A Multi-Time-Point Study of Newborn Self-Regulation and Child Self-Regulation in the First Two Years of Life: The Mediating Effects of Child Anger Temperament and Quality of Mother-Child Interaction

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การติดตามความสัมพันธ์ระยะยาว ระหว่างการกำกับตนเองของเด็กแรกเกิด และการกำกับตนเองเมื่อเด็กอายุ 2 ปี โดยมีพื้นฐานอารมณ์โกรธของเด็ก และคุณภาพความสัมพันธ์ระหว่างแม่และเด็กเป็นตัวแปรส่งผ่าน

น.ส.พิมพ์จุฑา นิมมาภิรัตน์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรดุษฎีบัณฑิต
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พิมพ์จุฑา นิมมาภิรัตน์ : การติดตามความสัมพันธ์ระยะยาว ระหว่างการกำกับตนเองของเด็กแรกเกิด และการกำกับตนเองเมื่อเด็กอายุ 2 ปี โดยมีพื้นฐานอารมณ์โกรธของเด็ก และคุณภาพความสัมพันธ์ระหว่างแม่และเด็กเป็นตัวแปรส่งผ่าน. (A Multi-Time-Point Study of Newborn Self-Regulation and Child Self-Regulation in the First Two Years of Life: The Mediating Effects of Child Anger Temperament and Quality of Mother-Child Interaction) อ.ที่ปรึกษาหลัก : รศ. ดร.พรรณระพี สุทธิวรรณ, อ.ที่ปรึกษาร่วม : ศ. ดร.Nancy Fiedler

การศึกษาพัฒนาการด้านการกำกับตนเองของเด็กในช่วงแรกเกิดจนถึง 2 ปียังมีอยู่จำกัด การวิจัยนี้จึงมีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่าง *การกำกับตนเองของเด็ก* เมื่ออายุ 1 เดือน และอายุ 2 ปี โดยมี *พื้นฐานอารมณ์โกรธของเด็ก* เป็นตัวแปรส่งผ่านที่เป็นปัจจัยด้านธรรมชาติของตัวเด็ก และ *คุณภาพความสัมพันธ์ระหว่างแม่และเด็ก* เป็นตัวแปรส่งผ่านที่เป็นปัจจัยด้านการเลี้ยงดู

ผู้เข้าร่วมการวิจัยได้แก่ แม่และเด็ก 322 คู่ จากอำเภอจอมทอง และอำเภอฝาง จังหวัดเชียงใหม่ งานวิจัยนี้เป็นงานวิจัยระยะยาวที่มีการเก็บข้อมูลจากแม่และเด็ก เมื่อเด็กอายุ 1 เดือน 1 ปี และ 2 ปี เครื่องมือที่ใช้ในงานวิจัยครั้งนี้ใช้การประเมินผ่านการสังเกตพฤติกรรมตรงเป็นหลัก โดยการกำกับตนเองของเด็ก 1 เดือน ประเมินโดย NICU Network Neurobehavioral Scale (NNNS) การกำกับตนเองของเด็ก 2 ปี ประเมินโดย battery tests of Crayon delay, Snack delay, and Prohibited toy task พื้นฐานอารมณ์โกรธของเด็ก 1 ปี และ 2 ปี ประเมินโดย Attractive toy behind a barrier episode of the Laboratory Temperament Assessment Battery (Lab-TAB) และ Early Childhood Behavior Questionnaire short form (ECBQ-sf) และคุณภาพความสัมพันธ์ระหว่างแม่และเด็ก ประเมินโดย Emotional Availability Scale

ผลการวิเคราะห์ด้วยโมเดลสมการโครงสร้าง โดยควบคุมอิทธิพลของ 3 ตัวแปร ได้แก่ ปริมาณสารกำจัดศัตรูพืชที่แม่ได้รับในขณะตั้งครรภ์ ระดับการศึกษาของแม่ และที่อยู่อาศัยของครอบครัว พบว่า*พื้นฐานอารมณ์โกรธ เมื่อเด็กอายุ 1 ปี* และ *คุณภาพความสัมพันธ์ระหว่างแม่และเด็ก เมื่ออายุ 2 ปี* ไม่ได้ทำหน้าที่เป็นตัวแปรส่งผ่าน แต่เป็นตัวแปรทำนายทางตรงในการกำกับตนเองของเด็ก เมื่ออายุ 2 ปี โดยผลจากการวิเคราะห์นี้ สามารถอธิบายความแปรปรวนของการกำกับตนเองของเด็ก เมื่ออายุ 2 ปี (R^2) ได้ ร้อยละ 25.7

ทั้งนี้ การกำกับตนเองเมื่อเด็กอายุ 1 เดือน ไม่มีความสัมพันธ์กับ การกำกับตนเองเมื่อเด็กอายุ 2 ปี หรือพื้นฐานอารมณ์โกรธของเด็ก หรือคุณภาพความสัมพันธ์ระหว่างแม่และเด็ก ในช่วง 2 ปีแรกของชีวิต

ผลการวิจัยนี้แสดงให้เห็นว่า การที่เด็กมีพื้นฐานอารมณ์โกรธในระดับต่ำ และมีคุณภาพความสัมพันธ์กับแม่ในระดับสูง ถือเป็นปัจจัยสำคัญที่ส่งผลต่อพัฒนาการด้านการกำกับตนเองของเด็ก ในช่วง 2 ปีแรกของชีวิต ผู้วิจัยจึงเสนอแนะการทำวิจัย และการจัดโปรแกรมกระตุ้นพัฒนาการที่ส่งเสริมให้พ่อแม่มีกลยุทธ์ในการเลี้ยงดูเด็ก ด้วยการสร้างความสัมพันธ์ระหว่างพ่อแม่และเด็กที่มีคุณภาพ การจัดสภาพแวดล้อมเชิงบวกที่ไม่ยั่วยุให้เด็กเกิดอารมณ์โกรธ และการส่งเสริมให้เด็กมีทักษะในการควบคุมอารมณ์โกรธ เพื่อให้เด็กมีพัฒนาการด้านการกำกับตนเองที่ดีต่อไป

สาขาวิชา	จิตวิทยา	ลายมือชื่อนิสิต .....
ปีการศึกษา	2564	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....
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KEYWORD: Self-regulation, Inhibitory control, Anger, Temperament, Mother-child interaction, Emotional availability, Longitudinal, Newborn, Infancy

Pimjuta Nimmapirat : A Multi-Time-Point Study of Newborn Self-Regulation and Child Self-Regulation in the First Two Years of Life: The Mediating Effects of Child Anger Temperament and Quality of Mother-Child Interaction. Advisor: Assoc. Prof. PANRAPEE SUTTIWAN, Ph.D. Co-advisor: Prof. Nancy Fiedler, Ph.D.

Studies on the development of child self-regulation during the first two years of life are limited. This study examined the association between *newborn self-regulation* at 1 month old and *child self-regulation* at 2 years old, with the *child anger temperament* and *quality of mother-child interaction* at 1 year and 2 years of age as the nature and nurture mediators for child self-regulation.

The participants were 322 mother-child dyads in Chomthong and Fang districts, Chiangmai. The study was a multiple time-point design with a longitudinal data collection from the mothers and children at 1 month, 1 year, and 2 years of age. The direct observational measurements to assess behaviors of children and mothers were the main method of assessments in this study. Newborn self-regulation was measured by the NICU Network Neurobehavioral Scale (NNNS), while child self-regulation at 2 years of age was measured by the battery tests of Crayon delay, Snack delay, and Prohibited toy task. Child anger temperament at 1 year, and 2 years were measured by Attractive toy behind a barrier episode of the Laboratory Temperament Assessment Battery (Lab-TAB), and the Early Childhood Behavior Questionnaire short form (ECBQ-sf), respectively. Quality of mother-child interaction was measured by maternal dimensions of the Emotional Availability Scale.

Results from the structural equation model, taking into account biomarkers of prenatal pesticide exposure, mother's education, and study location as covariates, revealed that *anger temperament of 1-year-old child* and *quality of mother-child interaction at 2 years* were not mediators but were direct predictors of the 2-year-old self-regulation. Newborn self-regulation at 1 month, however, had no association with child self-regulation, child anger temperament, or quality of mother-child interaction during the first two years of life. The coefficient of determination (R^2) indicated that 25.7% of the variance in self-regulation of 2-year-old children could be explained by its predictors and covariates in this study.

The findings highlight the importance of lower child anger temperament and high quality mother-child interaction for development of child self-regulation during the first two years of life. Thus, our study suggests that early intervention emphasizing effective parenting strategies for child anger control as well as high quality parent-child interaction practices should be evaluated to determine if these interventions can improve child self-regulation in the earlier years of life.

