MASTER

Investigating the relationship between parenting beliefs and parenting practice for in-app personalization

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Investigating the relationship between parenting beliefs and parenting practice for in-app personalization

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Abstract

It is never an easy job for new parents to take care of their baby. Parents may experience parenting stress and knowledge deficit in how to take care of the baby depending the baby’s development. We proposed that parenting apps can help to address these problems by providing personalised suggestion.

Currently, Philips has developed a mobile parenting app, uGrow. It functions as a logbook which allows mothers to track the way they take care of their baby. The goal of the current study is to provide suggestion in two aspects. First, we would like to determine what parenting beliefs and behaviours are most relevant to provide personalised in-app suggestions in uGrow. Second, we would like to give suggestion on what type of personalized suggestions can be provided, based on the selected beliefs and behaviours. Though parenting is a responsibility for both parents, the current study is mainly focused on mothers because it is mostly the maternal roles in parenting that have been examined extensively in the scientific literature.

Researchers coined the word “parenting practices” to refer to parenting behaviours in the contexts of infant caring. We adopted parenting related questionnaires from different literature sources and designed a new questionnaire to measure mother's and baby's demographic profiles, mother’s parenting beliefs in Structure (i.e. to what extent mothers apply a schedule on the baby’s daily activities) and Attunement (i.e. to what extent mothers are responsive and apply physical contact), maternal self-efficacy in infant caring, parenting stress and mother’s perception of infant difficulty. The questionnaire also measured some specific parenting practices in terms of feeding, sleeping and soothing a crying baby, some of which can be tracked by uGrow.

Around 200 mothers with an infant(s) less than one year old responded the questionnaire. We constructed a path model to examine the relations between different concepts that are measured in the questionnaire, and the relations between those concepts and parenting practices. The results show that parenting beliefs in Attunement and Structure are the two main aspects that influence parenting practices, and they are negatively correlated to each other. Mothers who have higher level of Attunement are more likely to perform intimate and responsive parenting practices, and mothers who have higher level of Structure are more likely to perform routine-based parenting practices. Because some of these influencing effects are moderated by parenting stress, perceived infant difficulty and the baby’s age, it is not possible to infer an individual’s level in Attunement/Structure, parenting stress and perceived infant difficulty at the same time based only on parenting practices. Therefore, we propose that by measuring mother’s Structure and Attunement score through questionnaire, and by using the demographic information which one provides when creating a user account, it is possible for a mobile parenting apps to provide personalised suggestions on parenting stress coping strategies.
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Chapter 1. Introduction

It is never an easy job for new parents to take care of their baby. Upon their arrival in this world, babies forever change their parents’ daily schedules and their beliefs in the parenting role. Parents need to quickly learn how to become a competent caregiver, because newborns cannot verbally communicate their needs, and their survival completely depends on their caregivers (Bornstein, 1995). Though parenting is a responsibility for both parents, we will focus mostly on mothers because it is mostly the maternal roles in parenting that have been examined extensively in the scientific literature.

1.1 Infant parenting

1.1.1 The constitutions of infant parenting

Bornstein defined infant parenting as it “constitutes the initial and all encompassing ecology of infant development” (Bornstein, 1995. p14). He indicated that both parenting beliefs and parenting behaviours play fundamental roles in parenting, where parenting beliefs can generate and influence parenting behaviours (Darling & Steinberg, 1993; Maccoby & Martin, 1983; Murphey, 1992; Teti & Candelaria, 2002). However, this relation mentioned above is not a one-to-one match, because research shows that parenting behaviours can also be affected by many other determinants such as marital and social support, life events, parents’ personality, infant’s characteristics, and parenting stress (Belsky, 1984; Abidin, 1992). Therefore, when examine the relation between parenting beliefs and parenting behaviours, it is necessary to take into account other determinants.

1.1.2 Issues raised in infant caring

Bowman (2005) studied new mothers during their baby’s infancy, and he indicated that new mothers have a lot new knowledge and skills to learn, such as feeding, interpreting the baby’s crying signals, detecting the baby’s illness, and understanding the baby’s growth and development. Furthermore, infant parenting is a dynamic process (Bornstein, 1995). Maloni (1994) showed that mothers’ learning needs change with the baby’s age and development. Due to this rapid change, new mothers may experience a knowledge deficit in infant care taking (Iceland & Wilkes, 2006). We therefore propose that mothers should be aided in applying different infant care-taking techniques based on the understanding of their baby’s growth and development.

Another important issue related to infant parenting is parenting stress. Research shows that parenting stress is associated with reduced maternal sensitivity, child abuse and neglect, perceived negative marital quality, and negative child outcomes (e.g. children’s violent behaviours or less optimal academic performance) (Crnic & Low, 2002; Darke & Goldberg, 1994, Chan, 1994; Mash & Johnston, 1990; Rodriguez & Green, 1997; Lavee, Sharlin & Katz, 1996). Östberg and Hagekull
(2000) reported that higher maternal parenting stress is associated with different aspects, such as being a mother of older age, experiencing low social support, and perceiving the baby to be difficult. Therefore, in order to achieve optimal infant parenting outcomes, it is necessary to help mothers to be aware of their stress level and assist them in coping with parenting stress.

In conclusion, infant parenting is such a difficult job that mothers would benefit greatly from some assistance in order to be a competent caregiver. It requires a solution which not only aims at providing care-taking knowledge, but can also help mothers to optimize their psychological states, for example, providing suggestions on how to cope with parenting stress.

### 1.2 Traditional media in parenting VS. parenting apps

Because of the difficulties in parenting, there is a big market of infant parenting books and magazines nowadays, but many of them focus primarily on one of two quite different approaches of parenting: parent-led or baby-led parenting. The former suggests strict routines and regular physical contacts. The latter, on the contrary, suggests parents to follow the baby's cues and respond to baby’s needs immediately (Hardyment, 2007). These two contradictory approaches may put new parents in a difficult position where they can feel confused, or conversely, follow only one approach regardless the lack of empirical support (Arnott & Brown, 2013).

In addition, traditional media such as parenting books and magazines can only provide general information. Since different families have different situations for mothers to deal with, it might be hard for mothers to obtain some specific information that they need from those parenting books. Therefore, in order to better assist mothers in infant parenting, instead of providing only a one-size-fits-all solution, providing personalized services could be a great help.

In recent years, there are a lot of parenting apps in the market and using parenting apps has become very popular. Parenting apps which focus on the first year of babies’ life become an important part of the daily life of parents. These apps are mainly focus on three functional areas (Research2Guidance, 2013): first, there are parenting apps aiming to help parents to capture every important moment of a baby’s life. For example, apps such as “Baby pics” and “My baby milestones” (on IOS platform) allow parents to take pictures or videos of the baby’s important moments, edit them, and then share them on the social network. Second, parenting apps can provide information and guidance on how to take care of babies. For example, “MammaBaby” (on IOS platform) provides 26 milestones for parents to compare with their own baby and 62 tips about how to take care of the baby. Third, parenting apps often provide a logbook or dairy in order to help parents keep track of the the baby’s growth and daily events. For example, “MammaBaby” also allow parents to input information such as the feeding duration, times of diaper change and the baby’s length and weight. After several times using this app, parents can get information about the daily average and the trend of those inputs.
However, these current parenting apps have not fully made use of the digital data that they have access to, so what they provide is merely a digital version of an interactive parenting book or an interactive notebook, instead of personalized assistance. Even though that some of the apps also provide integrated information such as daily average of feeding duration, they only function as tracking apps instead of personal assistants in infant caring. We believe that parenting apps could be used to achieve more than what is provided now.

Philips has developed its own mobile app ‘uGrow’ in order to assist mothers in taking care of their babies. Currently, it mainly functions as a logbook which allows mothers to track the way they take care of their baby (see Figure 1). Research suggests that personalisation should be based on static and dynamic profiles (VanderMeer, Dutta, Datta, Ramamritham, & Navanthe, 2000; Albanese, Picariello, Sansone & Sansone, 2004). Static profiles contain users’ information when they create a user account. Dynamic profiles include information of users’ online behaviour. In the case of uGrow, a user profile contains demographic information of a mother and her baby when she creates an account in uGrow. Behavioural data records how a mother takes care of her baby in daily life, such as the time to put the baby to sleep, the duration of soothing the baby from crying, the amount of food intake, and the feeding method. We propose that by using uGrow, personalisation can be easily achieved, because we can get access to static user profile data, as well as user behavioural data.

We believe that, in order to give useful assistance, personalisation should be based on our understanding of individual differences in both static and behavioural data. For example, the app can give information on how to take care of a preterm baby simply by knowing the difference between the actual birth date and the expected birth date. The app can also infer what kind of parent a mother is, judging by the level of warmth and control she applies to her baby, and gives her advice.
on how to achieve optimal infant development accordingly. Personalization functions can also be provided such as different coping strategies, based on the level of stress that we may infer from a user’s behaviour.

1.3 Goal of this study

The final goal of the current study is to provide suggestions in two domains. First, we aim to provide suggestions on what parenting beliefs and behaviours we should focus on, in order to provide in-app personalization. Second, we would like to give suggestions on what type of personalization service can be provided. To find support for this goal, we need to understand infant parenting and how people differ in terms of infant parenting. Therefore, the following questions will be answered in this study:

1. What are the parenting beliefs that can influence parenting behaviours? How are these beliefs related? And how are they related to parenting behaviours?
2. What role do other determinants of parenting behaviours (e.g. parenting stress, perceived infant difficulty, mother’s and baby’s demographic information, etc) play in the relations mentioned above?
3. Can we describe a mother in terms of parenting beliefs, parenting stress, or perception of infant difficulty, based solely on the app-tracked parenting behaviours?

In the next chapter, we will first describe theories and findings in parenting, and make clarifications of the terminologies that we used in the current study. Then a Social Cognitive Theory framework that we used to construct our own research model will be introduced, followed by our research model and our hypotheses. In the third chapter, we will present the methodologies of the study, including participants profiles, sample size and questionnaire design. In chapter four, analysis and results will be reported and discussed, together with our main conclusions and suggestion on personalization. We will discuss limitations and the future work in the last chapter, chapter five.
Chapter 2. Literature Review

2.1 Theories in parenting

Studies in parenting originated in the observations of their own babies by philosopher, educator, or scientist parents (Bornstein, 1995). They kept records of the development of their own children in their natural settings, in the form of “baby biographies” (Darwin, 1877; Hall, 1891; Rousseau, 1762; Taine, 1877; Tiedemann, 1787; Jaeger, 1985; Prochner & Doyon, 1997; Wallace, Franklin & Keegan, 1994). Because of such a broad construct and origins, we have noticed that researchers use different and inconsistent terminologies with respect to parenting, which may result in a lack of common understanding of the constitution of parenting for researchers across different fields and time. Therefore, it is important for our study to examine different approaches that different researchers used in parenting studies in order to find a common ground where we can base our own study on. The first approach focuses on parenting beliefs and behaviours, and the second approach focuses on parenting styles and practices.

2.1.1 Approach A: Parenting belief-behaviour

2.1.1.1 Parenting beliefs

Social psychologists usually see parenting beliefs as a combination of attitudes, feelings, values and beliefs (Baldwin, 1965; Goodnow, 1985; Heider, 1958; McGuire, 1999; Rokeach, 1980). However, this notion has suffered from being associated with so many ambiguous and various everyday meanings (Goodnow & Collins, 1990). Researchers in parenting have then realized that the core component of the belief construct is cognition — the cognition about children and parenting (Bugental, 1992).

Bornstein (1995) indicated that parenting beliefs include beliefs about parents themselves, such as how competent they are in a parenting role. Parenting beliefs also include parent’s expectations of infant development, such as what emotion can a baby convey when he/she is relatively young (Johnson, Emde, Pennbrook, Stenberg, & Davis, 1982). In addition, parenting beliefs include those attitudes, ideas and beliefs of how to take care of a baby and of the infant-parent relationship (Wachs & Camli, 1991; Bornstein, 1995).

2.1.1.2 Parenting behaviours

As another important aspect of parenting, parenting behaviours also receive intensive studies. Specifically, Bornstein (1995) identified four main aspects of parent caregiving behaviours during infancy: They are nurturant, social, didactic and material. Nurturant behaviours are aiming to meet the physical needs of the baby in order to keep him/her alive. Those behaviours include providing shelters for protection, feeding the baby, and preventing the baby from illness. Social behaviours
includes a variety of behaviours which express parents’ warmth and affection, such as kissing, vocalising and eye contact. Didactic behaviours focus on helping the baby to engage and understand the external world, such as leading the baby’s attention to a singing bird, or a special event. At last, material caregiving behaviours define the physical world of the baby, such as new toys or the limitation of a physical space.

