and analyzed.
 - All data will be destroyed after the project is finished.
 - Your participation in this study is voluntary. You can withdraw your participation at any time without penalty or loss of benefits.
 - You will receive \$20 Amazon Gift Card in the exit interview as a compensation for the participation in this study.
- If they agree, have participants sign the IRB consent form.

(5) OmniTrack (10 mins)

- What is OmniTrack?
 - : OmniTrack is a platform that allows individuals to create personalized trackers.
- What can we do with OmniTrack?
 - : You can create multiple personalized trackers, and customize data types as you want.
- What kind of data can we collect with OmniTrack?
 - : Short text, long text, number, score, time, location, pictures, audio note, simple choice and multiple choices.
- How can I track with my tracker?
 - : prompted by a pre-set reminder or without prompt
- Example Trackers
 - Snack tracker

When I had snack (time), What kind of snack I had (short text), What made me eat (long text), What kind of snack I had (picture), How I felt after snacking (score/short text)

- Yelling tracker

When I yelled at my child (time), In what situation I yelled at my child (long text), how angry I was (score), how I yelled at my child (long text), how things turned out after yelling at my child (long text), how I felt after yelling (score/short text)

- Sleep tracker

From when to when I slept (time range), how the quality of sleep was (score), how many hours I slept (number), what was helpful for getting asleep (short/long text), what was not helpful for getting asleep (short/long text)

2) Brainstorming tracking topics for tracking (15 mins)

I will hand out a worksheet that provides scaffolded questions that could help individuals reflect on themselves focusing on factors that may affect parenting stress.

Participants do not need to answer all the questions, these are just thought-provoking questions.

I will not spend too much time on this because this is just meant to help parents brainstorm potential tracking topics related to parenting stress.

I will emphasize that this activity should be about themselves, not about their child.

(1) Worksheet: How was your life over the last month?

- Basic needs
 - Do you feel you slept well over the last month? Why or why not?
 - Do you feel you ate well over the last month? Why or why not?
- Childrearing
 - Over the last month, how often did you feel tired? In what situation did you feel so? What did you do then?
 - Over the last month, how often did you feel overburdened? In what situation did you feel so? What did you do then?
 - Over the last month, how often did you feel irritable and impatient with your kids about small things? In what situation did you feel so? What did you do then?
 - Over the last month, how often did you feel frustrated due to lack of time? In what situation did you feel so? What did you do then?
 - Over the last month, how often did you feel you are incapable as a parent? In what situation did you feel so? What did you do then?
- Social support
 - Over the last month, how often did you engage in a meaningful conversation with your spouse?

- Over the last month, how often did you engage in a meaningful conversation with others other than your spouse and child?
 - Over the last month, how often did you ask help from others?
- Time for yourself
- Did you have some time for yourself over the last month? If so, what did you? If not, why couldn't you?
 - What are small things that you think would be helpful for relieving parenting stress?
 - What do you often do when you are stressed out? Do you often find your strategies helpful?
- In general
- What were the best and the worst moments of last week?

3) Write down three tracking topics and data types that they would like to track. (15 mins)

Worksheets will be provided for this activity.

(1) Criteria for choosing tracking topics:

- choose 1-3 topics that they would like to track,
- any topics that are most relevant to one's parenting stress,
- something that one can record almost every day (weekend is optional, not required).

(2) I will maintain a neutral stance and let them choose to track any topics that are most relevant to parenting stress and they are interested in exploring to give them the option to choose between self-interventions (to improve) and self-reflection (to understand).

(3) I will ask them to write down 3-5 questions regarding each topic to identify appropriate data types for each question.

4) Create a personal tracker, define data entries, and set a reminder (10 mins)

- (1) I will work with them individually to create trackers and define data entries.
- (2) I will teach them how to record and how to check collected data.
- (3) I will let them practice creating a tracking item and check collected data.
- (4) I will let them configure a shortcut & a reminder.

5) Present each one's tracker (5 mins)

I will use a worksheet for this activity.

- (1) What kind of topics I chose
- (2) What kind of data they plan to track
- (3) Why I chose the topics
- (4) What I learned from creating trackers

5) Information about the next step (5 mins)

- (1) Take screenshots of individual trackers
- (2) Let participants know they can contact the researcher whenever they have concerns or questions
- (3) Schedule next interviews
- (4) Ask if there are any questions.

THE SECOND WORKSHOP PROTOCOL (FEB 20TH AND 21ST, 2019)

1) Before the interview

(1) Ask participants to take screenshots of their trackers and send them to me

2) General questions

(1) Did you have any difficulties recording data?

(2) Can you tell me a little bit about your experience with tracking your data? What was the best part of tracking data?

(3) Have you checked the items that you have tracked? If so, what did you learn from it?

(4) Have you told anyone that you are tracking about your parenting stress? Or have you shared your data with anyone? What was the motivation?

(5) Do you want to revise anything about your tracker? (including adding or deleting fields or trackers, changing tracking topics)

3) Specific questions for each participant

(1) P1

- Why did you want to add more trackers or data fields to trackers?
- How have you been using the long text data field? Let's give a name to the newly added "long text" data field.
- What do you rate for? (Husband's involvement in childrearing & Time for myself)

(2) P2

- Overlapping fields: satisfaction of conversation
- What do you rate for? (time for myself & fun conversation with husband)
- How do you define "fun conversation" with your husband? When did you log conversation with your husband, right after the conversation or at other times?

(3) P3

- What do you rate for? (Going out & exercise)
- I was really curious (or surprised) that all the other participants chose to rate their husbands as well. Did you pick up on that, too?
- Were there specific reasons for your decision to NOT rate your husband?

(4) P4

- What was the motivation for logging location for stress reduction strategies?
- What was the motivation for logging how often you get angry toward your baby? Do you think it is helpful for your stress management?

- How about adding a new field to log what was helpful for your sleep or disturbing your sleep?

(5) P5

- What do you rate for? (husband's involvement in childrearing, sleep, going out)
- How about adding a new field to log what was helpful for your sleep or disturbing your sleep?

THE THIRD WORKSHOP PROTOCOL (FEB 27TH, 2019)

1) I will print out each one's tracking data and hand it out to help share each one's tracking experiences better with others.

2) Please fill out a worksheet to reflect on tracking experiences (5~7 mins)

- (1) The tracking topics
- (2) What they learned through the tracking experiences
- (3) Any interesting facts about yourself through the data
- (3) Any impacts of the tracking experiences on their stress management

3) Present what they wrote on the worksheet to each other (15 mins)

I will encourage participants to give positive feedback to each other.

- (1) Take pictures together.
- (2) Hand out the study compensation (Amazon gift card \$20).

4) Individual interview (20-30 mins, each)

(1) The impact of the tracking experiences on stress management

- Any difficulties throughout the self-tracking experiences?
- Do you think you have gained better knowledge associated with your parenting stress?
 - What kind of knowledge did you gain?
- Do you think the self-tracking practices were helpful for parenting stress management?
 - If so, in what way was it helpful?
 - If not, why do you think it could not help much?