Field of Study:	Psychology	Student's Signature .....
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Introduction

Background and importance of the study

Self-regulation is an important factor for success in life and a crowning achievement for early childhood (Berk, Mann & Ogan, 2010). Stronger self-regulation is associated with higher academic achievement in childhood and adolescence (Cambron et al., 2017; McClelland et al., 2007; Nota, Soresi & Zimmerman, 2004, Shoda, Mischel & Peake, 1990) and better health outcomes across lifespan (Heatherton & Wagner, 2011; Moffitt et al., 2011; Schlam, Wilson, Shoda, Mischel & Ayduk, 2013). On the other hand, failure to regulate oneself can be a significant contributor to obesity, addiction, sexual infidelity, poor financial decisions, and substance use (Heatherton & Wagner, 2011; Wills, Walker, Mendoza & Ainette, 2006). Tangney, Baumeister & Boone (2004) mentioned that a high capacity and capability to regulate oneself predicts happier and healthier lives.

Researchers believe that development of self-regulation is a bidirectional process between intrinsic factors and extrinsic factors of the child (Kopp, 1982), and a continual process starting with reflexive neurophysiological development at birth, which help the newborns to modulate their homeostasis physiological regulation (Lester, & Tronick, 2004). Then continuously develop to more complex and cognitive control aspects of self-regulation later in life (Kopp, 1982; Rothbart, & Posner, 1985).

Nowadays, there is large body of literature on child intrinsic and extrinsic factors that associate with the development of self-regulation, which mostly focused on early childhood and adolescent periods (Vink et al, 2020). Additionally, there is a growing body of literature on development of self-regulation at infancy and toddlerhood as well (Kochanska et al., 2001; Kochanska & Kim, 2013). However, empirical study of the development of self-regulation starting at birth to later years in life is still lacking. Moreover, there are recently concerns about lacking the integrated study on development of self-regulation across lifespan (McClelland et al., 2018; Vink et al, 2020). This present study is based on a belief that the newborn to toddlerhood period is the earliest stage of self-regulation. Investigating potential intrinsic and extrinsic factors that effect on developmental trajectories of self-regulation since birth to toddlerhood is an important first step of three issues. The first one is that it would help extending knowledge of how nature and nurture play roles on development of self-regulation. Because to distinguish the mixed effects of intrinsic and extrinsic influences on self-regulation, neurobehavior of newborns needs to be assessed in the first month of life (Lundqvist-Persson, 2001). Second, It would help establishing proactive plan to promote essential environmental factors that relevant to better self-regulation. Third, it would help establishing preventive plan to prevent the risk factors that have negative impact on child self-regulation early in life.

Literature on development of self-regulation

To study the development of self-regulation from newborn to toddlerhood period, the general development of self-regulation needs to be reviewed. Mainly, research and studies of child self-regulation in developmental perspective suggested that the development of self-regulation is starts from birth (Kopp, 1982).

Kopp (1982) proposed the five phases of control as the summarization of the development of self-regulation. The five phases of control suggested each developmental stage of self-regulation from the early months of life and continues as more sophisticated forms of self-control are required. The five phases of control included (1) Neurophysiological modulation phase, (2) Sensorimotor modulation phase, (3) Control phase, (4) Self-control phase, and (5) Self-regulation phase.

1. Neurophysiological modulation phase (birth to 3 months old)

In the first three months, newborn regulation is believed to be mediated by neurophysiological maturation, and routines that parents respond to child's physiological needs (feeding, sleeping, etc.). However, during the early months of life, regular parenting does not have a significant effect on child neurodevelopment, unless the caregiver is neglectful or traumatized. This is because the child's sensory systems are not fully developed and most of the reactivity is from physiological arousal (Gable & Isabella, 1992; Sroufe, 1979).

The efficient neurodevelopment enables newborns to maintain homeostasis and contributes to organizing and compromising internal bodily sensations and the external environment. Infants who are irritated by internal sensations may be described as having a difficult temperament because they tend to be hard to console and vulnerable to mood and arousal lability (DeSantis, Coster, Bigsby, & Lester, 2004).

2. Sensorimotor modulation phase (3 to 9 months old)

In the next stage of self-regulation, children can modulate their sensorimotor acts in response to events and external stimuli, such as reaching for a toy, putting it in his/her mouth, crying when mother is taking a toy away from his/her mouth, and trying to self-soothe by putting his/her hand in the mouth. At this age, children depend on parents' care and sensitivity to respond to the child needs, because motor skills are not fully developed.

3. Control phase (12 to 18 months old)

Children ages 12 - 18 months are mediated more by preference toward social behavior, especially the mother-child interaction. At this age, children develop compliance and self-initiated monitoring, so they can respond to warning signals or simple verbal or non-verbal communication, such as "no", or shaking the head for nonverbal communication. However, children at this age still have limitations in their ability to remember the

instruction, so parents need to repeat the signal to help the children reconstruct an awareness of appropriate behaviors. In addition, 12- to 18-month-old children depend more on external monitoring to regulate their behavior.

4. Self-control phase (24 to 36 months old)

The second year of life is the emergence of internally self-control, including compliance, abilities to delay response, and to behave according to parent and social expectations without external monitoring. At this age, children can perform basic self-regulation tasks including inhibitory control and effortful control tasks (Kim & Kochanska, 2012; Kochanska & Kim, 2013).

Inhibitory control refers to a cognitive ability that enables children to inhibit some responses. Children start to control attention, behavior, thoughts, and emotions to overcome their inappropriate responses and/or impulses to fit with the social demands (Diamond, 2013). Inhibitory control is relevant to the “Don’t” aspect of self-regulation. That is, children try to inhibit their impulsive actions, or suppress a dominant response (Kochanska et al., 2001), such as wait for the bell ring before they can eat a marshmallow.

In contrast with inhibitory control, effortful control refers to abilities to focus attention, to force children to do something necessary but unpleasant

(Eisenberg, 2005; Kim & Kochanska, 2012; Rothbart, Ellis, Rueda, & Posner, 2004). Effortful control is relevant to the "Do" aspect of self-regulation. That is, children must put effort to do something undesirable (Kochanska et al, 2001), such as finishing the meal before playing. Effortful control seems to be an extension of inhibitory control. Children need to gain the ability of inhibition first, and then they can shift their attention to do the requested response. Research found that children at age 14 – 45 months can perform better on the Don't task than the Do task (Kochanska et al, 2001).

5. Self-regulation phase (36 months old and older)

After the second year, at 3 to 4 years old, children use more language skills to regulate themselves. Children use overt speech at around 3 years old and then covert speech at around 6 years old. Lastly, in the preschool period onwards, children use more cognitive abilities, planning, and strategies to regulate themselves.

According to the five phases of control, Kopp suggested the interplay between child's internal factors, such as child temperament, and environmental factors, especially mother-child interactions. In addition, several studies support that self-regulation development is a bidirectional process involving child's nature, such as child temperament and mother-child interaction (see Gagne, & Goldsmith, 2011; Geva, Schreiber, Caspi, & Shiffman, 2014; Kim & Kochanska, 2012).

Consideration of relevant time points to measure child temperament and quality of mother-child interactions.

From the neurophysiological modulation phase (birth – 3 months old) to the sensorimotor modulation phase (3 – 9 months old), there are minor developmental change from reflexive response to more sensorimotor control, which due to the developing of motor skills. However, in the sensorimotor modulation phase, infants still rely mostly on maternal care to help them console or to fulfill their needs, like in the neurophysiological modulation phase.

Comparing between the sensorimotor modulation phase (3 - 9 months old) and the control phase (12 - 18 months old), infants aged 12 to 18 months are more autonomous and capable for initiating self-monitoring and adapt their behavior according to social demands or environment. The 12 - 18 months age range is also a challenging interactive period between the child temperament and mother-child interaction. For example, Gagne & Goldsmith (2011) found that infants who showed more anger at age 12 months were likely to have more Inhibitory control at age 36 months. In contrast, when the infants grew up, if they showed more anger at 36 months old, they tended to have less inhibitory control at 36 months old. The finding suggested some change in the effect of child anger temperament to child self-regulation from 12 months old to 36 months old. One potential reason of finding instability of child anger temperament might be because the difference of how mother and child interact with each other. For example, Kim & Kochanska (2012)

found that highly negative emotional infants at 7 months old showed less self-regulation 18 months later, when they were in unresponsive relationships, whereas children aged 18 months old were more self-regulated when in responsive relationships. This finding suggested an important of child anger temperament and maternal responsiveness that effect on development of child self-regulation within the age range from the late the sensorimotor modulation phase to the control phase. Moreover, for infants aged 12 to 18 months old, the mother plays an important role to provide external control to the infants. So, they can perform appropriate behaviors according to each situation. Then, when the infants grow up, they start to internalize the maternal control and develop their own means to distract themselves from distressing stimuli (Kochanska et al, 2001; Rothbart et al., 2006). Therefore, the 1 year of age (the control phase) might be an important time point of investigate how child anger temperament and mother-child interaction play roles to the development of self-regulation from birth to toddlerhood at 2 years of age.