2.1.1.3 Relations between parenting beliefs and behaviours
Parenting beliefs mainly serve two functions in parenting: (1) generating and influencing parenting behaviours and (2) mediating the relations between maternal perceptions and parenting behaviours (Darling & Steinberg, 1993; Maccoby & Martin, 1983; Murphey, 1992; Teti & Gelfand, 1991). The first function is rather easy to understand. For example, research shows that mothers who feel competent in the parenting role, in other words, mothers who have high maternal self-efficacy, are more responsive to their babies (Parks & Smeriglio, 1986; Schellenbach, Whitman & Borkowski, 1992). The second function can be illustrated by the findings that maternal self-efficacy mediates the influence of perceived infant difficulty on maternal behavioural competence (Teti & Gelfand’s, 1991). It implies that the baby’s fussy temperament has negative effects on maternal behaviours, only when a mother’s self-efficacy is reduced because of the baby’s difficulty. For mothers with difficult babies but who have a high level of self-efficacy, the behavioural competence will be more likely to stay stable. In order to understand why and how mothers behave differently, it is fundamental to examine the differences in their parenting beliefs, as well as the mediating effects of some parenting beliefs.

2.1.1.4 Other determinants of parenting behaviours
Besides parenting beliefs, parenting behaviours can be affected by many other variables. For example, in Belsky (1984) process model (see Figure 2), the determinants of parenting behaviours were not focused on parenting beliefs but rather sociological characteristics, such as child characteristics, social network, marital relations, working stress, and the personality of the parent.

![Figure 2. Belsky’s process model of determinants of parenting behaviours (Belsky, 1984)](image)

Abidin (1992) developed an integrative model (see Figure 3) illustrating that parenting behaviours are influenced by sociological, environmental, behavioural and developmental variables. He indicated that the path of influence of those variables is moderated by Parenting Role Relevance.
Parenting Role Relevance represents beliefs and expectations of the role of being a parent, which we believe is similar to self efficacy. Those beliefs and expectations can lead to different level of Parenting Stress that parents may experience, which in Abidin’s point of view, can motivate parents to utilise resources to support their parenting behaviour.

As we can see from the two models presented above, parenting behaviours are determined by many different determinants, which results in strong debates on whether parenting behaviours can be predicted by parenting beliefs. Some researchers argue that parenting beliefs are key determinants of parenting behaviours, because parents will use those well-rehearsed strategies to achieve their parenting goals (Dix & Grusec, 1985; Goodnow & Collins, 1990). However, Miller (1999) suggested that many parenting beliefs and behaviours are not matching. Rubin and his colleagues (2005) pointed out that whatever parents said about the activities they did with their children was uncorrelated with what was observed (Chen, 2005). Therefore, in the current study, it is important to examine to what extent parenting beliefs can influence parenting behaviours, and what roles other determinants play in this relationship.

### 2.1.2 Approach B: parenting style - practice
In addition to the approach we introduced above, researchers who focus on what constitutes good parenting examine parenting in a different way, by constructing two new concepts: parenting style and parenting practice.

The concept of “parenting style” was created by Diana Baumrind’s works (1967, 1971) where she categorised parenting into three styles: authoritative parenting, authoritarian parenting, and permissive parenting. This classification is based on the evaluations on two dimensions: control (e.g. to what extent do parents apply rules and disciplines to their children’s daily life) and responsiveness (e.g. to what extent do parents respond to their children’s needs). Authoritative parenting are characterised by high level of responsiveness and medium amount of control. Authoritarian parenting is characterised by high level of control but low level of responsiveness. Permissive parenting is characterised by low level of control but high level of responsiveness. Later, Maccoby and Martin (1983) expanded the Baumrind’s model, where they included neglectful parenting, which is characterised by low level of both control and responsiveness.

Darling and Steinberg defined parenting style as a “constellation of attitudes toward the child that are communicated to the child and create an emotional climate in which the parents’ behaviors are expressed” (Darling & Steinberg, 1993, p.493). For example, an authoritative mother may convey her recognition encouragement by praising the baby, and she may also communicate her warmth of the baby by not harshly scolding him/her. The authors also indicate that parenting style is a context-independent concept and it should stay stable across different parent-child interaction situations.

Parenting practice, on the other hand, is defined as “behaviours defined by specific content and socialization goals” (Darling & Steinberg, 1993, p.492) which can influence children’s development. Parenting practice can be influenced by parenting styles but it is not always the case, because unlike parenting style, parenting practice is context-based, domain specific behaviours (Darling & Steinberg, 1993). Therefore, parents with the same parenting style may differ in their parenting practices because of the characteristics of their babies, and their social status.

In addition, Darling and Steinberg (1993) indicated that the parents’ behaviours include parenting practice, as well as parent-child interaction behaviours that are not goal oriented, such as vocalisation, kissing, and hugging behaviours, which are embedded in parenting styles.

2.1.3 Conclusions

From the discussion above, one can conclude that individual differences in parenting lie in both approaches. First, different parents can have different parenting beliefs and behaviours. A corresponding behaviour may be a result of a specific belief, but they are not always perfectly matched, because of other determinants of parenting behaviours. On the other hand, parents are different in parenting styles and practices, where the former one can influence the latter.
Because some concepts in these two approaches overlap, one should make clear distinctions in order to understand the relationship among different aspects in parenting. The concept of parenting style is a mix of parent's attitudes and parent-child interaction behaviours. Those attitudes only form part of the general parenting beliefs, and those parent-child interaction behaviours correspond to social and didactic caregiving behaviours, which are presented in the parenting belief - behaviour approach. Parenting practice, on the other hand, only focuses on infant care-taking behaviours, which match the nurturant and material caregiving behaviours in the parenting belief - behaviour approach. This implies that parenting belief - behaviour approach has a broader view compared to parenting style - practice approach. Moreover, one should conclude that parenting style focuses more on the field of parent-child interaction, while parenting practice focuses more on infant care-taking behaviours. Figure 4 shows the distinctions and relations of the terminologies in the two approaches.

![Figure 4. The distinctions and relations of the terminologies in the two approaches. The concepts in red are the focus of the current study.](image)

Since uGrow is an app which focuses on the context of infant care-taking, the app can not track any parent-infant interaction behaviours (e.g. kissing or hugging). This means that we have no information about how many times a mother kisses and hugs her baby, but only the information about when she feeds the baby and how long it takes. Therefore, in the current study, we are mainly interested in the relationship between parenting beliefs and infant care-taking behaviours, in other words, parenting practices.

### 2.2 Applying Social Cognitive Theory framework to parenting
From the parenting models constructed by Belsky (1984) and Abidin (1992), we can see that determinants of parenting behaviours come from different aspects of parents’ life. It includes personal determinants such as the parents’ personalities, personal beliefs and expectations, and personal experiences of younger life. Environmental determinants such as working loads, resources, and marital statuses also play important roles to determine parenting behaviours. We propose that we can apply Social Cognitive Theory as a framework in order to guide us to understand the mechanism of how parenting practices are influenced by different determinants, and how these determinants are related.

### 2.2.1 Fundamental components of SCT

Social Cognitive Theory is first proposed by Albert Bandura (1982), which emphasizes that human functioning is the result of an interplay between three factors: person, environment and behaviour. Those three factors can influence each other bidirectionally with different strength (Bandura, 1989). This relationship is presented in his Triadic Reciprocal Determinism model (see Figure 5).

#### 2.2.1.1 Person $\leftrightarrow$ Behaviour

The first relation focuses on the interaction between personal cognitions and behaviours. Research shows that people’s thought, beliefs, feelings can influence their behaviours (Bandura, 1986; Bower, 1975; Neisser, 1976). Their actions, in turn, will also affect people’s thoughts and emotions. For example, in the context of infant caring, a mother who believes that a structured schedule is beneficial for her baby will more likely to apply a strict daily routine for her baby. However, if the baby keeps being more fussy because of the routine, the mother will be more likely to doubt if she uses the right method taking care of her baby.

![Figure 5. An illustration of the Triadic Reciprocal Determinism model from Social Cognitive Theory](image-url)
Another central concept in this relation is self-efficacy, which represents beliefs of one’s competence in a particular task (Bandura, 1989). It affects human’s motivation to perform the task by influencing their thoughts, feelings and actions (Jerusalem & Schwarzer, 1992). It also mediates relations between people’s knowledge and behaviours (Teti & Gelfand, 1991). For example, a mother may have enough knowledge to initiate solid food when the baby is old enough, but she may not be able to do so because of self-doubt.

The information on which people base their judgement of self-efficacy comes from four main sources: performance mastery experiences; performance of judgement capability compared to others, social influences such as verbal persuasion; and physiological states (Bandura, 1989). We may therefore expect that self-efficacy is a dynamic variable. For example, a mother may witness or hear of that it is easy to soothe a fussy baby with milk, so she may gain high level of self-efficacy to do so with her own baby. However, if the baby continues to cry for a long time even after the introduction of milk, the mother may experience reduction in her self-efficacy of this specific task.

2.2.1.2 Environment <---> Person

The second relation focuses on personal characteristics and environmental influences. Environmental factors can shape people’s expectations, beliefs and cognitive competencies (Bandura, 1986). For example, a baby with low birth weight is more likely to elicit the mother’s anxiety. On the other hand, people with different physical characteristics react differently to their social environment (Lerner, 1989), and such reactions elicited from the environment can also alter people’s bias of the perception of the environment (Bandura, 1989). For example, research shows that compared to younger mothers, mothers with older age experience higher level of stress during the baby’s infancy, and a stressed mother will be more likely to perceive her baby to be difficult (Östberg & Hagekull, 2000).

2.2.1.3 Behavior <---> Environment

The third interaction focuses on the two-way influence between behaviours and the environment. In daily life, behaviour can change environmental conditions, and “is, in turn, altered by the very conditions it creates” (Bandura, 1989. p.65). For example, when confronted with a crying baby, a mother’s behaviour can influence her environment by taking actions to calm the baby down, but she will not act until she hears her baby crying.

In conclusion, the Social Cognition Theory can help us decide what determinants to look in relation to parenting practices. Those determinants can be groups into three categories: personal determinants may include mothers’ demographic profiles, beliefs in infant care-taking, beliefs in self-efficacy and parenting stress; environmental determinants should focus on the baby’s physical characteristics, as well as maternal perception of the baby. Parenting practices are the behaviours that we should focus on.
2.2.2 The present study

In this section, we will introduce the present study. We constructed our research model based on the SCT framework (see Figure 6). The model includes three key constructs: personal determinants, environmental determinants, and parenting practices. Each construct includes several main concepts, which will be further explained in detail in 2.2.2.1 to 2.2.2.3. Personal determinants include parenting beliefs in Structure and Attunement, maternal self-efficacy, parenting stress, and maternal demographic information (e.g. mothers’ age and education level). Environmental determinants include perceived infant difficulty by mothers, and infant’s physical characteristics (e.g. gender, birth weight and current weight/length). Parenting practices focus on three infant care-taking domains: putting the baby to sleep, feeding the baby and soothing the baby from crying. The arrows in the model represent our hypotheses about the relations between different concepts, which will also be explained in detail later.

2.2.2.1 Parenting practices:

Research in the context of infant care-taking mainly focuses on parenting practices in a specific domain, such as feeding the baby, putting the baby to sleep, or soothing baby from crying (Thompson et al., 2009; Hughes et al., 2012; Hughes, Power, Orlet, Fisher, Mueller, & Nicklas, 2005; Sadeh, 2004; Morrell & Cortina-Borja, 2002). For example, the Infant Feeding Style Questionnaire (IFSQ; Thompson et al., 2009) and the Caregiver’s Feeding Style Questionnaire (CFSQ) measure parenting beliefs and behaviours related to infant feeding and the questionnaires are usually used to identify specific strategies for feeding. The Brief Infant Sleep Questionnaire (Sadeh, 2004) and the Parental Interactive Bedtime Behaviour Scale (Morrell & Cortina-Borja, 2002) are parents’ self-reported questionnaires which were used to examine the relations between parenting practices and the outcome of infant development, such as bedtime routines and infant sleeping problems.
In the current study, we would like to investigate the determinants of parenting practices across different domains, because it will give us more integrated information in the context of infant care-taking, which may become valuable insights in what kind of in-app personalization services should be provided through uGrow.

a. Sleeping practice
It reflects mothers’ strategies and behaviours in the context of infant sleeping, such as bed arrangement (e.g. bed-sharing, sleep in a crib in a separate room, or sleep in a separate room), time to put the baby to sleep, soothing strategies when the baby wakes up at night (e.g. feed back to sleep, pat or rock back to sleep), etc.

b. Feeding practice
It focuses on mothers’ behaviours in infant feeding, such as the usage of breast milk or formula milk, how frequent and how much the mother feeds the baby, if mothers are following a schedule or the baby’s cues to initiate feeding, etc.

c. Soothing crying practice
It focuses on mothers’ strategies and behaviours to soothe the baby when it cries. It includes how long it takes for a mother to soothe the crying baby, to what extent she intentionally delays responding to a crying baby and what the mother does when she cannot stop the baby from crying, etc.

There are natural overlaps between sleeping and soothing, and between feeding and soothing. For example, when babies wake up at night, it is often that they will also cry. Similarly, babies will cry to indicate that they are hungry and ask to be fed. The three categories of parenting practices that we apply here does not aim to make strict distinctions but mainly aim to help us to make clear reference in the research model.