(2) Motivation and goals for self-tracking

- What was your motivation for constant tracking? Or, what were the challenges hampering steady tracking?
- The goals that participants had in mind when they started tracking
 - P1: To objectively examine what her husband and she were doing, to have better relationship with her husband
 - P2: To have more fun conversation with her husband, to have better communication with her husband
 - P3: To have a healthy habit (exercise), to examine her mental state and promote mental health

- P4: To reflect on her daily life, to promote the quality of life, to share parenting duties with her husband
- P5: To better-understand her daily life

- Did you have any other specific goals in mind when starting self-tracking?
- Have the goals changed?
- Do you think you have accomplished the goals?

(3) The changes after revising trackers

- P1: How was your tracking experience after you changed the ‘time for myself’ to ‘time spent with my husband’?
- P2: How was your tracking experience after you changed the ‘Fun conversation with my husband’ to ‘Communication with my husband’?
- P3: How was your tracking experience after you added the ‘Baby naps’ tracker?
- P4: How was your tracking experiences after you added a new data field ‘what disturbed my sleep?’
- P5: How was your tracking experience after you added a new data field ‘what disturbed my sleep?’

(4) General impressions toward workshops

- How were the workshops for co-design and co-review?
 - How did you feel about sharing about your parenting experiences with others?
 - How did you feel about giving feedback with other participants?

(5) Sharing with husband

- Individual questions
 - P1: Have you let your husband know that you were tracking him?
 - P2: Did you have any specific reasons of telling your husband about your tracking experiences from the beginning?
 - P3: Have you talked about your tracking experiences with your husband or others after the second workshop? If so or not, what were the reasons?
 - P4: Since your goal was to split parenting duties with your husband, have you shared your tracking data with your husband? If not, what were the reasons?
 - P5: Have you talked about your tracking experiences with your husband or others after the second workshop? If so or not, what were the reasons?

(6) Sharing with others

- Would you be interested in sharing your data with others?
 - If so, in what ways would it be helpful for better stress management of you?
 - If not, what makes you reluctant to share data with others?

(7) The role of technology

- Do you have any previous tracking experiences? What kind of tracking were they? Did you find any differences between your previous experiences and the one for this study?
- How do you think self-tracking can better support parenting stress management?

(8) Miscellaneous

- P1: You have talked about your subjective criteria of evaluating your husband's parenting in the last workshop. Have you found something new after the second workshop as well?
- P2: You have creatively used multiple choices fields both in your 'Time for myself' and 'Communication with my husband' trackers. Have you learned something new through using the multiple choices fields?
- P3: Will you be interested in tracking your husband's parenting or emotional support like other participants did?
- P4: You have tracked your husband's parenting once in a few days. Did you miss tracking on purpose on the dates when your husband could not help you out?
Same for 'Frustration towards my baby?'
- P5: You have entered 'N/A' for a few times in your 'Going out' and 'Husband's involvement in parenting' trackers. Did you have any specific reasons for that?

(9) Wrap-up

- Anything that you want to know more through self-tracking in the future?
- Anything that you would like to add

APPENDIX B. WORKSHEETS

THE FIRST WORKSHOP

Participatory Design Workshop for Parenting Stress Management (Feb 13th, 2019)

Activity 1. 당신의 최근 한달 간의 삶은 어땠나요?

아래의 질문들은 여러분이 최근의 일상 생활을 돌아보면서, 여러분의 양육 스트레스 관리와 가장 밀접한 관련이 있는 다양한 트래킹 주제에 대해서 브레인스토밍해보는 과정을 돕기 위한 목적으로 구성되어 있습니다. 모든 질문에 답할 필요는 없으며, 각 질문에 대해서 생각해보면서 떠오르는 것들을 빈칸에 자유롭게 적어주시면 됩니다.

이름 _____

❖ 일상생활

- 최근 한달 간 충분한 수면을 취했다고 생각하시나요? 그렇게 생각하는 이유는 무엇인가요?

- 최근 한달 간 충분한 휴식을 취했다고 생각하시나요? 그렇게 생각하는 이유는 무엇인가요?

- 최근 한달 간 규칙적이고 건강한 식사를 했다고 생각하시나요? 그렇게 생각하는 이유는 무엇인가요?

❖ 양육 스트레스

- 최근 한달 간 얼마나 자주 피곤하다고 느꼈나요? 어떤 상황에서 주로 그렇게 느꼈나요? 그럴 때 주로 어떻게 하셨나요?

Participatory Design Workshop for Parenting Stress Management (Feb 13th, 2019)

- 최근 한달 간 얼마나 자주 지나치게 과중한 부담을 지고 있다고 느끼셨나요? 어떤 상황에서 주로 그렇게 느끼셨나요? 그럴 때 주로 어떻게 하셨나요?

- 최근 한달 간 얼마나 자주 짜증이 나거나 인내심을 쉽게 잃어버린다고 느끼셨나요? 어떤 상황에서 주로 그렇게 느끼셨나요? 그럴 때 주로 어떻게 하셨나요?

- 최근 한달 간 얼마나 자주 시간에 쫓긴다고 느끼셨나요? 어떤 상황에서 주로 그렇게 느끼셨나요? 그럴 때 주로 어떻게 하셨나요?

- 최근 한달 간 얼마나 자주 스스로 부모로서의 능력이 부족하다고 느끼셨나요? 어떤 상황에서 주로 그렇게 느끼셨나요? 그럴 때 주로 어떻게 하셨나요?

❖ 사회적 지지

- 최근 한달 간 얼마나 자주 배우자와 의미 있는 대화를 나누셨나요?

Participatory Design Workshop for Parenting Stress Management (Feb 13th, 2019)

- 최근 한달 간 얼마나 자주 배우자 외의 다른 사람들과 의미 있는 대화를 나누셨나요?

- 최근 한달 간 얼마나 자주 다른 사람에게 도움을 요청하셨나요? 혹은 얼마나 자주 다른 사람에게 도움을 주셨나요?

❖ 개인적 시간

- 지난 한달 간 때때로 자신만을 위한 시간을 가지셨나요? 무엇을 하면서 자신만의 시간을 주로 보내셨나요? 만약 거의 그런 시간을 가질 수 없었다면, 이유는 무엇인가요?

- 육아 스트레스 해소에 도움이 되는 자신만의 작은 팁이 있다면 어떤 것인가요?

- 스트레스를 받을 때 주로 어떻게 하시나요? 평소 사용하시는 전략이 스트레스 해소에 효과적이라고 느끼시나요?

- 지난 한 주를 돌아볼 때 가장 좋았던 순간과 가장 힘들었던 순간은 언제였나요?

Activity 2. 트래킹 주제 정하기

위의 질문을 통해 생각하고 기록한 내용을 바탕으로, 여러분이 2주간 기록하고 싶은 주제 1~3 가지를 적어주세요. 기준은 1) 여러분의 일상생활을 바탕으로 본인의 육아 스트레스와 가장 관련이 깊다고 느껴지는 주제, 그리고 2) 주중에 거의 매일 기록할 수 있는 주제 (주말은 선택 사항) 여야 합니다. 여러분이 일상생활에서 본인의 육아 스트레스 경험에 관하여 조금 더 깊이 이해하고 싶은 주제를 선택해도 좋고, 보다 나은 육아 스트레스 관리를 위하여 스스로 새로운 계획을 세워서 시도해보고 이에 대해서 기록하셔도 좋습니다.

어떤 주제로 트래킹하고 싶으신가요?

- 1) _____
- 2) _____
- 3) _____

위의 주제를 선택하신 이유는 무엇인가요?