The differences between the control phase (12 - 18 months old) and self-control phase (24 to 36 months old) are that children around 2 years of age can perform basic self-regulation, for example, they can inhibit themselves according to their mother's prohibition, even when the mother does not present. The mother-child interaction in the self-control phase might change due to the developmental stage of self-regulation. For example, the mother may use less physical control,

because the child needs less external control from mother (Bornstein et al., 2010) . Therefore, not only measuring child self-regulation at 2 years old, but the child anger temperament and the quality of mother-child interactions investigated at 2 years old as well.

Literature on effects of child anger temperament and quality of mother-child interaction on the development of self-regulation

Association between newborn self-regulation and later developmental outcomes

According to the lack of evidence of longitudinal association from newborn self-regulation to later child self-regulation. This section reviewed associations between newborn self-regulation to later social and cognitive developmental outcomes, which may also be relevant to self-regulated skills. The self-regulation problems in newborns are usually indicated by sleeping, feeding, state control, self-calming, sensory reactivity, mood regulation, and emotional and behavioral control (DeGangi et al., 2000). For example, Lundqvist-Persson (2001) studied correlations between newborn self-regulation and later cognitive and social developmental outcomes at 2 years old, including (1) locomotor, (2) personal-social, (3) hearing and speech, (4) eye and hand coordination and (5) performance scales, measured by Griffiths' Mental Developmental Scales. Lundqvist-Persson grouped newborns into 3 self-regulation level: (1) low level of self-regulation, (2) ordinary level of self-

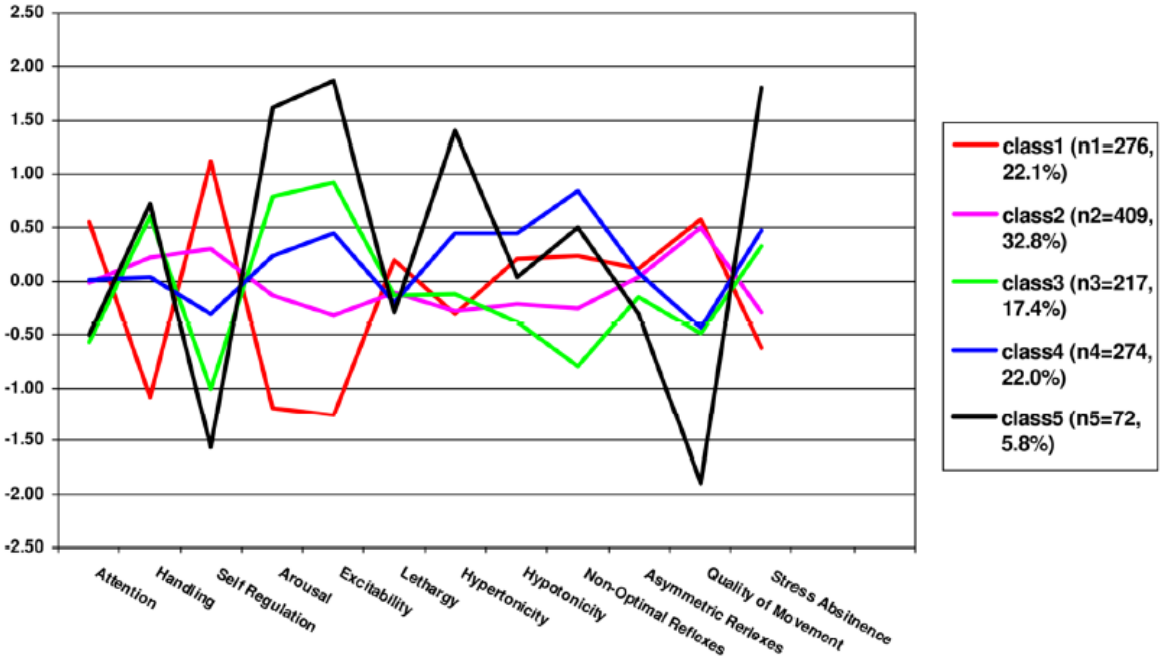
regulation, and (3) high level of self-regulation. The level of self-regulation was identified by 7 items in the Neonatal Behavioral Assessment Scale (NBAS), including (1) peak of excitement, (2) rapidity of build-up, (3) irritability, (4) lability of states, (5) cuddliness, (6) consolability, and (7) self-quieting activity. The result showed that an infant with a low level of self-regulation was at risk for poorer quality of social-interaction development, Hearing & Speech, and Eye & Hand Coordination. Moreover, an infant with a low level of self-regulation was at risk of regulatory disorders as well.

However, in these recent years, research studies in newborn use NICU Network Neurobehavioral Scale (NNNS; Lester & Tronick, 2004), the grandchild version of NBAS (Tronick & Lester, 2013) to indicate the neurobehavior characteristics of newborns, which also included self-regulation as one of the subscales.

For example, Liu et al. (2010) examined NICU Network Neurobehavioral Scale (NNNS) profiles, measured at age 1 month, as a predictor of negative medical and developmental outcomes at 4½ years of age. The sample in this study was 1,248 mother-infant dyads who were participating in a longitudinal study of the effects of prenatal substance exposure on child development. Latent Profile Analysis (LPA) was used to classify NNNS summary scale scores into discrete profiles, which finally were summarized into 5 NNNS profiles (Figure 1). According to Figure 1, Liu et al.

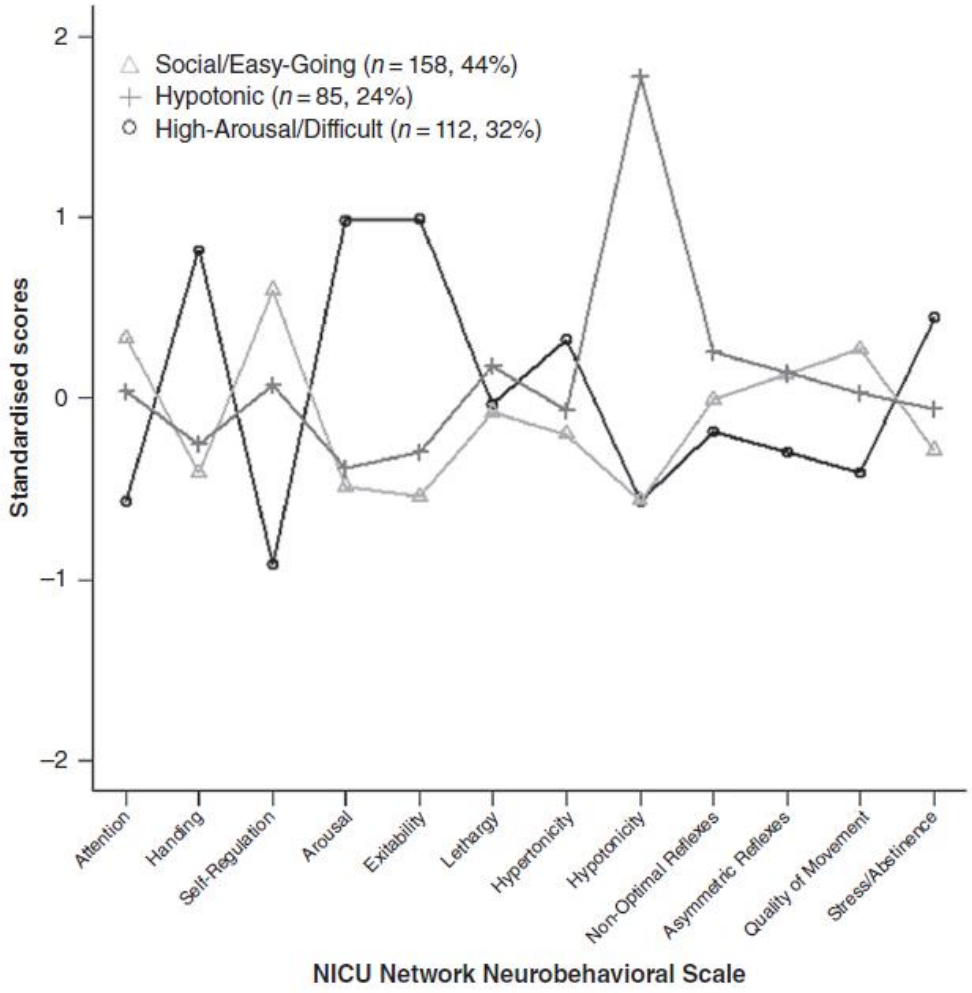
(2010) summarized that NNNS profile 5 showed the poorest neurobehavior performance and hypothesized that Profile 4 and 5 would show more medical and developmental problems than infants in the other 3 profile groups. The results revealed that after controlling for gestational age and SES, infants in Profile 5 were likely to have poorer medical outcomes and more behavior problems, compared to other Profile groups. Similarly, when combining Profile 4 and 5 groups after controlling for covariates, they were more likely to be exposed to prenatal toxic substances (e.g., cocaine, tobacco, alcohol, and marijuana), had birthweight less than 2500 g, had chronic neurological abnormalities and brain related illnesses by age 3, as well as concept problems and language problems at age 4, compared to Profiles 1 – 3.