2.2.2.1 Personal determinants:

a. Parenting beliefs in Structure and Attunement
Based on the parenting belief-behaviour approach, parenting beliefs influence parenting behaviours. This was supported by Winstanley and Gattis's (2013) study, where they found that maternal beliefs in Structure and Attunement relate to parenting practices in three domains: dealing with infant sleep, feeding, and soothing infant crying. Structure refers to the extent to which mothers endorse control in infant care, such as setting sleeping and eating schedules. Attunement refers to two aspects: responsiveness — to what extent a mother values and relies on children’s cues to endorse parenting practices (Hughes et al., 2012; Tikotzky & Sadeh, 2009), and warmth — to what extent a mother endorses close physical contact. Winstanley and Gattis's (2013) study showed that Structure and Attunement were negatively correlated. Moreover, higher level of Attunement was correlated...
with more intimate parenting practices such as more nights of bed-sharing, higher chance to adopt breastfeeding, and longer duration of holding the baby.

Therefore, our Hypothesis 1 to 3 concerns relationships between parent beliefs in Attunement and Structure, and the relation between these two concepts and parenting practices.

**H1:** Parent beliefs in Attunement is negatively correlated to Structure.

**H2:** Mothers who have higher level of Attunement perform more intimate and responsive parenting practices (e.g. bed-sharing, feeding one cues, frequent physical contact).

**H3:** Mothers who have higher level of Structure perform more routine-based parenting practices (e.g. feeding on schedule, put the baby to sleep on schedule).

To measure Structure and Attunement, we adopted relevant questions from Infancy Parenting Styles Questionnaire (IPSQ) (Arnott & Brown, 2013) and the Baby Care Questionnaire (BCQ) (Winstanley & Grattis, 2013). IPSQ is a 36-item questionnaire which aims to measure parenting behaviour and attitude during infancy. The questionnaire has five subsets: Discipline, Routine, Anxiety, Nurturance and Involvement. BCQ is a 30-items questionnaire which aims to measure parenting beliefs in parenting practices. The questionnaire has two subsets: Attunement and Structure. We used BCQ as our main reference and chose questions which had the highest factor loading on Structure and Attunement. Then we combined them with the questions which had the highest factor loadings on Routine and Nurturance in IPSQ. The number of final questions is 15.

**b. Maternal self-efficacy**

As explained before, Bandura’s (1989) self-efficacy theory emphasized on whether a person believes his ability to perform a specific behaviour. In the case of parenting, maternal self-efficacy refers to beliefs about one’s ability to be successful as parents (Hess et al. 2004).

Coleman and Karraker (2000) identified four types of self-efficacy: task-specific, domain-specific, domain-general and general self-efficacy. Task-specific self-efficacy measures one’s self-efficacy of a specific task, such as a mother’s ability to feed the baby. Domain-specific self-efficacy refers one’s self-efficacy of a particular domain of functioning. In the case of infant care-taking, it measures a mother’s efficacy of parenting practices as a whole. Domain-general self-efficacy also focuses on a particular domain but it does not specify the tasks or activities. General self-efficacy refers to one’s efficacy beliefs across different domains. However, general or domain-general measurement were once suggested to be avoided because they suffer from a ‘questionable relevance to the domain of functioning being explored’ (Bandura, 1997). Bandura (1997) then strongly recommended that the measurement of self-efficacy should be domain-specific.
As we discussed before, maternal self-efficacy would influence mothers motivation to perform a specific action. We can then infer that higher maternal self-efficacy would be more likely to predict a matching pattern between parenting beliefs and parenting practices.

Hypothesis 4 describes the moderation effect of maternal self-efficacy on the relations between Attunement/Structure and parenting practices.

**H4:** Maternal self-efficacy moderates the strength of the relation between Attunement/Structure and parenting practices.

To measure maternal self-efficacy, we adopted the Maternal Self-efficacy Scale (Teti & Gelfand, 1991). It is a domain-specific measurement of maternal self-efficacy (Barnes & Adamson-Macedo, 2007). The questions focused on how competent the mother felt when she performed daily tasks during the day, such as calming the baby down, giving the baby a bath, etc.

Another role that maternal self-efficacy plays is the mediator between perceived infant difficulty and parenting practices, which will be discussed later in 2.2.2.3.

c. Parenting Stress
Parenting stress may arise from many sources, including child, parent, and environmental characteristics (Abidin, 1990; Mash & Johnston, 1990). It has been seen as a factor influencing parenting behaviours (Abidin, 1992; Belsky, 1984; Rodgers, 1993) and it is also related to self-efficacy. Gandy (2014) claims that compared to those with high self-efficacy, people with lower self-efficacy are more susceptible to stress and depression, and they also need more time recovering from failures. Furthermore, based on the Environment - Person relation described in the Social Cognitive Theory, people’s reaction elicited from the environment can also alter people’s bias of the perception of the environment (Bandura, 1989). Thus, a stressed mother will be more likely to perceive her baby to be difficult.

Our Hypotheses 5 and 6 describes the relation between self-efficacy and parenting stress, and between parenting stress and perceived infant difficulty.

**H5:** Maternal self-efficacy negatively influences parenting stress.

**H6:** Parenting stress positively influences the perception of infant difficulty.

To measure parenting stress, we adopted the subset “Parenting Distress” from the Parenting Stress Index- short form (PSI-SF) (Abidin, 1995). The original questionnaire was used to measure parenting stress resulting from different aspects of the parent’s life: parental distress, parent-child dysfunctional interaction, and difficult child. The Parental Distress subscale mainly focuses on a parent’s perception of his or her social environment such as marital quality and social support, as
well as the restriction placed in his or her life because of the parenting role. The Parent–Child Dysfunctional Interaction subscale measures a parent’s stress when the baby can not meet his or her expectations in terms of parent-child interactions. The Difficult Child subscale measures a parent’s perception of the infant's difficulty in temperament, such as fussiness and demands.

The subset “Parenting Distress” was chosen because we would like to minimise the overlap between the measure of Parenting Stress and Perceived Infant Difficulty (which will be discussed in 2.2.2.3).

d. Mothers’ demographic profile

Research shows that mother’s age is positively associated with parenting stress (Östberg & Hagekull, 2000) and the use of routine, whereas a negative correlation was found between mother’s age and warmth (Arnott & Brown, 2013). Similar results were found on mother’s education level: it was found positively correlated with the use of routine and negatively correlated with warmth (Arnott & Brown, 2013).

Based on the findings discussed above, our hypotheses 7 to 9 are as following:

H7: Mother’s age positively correlates with and parenting stress.

H8: Mother’s age positively correlates with Structure, but negatively correlates with Attunement.

H9: Mother’s education level positively correlates with Structure, but negatively correlates with Attunement.

2.2.2.3 Environmental determinants:

a. Infants’ biological profiles

In the context of infant care taking, the function of infants is twofold: first, infants are the receiver of mothers’ parenting practices. Therefore, mother may alter or enhance their behaviours depending on the behaviour outcomes of the baby. On the other hand, infants are also the environment where mothers’ behaviours perform, and the infants may alter mothers’ parenting beliefs by possessing a specific characteristic. For example, research has found that parenting differs depending on infants’ biological profiles. Parenting beliefs and behaviours are found to be different based on the status and growth in infants’ weight: mothers with preterm infants are more active and directive (Goldberg & DiVitto, 2005); babies with higher birth weight are more likely to be scheduled to a routine and experience longer time crying before being soothed (Arnott & Brown, 2013). Moreover, when babies are perceived to gain weight quickly, parents feel less anxious and are more likely to apply a feeding routine (Sachs, Dykes, & Carter, 2006; Brown, Raynor, & Lee, 2011). Furthermore, infants’ age also make differences in parenting. Mothers with older infants have stronger beliefs of the need for a routine and they are less likely to adopt a nurturing way to the baby (Arnott & Brown, 2013).
Our hypotheses 10 and 11 focus on the effect of infant’s biological profile on parenting beliefs.

**H10:** Baby’s birth weight, and the ratio between baby’s current weight and length (which can be seen as a perception of a heavy baby) are positively associated with Structure but negatively associates with Attunement.

**H11:** Compared to mothers with younger babies, mothers with older babies have higher level of Structure but lower level of Attunement.

b. Perceived infant difficulty
Perceived infant difficulty indirectly affects parenting behaviours through its influence on maternal self-efficacy. Goldberg (1977) has hypothesised that maternal feelings of competence of her role as a mother are easier to foster when the baby has an easy temperament. Research has found that maternal self-efficacy is negatively associated with perceived infant difficulty (Teti & Gelfand’s, 1991).

Our last hypothesis 12 focuses on the relation between perceived infant difficulty and maternal self-efficacy.

**H12:** Perceived infant difficulty negatively influences maternal self-efficacy.

To measure perceived infant difficulty, we adopted the “Fussiness” subset of the Infant Characteristics Questionnaire (Kohnstamm, 1984). This subgroup mainly focused on how often the baby became fussy, how well the baby could play by him/herself, how fussy the baby presented to the mother, etc.
Chapter 3. Methods

3.1 Participants
Data was collected from UK and the Netherlands. In UK, an online questionnaire which was posted on a mother and childcare website. In the Netherlands, flyers with the link of the online questionnaire were handed out to parents who visit the consultatiebureau, where babies can be checked by the doctors regularly. However, the number of Dutch responses was not sufficient for further analysis (only 21), so we only used the data from UK for analysis.

For every 10 participants, one was randomly selected for a 10 euro (about 7 pounds) gift. 210 participants completed the questionnaire. Participants were included if they were mothers with an infant(s) who is less than 1 year old. If they had more children, participants were asked to answer the questionnaire based only on the infant(s) who fits this condition.

3.2 Procedure and questionnaire design
Completing the questionnaire took about 15 minutes. First, participants received a short introduction about the study and they gave their consent for the participation by clicking the “I agree” button. Next, participants had to fill in a questionnaire which was designed specifically for the current study: The content of the questionnaire is shown below. A complete version of the questionnaire can be found in Appendix A.

- Demographics: Participants were asked about their age, their education level, if there were a first-time mother, their baby’s age, gender, birth weight, current weight and current length.

- Parenting beliefs in Structure and Attunement: There were 15 questions, which aimed at measuring parenting beliefs in Structure and Attunement. Questions were selected from Infancy Parenting Styles Questionnaire (IPSQ) (Arnott & Brown, 2013) and the Baby Care Questionnaire (BCQ) (Winstanley & Grattis, 2013). 15 questions were arranged in a random order to prevent participants from distinguishing the two concepts. All items were measured in a 4-point Likert scale (Strongly disagree, Disagree, Agree, Strongly Agree) as they were originally measured in IPSQ and BCQ.

- Maternal self-efficacy: 10 questions were asked in this section, which were from the Maternal Self-efficacy Scale (Teti & Gelfand, 1991). All items were measured in a 4-point Likert scale (Not good at all, Not good, Good enough, Very good) as the original one.

- Parenting stress: 12 questions were included in this section, which were extracted from the subset “Parenting Distress” of the Parenting Stress Index- short form (PSI-SF) (Abidin,
1995). All items were measured in a 5-point Likert scale (Strongly Disagree, Disagree, Neither disagree nor agree, Agree, Strongly Agree) as the original one.

- **Perceived Infant difficulty**: 5 questions were included, which were from the “Fussiness” subset of the Infant Characteristics Questionnaire (Kohnstamm, 1984). All questions were measured in a 7-point Likert scale (from the most optimal choice to the most negative one) as the original one.

- **Parenting practices**: 27 questions related to parenting practices were designed by the author and were mainly based on the functionality of uGrow. Participants were asked to answer those questions based on actual behaviour in the week before filling in the questionnaire. The questions focused on three context: feeding, sleeping and soothing a baby from crying.

Example questions in feeding context are: “Do you use direct breast feeding? (Yes/No)” and “When deciding how often to feed your baby, do you? (5-Likert Scale: 1 “Follow a schedule”; 5 “Feed on demands”)”. Example questions in sleeping context are: “What do you usually do to make your baby fall asleep? (5 options such as “feed to sleep”, “rock to sleep”, etc)” and “How long does it usually take for you to put your baby to sleep at night? (5 ordinal scale: 1 “10 or less than 10 minutes”; 5 “more than 40 minutes”; increased by half an hour)”. Examples questions in soothing context are “How often do you intentionally delay responding to your baby when he/she cries? (5-Likert Scale: 1 “Never”; 5 “Always”)” and “How often does it happen when your baby cannot stop crying no matter what you do? (5-Likert Scale: 1 “Never”; 5 “Always”)."
Chapter 4. Results

We received a sample of 210 people. Prior to data analyses, demographic, ordinal and nominal data were re-coded, and variables were examined for the presence of missing data and outliers. There were all together 17 missing data and outliers appeared in babies’ birth weight, babies’s current weight, babies’ current length. In order to make efficient use of the data, the 17 participants were included in Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), where we only examine the factor construct of the questions related to parenting beliefs in Structure and Attunement, parenting stress, maternal self-efficacy, and perceived infant difficulty. When we included demographic data as independent variables in the path analysis, those 17 participants were excluded.

Participants’ answers in parenting beliefs in Structure and Attunement were checked against the reversed items in the questionnaire. For example, participants were asked if they (strongly) agreed or (strongly) disagreed that “routine leads to more crying” and “routine makes the baby calm and secure”. 8 participants were eliminated from the whole analysis because they gave contradictory answers in more than two pairs of this kind of questions.

Therefore, we used the sample size of 202 (210-8=202) in EFA and CFA. And we use the sample size of 185 (202-17=185) in the final path analysis.