위 주제에 대해서 구체적으로 무엇이 알고 싶으신가요?

: PPT로 제공되는 예시 및 OmniTrack이 제공하는 다양한 데이터 필드를 참고해서 작성해주세요.

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____
- 7) _____

Activity 3. 트래커 소개하기

여러분들이 만든 트래커를 다른 사람들에게 간단하게 소개해주세요.

1) 트래킹 주제

2) 기록하고자 하는 데이터 종류:

3) 이 주제를 선택한 이유

4) 트래커를 디자인하면서 느낀 점

THE THIRD WORKSHOP

Participatory Design Workshop for Parenting Stress Management (Feb 28th, 2019)

육아 스트레스 관리를 위한 셀프 트래킹 종료 워크숍

이름 _____

Activity 1. 셀프 트래킹 경험 돌아보기

이번 시간에는 여러분의 지난 2 주간의 셀프 트래킹 경험에 대해서 다른 참여자들과 공유하는 시간을 가질 것입니다. 그간의 셀프 트래킹 경험에 대해서 돌아보면서 어떠한 내용을 다른 참여자분들과 공유하면 좋을지 생각해 보시고 아래의 빈칸에 적어주세요. 나누어 드린 개인별 트래킹 데이터 프린트물을 참고하셔도 좋습니다.

❖ 트래킹 주제

여러분이 지난 2 주일 간 트래킹하신 주제가 무엇이었는지 아래에 적어주세요. 중간 인터뷰를 통해서 트래킹 주제가 변경 또는 추가되었다면 그 부분도 간단하게 적어주세요.

❖ 트래킹 경험을 통해서 새롭게 알게 된 점

여러분이 지난 2 주일 간의 트래킹 경험을 통해서 새롭게 알게 된 점, 발견하게 된 재밌는 사실들이 있다면 아래에 적어주세요. 나누어 드린 개인별 트래킹 데이터 프린트물을 활용하셔도 좋습니다.

Participatory Design Workshop for Parenting Stress Management (Feb 28th, 2019)

❖ 육아 스트레스 관리에 대한 영향

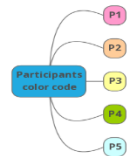
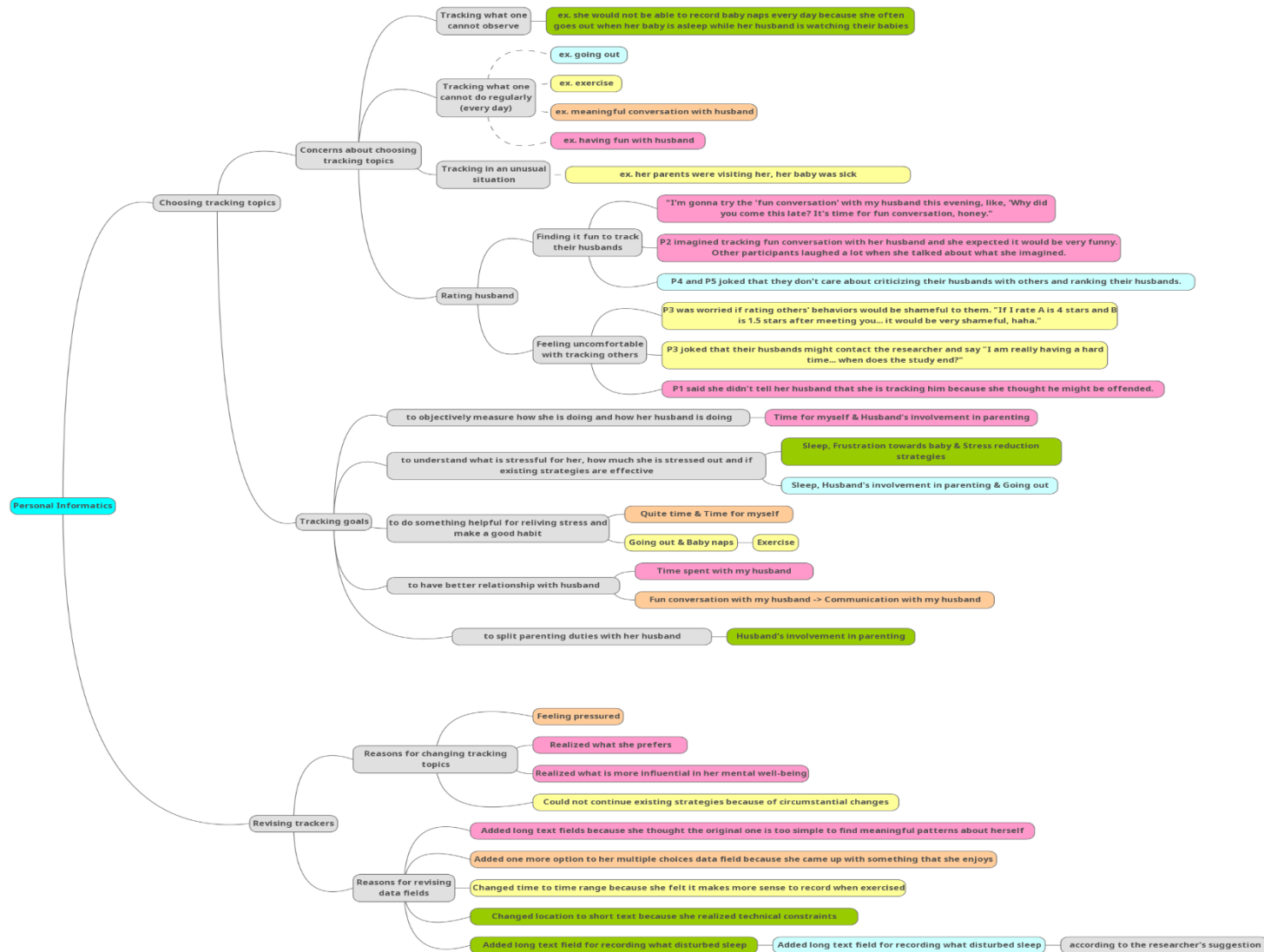
지난 2 주간의 트래킹 경험이 여러분의 일상 생활, 그리고 육아 스트레스 관리에 어떤 영향을 미쳤나요?
 혹은 지난 2 주간의 트래킹 경험이 여러분이 기존에 갖고 있던 자신에 대한 생각과 감정에 어떠한 변화를
 가져왔나요?