Figure 1 Five NNNS profiles (N = 1248). From Liu et al. (2010).



Another remarkable NNNS profile study is from Sucharew, Khoury, Xu, Succop, & Yolton (2012). They measured NNNS with 355 low-risk infants at approximately 5 weeks after birth. LPA was used to classify NNNS summary scale score into 3 profile groups, described as Social/easy-going, Hypotonic, and High-arousal/difficult (Figure 2).

Figure 2 Three NNNS profiles (N = 355). From Sucharew et al. (2012).



The results showed that Hypotonic profile had a significantly lower score on the Bayley Scales of Infant Development 2nd edition (BSID-II) psychomotor developmental index (PDI) by age 3 than the other 2 profile groups and had lower scores on externalizing problems reported by the primary caretaker by age 3 when compared to the social/easy-going group. However, they found no difference between the hypotonic and the high-arousal/difficult group. In addition, there was no difference between

social/easy-going, and high-arousal/difficult profile. These research findings suggested the validity of using NNNS profile approach to predict different outcomes due to newborn characteristics.

When investigating the NNNS profiles from the previous studies, the self-regulation subscale scores of each profile could reflect the quality of newborn's characteristics. For example, the self-regulation subscale score of Profile 5, showed the lowest self-regulation score among the other profiles. The Profile 1, which was the lowest risk of prenatal toxicant exposure, showed the highest level of self-regulation. In the same hand, self-regulation score in Sucharew et al.'s study showed distinctive score between social/easy-going and high-arousal/difficult infants. The social/easy-going group showed the highest level of self-regulation, but the high-arousal/difficult showed the lowest level of self-regulation.

The aim of this study is to focus on intrinsic self-regulation of infants. Therefore, the self-regulation subscale score of NNNS was used to indicate level of newborn self-regulation in this study.

Association between newborn self-regulation and child anger temperament

Child temperament is a fundamental aspect of children's emotional reactions. Temperament also depends on the ability to regulate their physiological conditions in response to the external environment (Lester &

Tronick, 2004). Usually, self-regulation and child temperament is defined closely with each other. For example, Sucharew et al. (2012) named the NNNS profile using the temperamental characteristics (i.e., easy-going, and difficult). The easy-going child was characterized by the NNNS profile was a child who had better attention, self-regulation, and quality of movement; the less score for handling, arousal, excitability, and stress/abstinence. In contrast with the difficult child who showed higher level of arousal, excitability and stress/abstinence and need more handling to calm down; showed less attention, and self-regulation. DeSantis et al. (2004) found that infants who showed longer hour of fussing at 4 to 12 weeks tended to show more negative emotional reactivity at 3 to 8 years of age, reporting by mother. In contrast, DeSantis, Harkins, Tronick, Kaplan, & Beeghly (2011) found that the score from NNNS, measuring at 1 month old, was not associated with other infant temperamental mother-report questionnaires (i.e., the Early Infancy Temperament Questionnaire (EITQ) or the Infant Sensory Profile (ISP)), reporting when infant was at 1 month old. However, the two mother-report questionnaires were associated with each other. They also found that NNNS subscale scores were loaded into one factor relevant to more regulation and coordination of movement, but subscale scores from EITQ and ISP were loaded more relevant to temperamental aspects. The findings suggested that

the NNNS could measure unique newborn characteristics that might not be captured by the mother-report questionnaires (Tronick & Lester, 2013).

In sum, the association between newborn self-regulation and child anger temperament later in life is not fully corroborated by the empirical evidence.

Association between child anger temperament and child self-regulation

Studies of the relationship between the child anger temperament and self-regulation have shown associations between negative emotional reactivity and self-regulation tasks (Frick et al., 2018, Gagne & Goldsmith, 2011, Kim & Kochanska, 2012). Negative emotional reactivity usually has been observed by the child's intensity of distress in response to novel unfamiliar events or frustrating situations (Fox & Calkins, 2003). For example, the Infant Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999) is an observational measurement designed to assess temperament dimensions through a series of episodes that were created to be relevant to everyday situations. Lab-TAB's temperament dimensions consist of fearfulness, anger/frustration, joy/pleasure, interest/persistence, and activity level.

The anger/frustration situation of Lab-TAB is generally used to study the child's negative emotional responses and how they relate to

development of self-regulation. Studies have shown that Lab-TAB's anger dimension is associated with the inhibitory control aspect of self-regulation. For example, Gagne & Goldsmith (2011) conducted a longitudinal study, which assessed anger in children aged 12 and 36 months and assessed children's inhibitory control at 36 months. At age 12 months children's anger was assessed using 2 episodes of LabTAB locomotor version (Goldsmith & Rothbart, 1999), including Gentle Arm Restraint and Restraint in Car Seat (frustration from restriction of body movement for toddler). At age 36 months children's anger was assessed using 2 episodes of Lab-TAB preschool version (Goldsmith, Reilly, Lemery, Longley & Prescott, 1995), including End of the Line (frustration from taking a toy away for preschool), and inhibitory control with Dinky Toys (inhibiting the urge to pick more than one attractive toy from a clear container) and Snack Delay (wait for a snack task) episodes from the Preschool Lab-TAB. The results revealed that anger at 12 months had positive correlation with 36 months inhibitory control, suggesting that if children showed more anger at age 12 months, they were likely to have more Inhibitory control at age 36 months. In contrast, anger at 36 months correlated negatively with 36 months inhibitory control, indicating that if children showed more anger, they tended to have less inhibitory control when assessed concurrently. Interestingly, they found no relation between

anger at 12 months and anger at 36 months. In addition, children at 36 months old showed less anger than 12 months old.

Gagne & Goldsmith (2011) suggested that it might be because there was developmental change in the improvement of emotional control skills from 12 months old to 36 months old. And the anger episodes used at 12 months observed different aspect and less complex of anger than the anger episode administered at 36 months. Both Gentle Arm Restraint and Restraint in Car Seat that were used at 12 months old were about restriction of their body movement, which was relevant to a physical condition, but End of the Line, used at 36 months old, was about taking away the child's interesting object, which is relevant to their psychological frustration.

Supporting the discussion, Buss & Goldsmith (1998) found no correlation between these episodes: Gentle Arm Restraint (restriction of body movement), and Attractive toy placed behind barrier (taking away a toy and placed behind a clear Plexiglass). They suggested that these episodes elicit distinctive aspects of anger and should be analyzed separately.

Frick et al. (2018) used Attractive Toy Placed Behind Barrier (will be called 'ATB' after this point), one of the anger-induced tests in Lab-TAB (Goldsmith & Rothbart, 1999. The ATB is about taking away an attractive toy from the child, place it behind a clear barrier, and observe children's facial,

vocal, and bodily anger reactivity to this frustrating event. However, Frick et al. used this task to observe child emotional regulation, rather than observe anger reactivity as usual. They used latency to anger and mean seconds of child's looking away (disengagement) from frustrating event to evaluate child emotional regulation at 18 months. The study found a negative correlation between children's emotional regulation and children's inhibitory control at 18 months old. One reason they suggested was that children who have high level of inhibitory control might be less emotionally reactive, so they are in less need of using regulatory strategy. They also suggested to assess the intensity of anger rather than emotional regulation to study the relation between child's emotionality and inhibitory control.

Association between newborn self-regulation and quality of mother-child interactions

Research suggested that infant characteristics can affect parental response. The child who had lower self-regulation, became harder to console may elicit negative maternal responses such as less sensitive, less structuring, or more intrusive strategies to stop child's negative behavior (Laukkanen, Ojansuu, Tolvanen, Alatupa & Aunola, 2014; Shiner & Caspi, 2003). In addition, poor regulated infants may be potentially at risk of later mother-child relationship problems (DeGangi et al., 2000; DeSantis et al., 2004).