4.1 Descriptive Analysis

The mothers’ age ranged from 19 to 43 (mean=30.38, S.D.= 4.76). 140 of them were first time mothers (69.3%), and 128 of them obtained a Bachelor or lower degree (63.3%)\textsuperscript{1}. The babies’ age ranged from 2 to 11 months (mean=6.11, S.D. = 2.37), where 107 babies were no older than 6 months (53%). 98 babies were boys (48.5%). Babies’ birth weight (5 data missing) ranged from 1656 to 5005 grams (mean=3391.52, S.D. = 489.98). Babies’ current weight (4 data missing) ranged from 4173 to 11600 grams (mean=7571.39, S.D. = 1569.32) and the current length (13 data missing) ranged from 45 to 90 centimetres (mean= 67.05, S.D. = 7.2). Moreover, in order to measure if the baby was perceived to be heavier than average, the ratio between the current weight and length was calculated and it ranged (13 data missing) ranged from 64.29 to 171.11 (mean=112.23, S.D.=18.87).

When exploring parenting practice data, we discovered that mothers behaved quite differently depending on the baby’s age. For example, among younger babies (sample size 107, 2-6 months), 66 of them (61.7%) were completely fed on demand and only 6 of them (5.6%) were fed completely.

\textsuperscript{1} Out of 202 mothers, only 56 (27.75%) obtained a degree which is lower than Bachelor. 72 (35.64%) of them obtained a Bachelor degree and the others (36.63%) obtained a degree which is higher than Bachelor. In order to separate the data in an appropriate way, the threshold was set to “obtained a Bachelor or lower degree”.

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by a schedule. However, among older babies (sample size 97, 7-11 months), these two numbers were 24 (25.3%) and 18 (18.9%) respectively. Therefore, we believe that it is necessary to construct a multi group path analysis.

4.2 Path Analysis

4.2.1 Exploratory Factor Analysis (EFA)

In our questionnaire, 42 questions were intended to measure 5 aspects of mothers’ cognition and perception in the context of infant care taking: parenting beliefs in Structure and Attunement, Parenting Stress, Perceived Infant Difficulty, Maternal Self-Efficacy. For clearer reference in the rest part of the report, those 5 concepts will be called “Five Cognitive Factors”.

Because we combined different questionnaires from different literature into one, it is important to examine the factor structure of the current questionnaire. An EFA was performed in SPSS. A Principle Axis Factoring (PAF) with promax (default: kappa=4) rotation was conducted on 42 items used to measure the Five Cognitive Factors. This initial analysis was run to obtain eigenvalues for each component in the data. 10 components had eigenvalues of 1 or higher and they explained 64% of the variance. However, using this standard to extract copenents is often criticised for retaining too many factors (Hayton, Allen, & Scarpello, 2004; O’Connor, 2000), so we used Horn’s (1965) parallel analysis (PA) and Cattell’s (1966) scree method to determine the number of components. Parallel analysis is a way to determine the number of components in factor analysis. The analysis creates a random dataset with the same number of observations as the original dataset. A component is considered to be valid when its eigenvalue is larger than the eigenvalue of the random data. Researchers also suggested to use the eigenvalue that corresponds to the 95th percentile of the distribution of eigenvalues derived from the random data (Cota, Longman, Holden, Fekken, & Xinaris, 1993; Glorfeld, 1995).

Figure 7 shows the plot of component number by eigenvalue for the real data and for random data with the same sample size. This plot shows that 5 components have the eigenvalue larger than the eigenvalue of the random data. Therefore, 5 components should be extracted. The EFA was re-run specifying a 5-factor solution. In total, 5 factors explained 52.9% of the variance.

Based on this 5-factor solution, 18 items were dropped due to low loadings, high complexity and intercorrelations between items. Therefore, 6 items were remained to measure Parenting Stress, 5 items in Structure, 4 items in Attunement, 4 items in Difficult Baby, and 5 items in Self-Efficacy (in total 24 items). The model showed that KMO = .795, and Bartlett’s test of sphericity tests was $\chi^2(276) = 2080.409$ ($p < .001$), indicating that correlations were sufficiently large for EFA. Table 1 shows the factor loadings after rotation. Each factor showed adequate internal consistency in terms of Cohens Kappa: Structure ($\alpha=0.855$), Attunement ($\alpha=0.791$), Self-efficacy ($\alpha=0.764$), Perceived Infant Difficulty ($\alpha=0.853$), and Parenting Stress ($\alpha=0.858$).
Figure 7. The scree shot of the plot of component number by eigenvalue for the real data and for random data with the same sample size. A 95th percentile of the distribution of eigenvalues derived from the random data was used.

Table 1. Factor loadings on remaining 24 items in Five Cognitive Factors. Asterisks in factor Structure and Attunement indicate that the answers in those items were reverse coded.

<table>
<thead>
<tr>
<th>Structure (α=0.855)</th>
<th>Attunement (α=0.791)</th>
<th>Self-efficacy (α=0.764)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babies need a routine.</td>
<td>Responding quickly to a crying baby leads to less crying in the long run.</td>
<td>Babies benefit from physical contact with parent(s) when they wake up during the night.</td>
</tr>
<tr>
<td>Everyone is happiest when the baby is in a routine.</td>
<td>Parent(s) should delay responding to a crying baby.*</td>
<td></td>
</tr>
<tr>
<td>Sleeping schedules make babies unhappy. *</td>
<td>When babies cry in the night to check if someone is near, it is best to leave them. *</td>
<td></td>
</tr>
<tr>
<td>A routine makes a baby calm and secure.</td>
<td>Babies need a routine.</td>
<td></td>
</tr>
<tr>
<td>Routines lead to more crying.*</td>
<td>Everyone is happiest when the baby is in a routine.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Routines lead to more crying.*</td>
<td></td>
</tr>
</tbody>
</table>
In the previous descriptive analysis, differences were observed in parenting practices between mothers of either older or younger babies. Thus we would like to investigate if mothers’ score on the Five Cognitive Factors also depended on the baby’s age group. In order to do this, the factor scores that resulted from the previous factor analysis were saved as new variables in SPSS, and a new grouping variable “Older Baby” was created, where 0 referred to “2-6 months”, and 1 referred to “7-11 months”. Five T-tests were run to compare the means of the factor scores of the Five Cognitive Factors. No significant differences were found, indicating that mothers did not differ in the Five Cognitive Factors based on the baby’s age group.

**4.2.2 Confirmatory Factor Analysis (CFA)**
Next, a CFA was conducted in Mplus in order to check if the 5-factor solution still existed if factor indicators were treated as ordinal data instead of linear data (which was treated as such in SPSS). The five factors extracted from the same question items resulted from SPSS showed adequate model fit in Mplus. We used ordinal factor indicators with weighted least squares with mean and variance adjustment (WLSMV) estimator. The model demonstrated decent fit, where $\chi^2(242) = 365.396 \ (p < .001)$, CFI=0.968, TLI=0.964 and RMSEA=0.050, with a 90 percent C.I. between 0.039 to 0.060. A model is thought to show good fit if the $\chi^2$ test is not significant ($p > .05$), the CFI and TLI are .90 or above (Bentler, 1990; Marsh, Balla, & Hau, 1996) and the RMSEA is .06 or smaller (Hu & Bentler, 1999). Because research shows that $\chi^2$ is not a robust indicator and it is sensitive to small samples and the size of the correlations in the model (Cheung & Rensvold, 2002; Miles & Shevlin, 2007), we think the resulting model was adequate based the results of other model fit indicators.

In order to test our hypotheses ($H_1$, $H_5$, $H_6$ and $H_{12}$) about the correlations and influencing effects among the Five Cognitive Factors, an initial SEM model based on our hypotheses was conducted, where Attunement was negatively correlated to Structure; Self-Efficacy was determined by Perceived Infant Difficulty; Parenting Stress was determined by Self-efficacy; and Perceived Infant Difficulty was determined by Parenting Stress. The model demonstrated a good fit, where $\chi^2(248) = 330.588 \ (p = .0003)$, CFI=0.979, TLI=0.976 and RMSEA=0.041, with a 90 percent C.I. between 0.028 to 0.052.

Figure 8 shows the result of the initial SEM with the Five Cognitive Factors. According to $H_1$ we expected a negative correlation between Attunement and Structure, and this hypothesis was supported ($\beta = -0.439, \ p = 0.000$). According to $H_5$, $H_6$ and $H_{12}$, we expected a circular effects of Self-efficacy on Parenting Stress, of Parenting Stress on Perceived Infant Difficulty, and of Perceived Infant Difficulty on Self-efficacy. These three hypotheses were also supported: Self-efficacy negatively influenced Parenting Stress ($\beta = -0.287, \ p = 0.002$), indicating that the decrease in self-efficacy would induce a higher level of parenting stress; Parenting Stress positively
influenced Perceived Infant Difficulty (β = 0.371, p = 0.000), indicating that a stressed mother would perceive her baby as more difficult; Perceived Infant Difficulty negatively influenced Self-efficacy (β = -0.178, p = 0.048), indicating maternal self-efficacy would reduce because of a difficult baby.

Next, we would like to know the relations between the Five Cognitive Factors and parenting practices, and also to examine the role of demographic information plays in this model. Because we hypothesised that Self-efficacy would moderate the relations between Attunement/Structure and parenting practices (H4), and there was a circular relation between Self-efficacy, Parenting Stress and Perceived Infant Difficulty (H5, H6, and H11). We expected that Parenting Stress and Perceived Infant Difficulty might also moderate the relations between Attunement/Structure and parenting practices. Therefore, we would like to include six interaction effects (Structure x Parenting Stress, Structure x Self-efficacy, Structure x Perceived Infant Difficulty, Attunement x Parenting Stress, Attunement x Self-efficacy, Attunement x Perceived Infant Difficulty) in the SEM model for the next step.

However, in order to test the interaction effect, a different estimator “maximum likelihood” (ML) must be used in Mplus. But when the factor indicators were categorical, the computing resources required for this estimator increased to the point that Mplus could not run successfully. Therefore, we had to save the factor scores and conducted a path analysis for the next step instead of an SEM analysis. Moreover, by including the demographic data as independent variables in the path model, cases with missing data appeared (e.g. in birth weight, current weight, current length, and current weight/length), resulting in a reduced sample size of 185.

### 4.2.3 Path analysis

#### 4.2.3.1 Parenting practice data

Before conducting the path analysis, parenting practices questions were pre-selected and their answers were recoded. In this model, we only focused on the self-reported practices that can be objectively measured through uGrow, and practices where maternal beliefs were involved (i.e. to what extent that the mother believes she followed a schedule for feeding and sleeping). In addition, some nominal parenting practices answers were re-coded into binary answers in order to be handled in Mplus without facing the issue of free parameters outnumbering the sample size. In our model, all parenting practices were treated as ordinal/binary data.

In addition, based on the descriptive analysis we discussed previously, we expected differences in parenting practices depending on the baby’s age group, so a multi group path analysis using the baby’s age group as the grouping variable was performed. Thus some categories in some parenting practices answers were collapsed to keep equal categories across two groups in the multi group
model. Both single group and multi group path analysis were run and the models were compared in section 4.2.3.3. The 12 parenting practices in the final model are shown in Table 2

Table 2. Parenting practices in the final path analysis  
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Answer coding in the path model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast Feeding</td>
<td>If a mother used direct breast feeding</td>
<td>Binary: 0 No; 1 Yes</td>
</tr>
<tr>
<td>Feeding Schedule</td>
<td>To what extent a mother followed a schedule to initiate feeding</td>
<td>Ordinal 5-Likert scale: 1 “completely feed on schedule”; 5 “completely feed on cues”</td>
</tr>
<tr>
<td>Sleeping Schedule</td>
<td>To what extent a mother followed a schedule to put the baby to sleep</td>
<td>Ordinal 5-Likert scale: 1 “completely follow a schedule”; 5 “completely follow the baby’s cues”</td>
</tr>
<tr>
<td>Feeding Time Interval</td>
<td>The time period between two feeds on average</td>
<td>Ordinal 6 categories: it ranged from “less than 1.5 hours or 1.5” to “more than 3.5 hours”, increased by half an hour</td>
</tr>
<tr>
<td>Feeding When Cry</td>
<td>How often a mother fed her baby immediately when she heard the baby crying</td>
<td>Ordinal 5-Likert scale: 1 “Never”; 5 “Always”</td>
</tr>
<tr>
<td>Sleep Time</td>
<td>The time a mother put her baby to sleep</td>
<td>Ordinal 7 categories: it ranged from “7 pm or before” to “after 9:30 pm”, increased by half an hour</td>
</tr>
<tr>
<td>Duration before Sleep</td>
<td>How long it took for a mother to make her baby fall asleep at night</td>
<td>Ordinal 5 categories: it ranged from “10 or less than 10 minutes” to “more than 40 minutes”, increased by 10 minutes</td>
</tr>
<tr>
<td>Feed to Sleep*</td>
<td>If a mother fed her baby to sleep</td>
<td>Binary: 0 No; 1 Yes</td>
</tr>
<tr>
<td>Same Room Sleep*</td>
<td>Whether the baby was put to sleep in a crib in the same room with the parent(s) or in a different room.</td>
<td>Binary: 0 different room; 1 same room</td>
</tr>
<tr>
<td>Feed when Wake Up*</td>
<td>If a mother fed the baby back to sleep when she/he woke up at night</td>
<td>Binary: 0 No; 1 Yes</td>
</tr>
<tr>
<td>Delay Responding to Crying*</td>
<td>How often a mother intentionally delayed her respond to her crying baby</td>
<td>Ordinal 4-Likert scale: 1 “Never”; 4 “Most of the time” or “Always”</td>
</tr>
</tbody>
</table>

*Feed to Sleep: Originally from “Sleeping Strategy”, which focused on the strategy a mother used in order to put her baby to sleep. 44.9% of mothers chose “feed to sleep”.