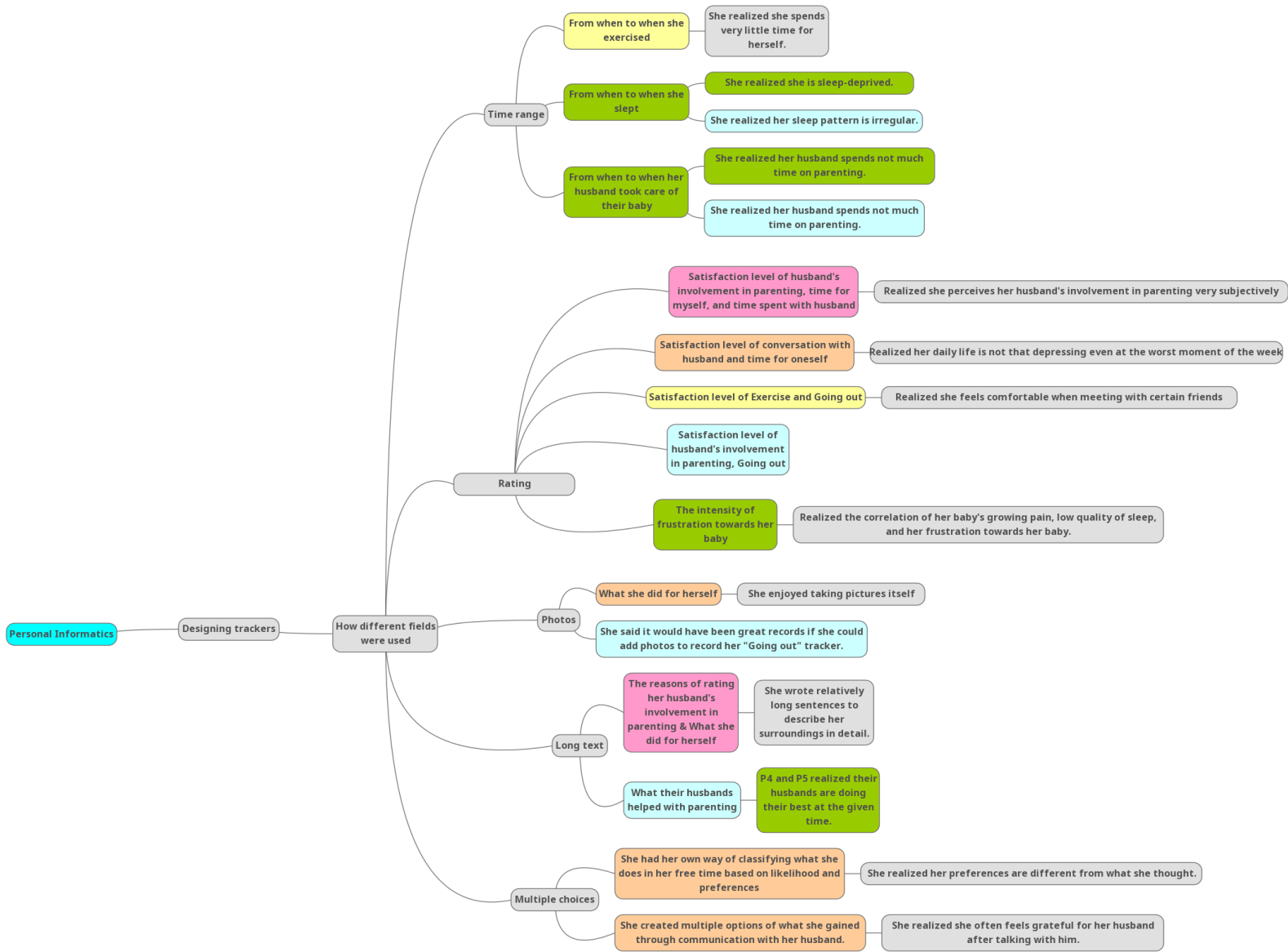
위의 내용을 토대로, 여러분의 지난 2 주 간의 트래킹 경험을 다른 사람들과 약 3 분 내외로 공유해주세요.
 나누어 드린 개인별 트래킹 데이터 프린트물을 활용하셔도 좋습니다.