Association between quality of mother-child interactions and child self-regulation

Many researchers have shown significant associations between the quality of mother-child interaction and child self-regulation. There are many aspects of quality of mother-child interactions. For example, Bernier, Carlson, & Whipple (2010) studied relations between maternal dimensions and the child's later development of self-regulated skills.

The maternal dimensions include (1) maternal sensitivity (appropriate and consistent responses to infants' signals), (2) maternal autonomy support (supporting children's goals, choices, and sense of will), and (3) maternal mind mindedness (to use mental terms while talking to the child). The child self-regulated skills include attention shifting, working memory, and inhibitory control. The study found that maternal autonomy support, measured among 12-month-old children, was the most predictive of child self-regulated skills at 26 months. In addition, Cheng, Lu, Archer, & Wang (2018) found that in Chinese samples, maternal mind-mindedness and maternal autonomy support predicted better inhibitory control of the child at 25 and 38 months. van Aken, Junger, Verhoeven, van Aken, & Dekovic (2007) found that higher maternal negative control and lack of maternal sensitivity predicted higher externalizing behaviors, such as attention problems, aggressive behavior, or antisocial behavior, for temperamentally difficult children only. Maternal

hostility has also been suggested to be associated with the child's behavioral and emotional regulation. Child's experience of a hostile environment and internalization of inappropriate strategies tend to exhibit less emotional regulation and less compliance (Scaramella, & Leve, 2004).

Generally, quality of mother-child interactions in previous studies were observed based on the mother's behavior; however, interaction of mother and child should account for child behavior as well. Emotional availability offers emotional expressions in an interaction between parent and child, in which both partners are attuned and responsive to a range of emotional exchange to the other (Biringen et al., 2005). Moreover, the parent should interact with a child in an age-appropriate, accepting, non-intrusive and non-hostile way (Biringen, Derscheid, Vliegen, Closson, & Easterbrooks, 2014).

Associations between maternal emotional availability and child self-regulation have also been shown. For example, Lehman, Steier, Guidash, & Wanna (2002) studied fifty-one mother-child dyads (age range 15 – 30 months), and found that the EA scale scores of maternal sensitivity, and maternal structuring predicted the child's compliance when asking for toys clean up after free-play ($\Delta R = 0.21$, $F(14, 34) = 2.66$, $p < 0.05$, while all of the variables together accounted for 45.4% of the variance in child's compliance

score). These results support the role of quality of mother-child interactions in developing behaviors indicative of self-regulation.

Literature review of measurement

Newborn self-regulation measurement

NICU Network Neurobehavioral Scale (NNNS) is a direct observational assessment of neurological, behavioral, and stress/abstinence neurobehavioral functions designed for infants ranging in age from 32 weeks gestational age to 8 weeks' corrected gestational age and can be used with low and extremely high-risk, but medically stable infants (Lester & Tronick, 2004). The NNNS consists of 13 subscales to include orientation, habituation, hypertonicity, hypotonicity, excitability, arousal, lethargy, non-optimal reflexes, asymmetric reflexes, stress, self-regulation, quality of movement, handling. The internal consistency of the NNNS is well within the acceptable range for the summary scores (α = .87-.90) (Tronick & Lester, 2013).

The self-regulation in NNNS is described as the newborn's capacity to organize motor activity, physiology, and state during the examination and to respond to cuddling, consoling, and negative stimuli (Lester & Tronick, 2004). The mean of scores from 15 items in NNNS comprise the self-regulation summary score. The self-regulation summary score range is 1-9, with higher scores indicating better intrinsic self-regulation. The 15 items are Pull to sit,

cuddle in arms, cuddle on shoulder, defensive response, alertness, general tone/predominant tone, motor maturity, consolability with intervention, rapidly of build-up, tremulousness, amount of startle, lability of skin, lability of states, self-quieting activity, and hand-to-mouth facility.

Child anger temperament measurement

Child anger temperament has been usually observed through the child's emotional reactivity to emotionally arousing events. This study observed anger/frustration of temperament using Lab-TAB locomotor version 3.0 (Goldsmith & Rothbart, 1999). The ATB episode was used to assess child anger temperament at 1-year-old in this study, and intensity of anger expressions on facial, posture, and vocal were coded.

However, child anger temperament at 2 years old was assessed by parent-report method to also examine some potential effects from mother's perception. Infant Behavior Questionnaire-revised (IBQ-R), Early Childhood Behavior Questionnaire (ECBQ), and Children's Behavior Questionnaire (CBQ) are a series of parent-report of child's temperament questionnaires that cover all age ranges in childhood (Putnam, Rothbart, Gartstein, 2008).

Convergent validity was found between these three questionnaires, and they include the same factors of temperament, i.e., surgency, negative affect, and effortful control (Putnam et al., 2008).

However, correlations between the observation and parent-report method were found but not consistent. For example, Gagne & Goldsmith (2011) found significant correlation between Lab-TAB anger at 12-month and parent-report on child's anger using the IBQ at 12-month, but there was no correlation found between Lab-TAB anger at 36-month and parent-report on child's anger using the CBQ at 36-month. Parent-report seemed to be more consistent in younger age rather than at 36 months old.

Gagne & Goldsmith (2011) suggested that the inconsistency between the laboratory observation and parent-report at 36 months old might be because some parents might intervene more than the others when their child show negative emotion, which might result in their different perceptions about the child. They also suggested that there might be developmental difference in anger reactivity measuring in the lab at 12-month-old and 36-month-old child, as 36-month-old child can control themselves better than 12-month-old. Additionally, it might be because the different aspects of the temperamental traits that these measurements capture. The laboratory observation observes every child in the same situation and allow the child to show anger. While parent-report depends more on the parent's perception and previous experience with the child in many situations. When the child gets older and expose to more environment such as school, so the perception of the mother might be different from what the child performs in

the laboratory. However, this study used parent-report to assess child anger at 24 months which might not be differently exposed to other environment comparing to when the child was 12 months old.

Quality of mother-child interaction measurement

The Emotional Availability Scale (Biringen, 2008) is an observational measurement that measures six dimensions of dyadic mother-child interaction in controlled situation, including maternal sensitivity, maternal structuring, maternal non-intrusiveness, maternal non–hostility, child responsiveness, and child involvement.

Psychometric properties for the operationalization of emotional availability in the EA Scales has demonstrated acceptable level (Biringen et al., 2014). For instance, Ziv, Aviezer, Gini, Sagi, & Koren-Karie (2000) studied the association between EA scales (Biringen, Robinson, & Emde, 1993, as cited in Ziv et al., 2000) and infant's attachment relationship using the strange situation procedure (Ainsworth, Blehar, Waters, & Wall, 1978, as cited in Ziv et al., 2000) with 687, 12-month Israeli mother-child dyads. The results revealed that higher scores on the EA scale were associated with infant secure attachment and discriminated between insecure-ambivalent and secure attachment classifications, but not other forms of insecure attachment (e.g., avoidant, and disorganized infant). This study had some limitations. First,

when they categorized attachment style of the infants, only 2.5% (n = 17) , 6.5% (n = 44), and 2% (n = 13) of the total infants (N = 687) were categorized into avoidant, disorganized, and cannot classify subgroups, respectively ,which may cause a loss of statistical power due to small cell sizes (Keppel, 1982, as cited in Ziv et al., 2000). Moreover, they only observed emotional availability for 6 minutes in a free-play context, which might be too short to assess the quality of interaction. Biringen (2008) suggested that the observed session should be at least 20 minutes long, so real quality of interaction can be captured.

De Falco et al. (2014) conducted a longitudinal study with 25 mother-child dyads, and found significant correlations between EA scale 4th edition (measured at child's age 12 months) and Italian version of Attachment Q-sort (AQS; Weters,1987; Cassibba & D'Odorico, 2009, as cited in De Falco et al., 2014) (measured at child's age 18 months). They found positive correlation between AQS and maternal non-intrusiveness (r = .38, p < .05), and child responsiveness (r = .40, p < .05). The items in AQS mostly focus on the child, and usually ask about how the child is doing and responding to mother or any other situations during home observation context. For example, '*Child readily shares with mother or lets her hold things if she asks to*'. This item itself indicates if the child feels that mother asking to share is intrusive, or

not, and if it is intrusive, child may be unresponsive to that request (Weters, 1995). This result provides an example of convergent validity.