*Same Room Sleep: Originally from “Sleeping Arrangement”, which focused on where a mother put her baby to sleep. 28.2% of mothers chose “crib in a different room”, and 42.1% of mothers chose “crib in the same room”. Other answers were coded as missing data (29.7%).

*Feed when Wake Up: Originally from “Sleeping Strategy”, which focused on the strategy a mother used when the baby woke up at night. 49.0% of mothers chose “feed back to sleep”.

*Delay Responding to Crying: Originally, a ordinal 5-Likert scale was used (1 Never; 5 Always). In the path model, scale 4 and 5 were collapsed.

*Non-stop Crying Frequency: Originally, a ordinal 5-Likert scale was used (1 Never; 5 Always). No one chose option 5. In the path model, scale 3 and 4 were collapsed.
4.2.3.2 Probit Regression
Both single group and multi group path models were run using a maximum likelihood estimator with a probit link function. Depending on if the dependent variable is categorical, the path model with a probit link function can give the coefficients of two types of regression analysis: linear regression coefficients are obtained if the dependent variable is continuous (in our case, the Five Cognitive Factors), and probit regression coefficients are obtained if the dependent variable is categorical (in our case, the parenting practices). It is suggested that a probit regression should be used instead of a logit regression when the independent variables are ordinal data with more than two categories (Rajulton, 2011). The difference between the logit and probit regression is the link function, which is used to transform the original categorical/binary dependent variable into another variable that can be used in linear regression. Probit regression uses the inversed Cumulative Normal Distribution (CND) Function as the link function. A probit regression is an S-shaped function, which describes the probability of the dependent event to happen (always being referred to ‘success’) on specific values of the predictor.

The interpretation of the coefficients of the probit regression is not as straight-forward as interpreting the coefficients in the linear regression, so here we would like to explain more about the interpretation. In a probit model where x is used to as the predictor and y (binary) is used as the dependent variable (0: fail, 1: success), the model aims to describe the possibility of ‘success’ in relation to the predictor x. Because the link function is an inversed CND Function, the unstandardized coefficient $\beta$ of the predictor x describes how much the z-score will increase/decrease if there is one unit increase in x.
A one unit increase in $x$ has a constant effect of the $z$-score. However, it does not mean that the one unit increase in $x$ has a constant effect of the probability of ‘success’ (see Figure 9). Because the probit function is an S-shaped function, the one unit increase $x$ has a bigger impact of the probability of ‘success’ when it happens in the middle (i.e. increase the $z$-score from 0 to 1) than at the edge (i.e. increase the $z$-score from 2 to 3) of the S-shape. Thus, with one unit increase in $x$, the magnitude of the change of the probability of ‘success’ depends on the starting point of $x$. Because of the not straight-forward interpretation, it is suggested to focus on the signs rather than the magnitudes of the coefficients (Katchova, 2013), because the signs can give us the information if “success” is more (the sign is positive) or less (the sign is negative) likely to happen when $x$ increases.

### 4.2.3.3 Single group VS. Multi group path analysis model

The initial single group path model was constructed in three parts, the independent and dependent variables used in the first and third parts are shown in Table 3:

a) First: For each of the Five Cognitive Factors being used as the dependent variable, we included all demographic information, and Older Baby as independent variables.

b) Second: The circular relations between Self-efficacy, Perceived Infant Difficulty, and Parenting Stress, which were tested previously, were included.

c) Third: For each parenting practice being used as the dependent variable, we included all Five Cognitive Factors, all demographic information, Older Baby and all five interaction effects between Older Baby and the Five Cognitive Factors, and six interaction effects between Structure/Attunement and other three cognitive factors as independent variables.

The independent variable Older Baby was used and kept as an independent variable in both the first and the third part in order to examine if those dependent variables differed between two age groups. When using parenting practices as dependent variables in the third part, the interaction effects between Older Baby and the Five Cognitive Factors were also included as independent variables in order to examine if Older Baby moderated the relation between the Five Cognitive Factors and the parenting practice.

| Table 3. The independent and dependent variables in the initial single group path model |
|---------------------------------|------------------------------------------|
| **Part 1**                      | **Independent Variables**                |
| **Dependent Variables**         | **Independent Variables**                |
| Structure (standardized)        | Older Baby (0: 2-6 months; 1: 7-11 months) |
| Attunement (standardized)       | baby’s gender (0: boy; 1: girl)          |
| Perceived Infant Difficulty     | baby’s birth weight (standardized)       |
| (standardized)                  |                                          |
| Parenting Stress (standardized) | baby’s current weight (standardized)      |
To optimize the initial path model, in the first part, we discarded the demographic independent variables which did not significantly explain sufficient variance of the Five Cognitive Factors. In the third part, we first eliminated the parenting practices of which only one option was chosen by almost everybody (e.g. duration of soothing a crying baby) and the practices which caused multicollinearity (e.g. formula feeding). Next, for each parenting practice that was left, we eliminated the independent variables which did not contribute significantly. The resulting final model demonstrated a good fit (Log-likelihood = -3434.364, AIC=7116.728, BIC=7516.052).

In order to test if the multi group model would result in a better fit and give us more information, the multi group path model was constructed based on the optimized single group model above. However, in the multi group model, Older Baby was used as the grouping variable instead of an independent variable. Therefore, the interaction effects between Old Baby and Five Cognitive Factors on parenting practices were not included. Other dependent and independent variables were the same as the ones in the single group model.
We constrained all coefficients across two age groups to be equal, except for the ones that were found to be (almost) significant moderated by “Older Baby” in the single group model. For example, in the previous model, if Older Baby significantly moderates the relation between Structure and parenting behavior W, but has no effect on the relation between Attunement and W, then the coefficients between Attunement and W will be constrained to be equal across groups, while the coefficients between Structure and W will be freely estimated in two groups. Comparing with the single group model, the multi group model resulted in a less optimal model fit (Log-likelihood = -3441.617, AIC=7181.235, BIC=7661.068).

Considering the fact that we already used Older Baby as independent variables for all dependent variables, and we used the interaction between Older Baby and the Five Cognitive Factors as independent variables for parenting practices, the multi group path model did not add much value to our analysis. From the multi group model, we could now see the magnitude of the freely estimated coefficients between the Five Cognitive Factors and parenting practices in two age groups, but we could already tell the moderation effects of Older Baby on the relation between the Five Cognitive Factors and parenting practices from the single group model. Moreover, the single group model resulted in a better model fit. Therefore, the multi group path model did not contribute to our analysis very much so we remained to use single group model. In the next section, the results reported are from the single group path model.

4.2.3.4 Path analysis results

Figure 10 shows the overall single group path model resulted from the previous section. As we can see, the coefficients among the Five Cognitive Factors remained almost the same as Figure 8: Attunement was negatively correlated with Structure (β = -0.402, p = 0.000). The circular relations between Perceived Infant Difficulty, Self-efficacy, and Parenting Stress were also confirmed, where Perceived Infant Difficulty negatively influenced Self-efficacy (β = -0.168, p = 0.005); Self-efficacy negatively influenced Parenting Stress (β = -0.393, p = 0.000); and Parenting Stress positively influenced Perceived Infant Difficulty (β = 0.410, p = 0.000). The results again supported our hypotheses H1, H5, H6 and H12, which were discussed previously.

The path model also gave us information about the relations between demographic information and the Five Cognitive Factors. From our hypotheses, we expected that Structure would positively correlate with mother’s age (H8), mother’s education level (H9), baby’s birth weight and current weight/length (H10), and baby’s age (H11). However, none of our hypotheses mentioned above were supported because we found that Structure was only influenced by baby’s gender (β = -0.301, p = 0.006), and first-time mother (β = 0.238, p = 0.040). It implies that first-time mothers, and mothers who have a male baby have stronger belief in setting a routine in the baby’s daily life. We also expected that Attunement would be negatively related to mother’s age (H8), mother’s education level (H9), baby’s birth weight and current weight/length (H10), and baby’s age (H11).
Again, none of those hypotheses were supported because we did not find any demographic information which significantly contributed to the difference in Attunement. Moreover, we expected that parenting stress would be positively related to mother’s age (H7). In contradiction with H7, we found that Parenting Stress was negatively influenced by mother’s age ($\beta = -0.137, p = 0.035$), indicating that older mothers experience lower level of parenting stress. Moreover, we found that Perceived Infant Difficulty was negatively influenced by the baby’s birth weight ($\beta = -0.124, p = 0.066$), indicating that babies with a low birth weight are more likely to be perceived to be difficult.

Regarding parenting practices, the detailed results will be presented in section 4.2.3.4 (a), (b) and (c). To conclude, 7 out of 12 parenting practices significantly differed between two age groups, indicating that mothers acted differently depending on the age of the baby. Parenting practices were also influenced by demographic profiles, such as baby’s gender, baby’s birth weight, baby’s current weight/length, mother’s age, mother’s degree, and first-time mother.
Furthermore, except for Duration before Sleep and Non-stop Crying Frequency, we found that the other 10 parenting practices were all influenced by Structure and/or Attunement. Participants who had stronger beliefs in Attunement were more likely to perform intimate and responsive behaviours, such as breast feeding, feeding on demand, shorter feeding time interval, feeding the baby to sleep at night, putting the baby in the same room with the parent(s) when sleeping, feeding the baby back to sleep when it woke up at night, and immediate responding to a crying baby. Mothers who had stronger beliefs in Structure were more likely to perform routine-based and disciplined behaviours, such as feeding on schedule, putting the baby to sleep by schedule, less often feeding a crying baby immediately, putting the baby in a different room when sleeping, and earlier sleeping time. The results supported our hypotheses that “mothers who have higher level of Attunement will perform more intimate and responsive parenting practices (H2)” and “mothers who have higher level of Structure will perform more routine-based parenting practices (H3)”, indicating that parenting beliefs in Attunement and Structure are indeed the two main aspects that can influence parenting practices in the context of feeding, sleeping and soothing a crying baby.

According to H4, we expected that maternal self-efficacy would moderate the strength of the relations between Attunement/Structure and parenting practices. This hypothesis was not supported by the results. Instead, we found that the relations between Attunement/Structure and parenting practices were moderated by parenting stress, perceived infant difficulty and baby’s age.

In the rest part of the result section, we will present the detailed results of different parenting practices in the context of feeding, sleeping and soothing a crying baby. All 12 parenting practices were presented previously in Table 2 in 4.2.3.1, together with the description, the coding in the path model and the coding in the original questionnaire.

(a) Feeding Practices

Breast feeding

This parenting practice focused on the adoption of breast feeding. Mothers were asked if they used direct breast feeding for the past week. 1 referred to the adoption of this practice. The results showed that the adoption of breast feeding was influenced by Attunement ($\beta = 0.472$, $p = 0.001$), Perceived Infant Difficulty ($\beta = 0.240$, $p = 0.021$) and the mother’s degree ($\beta = 0.635$, $p = 0.003$), indicating that breast feeding was more likely to happen when the mothers had higher level of Attunement, perceived the baby to be more difficult, and obtained a degree higher than Bachelor. The results are shown in Figure 11 (for each probit regression, other independent variables were set to their means).

No significant result was found of Structure ($\beta = -0.098$, $p = 0.555$) and Older Baby ($\beta = -0.279$, $p = 0.172$) on breast feeding, but the interaction effects of Older Baby x Structure ($\beta = -0.462$, $p = 0.073$) was found. The results indicated that when mothers had higher level of Structure, compared
with those who had younger babies, mothers who had older babies were less likely to adopt breast feeding. The results are shown in Figure 12.

![Figure 11. The probit regression of Attunement, Perceived Infant Difficulty and mother’s degree on the probability of breast feeding. BF=1 refers to the adoption of breast feeding.](image1)

**Feeding Schedule**

Mothers were asked how they decided to initiate feeding on a 5-Likert Scale: 1 referred to “completely feed on schedule” and 5 referred to “completely feed on cues”. We found that Feeding Schedule was influenced by Structure ($\beta = -0.512$, $p = 0.000$), Attunement ($\beta = 0.313$, $p = 0.010$), and Older Baby ($\beta = -0.923$, $p = 0.000$), indicating that mothers were more likely to feed on cues when they had lower level Schedule, higher level of Attunement, and had younger babies. On the contrary, mothers with higher level of Structure, lower level of Attunement and older babies were more likely to feed on schedule.

![Figure 12. The probit regression results of the interaction effect of Older Baby x Structure on the probability of breast feeding. BF=1 refers to the adoption of breast feeding.](image2)

No significant difference was found of Parenting Stress on Feeding Schedule ($\beta = -0.047$, $p = 0.697$), but this relation was moderated by Older Baby ($\beta = 0.391$, $p = 0.032$). The result showed that when mother had higher level of parenting stress, compared with those who had younger babies, mothers who had older babies were more likely to feed on cues (see Figure 13). Because Feeding Schedule was categorical dependent variable, five probit regression functions were
obtained for each of its option. Therefore, for clearer illustration of the interaction effect, only the probit function of option 5 “completely feed on cues” was presented.