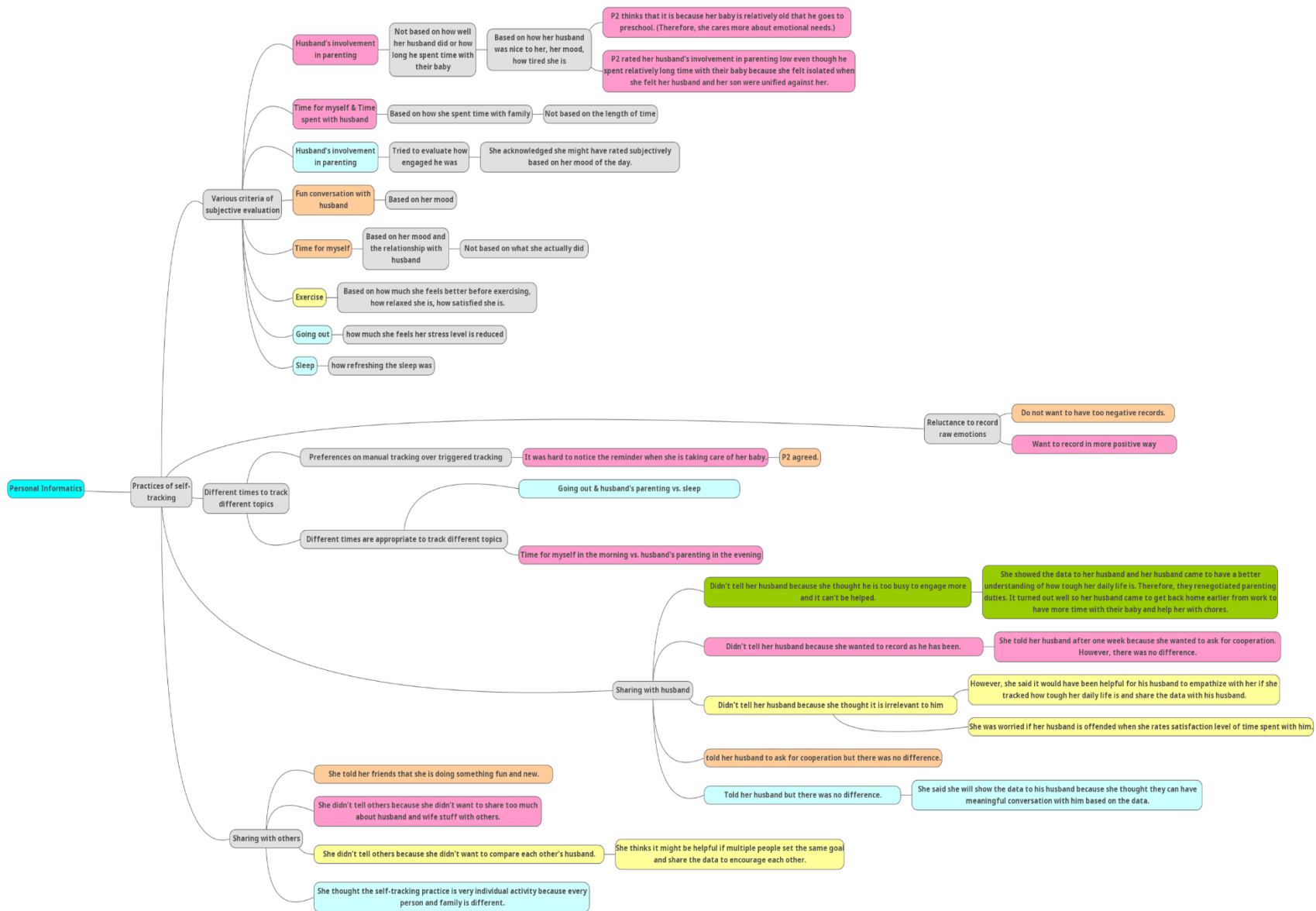
APPENDIX C. TRACKING TOPICS

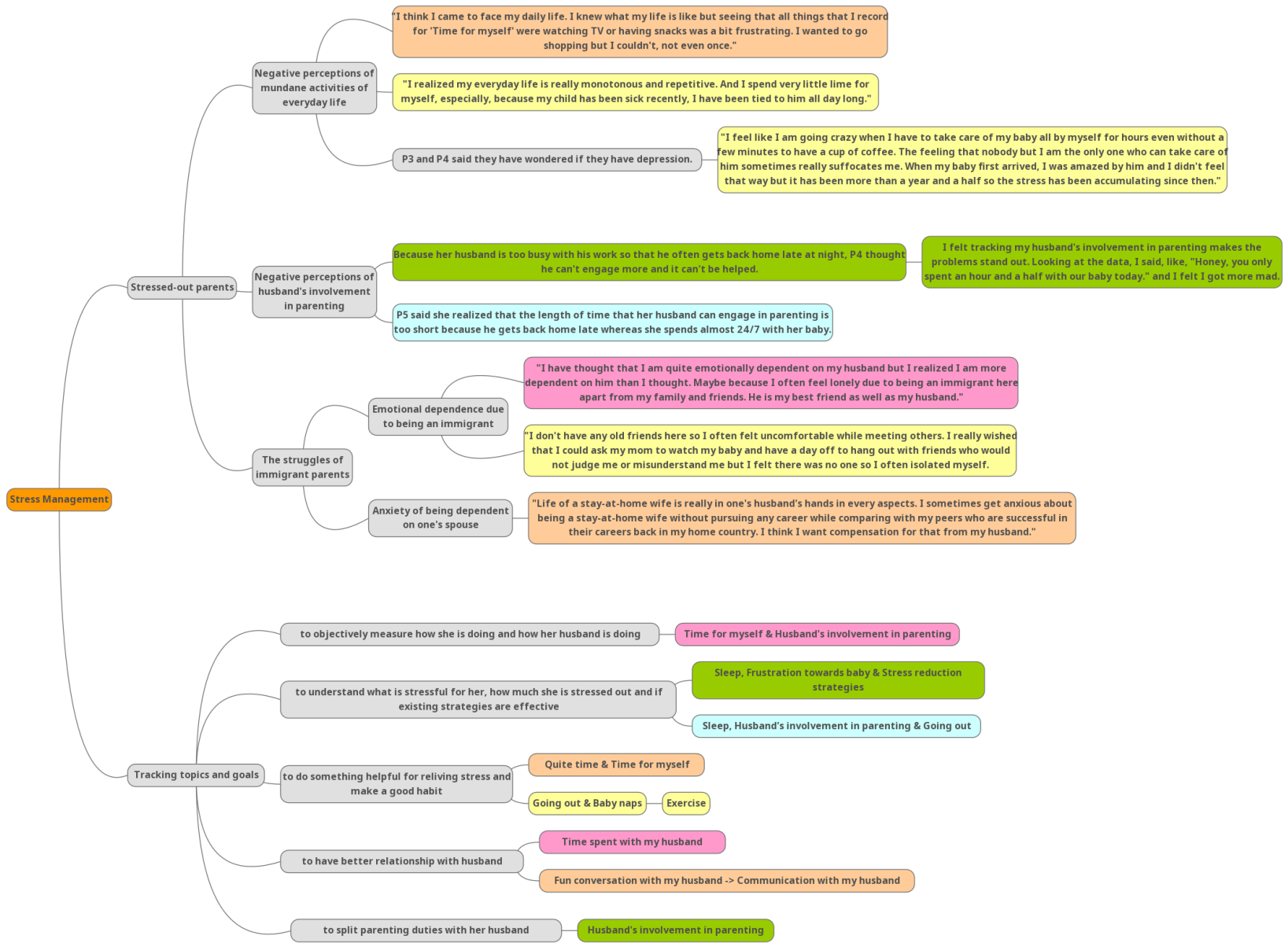
Participant code	Initial tracking topics	Initial tracking themes	Initial data fields	Reasons for choosing the topics	Revisions to topics	Revisions to data fields	Reasons for revisions	Revised tracking themes
P1	1) Husband's involvement in childrearing 2) Time spent on my own	Husband Time for myself	1) Time range, rating, short text 2) Time range, rating, short text	* The most relevant to the quality of her life and parenting * Wanted to measure what I do and what my husband does	Changed the first tracking topic to "Time spent with my husband"	1) Added long text fields for how her husband helped & reasons for ratings 2) Added long text fields for what she did & reasons for ratings	* She contacted me and said she wanted to add more fields to the tracker after a day of tracking because it felt too simple to find patterns about herself. * In the interview, she said she realized she actually prefers time spent with her husband over time spent on her own after a week of tracking experiences.	Husband
P2	1) Fun conversation with my husband 2) Time for myself 3) Quite time	Husband Time for myself Spiritual activity	1) Number (how fun it was), rating (satisfaction level), long text (her feelings after the conversation) 2) Multiple choices, photo, rating 3) Time, long text (what she felt)	* The most relevant and influential to her life as a parent	Renamed the first tracker as "Communication with my husband"	1) Added "what she gained through the conversation", "Main theme", and time 2) Moved watching TV shows to the second category 3) N/A	* She said it has been kind of a pressure to track "FUN" conversation with her husband so she chose a neutral word. * She had her own criteria for time for herself such as the most preferred way is shopping or meeting friends, and the second preferred way is taking naps or watching tv shows, and the least preferred way is having snacks. So she tuned the options.	Husband Time for myself Spiritual activity
P3	1) Going out 2) Exercise	Time for myself	1) Multiple choices (what she did), time, rating, long text (what she felt) 2) Time, rating, long text (what she felt after exercising)	* To make exercise a habit * The most helpful methods for relieving her stress	Added "Baby nap"	1) Changed time to time range 2) Changed time to time range	* She said it got a lot more difficult for her to go out or exercise because her baby got sick and her husband got too busy. She came up with a baby nap because it is something that she can log everyday and also very relevant to her quality of life.	Baby Time for myself
P4	1) Husband's involvement in childrearing 2) Parenting stress reduction strategies 3) Sleep 4) Frustration for baby	Husband Time for myself Basic needs Negative emotion	1) time range, short text (how he helped) 2) short text (methods), time range, location 3) time range, rating 4) short text (reasons for frustration), time range, rating (how frustrated she was)	* To reflect on and increase the quality of her life * To split parenting duties with her husband through the data	N/A	1) N/A 2) location -> short text 3) added long text (what disturbed my sleep) 4) N/A	* She realized the location only logs current location but she was able to use the app only when wifi is connected so she only used the smartphone at home. * The researcher recommended adding a new field.	Husband Time for myself Basic needs Negative emotion
P5	1) Husband's involvement in childrearing 2) Sleep 3) Going out	Husband Basic needs Time for myself	1) time range, rating, long text (what he did) 2) time range, rating, time (when her baby woke up at night) 3) time range, rating, short text (location)	1) she feels her husband's support and empathy plays a big role in relieving her stress 2) she feels sleep has a huge impact on parenting next day. Also, her baby's sleep pattern has been changed recently so she is interested in sleep patterns these days. 3) she feels her stress level decreases when she goes out	N/A	1) Added long text for what was helpful or disturbing 2) N/A 3) N/A	* The researcher recommended adding a new field.	Husband Basic needs Time for myself