EA stability was observed across ages (18 to 24 months), when observations were in the same context at home. But stability of EA was not observed among children aged 39 months, when observed in a lab-session (Biringen, Matheny, Bretherton, Renouf, and Sherman, 2000). In contrast, Bornstein et al. (2010) found maternal sensitivity, structuring, and non - intrusiveness decreased on average from 5 to 20 months; however, maternal non – hostility, child responsiveness, and child involvement were not different between 5 and 20 months. This result suggests that when the child matures and becomes more challenging, the parent needs to do more to keep the child on the right track and may result in less sensitivity and more intrusive strategy to discipline the child. For example, when child becomes fussy because he cannot get what he wants, parents need to distract and may encourage the child to take part in another fun but appropriate activity. Additionally, they need to be sensitive and flexible enough to change the strategies if it does not work with the child. On the contrary, some parents may give up and let the child have what he wants or use physical punishment to stop the child. In sum, the EA scale can be used to capture changes in quality of mother-child interaction.

Maternal EA and child EA are analyzed as separate aspects of the EA scale; however, some studies analyze only the parent EA composite score by combining the scores of each subscale, based on internal consistency statistics because it is still a dyadic measure due to the nature of the EA Scales (Garvin, Tarullo, van Ryzin, and Gunnar, 2012). For example, in maternal non – intrusiveness scale, there is a subscale that observes whether a child feels that the parent is intrusive. If the child shows some sign, such as becoming silent when the mother takes a toy from the child's hands, then this subscale will be scored lower. Moreover, the EA scale system emphasized that mother cannot be rated as having a good level of sensitivity, without good responsiveness from the child, and vice versa. Therefore, this scale is looking for the overall quality of the interaction and does not count on a discrete amount or frequency of behaviors (Biringen, 2008; Biringen et al., 2014).

Even though the EA dimensions tend to be correlated by the scoring system, there might be some different patterns in the interaction. For example, mother can be seen as sensitive to child, but low in structuring if she does not guide enough age-appropriate tasks for the child during the interaction. She also receives high scores on non-intrusiveness and non-hostility, because she allows the child to do things freely, and there is no negative expression. The child may seem responsive to the mother but does

not initiate the interaction with the mother enough to get a high score. Therefore, this study will not create composite score for EA, but will select some dimensions relevant to development of child self-regulation.

Child self-regulation at 2 years old measurement

Child self-regulation at age 24 months is a critical period of developing internalized self-regulation (Kim & Kochanska, 2012). Children at this age develop inhibitory control skills and be able to show compliance to mother's requests.

Many studies have used a battery of behavioral tests of self-regulation for toddlerhood (Kochanska, Murray, & Harlan, 2000; Kochanska, Murray, & Coy, 1997), such as Snack delay task and Gift delay task in which children must show the ability to delay and suppress an impulse action and perform a subdominant response (e.g., Bernier et al., 2010; Kim & Kochanska, 2012).

Kochanska et al. (2000) found significant correlations between observed behavioral battery and mother-report of child's self-regulation. That is, children who performed better on the behavioral battery at 22 months were rated as high self-regulation by mothers, using a 13-item scale of inhibitory control from the Child Behavior Questionnaire at 33 months. Moreover, the delay tasks were found to be able to capture developmental

change in inhibitory control. As children matured, they can inhibit their behavior better, and wait significantly longer (Kochanska et al., 2000).

Similarly, Joyce et al. (2016) found marginal associations between Early Childhood Behavior Questionnaire Inhibitory Control scale at 24 months and inhibitory control, using crayon delay and tongue task at the same age. Child's internalization in the inhibition context is planned to observe children's ability to regulate their impulse without a cue of prohibition (Kochanska et al., 2001).

In a study by Kochanska et al. (2001), internalization of prohibition at 22 months (children were left alone in a room with attractive but prohibited toys) was associated with committed compliance with mother in toy prohibition task (mother is with the child in the room), which is another task to assess inhibitory control. However, in the sense of internalization, it is more about the child's abilities to self-regulate than external regulation.

In sum, research has shown how the child's intrinsic neurologic maturity, temperament, and mother-child interaction related to each other and affect the child self-regulation. Nature and nurture have complex interactions in every period of life that shape the way children develop self-regulated skills. Newborns have their own self-regulated ability that helps them balance between their physiological conditions and the external environment. The newborn's ability to balance between

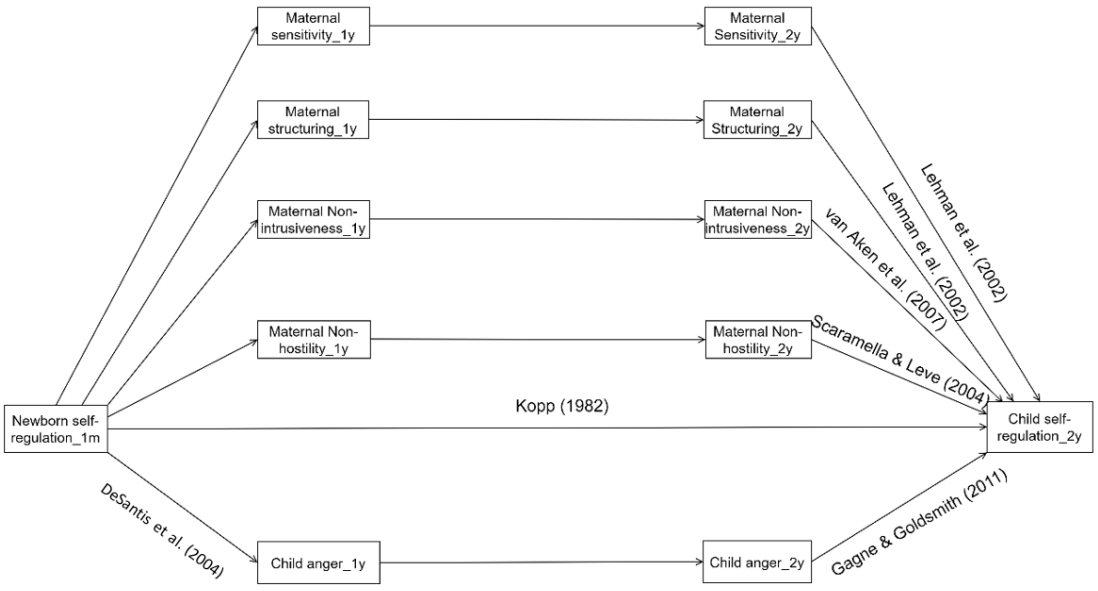
internal and external conditions consequently becomes their temperament. They communicate with caregivers by crying, fussing, or smiling to fulfill their internal needs. Children who have difficulties in maintaining homeostasis may exhibit excessive crying and be harder to console. The difficulty may result in negative maternal responses or lack of high quality of mother-child interaction. The lack quality of mother-child interaction may, in turn, result in lack of opportunity for the child to effectively learn to self-regulate. In sum, newborns who were born with neurophysiological self-regulation problem may develop into difficult temperament in infancy. Newborns who have difficulty to self-regulate, easily getting angry, and difficult to keep calm, may diminish a good relationship with their mother. The difficult temperament and lack of good quality of mother-child interaction may result in less chance to develop self-regulated skills.

Therefore, this present study would like to study on the relationship from newborn self-regulation to self-regulation at 2 years of age. The newborn self-regulation is in the neurophysiological modulation phase (birth to 3 months old). The self-regulation at 2 years of age is in the self-control phase (24 to 36 months old). To investigate the association between self-regulation from newborn to 2 years of age, the child anger temperament and quality of mother-child interaction at 12 months old (the control phase) and 24 months old (the self-control phase) are considered as mediators of the association between newborn self-regulation to child self-regulation at 2 years of age.

Current study

The present study is based on a hypothesis that newborn self-regulation at 1 month old causes an individual difference in child anger, maternal sensitivity, maternal structuring, maternal non-intrusiveness, and maternal non-hostility in the child at one year and continues at age 2. The child anger, maternal sensitivity, maternal structuring, maternal non-intrusiveness, and maternal non-hostility at 2 years affects child self-regulation at 2-years. The parallel-serial mediation model is used to present the study conceptual framework (Figure 3)

Figure 3 Conceptual framework of the study



Literature review of potential covariates in the current study

This study is a part of the Study of Asian Women and their Offspring's Development and Environment Exposure (SAWASDEE Study), which is designed to

examine the impact of prenatal exposure to organophosphates (OPs) on infant neurodevelopment. Because of the unique conditions, such as the level of prenatal pesticide exposure, and the unique culture of the participants in the SAWASDEE Study; therefore, pesticide exposure and cultural differences between two study locations needed to be controlled in the present study.

1. Pesticide exposure

Organophosphates (OPs) is the popular used insecticides among agriculture, even in Thailand (Panuwet et al., 2012). Many studies from many countries found prenatal exposure to OPs had adverse associations with attention, IQ, and mental development (Eskanezi et al., 2007; Marks et al., 2010; Rauh et al., 2012). Additionally, Rauh et al. (2012) found deformations in the dorsal and mesial surfaces of the left superior frontal gyrus, a region supporting higher-order cognitive functioning, including executive function which also relevant to self-regulated skills.