No significant difference was found of Perceived Infant Difficulty on Feeding Schedule ($\beta = -0.070$, $p = 0.455$), but the interaction of Attunement x Perceived Infant Difficulty was found ($\beta = -0.175$, $p = 0.066$). The results showed that when mothers had higher level of Attunement, compared with those who perceived their baby to be difficult, mothers who perceived their baby to be easy were likely to feed on cues (see Figure 14, only the probit function of option 5 “completely feed on cues” was presented).

Feeding Time Interval
Feeding Time Interval measured how long the time period was between two feeds. It was ordinal coded ranging from 1 “1.5 or less than 1.5 hours” to 6 “more than 3.5 hours”, increased by half an hour. We found that Feeding Time Interval was influenced by Attunement ($\beta = -0.235$, $p = 0.035$) and mother’s degree ($\beta = -0.346$, $p = 0.031$), and Self-efficacy ($\beta = 0.197$, $p = 0.070$), indicating that mothers with a higher degree than Bachelor, higher level of Attunement, and lower level of self-efficacy were more likely to have shorter time interval between two feeds.
No difference in Feeding Time Interval was found between two age groups ($\beta = 0.071, p = 0.654$). Parenting Stress had no significant influence on Feeding Time Interval ($\beta = -0.088, p = 0.319$), neither did Structure ($\beta = 0.100 p = 0.300$). But we found the interaction effects of Structure x Parenting Stress ($\beta = -0.238, p = 0.042$) and Attunement x Parenting Stress ($\beta = -0.190, p = 0.078$). The results showed that when mothers had higher level of Structure, compared with those with low level of parenting stress, mother with high level of parenting stress were more likely to have longer time interval between two feeds (see Figure 15, only the probit function of option 6 “more than 3.5 hours” was presented). When mothers had are at high level of Parenting Stress, those who have higher level of Attunement are less likely to have a longer feeding time interval (see Figure 16, only the probit function of option 6 “more than 3.5 hours” was presented).

**(b) Sleeping Practices**

**Sleeping Schedule**

Mothers were asked how they decided to put the baby to sleep at night on a 5-Likert Scale: 1 referred to “completely follow on schedule” and 5 referred to “completely follow the baby’s cues”. We found significant influence of Structure ($\beta = -0.812, p = 0.000$) and Older Baby ($\beta = -0.638, p = 0.000$) on Sleeping Schedule, indicating that mothers who had higher level of Structure, and had older babies were more likely to follow a schedule to put the baby to sleep. On the contrary,
mothers who had lower level of Structure and had younger babies were more likely to follow the baby’s cues to put the baby to sleep.

No significant difference was found of Parenting Stress on Sleeping Schedule ($\beta = -0.120, p = 0.263$), but this relationship was moderated by Older Baby ($\beta = 0.332, p = 0.055$). The results indicated that when mother had higher level of parenting stress, compared with those who had younger babies, mothers who had older babies were more likely to follow the baby’s cues to put him/her to sleep (see Figure 17, only the probit function of option 5 “completely follow the baby’s cues” was presented).

Feed to Sleep
Feed to Sleep was a binary answer originally from Sleeping Strategy, which focused on what strategy a mother used in order to put her baby to sleep. 1 referred to the adoption of this strategy. We found that Feed to Sleep was influenced by Attunement ($\beta = 0.211, p = 0.066$), baby’s gender ($\beta = 0.339, p = 0.091$), mother’s degree ($\beta = 0.609, p = 0.002$), and baby’s current weight/length ($\beta = 0.233, p = 0.045$). Feed to Sleep did not differ between two age groups ($\beta = -0.241, p = 0.281$). The results showed that mothers who had heavier babies, female babies, and had higher level of Attunement and a higher degree than Bachelor, were more likely to feed the baby to sleep at night.

Same Room Sleep
Same Room Sleep was a binary answer originally from Sleep Arrangement, which focused on where a mother put her baby to sleep. 0 referred to “the baby sleeps in the crib in a different room” and 1 referred to “the baby sleeps in the crib in the same room with parents”. Same Room Sleep was found to be influenced by Structure ($\beta = -0.401, p = 0.036$), Attunement ($\beta = 0.342, p = 0.083$), and Old Baby ($\beta = -1.432, p = 0.000$), indicating that putting the baby in the crib in the same room with the parent(s) was more likely to happen when mothers had higher level of Attunement, lower level of Structure and had younger babies.
An interaction effect of Attunement x Parenting Stress was found to be significant (β = 0.479, p = 0.012), while Parenting Stress did not significantly influence Same Room Sleep (β = 0.260, p = 0.116). The results indicated that when mothers had higher level of parenting stress, compared with those who had low level of Attunement, mothers who had high level of Attunement were more likely to put the baby in the crib in the same room with the parent(s) to go to sleep (see Figure 18).

**Feed when Wake Up**

Feed when Wake Up was a binary answer originally from Wake-Up Strategy, which focused on what strategy a mother used when the baby woke up at night. 1 referred to the adoption of this strategy. We found that Feed when Wake Up was influenced by Attunement (β = 0.484, p = 0.001), Perceived Infant Difficulty (β = 0.236, p = 0.027), Older Baby (β = -0.611, p = 0.003) and mother’s degree (β = 0.715, p = 0.001), indicating that mothers were more likely to feed the baby back to sleep when the baby woke up at night when mothers had higher level of Attunement, perceived the baby to be more difficult, had younger babies, and obtained a higher degree than Bachelor.

An interaction effect of Structure x Perceived Infant Difficulty on Feed when Wake Up was found (β = -0.204, p = 0.092), indicating that when mother had higher level of Structure, compared those who perceived their baby to be easy, mothers who perceived their baby to be difficult were less likely to feed the baby back to sleep when the baby woke up at night (see Figure 19).
Structure did not significantly contribute to the difference of Feed When Wake Up ($\beta = 0.047$, $p = 0.778$), but this relation was moderated by Older Baby ($\beta = -0.676$, $p = 0.009$). The results showed that when mothers had higher level of Structure, compared with those who had younger babies, mothers who had older babies were less likely to feed the baby back to sleep when the baby woke up at night (see Figure 20).

**Bed Time**

Bed Time measured what time a mother put her baby to sleep. It ranged from 1 “7 pm or before” to 7 “after 9:30 pm”, increased by half an hour. We found that Sleeping Time was influenced by Structure ($\beta = -0.324$, $p = 0.000$) and Older Baby ($\beta = -0.593$, $p = 0.000$), indicating that mothers who had higher level of Structure and had older babies were more likely to have an earlier bed time.

**Duration before Sleep**

Duration before Sleep aimed to measure how long it took for a mother to make her baby fall asleep at night. It ranged from 1 “10 or less than 10 minutes” and 5 referred to “more than 40 minutes”, increased by 10 minutes. We found that Duration before Sleep was influenced by Perceived Infant Difficulty ($\beta = 0.280$, $p = 0.001$), Older Baby ($\beta = -0.389$, $p = 0.016$), and first-time mother ($\beta = 0.335$, $p = 0.058$). The results showed that mothers who perceived their baby to be more difficult, had older babies and were first-time mothers were more likely to take longer time to make the baby fall asleep.
Structure did not influence Duration before Sleep ($\beta = -0.102$, $p = 0.261$), but the interaction effect of Structure x Perceived Infant Difficulty on Duration before Sleep was found ($\beta = 0.182$, $p = 0.030$). The result showed that when mothers had higher level of Structure, compared with those who perceived their baby to be difficult, mothers who perceive their baby to be easy were more likely to take shorter time to make the baby fall asleep (see Figure 21, only the probit function of option 1 “10 or less than 10 minutes” was presented).

(c) Soothing Crying Practices

Feed When Cry

Feed When Cry measured how frequent a mother fed her baby immediately when she heard the baby crying on a 5-Likert scale, where 1 referred to “Never” and 5 referred to “Always”. We found that Feeding When Crying was influenced by Structure ($\beta = -0.198$, $p = 0.071$), Older Baby ($\beta = -0.321$, $p = 0.051$) and mother’s age ($\beta = 0.137$, $p = 0.098$), indicating that mothers who were at older age, had lower level of Structure, and had younger babies were more likely to immediately feed a crying baby.

No significant difference was found of Attunement on Feed When Cry ($\beta = 0.041$, $p = 0.778$), however, this relation was moderated by Older Baby ($\beta = 0.950$, $p = 0.000$), indicating that when mothers had higher level of Attunement, compared with those who had younger babies, mothers who had older babies were more likely to feed the crying baby immediately (see Figure 22, only the probit function of option 5 “Always” was presented).

![Figure 22. The interaction effects of Older Baby x Attunement on the probabilities of Feed when Cry option 5. FwC=5 refers to “Always”.](image)

Moreover, no significant difference was found of Parenting Stress ($\beta = 0.064$, $p = 0.495$), and Perceived Infant Difficulty ($\beta = 0.046$, $p = 0.598$), while the interaction effects of Attunement x Parenting Stress ($\beta = -0.178$, $p = 0.059$) and Structure x Perceived Infant Difficulty ($\beta = 0.241$, $p = 0.009$) were found. The results showed that when mothers had higher level of Attunement, compared with those who experienced low level of parenting stress, mothers who experienced high level of parenting stress were more likely to immediately feed the crying baby (see Figure 23, only the probit function of option 5 “Always” was presented). Moreover, when mothers had higher level of Structure, compared with those who perceived the baby to be easy, mothers who perceived the
baby to be difficult were more likely to feed the crying baby immediately (see Figure 24, only the probit function of option 5 “Always” was presented).

![Figure 23. The interaction effects of Attunement x Parenting Stress on the probabilities of Feed when Cry option 5. FwC=5 refers to “Always”.](image)

![Figure 24. The interaction effects of Structure x Perceived Infant Difficulty on the probabilities of Feed when Cry option 5. FwC=5 refers to “Always”.](image)

**Delay Responding to Crying**

Delay Responding to Crying measured how often a mother intentionally delayed her respond to her crying baby. The coding used in the path model was a 4-Likert scale, where 1 referred to “Never” and 4 referred to “Most of the time” or “Always”. The results showed that Delay Responding to Crying was influenced by Attunement ($\beta = -0.938$, $p = 0.000$), indicating that mothers with higher level of Attunement were less likely to intentionally delay responding to the crying baby.

No significant difference was found of Parenting Stress ($\beta = 0.025$, $p = 0.815$) on Delay Responding to Crying, but the interaction effect of Older Baby x Parenting Stress was found to be significant ($\beta = 0.401$, $p = 0.032$). No difference was found in Delay Responding to Crying across two age groups ($\beta = 0.054$, $p = 0.757$). The results showed that when mothers had higher level of parenting stress, compared with those who had younger babies, mother who had older babies were less likely to respond to the crying baby without delay (see Figure 25, only the probit function of option 1 “Never” was presented).

**Non-stop Crying Frequency**

Non-stop Crying Frequency measured how often a baby kept crying no matter what the mother did. The coding used in the path model was a 3-Likert scale, where 1 referred to “Never” and 3 referred
to “Half of the time” or “Most of the time”. We have found that Non-stop Crying Frequency was influenced by Perceived Infant Difficulty ($\beta = 0.620$, $p = 0.000$) and baby’s birth weight ($\beta = -0.264$, $p = 0.005$), indicating that mothers were more likely to report higher frequency of that the baby could not stop crying, when the baby was perceived to be more difficulty and had lower birth weight.

**4.3 Conclusions**

**4.3.1 Questionnaire**

We selected 42 different questions from different questionnaires related to parenting, and we intended to measure mother’s parenting beliefs in Structure and Attunement, parenting stress, maternal self-efficacy, and perceived infant difficulty. After dropping some items, the 24-item questionnaire showed good quality in terms of adequate internal consistency: Structure (5 items: $\alpha=0.855$), Attunement (4 items: $\alpha=0.791$), Self-efficacy (5 items: $\alpha=0.764$), Perceived Infant Difficulty (4 items: $\alpha=0.853$), and Parenting Stress (6 items: $\alpha=0.858$). The results indicate that each of those five concepts could be measured with relative high accuracy by around 5 items.

There are 12 parenting practices that we found are important. However, not all of them are trackable through uGrow in the current version. Among these 12 practices, 6 of them could be recorded or calculated: breast feeding, feeding time interval, feeding when the baby cries, same room sleep, feeding to sleep, and feeding the baby when it wakes up at night. Questions related to feeding and sleeping schedule in the current study are mainly based on mother’s perception and beliefs of their own behaviours. For example, a mother who reports that she feed the baby “completely on cues” may appear to have a stable feeding time because the baby may already develop an eating habit. So the self-reported answers do not reflect the actual time. Parenting practices such as bed time and duration before sleep are not trackable through uGrow currently, because the app does not register the time when parents put the baby to sleep, but the time when the baby falls asleep. The other two parenting practices, delay responding to a crying baby and non-stop crying frequency, are again based on mother’s perception and beliefs about their own behaviours, so they cannot be measured through the mobile app.