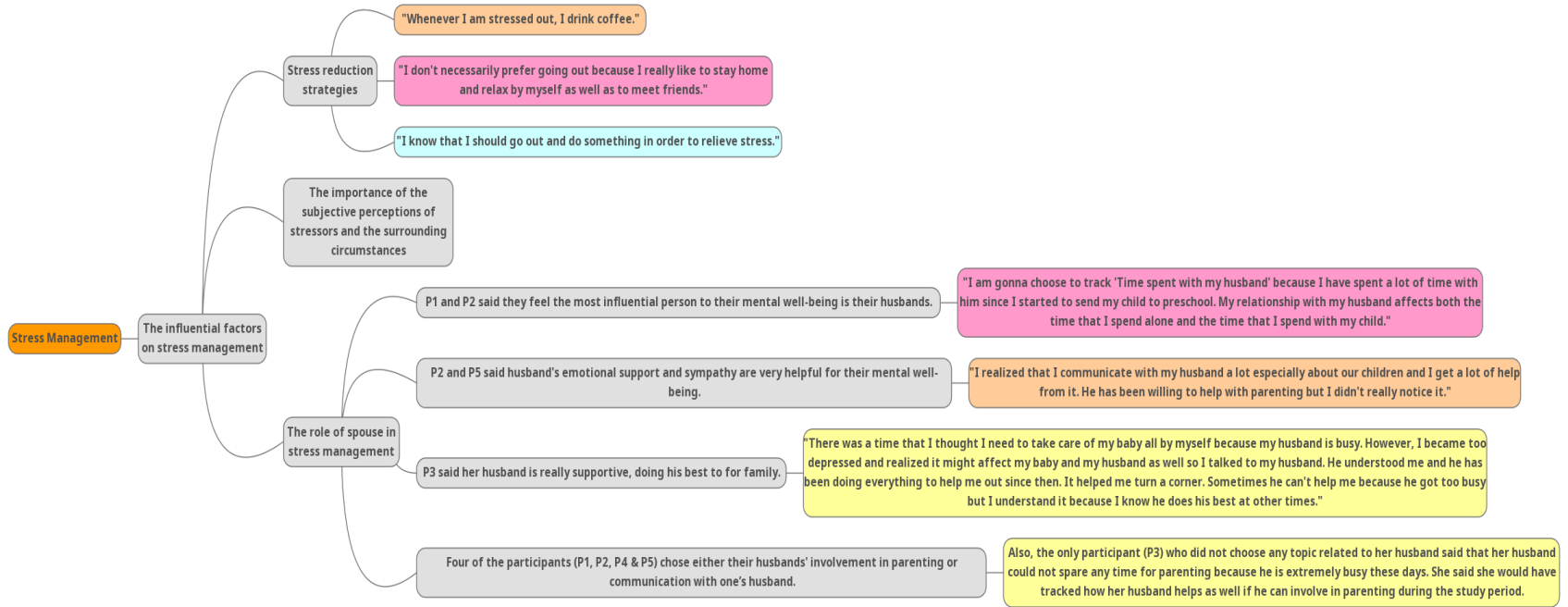
APPENDIX D. THEMES, CODES, AND EXAMPLE QUOTES

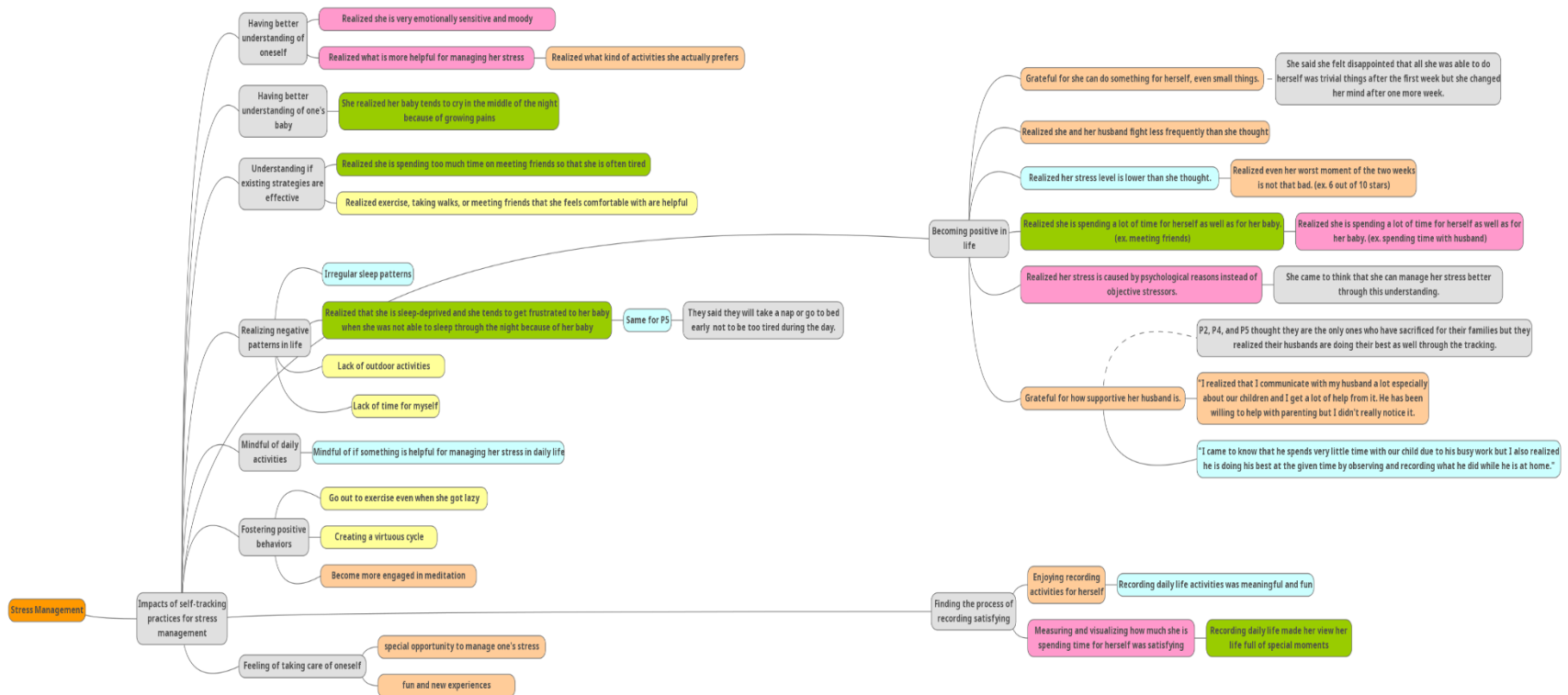