2. Cultural differences between two study locations

The SAWASDEE Study collected data in two different agricultural areas of Chiang Mai, Thailand. One area was at Chomthong district, and another one was a Fang district. Chomthong were mixed between suburban and rural lifestyles. In contrast, people in Fang were completely rural and many were tribal. The difference between rural and tribal is the self-identification

whether they belong to Thai nationality or a tribal people. The tribal have different social, cultural, and economic conditions from other sections of the national community. Their status is regulated wholly or partially by their own customs or traditions or by special laws or regulations (Errico, 2017). They are regarded as a minority and vulnerable; their accessibility to health care and other rights in Thailand nationality are limited.

Because of their vulnerable status, tribal members pay great respect and deference when they are in the presence of Thai officials. Therefore, self-regulation, especially inhibition, may be an important part of their lifestyles.

Research found that cultural differences were associated with development of self-regulation. Literature suggested that there were two types of socialization goals that can reflect on parenting practices which relevant to development of child self-regulation (Jaramillo, Rendón, Muñoz, Weis & Trommsdorff, 2017). The first socialization goal type is to preservation of social harmony, and the second one is to fulfill more on personal goal. Many studies found that the children who were in a culture that valued social harmony socialization goal, tended to be more compliant with mother's requests (Keller, Yovsi, Borke, Kärtner, Jensen, & Papaligoura, 2004; Lamm et al., 2018; Lewis et al., 2009).

Contributions of this study

1. Previous research of the interplay between intrinsic and extrinsic factors on child's self-regulation has been studied primarily among toddler and older children when the effects of intrinsic and extrinsic factors are already mixed. This study explored the developmental path, accordingly to Kopp's five phases of control, from intrinsic self-regulation from birth to child self-regulation at age 2 years that is mediated by child anger temperament as intrinsic, and maternal sensitivity, maternal structuring, and maternal non-intrusiveness as external environmental factors at two time points (1 and 2 years old).
2. This study explored both longitudinal and cross-sectional aspects, because the child anger temperament and quality of mother-child interaction will be assessed at child age of 1 and 2 years. In addition, the intrinsic and extrinsic influences at 1 and 2 years can be explored to determine at which age child anger temperament or dimensions of mother-child interactions are better predictors of later self-regulation. This can lead to an age-appropriate intervention for helping children who are at risk in the intrinsic or extrinsic influences relevant to self-regulation development.
3. Current research on child self-regulation focuses on the interplay between child's nature such as temperament and parent-child interactions, using direct observational measurements. Previously, many studies used questionnaires to evaluate child temperament, mother-child interaction, and child self-regulation.

However, self-report can be biased, especially by the reporter's condition and perception. Therefore, the present study depends on observational measurement to be more reflective of child anger temperament, mother-child interaction, and child self-regulation.

4. In contrast with previous studies that observed only the quality of mothers' behaviors or by mother self-report, in this study, mother-child interaction in the present study used the Emotional Availability scale which observes the dyad interaction in holistic view by considering both mother's response and child's response to each other as the core of the scoring system is interactive (Biringen, 2008).

Operational definitions

1. **Newborn self-regulation at 1 month old** refers to newborn's capacity to organize motor activity, physiology, state, and to respond to cuddling, consoling, and negative stimuli (Lester & Tronick, 2004). In this study, newborn self-regulation measured by NICU Network Neurobehavioral Scale (NNNS; Lester & Tronick, 2004). The higher score indicates better self-regulation in the newborn.
2. **Child anger at 1 year old** refers to intensity of anger/frustration reactivity that express on child's face, vocal, and body posture, in a goal-blocking situation. In this study, child anger at 1 year old measured by Attractive Toy Placed Behind Barrier (ATB) episode, which is one of the episodes in the Infant Laboratory

Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999). The higher score means high intensity of anger reactivity.

3. **Child anger at 2 years old** refers to the mother's report on the child's frustration/distress to limitations, which relevant to the negative affect related to confinement, interruption of ongoing tasks or goal blocking situations. In this study, child anger at 2 years old measured by Early Childhood Behavioral Questionnaire short form (ECBQ-sf; Putnam et al, 2010). The higher score means higher mother's report on child anger reactivity.
4. **Quality of mother-child interaction at 1 year and 2 years old** refers to the emotional expressions in an interaction between parent and child, in which both partners are attuned and responsive to a range of emotional exchange to the other (Biringen et al., 2005). In this study, quality of mother-child interaction measured by Emotional availability scale 4th edition, on maternal dimensions (Biringen, 2008). Maternal emotional availability consists of maternal sensitivity, maternal structuring, maternal non-intrusiveness, and maternal non-hostility. *Maternal sensitivity* refers to mother's genuine, congruence, relaxed, and gentle response to the child. Their emotional connection is healthy and secure. *Maternal structuring* refers to mother's providing guidance, or suggestion that move the child in an appropriate way, leading the child in a positive way. Maternal non-intrusiveness refers to mother's non-intrusive behavior, waiting for optimal breaks to enter interaction, rather than interrupting. Maternal non-

hostility refers to mother's behavior that does not use any negative expression in voice, face, and behaviors to interact with the child. The higher score means that mother provide better quality of mother-child interaction.

5. **Child self-regulation at 2 years old** refers to child's ability to inhibit their impulsive actions, or suppress a dominant response (Kochanska et al., 2001). In this study, child self-regulation measured by child's ability to wait longer for crayon until the experimenter came back (Crayon delay task), child's ability to wait for snack until the bell was rung (Snack delay task), and Child's internalization in inhibiting his/her behavior according to mother's prohibition (Prohibited toy task). The higher score means the child performs better self-regulation.

Aim of the study

To study the mediating effect of child anger temperament and quality of mother-child interaction on the relation between newborn self-regulation and self-regulation at 2 years.

Hypothesis

The relation between newborn self-regulation and child's self-regulation at 2 years is mediated by child anger temperament at 1 year old and 2 years old and quality of mother-child interaction at 1 year old and 2 years old.

Chapter 2

Methods

Participants

This study is a part of the Study of Asian Women and their Offspring's Development and Environment Exposure (SAWASDEE Study), which is a prospective birth cohort study designed to examine the impact of prenatal exposure to organophosphates (OPs) on infant neurodevelopment. This study certified an ethical clearance from Human Experimentation Committee, Research Institute for Health Sciences (RIHES), Chiang Mai University, Chiang Mai, Thailand (Appendix 1). Between AUG 2017 - FEB 2019, 1,291 pregnant women who presented at Chomthong or Fang hospital, Chiangmai were screened at their first antenatal care appointment. Both Chomthong and Fang are agricultural districts in Thailand. Three-hundred-ninety-four pregnant women who met the inclusion criteria listed in Table 1 were recruited for the study.

The pregnant women with abortion (n=21), blighted ovum (n=7), changed antenatal care (n=6), illness (n=6), moved out from the area (n=5), failure to return an appointment more than 3 visits (n=5), pregnancy problem (n=4), twin (n=3), GA more than 20 weeks by ultrasound (n=2), request to exit (n=1), and substance abuse (n=1), were excluded from the study. Therefore, 333 pregnant women delivered live

infants; however, infants whose GA was less than 32 weeks (n=1), birth weight less than 1,500 grams (n=2), who had frontal brain damaged (n=1), and had myelomeningocele (n = 1), moved out from the area (n=1), were excluded from this study after delivery according to the infant eligibility criteria (Table 1). In addition, participants who failed to return an appointment more than 3 visits (n=1) and failed to return an appointment at 1-month-old visit (n=4) were also excluded from this study. Therefore, total number of mothers and healthy infants that participated in this study was *322 mother-infant dyads*.