![Figure 25. The interaction effects of Older Baby x Parenting Stress on the probability of Delay Responding to Crying option 1. DRtC=1 refers to “Never”.](image-url)
4.3.2 Suggestions for in-app personalization

In the path model, we found that parenting beliefs in Attunement and Structure are indeed the two main aspects that can influence parenting practices, and they are negatively correlated to each other. Mothers who have higher level of Attunement are more likely to perform intimate and responsive parenting practices, and mothers who have higher level of Structure are more likely to perform routine-based parenting practices. Therefore, it is reasonable to say that we could judge the level of a mother’s beliefs in Attunement and Structure by knowing the digital data of one’s parenting practices in uGrow.

However, the judgement may suffer from severe inaccuracy because some of the relations between Structure/Attunement and parenting practices are moderated by parenting stress, perceived infant difficulty and the baby’s age. Even though we found that perceived infant difficulty was correlated with parenting practices such as duration before sleep and non-stop crying frequency, these two parenting practices are not trackable in the mobile app. Thus, we cannot give judgement of the level of one’s perceived infant difficulty without using questionnaires. In addition, we found that parenting stress had no direct correlation to any parenting practice. As we can see, based solely on parenting practices, we cannot judge a mother’s level of Structure/Attunement, and her level of parenting stress and perceived infant difficulty at the same. Therefore, we have to either measure parenting stress and perceived infant difficulty, or Structure and Attunement by questionnaires. We believe that each of these four concepts can be measured at relatively high accuracy by the corresponding subsets from the questionnaire of the current study.

Based on the results of the path model, we suggest that it is better to choose to measure parenting beliefs in Structure and Attunement by questionnaire, so we would be able to provide in-app personalised suggestions on parenting stress coping strategies. The reasons and the theory are as following:

First, Structure and Attunement directly influence all six parenting practices which are trackable from the mobile app (Breast feeding, Feeding Time Interval, Feed when Cry, Same Room Sleep, Feed to Sleep, and Feed when Wake Up). Second, these six parenting practices are also relatively highly influenced by demographic information (such as mother’s degree, baby’s age, baby’s current weight/length, and baby’s gender) but are less or not influenced by perceived infant difficulty, parenting stress and self-efficacy. Therefore, it is possible for us to calculate the theoretical probability of one individual performing a specific task at relative high accuracy, using only the demographic information and one’s score in Structure and Attunement.

On the other hand, parenting stress serves as a moderator between Structure/Attunement and three parenting practices: Same Room Sleep was positively correlated with Attunement x Parenting Stress; Feed Time Interval was negatively correlated with Attunement x Parenting Stress and Structure x Parenting Stress; Feed when Cry was negatively correlated with Attunement x Parenting Stress.
Stress. Therefore, when an individual’s has a higher than average Attunement score, the situation of her experiencing higher level of parenting stress can be indicated by noticeable increased probability of putting the baby to sleep in the same room, noticeable reduced frequency of feeding when the baby cries, and noticeable shortened feeding time interval, compared with the probability, the frequency and the interval that we calculated based on demographic information and one’s score in Structure and Attunement. However, when the individual’s Attunement score is lower than average, the change in these three parenting practices may not be that easy to notice. Therefore, in this case, we should instead look at this individual’s Structure score: if her Structure score is higher than average, the situation of experiencing higher level of parenting stress may be indicated by noticeable shortened feeding time interval.

In combination of what we discussed above, we believe that by measuring mother’s Structure and Attunement score through questionnaire, and by using the demographic information which one provides when creating a user account, it is possible for mobile parenting apps to provide parenting stress related suggestions. For mothers who have higher than average Attunement score, experiencing higher level of parenting stress may be indicated by noticeable reduced frequency of feeding when the baby cries, and noticeable shortened feeding time interval. For mothers who have higher than average Structure score, experiencing higher level of parenting stress may only be indicated by noticeable shortened feeding time interval. Therefore, we believe that feeding time interval is the most important parenting practice in order to for a parenting mobile app to provide parenting stress coping strategies, because a noticeable shortened feeding time interval (compared with the interval which is calculated based on demographic information and one’s score in Structure and Attunement) can be indicated as experiencing higher level of parenting stress, regardless of which score (Attunement or Structure) is higher than average. However, if an individual has lower than average score in both Structure and Attunement, it is hard to tell if she’s experiencing higher level of parenting stress, based on the change in the three parenting practices (Same Room Sleep, Feed Time Interval, and Feed when Cry).
Chapter 5. Discussions

The underlying goal of the current study is to provide suggestions on 1) what parenting beliefs and practices we should focus on in order to provide personalised suggestions in infant caring; 2) if personalization is possible, what type of suggestions we should focus on. This final goal leads to 3 research questions.

5.1 Research questions

The first question focuses on what the parenting beliefs are that can influence parenting practices, how these parenting beliefs are related, and how these parenting beliefs influence parenting behaviours. The results from the current study indicate that parenting beliefs in Structure and Attunement are the two main types of parenting beliefs that can influence parenting practices, and Structure and Attunement are negatively correlated. Moreover, mothers who have higher level of Attunement are more likely to perform intimate and responsive parenting practices, and mothers who have higher level of Structure are more likely to perform routine-based parenting practices. On the other hand, as another type of parenting belief, maternal self-efficacy did not add much significant contribution in relation to parenting practices.

The second question focus on what role other concepts play, such as parenting stress, perceived infant difficulty, and demographic information, in relation to parenting practices. Our results indicate that parenting stress, perceived infant difficulty and baby’s age are three main moderators in the relations between Structure/Attunement and parenting practices. Other demographic are mainly serve as independent variables which are correlated to specific parenting practices.

The third question mainly focus on if we are able to describe an individual in terms of Structure/ Attunement, maternal self-efficacy, parenting stress and perceived infant difficulty, based sorely on the app-tracked parenting practices. Our discussion in 4.3.2 indicate that one may face difficulty in doing so because of the complex relationships between different concepts. Our suggestion is to use questionnaire to measure an individual’s score in Attunement and Structure, and make use of the demographic information that a user provides when creating a user account. Then based on the behavioural chance in specific parenting practices, one may be able to describe the individual in terms of parenting stress.

5.2 Limitations and future work

In this study, we only used online questionnaires. Even though the parenting beliefs in Structure and Attunement, parenting stress, maternal self-efficacy, and perceived infant difficulty are measured in a relatively good quality, the self-reported parenting practices may suffer from inaccuracies.
Therefore, further examination of the difference between the self-reported parenting practices and the actual data from the mobile app should be performed in the future.

Moreover, in the current study, we propose a way to provide personalised parenting stress coping strategies judging by the behavioural change in specific parenting practices. Future studies are needed in order to test our proposal. The guidance of the study design is as following: The participant should still be mothers with an infant(s) who is less than one year old. In order to validate the current questionnaire, participants need to fill in the five-factor questionnaire (24-item) that is resulted from our factor analysis. Future researchers also need to ask participants to self report six parenting practices (breast feeding, feeding time interval, feeding when the baby cries, same room sleep, feeding to sleep, and feeding the baby when it wakes up at night) which can also be digital tracked through uGrow, using the questions that were used in the current study. The answers of these six practices should be the based on the re-coded answers that were used in our path analysis, instead of the original ones. Next, participants need to use the uGrow app for a certain period of time and make full use of its functionalities, in order to generate sufficient amount of digital information about their parenting practices.

When having all data available, researcher should first examine the factor structure and the internal consistency of the five-factor questionnaire. Then the difference between the self-reported parenting practices and the digital tracked parenting practices must be carefully examined. If the questionnaire is in good quality and self-reported parenting practices do not differ much from the digital tracked ones, then the proposed method in the current study to achieve personalization (see 4.3.2) should be performed. In order to check the accuracy of the personalization, the inferred parenting stress level from the experiment needs to be checked against the self-reported parenting stress which is measured in the questionnaire.
References


Gandy, A. M. (2014). Examining the impact of parental self-efficacy on the early intervention process for families with a child who is deaf or hard of hearing.


Research2Guidance. (2013). By 2015 parental apps will target 14 million parents in the U.S.


Rousseau, J. J. (1762). Émile, ou De l'éducation (Vol. 2).


INFORMED CONSENT FORM

This page gives you information about the ‘Infant Parenting Survey’. Before you fill in the questionnaire, it is important that you learn about the procedure followed in survey and that you give your informed consent for voluntary participation. Please read this page carefully.

**Aim and benefit of the survey:** The aim of this survey is to understand maternal individual differences in terms of taking care of their infants. This survey is done by Tiange Zhao of the HTI Group at Eindhoven University of Technology, in collaboration with Philips Research. It is under the supervision of dr.ir. Martijn Willemsen and PhD student Mark Graus of the HumanTechnology Interaction group.

**Procedure:** You will fill in the questionnaire online. You will be asked questions about you and your baby (who has to be LESS than 1 year old), as well as how you take care of him/her.

**Risks:** The survey does not involve any risks or detrimental side effects.

**Duration:** The survey will last approximately 10 to 15 minutes.

**Participants:** You were selected because you are a mother with the infant(s) who is less than 1 year old.

**Voluntary:** Your participation is completely voluntary. You can refuse to participate without giving any reasons and you can stop your participation at any time during the survey by closing the browser. You can also withdraw your permission to use your experimental data for up to 24 hours after the survey is finished. All this will have no negative consequences whatsoever.

**Compensation:** If you participate you will have a chance to win a coupon of €10 for every ten participants, which you can use for bol.com or Amazon.

**Confidentiality:** All research conducted at the HumanTechnology Interaction Group adheres to the Code of Ethics of the NIP (Nederlands Instituut voor Psychologen - Dutch Institute for Psychologists). We will not be sharing personal information about you to anyone outside of the research team. The information that we collect from this research project is used for writing scientific publications and will be reported at group level. It will be completely anonymous and it cannot be traced back to you. Only the researchers will know your identity and we will lock that information up with a lock and key.

**Further information:** If you want more information about this experiment you can ask Tiange Zhao (t.zhao@student.tue.nl).

If you have any complaints about this experiment, please contact the supervisor, dr.ir. Martijn Willemsen (M.C.Willemsen@tue.nl).

By choosing ‘I agree’ you agree that you have read and understood this consent form and that you agree to voluntarily participate in this survey carried out by the research group Human Technology Interaction of the Eindhoven University of Technology.

*IMPORTANT:* The questionnaire is designed for mothers with the infant(s) who is less than 1 year old. If you have any other older children, please answer the questions based ONLY on the specific infant(s) who fits this condition.

☐ I agree
BASIC INFORMATION

2. What is your age?

3. What's your level of education?
   Mark only one oval.
   - Lower than High School
   - High School Diploma
   - HBO/WO Bachelor Diploma
   - Master Degree
   - MBA Degree
   - Higher degree

4. Are you a firsttime mother?
   Mark only one oval.
   - Yes
   - No

5. What is your baby's age? (in months)

6. What is the gender of your baby?
   Mark only one oval.
   - It's a girl.
   - It's a boy.

7. What was the birth weight of your baby? (in grams)

8. What is the current weight of your baby? (in grams)

9. What is the current length of your baby? (in cm)
## YOUR OPINIONS ABOUT BABY CARING

Please indicate to what extent you agree or disagree to the following statements. Mark only one oval per question.

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Babies need a routine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Responding quickly to a crying baby leads to less crying in the long run.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Routines lead to more crying.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13. Babies should be encouraged to entertain themselves.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14. Holding babies frequently during the day makes them more demanding.</td>
<td></td>
<td></td>
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<tr>
<td>15. Everyone is happiest when the baby is in a routine.</td>
<td></td>
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<tr>
<td>16. When babies cry in the night to check if someone is near, it is best to leave them.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>17. It is important to introduce a sleeping schedule as early as possible.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. It is important to introduce a feeding/eating schedule as early as possible.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>19. Babies benefit from physical contact with parent(s) when they wake up during the night.</td>
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<tr>
<td>20. Sleeping schedules make babies unhappy.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>21. It is a good idea to have a set time to leave a baby to calm herself/himself down, and increase this amount of time each week.</td>
<td></td>
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<tr>
<td>22. A routine makes a baby calm and secure.</td>
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<tr>
<td>23. Physical contact such as stroking or rocking helps a baby to be calm.</td>
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<tr>
<td>24. Parent(s) should delay responding to a crying baby.</td>
<td></td>
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</tr>
</tbody>
</table>
### YOUR SKILLS ABOUT BABY CARING

Please indicate how good you are at the following. Mark only one oval per question.