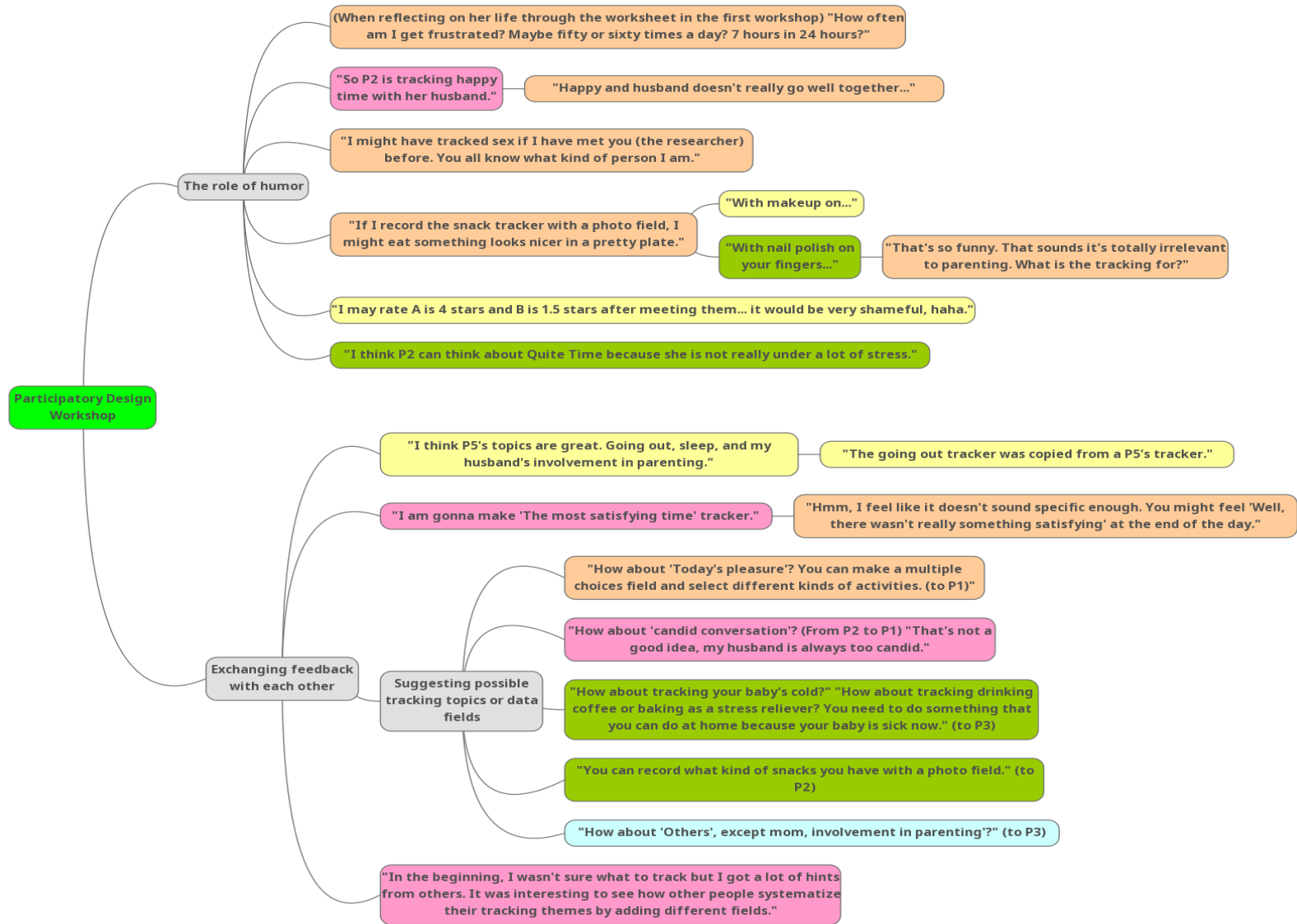


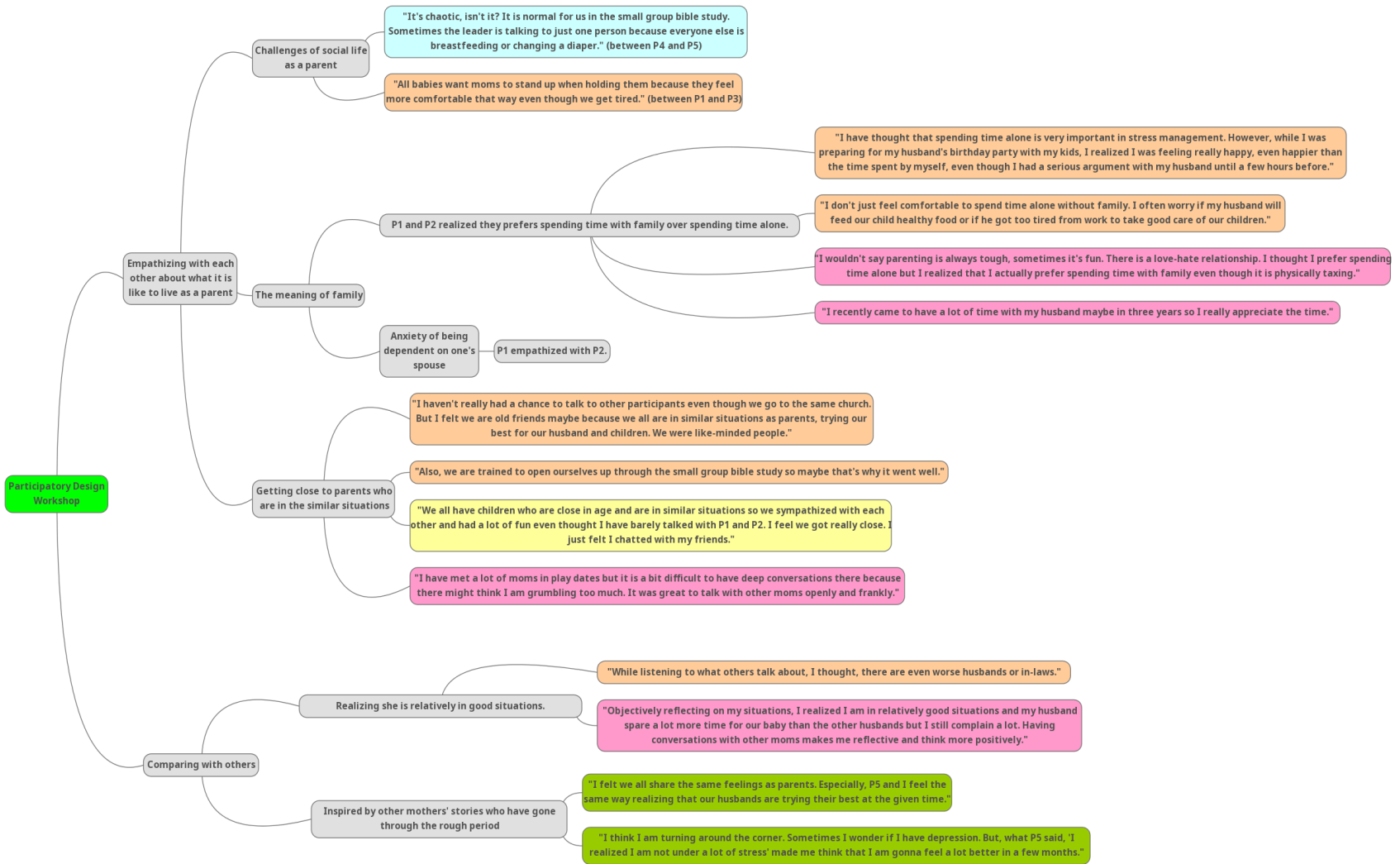


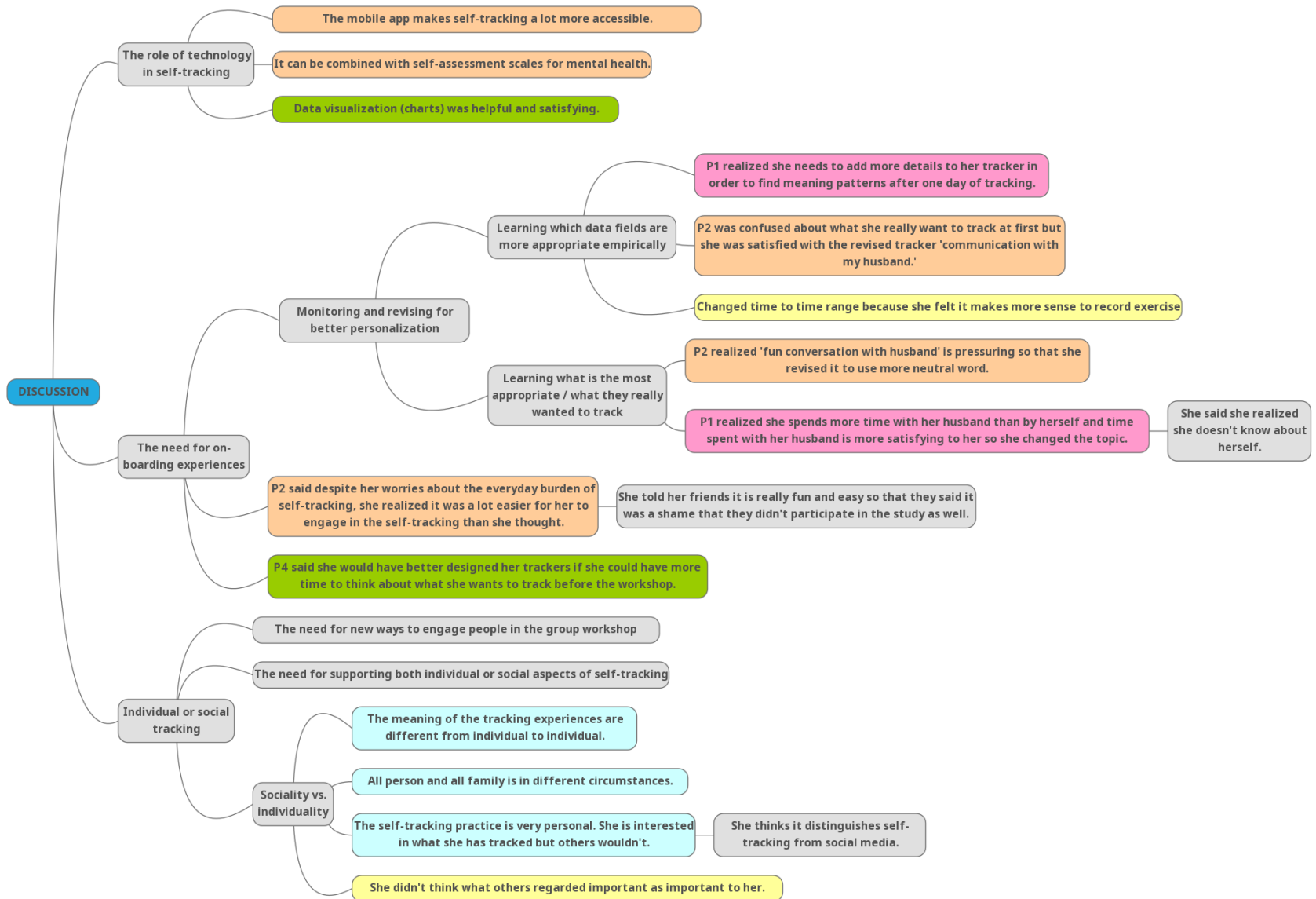