<table>
<thead>
<tr>
<th>Question</th>
<th>Not good at all</th>
<th>2</th>
<th>3</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. When your baby is upset, fussy, or crying, how good are you at soothing him or her?</td>
<td></td>
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<tr>
<td>26. How good are you understanding what your baby wants or needs? For example, do you know when your baby needs to be changed or wants to be fed?</td>
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</tr>
<tr>
<td>27. How good are you at making your baby understand what you want him/her to do? For example, if you want your baby to eat or play quietly, how good are you at making her or him do that?</td>
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<tr>
<td>28. How good are you at getting your baby to pay attention to you? For example, when you want your baby to look at you, how good are you at making him or her do it?</td>
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<td></td>
<td></td>
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<tr>
<td>29. How good are you at getting your baby to have fun with you? For example, how good are you at getting your baby to smile and laugh with you?</td>
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<tr>
<td>30. How good are you at knowing what activities your baby will enjoy? For example, how good are you at knowing what games and toys your baby will like to play with?</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>31. How good are you at keeping your baby occupied when you need to do housework? For example, how good are you at finding things for your baby to do when you need to do the dishes?</td>
<td></td>
<td></td>
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<tr>
<td>32. How good do you feel you’re at feeding, changing, and bathing your baby?</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. How good are you at getting your baby to show off for visitors? For example, how good are you at making your baby smile or laugh for people who visit?</td>
<td></td>
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<tr>
<td>34. In general, how good a mother do you feel you are with your baby?</td>
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</tbody>
</table>
**YOUR WORRIES**
Please indicate to what extent you agree or disagree to the following statements. Mark only one oval per question.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>2</th>
<th>3</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>35. I feel that I cannot handle things.</td>
<td></td>
<td></td>
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<tr>
<td>36. I gave up my life for children’s needs.</td>
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<tr>
<td>37. I feel trapped by parenting responsibilities.</td>
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<tr>
<td>38. I am unable to do new and different things.</td>
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<tr>
<td>39. I am never able to do things that I like to do.</td>
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<tr>
<td>40. I am unhappy with last purchase of clothing for myself.</td>
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<tr>
<td>41. Quite a few things bother me.</td>
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<tr>
<td>42. Having a child caused problems with spouse.</td>
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<tr>
<td>43. I feel alone and without friends.</td>
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<tr>
<td>44. I expect not to enjoy myself at parties.</td>
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<tr>
<td>45. I am not as interested in people as I used to be</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46. I do not enjoy things as I used to do.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
ABOUT YOUR BABY
On the following questions, please choose the number that is most typical of your baby. Mark only one oval per question.

47. How many times per day, on the average, does your baby get fussy and irritable for either short or long periods of time?

- Never
- 12 times per day
- 34 times per day
- 56 times per day
- 79 times per day
- 1014 times per day
- More than 15 times per day

48. How much does your baby cry and fuss in general?

Very little - much less than the average baby

1 2 3 4 5 6 7

A lot - much more than the average baby

49. How changeable is your baby’s mood?

Changes seldom, and changes slowly when changing

1 2 3 4 5 6 7

Changes often and rapidly

50. When left alone, does your baby play well by him/herself?

Almost always

1 2 3 4 5 6 7

Almost never won’t play by self

51. Please rate the overall degree of difficulty your baby would present to yourself.

Super easy

1 2 3 4 5 6 7

Highly difficult to deal with
TAKE CARE OF YOUR BABY
How do you take care of your baby currently? Please answer the following questions based on the facts in LAST WEEK.

Direct breast feeding
52. Do you use direct breast feeding?
   Mark only one oval.
   ○ Yes - Skip to question 53
   ○ No - Skip to question 55

53. Typically, how many times of direct breast feedings does your baby have in 24 hours?
   Mark only one oval.
   ○ Less than 5 times
   ○ 5 to 6 times
   ○ 7 to 8 times
   ○ 9 to 10 times
   ○ 11 to 12 times
   ○ More than 12 times

54. How many minutes does a typical direct breast feeding last from 7am to 7pm?
   Mark only one oval.
   ○ Less than 10 minutes
   ○ 10 to 20 minutes
   ○ 21 to 30 minutes
   ○ More than 30 minutes

Expressed breast milk feeding
55. Do you use expressed breast milk feeding?
   Mark only one oval.
   ○ Yes - Skip to question 56
   ○ No - Skip to question 59

56. Typically, how many times of expressed breast milk feeding does your baby have in 24 hours?
   Mark only one oval.
   ○ Less than 5 times
   ○ 5 to 6 times
   ○ 7 to 8 times
57. How much amount of expressed breast milk PER FEED does your baby have from 7am to 7pm?
Mark only one oval.

- [ ] 9 to 10 times
- [ ] 11 to 12 times
- [ ] More than 12 times

58. How often do you encourage your baby to finish the expressed milk in the bottle?
Mark only one oval.

- [ ] Never
- [ ] 1
- [ ] 2
- [ ] 3
- [ ] 4
- [ ] 5 Always

59. Do you use formula milk feeding?
Mark only one oval.

- [ ] Yes – Skip to question 60
- [ ] No – Skip to question 63

60. Typically, how many times of formula milk feeding does your baby have in 24 hours?
Mark only one oval.

- [ ] Less than 3 times
- [ ] 3 to 4 times
- [ ] 5 to 6 times
- [ ] 7 to 18 times
- [ ] More than 8 times

61. How much amount of formula milk PER FEED does your baby have from 7am to 7pm?
Mark only one oval.

- [ ] Less than 50ml
62. How often do you encourage your baby to finish the formula milk in the bottle?
Mark only one oval.

<table>
<thead>
<tr>
<th>Never</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Always</th>
</tr>
</thead>
</table>

Solid/semisolid food
63. Do you feed your baby with solid/semisolid food?
Mark only one oval.

- Yes - Skip to question 64
- No - Skip to question 66

64. Typically, how many times of solid/semisolid food feeding does your baby have in 24 hours?
Mark only one oval.

- 1 time
- 2 times
- 3 times
- More than 3 times

65. What was your baby’s age in months when you started solid/semisolid food?
Mark only one oval.

- Less than 4 months old
- 4 to 5 months old
- 5 months old
- 5 to 6 months old
- 6 months old
- More than 6 months old

66. When deciding how often to feed your baby, do you?
Mark only one oval.
67. Typically, what is the time duration between two feeds in daytime from 7am to 7pm
Mark only one oval.

- 1.5 or less than 1.5 hours
- 1.5 to 2 hours, including 2 hours
- 1.5 to 2 hours, including 2 hours
- 2.5 to 3 hours, including 3 hours
- 3 to 3.5 hours, including 3.5 hours
- More than 3.5 hours

68. How often do you feed your baby immediately when she/he cries
Mark only one oval.

Never | 1 | 2 | 3 | 4 | 5 | Always

69. What is the typical sleep arrangement?
Mark only one oval.

- In an infant crib in a separate room
- In an infant crib in parent’s room
- In parent’s bed
- In parent’s bed first and then move to a crib
- In a crib first and then move to parent’s bed
- Other: ______________________________

70. When deciding what time to put your baby to sleep, do you?
Mark only one oval.

Follow a schedule | 1 | 2 | 3 | 4 | 5 | Follow baby’s cues

71. What do you usually do to make your baby fall asleep?
Mark only one oval.

- Leave him/her alone in a crib in the room
- Put him/her in a crib/bed with parent’s present
- Put him/her in parent’s bed with parent
72. What time do you usually put your baby to sleep at night from 7pm to 7am?
Mark only one oval.
- 7:00 pm or before
- 7:01 to 7:30 pm
- 7:31 to 8:00 pm
- 8:31 to 9:00 pm
- 9:01 to 9:30 pm
- After 9:30 pm

73. How long does it usually take for you to put your baby to sleep at night from 7pm to 7am?
Mark only one oval.
- 10 or less than 10 minutes
- 11 to 20 minutes
- 21 to 30 minutes
- 31 to 40 minutes
- More than 40 minutes

74. What do you usually do when your baby wakes up at night?
Mark only one oval.
- Feed him/her
- Rub or pat him/her in the crib/bed to sleep
- Hold or rock him/her to sleep
- Bring the baby to parent’s bed
- Wait for some minutes until the baby goes back to sleep by him/herself
- Let him/her cry to fall asleep
- Other: ______________________________
Infant crying

75. How long does it usually take to soothe your baby when he/she is crying?
   Mark only one oval.
   - 10 or less than 10 minutes
   - 11 to 20 minutes
   - 21 to 30 minutes
   - More than 30 minutes

76. How often do you intentionally delayed responding to your baby when he/she cries?
   Mark only one oval.
   Never 1 2 3 4 5 Always

77. How often does it happen when your baby cannot stop crying no matter what you do?
   Mark only one oval.
   Never 1 2 3 4 5 Always

78. When you cannot stop your baby from crying, you usually
   Mark only one oval.
   - Not applicable
   - Leave him/her alone
   - Give him/her to your partner
   - Call family or friends to help
   - Call the doctor
   - Other: ______________________________
PARTICIPATE IN OUR NEXT STEP STUDY

Philips will soon launch a mobile application uGrow to assist mothers of young infants with daily care. We would like to invite you to use uGrow for 24 weeks with compensation as our next study next month. You will receive an email asking you to fill in a questionnaire, which will take 5 minutes, and then download the uGrow app and use it. The app will help you keep track of your baby’s development, and provide you with insight and content that you need to better take care of your baby.

Thank you for your time and participation!

79. If you agree to participate in uGrow study, please leave your email address below. The email address will only be used for us to invite you when the study starts.

______________________________

80. If you wish to win a coupon of €10 for the compensation, please enter your email address below. The email address will only be used for us to contact you if you are the winner.

______________________________

81. Which website would you like to receive the coupon for?
Mark only one oval.

☐ Bol.com
☐ Amazon UK
☐ Amazon Germany
## Appendix B. Output of the path model

### MODEL FIT INFORMATION

- **Number of Free Parameters**: 124
- **Loglikelihood**
  - H0 Value: -3434.364

### Information Criteria

- **Akaike (AIC)**: 7116.728
- **Bayesian (BIC)**: 7516.052
- **Sample-Size Adjusted BIC** (\(n^* = (n + 2) / 24\)): 7123.307

### MODEL RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>S.E.</th>
<th>Est./S.E.</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parenting Stress</strong> ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Baby</td>
<td>0.196</td>
<td>0.131</td>
<td>1.497</td>
<td>0.134</td>
</tr>
<tr>
<td>Mother’s age</td>
<td>-0.137</td>
<td>0.065</td>
<td>-2.106</td>
<td>0.035</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>-0.393</td>
<td>0.088</td>
<td>-4.487</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Structure</strong> ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Baby</td>
<td>0.143</td>
<td>0.130</td>
<td>1.103</td>
<td>0.270</td>
</tr>
<tr>
<td>Baby’s gender</td>
<td>-0.301</td>
<td>0.109</td>
<td>-2.767</td>
<td>0.006</td>
</tr>
<tr>
<td>First-time mother</td>
<td>0.238</td>
<td>0.116</td>
<td>2.049</td>
<td>0.040</td>
</tr>
<tr>
<td><strong>Attunement</strong> ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Baby</td>
<td>-0.002</td>
<td>0.124</td>
<td>-0.014</td>
<td>0.989</td>
</tr>
<tr>
<td><strong>Perceived Infant Difficulty</strong> ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Baby</td>
<td>-0.074</td>
<td>0.136</td>
<td>-0.546</td>
<td>0.585</td>
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<tr>
<td>Birth weight</td>
<td>-0.124</td>
<td>0.068</td>
<td>-1.836</td>
<td>0.066</td>
</tr>
<tr>
<td>Parenting Stress</td>
<td>0.410</td>
<td>0.073</td>
<td>5.602</td>
<td>0.000</td>
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<td>Delay Responding $3</td>
<td>1.892</td>
<td>0.192</td>
<td>9.861</td>
<td>0.000</td>
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<tr>
<td>Non-stop Crying Frequency $1</td>
<td>-0.138</td>
<td>0.130</td>
<td>-1.064</td>
<td>0.287</td>
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<tr>
<td>Non-stop Crying Frequency $2</td>
<td>1.588</td>
<td>0.173</td>
<td>9.172</td>
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<tr>
<td>Feed to Sleep $1</td>
<td>0.443</td>
<td>0.179</td>
<td>2.471</td>
<td>0.013</td>
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<tr>
<td>Same Room Sleep $1</td>
<td>-1.107</td>
<td>0.206</td>
<td>-5.375</td>
<td>0.000</td>
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<tr>
<td>Feed when Wake Up $1</td>
<td>-0.051</td>
<td>0.157</td>
<td>-0.324</td>
<td>0.746</td>
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</table>

Residual Variances

<table>
<thead>
<tr>
<th>Parenting Stress</th>
<th>0.774</th>
<th>0.081</th>
<th>9.550</th>
<th>0.000</th>
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</thead>
<tbody>
<tr>
<td>Structure</td>
<td>0.769</td>
<td>0.080</td>
<td>9.607</td>
<td>0.000</td>
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<tr>
<td>Attunement</td>
<td>0.711</td>
<td>0.074</td>
<td>9.618</td>
<td>0.000</td>
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<tr>
<td>Variable</td>
<td>Value1</td>
<td>Value2</td>
<td>Value3</td>
<td>Value4</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
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<td>--------</td>
</tr>
<tr>
<td>Perceived Infant Difficulty</td>
<td>0.836</td>
<td>0.087</td>
<td>9.574</td>
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<tr>
<td>Self-efficacy</td>
<td>0.571</td>
<td>0.060</td>
<td>9.446</td>
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QUALITY OF NUMERICAL RESULTS

<table>
<thead>
<tr>
<th>Condition Number for the Information Matrix</th>
<th>0.205E-04</th>
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</thead>
<tbody>
<tr>
<td>(ratio of smallest to largest eigenvalue)</td>
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</tbody>
</table>