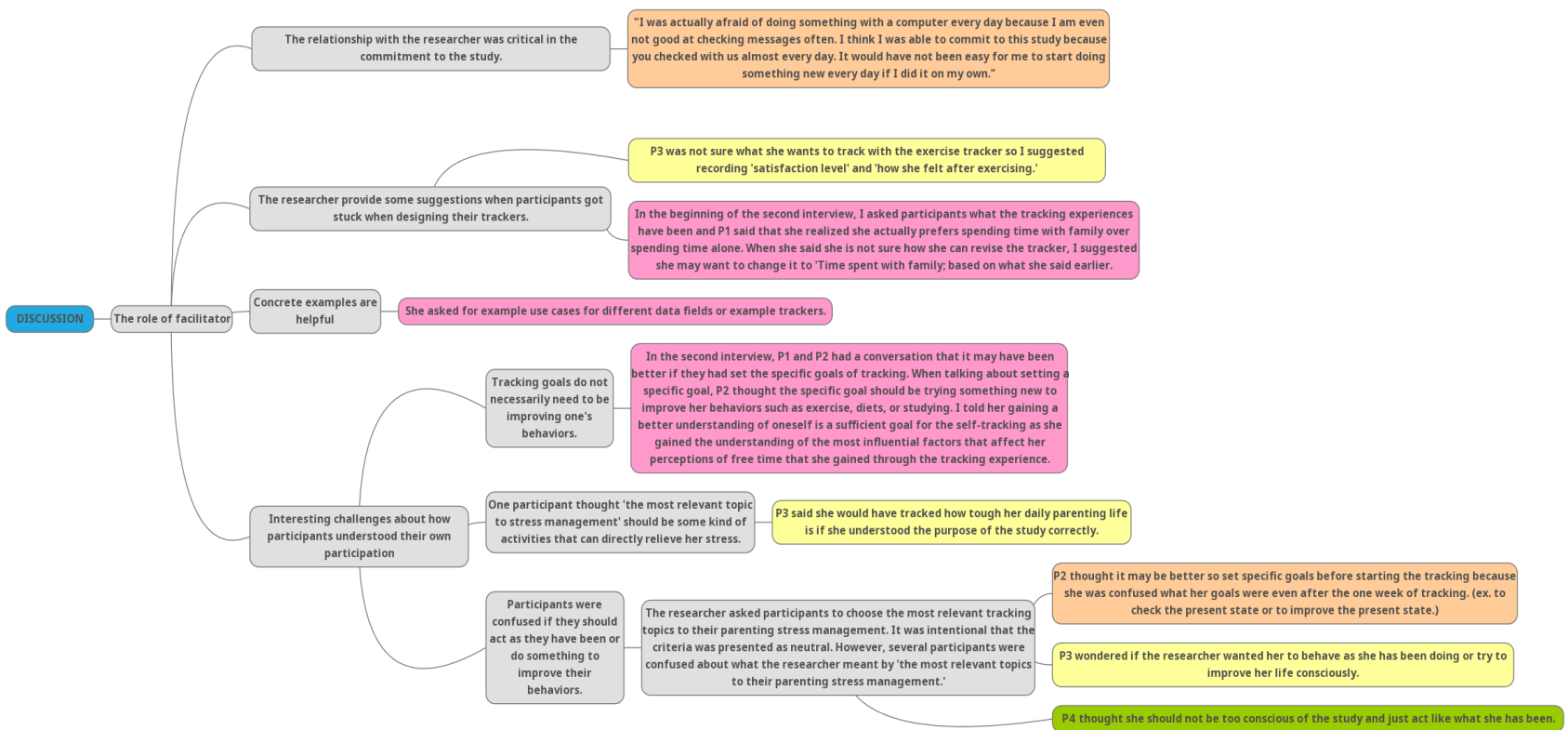












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