Table 1 Eligibility criteria for the SAWASDEE Study - pregnant women and child

	Pregnant women Eligibility criteria
1.	Age Between 18-40 years old
2.	Gestational age less than or equal to 20 weeks
3.	Have a farmer or agricultural occupation
4.	Have an ID card or have Universal Health Coverage Service for the hospital
5.	Planning to deliver at Chomthong hospital or Fang hospital
6.	Understand and speak Thai
7.	Healthy, (no diabetes, high blood pressure, Hepatitis B virus, syphilis, HIV infection and no psychiatric disorder)
8.	Live in district > 6 months and plan to reside there at least 3 years after delivery
9.	Consume alcohol less than 2 glasses per day
10.	Do not smoke or use drugs.
11.	No history of abortion, threatening or premature birth
12.	Single baby pregnancy (singleton)
13.	Agree to participate with informed consent
	Child Eligibility criteria
1.	Birth, gestation more than 32 weeks
2.	Baby weight after birth is more than 1,500 grams
3.	Healthy (no anomaly)

Average age of mothers when their child was 1 month was 25.02 years (*SD* = 5.28, range = 18 – 39 years) and child's average age at 1-month-old visit is 34.75 days (*SD* = 3.78, range = 25 - 50). They were 160 boys (49.7%) and 162 girls (50.3%). Among *322 mother-child dyads*, 216 dyads (67.1%) lived in Chomthong district, Chiangmai. The other 106 dyads (32.9%) lived in Fang district, Chiangmai. The participants of this study had diverse ethnicity, including Pakakoyo (n = 93, 28.9%), followed by Thai (n = 72, 22.4%), Hmong (n = 59, 18.3%), Lahu (n = 39, 12.1%), Dara-Ang (n = 36, 11.2%), and others (n = 23, 7.1%). The average family income was 10,640.78 baht per month (*SD* = 8338.05, range = 1,000 – 58,333). Most of the participants' family income were less than 15,000 baht per month (n = 249, 77.3%). Only 16 mothers (5%) reported that they earned more than 30,000 baht per month. Most mothers in this sample finished middle school (n = 110, 34.2%) as shown in Table 2.

Table 2 Demographic data (N = 322)

Variables		M (SD)	range	n	%
Mother's age (year)		25.02 (5.28)	18 - 39		
Child's age at T1 (day)		34.75 (3.78)	25 - 50		
Child's sex	Boy			160	49.7
	Girl			162	50.3
	Total			**322**	**100.0**
Location	Chomthong			216	67.1
	Fang			106	32.9
	Total			**322**	**100.0**
Ethnicity	Thai			72	22.4
	Hmong			59	18.3

	Pakakoyo			93	28.9
	Myanmar			1	0.3
	Dara-ang			36	11.2
	Lahu			39	12.1
Variables		M (SD)	range	n	%
	Tai-Yai			21	6.5
	Lua			1	0.3
	Total			**322**	**100.0**
Family income (baht/month)		10,640.78 (8338.05)	1,000 – 58,333		
	Less than 15,000			249	77.3
	15,000 – 30,000			57	17.7
	More than 30,000			16	5.0
	Total			**322**	**100**
Mother's education		**7**.96 (4.66)	0 - 16		
	No education			60	18.6
	Elementary school			51	15.8
	Middle school			110	34.2
	High school			67	20.8
	Vocational Certificate			14	4.3
	High Vocational Certificate			6	1.9
	Bachelor			14	4.3
	Total			**322**	**100.0**

Overview study procedure

Participants were recruited by screening for their first antenatal care at Chomthong hospital or Fang hospital, Chiangmai. Families who agreed to participate in the project were informed about the study and sign a consent form (Appendix 2). The participants visited the lab when their child was 1 month old, 1 year old, and 2 years old. Participants were compensated 600 Thai baht for the 1-month-old visit,

900 Thai baht for 1-year-old visit, and 600 Thai baht for the 2-year-old visit. The compensations were granted by NIH-Fogarty funded R21, titled “Impact of prenatal insecticide exposure on neurodevelopmental trajectories in a Thai birth cohort: building exposure science and neurodevelopmental research capacity in Thailand”.

The participants were reminded of the appointment for each visit 1 month before and 1 day before the appointed date. The 1-month-old visit lasted approximately 30 – 60 minutes. The testing procedure of 1-month-old visit was unique. There were 2 main activities for the 1-month-old visit, including (1) NNNS administration and (2) questionnaires and specimens’ collection. The order of the activities depended on conditions and states of the child. After both activities were done, participants were appointed to the next visit and received the compensation. Then the session was done for this visit. The detail of NNNS administration and scoring is in the following section of this chapter.

The 1-year-old and 2-year-old visits lasted approximately 120 – 180 minutes. These 2 visits had the same overall procedure which are listed as follows.

1. Psychologist greeted the mother and child when they arrived and brought them to the laboratory room.

2. Neuro check-in questionnaire was asked for screening overall child’s conditions, such as sleep hours, health conditions, and meals.

3. Psychologist left the mother and child for 10-minute free-play in the laboratory room. So, the child could become more familiar with the room.

4. After 10-minute free-play, the testing session started according to the measurements' procedure for each age visit.

5. Lastly, participants were appointed to the next visit and received the compensation.

Measurements

1. NICU Network Neurobehavioral Scale (NNNS) – Self-regulation subscale

In the present study, the NNNS was administered to infant subjects at approximately 1 month after delivery. Two nurses who were certified to administer the NNNS, performed the administration and coding. All the NNNS's items were administered in a quiet laboratory room with only the experimenter, the baby, and the mother present in the room, and the mother was instructed to keep quiet and seated at a corner in the room. However, this study only used self-regulation subscale from the NNNS.

1.1 NNNS Procedure

Even though, this study used only self-regulation subscale, all the NNNS items were administered according to NNNS manual. The

NNNS began with *preexamination observation* of respiration, color and tone. If the infant was sleeping, *habituation* items were administered. If not, the administration was continued with *unwrap and supine* package. The administration ended with *postexamination observation*. The NNNS was recommended to be administered in the same order for all infants; however, if the required state was not met, the examiner rearranged the package order, but maintained the items order within the package.

According to Lester & Tronick (2004), the NNNS consists of 115 items. Items are coded in 20 packages. However, the self-regulation subscale includes only 15 items which are in bold texts. (See Table 3, and 4 for more details).

Table 3 Sequential administered packages, state requirement, and items. (modified from Lester & Tronick, 2004)

Packages	State requirement	Items
Preexamination observation	1 - 5	1. Initial state observation (infant asleep and covered)
Habituation	1 – 2	2. Response decrement to light
	1 – 2	3. Response decrement to rattle
	1 – 2	4. Response decrement to bell
Unwrap and Supine	1 – 5	5. Posture
	1 – 5	6. Skin color
	1 – 5	7. Skin texture
	1 – 4	8. Movement
	1 – 4	9. Response decrement to tactile Stimulation of the foot
Lower Extremity Reflexes	3 – 5	10. Plantar grasp
	3 – 5	11. Babinski
	3 – 5	12. Ankle clonus
	3 – 5	13. Leg resistance
	3 – 5	14. Leg recoil
	3 – 5	15. Power of active leg movements
	3 – 5	16. Popliteal angle
Upper Extremities and Facial Reflexes	3 – 5	17. Scarf Sign
	3 – 5	18. Forearm resistance
	3 – 5	19. Forearm recoil
	3 – 5	20. Power of active arm movements
	3 – 5	21. Rooting
	3 – 5	22. Sucking
	3 – 5	23. Hand grasp
	3 – 5	24. Truncal tone
	3 – 5	**25. Pull-to-sit**
Upright Responses	3 – 5	26. Placing
	3 – 5	27. Stepping
	3 – 5	28. Ventral suspension
	3 – 5	29. Incurvation
Infant Prone	3 – 5	30. Crawling
	3 – 5	31. Stimulation needed
	3 – 5	32. Head raise in prone
Pick up Infant	4 – 5	**33. Cuddle in arm**
	4 – 5	**34. Cuddle on shoulder**
Infant Supine on Examiner's Lap		Orientation (order not predetermined):
	4 – 5	35. Inanimate visual
	4 – 5	36. Inanimate auditory

Packages	State requirement	Items
	4 – 5	37. Inanimate visual and auditory
	4 – 5	38. Animate visual
	4 – 5	39. Animate auditory
	4 – 5	40. Animate visual and auditory
Infant Spin	3 – 5	41. Tonic deviation of head and eyes
	3 – 5	42. Nystagmus
Infant Supine in Crib	3 – 5	**43. Defensive response**
	3 – 5	44. Asymmetrical tonic neck reflex
	3 – 5	45. Moro reflex
Postexamination Observation	1 – 6	64. Postexamination state observation

The NNNS procedures require that the packages be administered in the same order (as shown in Table 3), and the infant's state must be as the state requirement. There are 6 states: *State 1* - Sleep with regular breathing, eyes closed, no spontaneous activity except startles or jerky movements at quite regular intervals, *State 2* - Sleep with eyes closed, rapid eye movements can often be observed under closed lids, *State 3* - Drowsy or semidozing, *State 4* - Alert, eyes open with bright look and appropriate changes in facial expression as stimulation is varied, *State 5* - Eyes likely to be open, considerable motor activity, with thrusting movements of the extremities, and even a few spontaneous startles, and *State 6* – Crying longer than 15 seconds. Items in Table 4 are nonsequential, and were observed during the test, and coded following the infant's physiology, motor, behavior, and state.

Table 4 Nonsequential packages, state requirement, and items. (modified from Lester & Tronick, 2004)

Packages	State required	Items
Summary Items (this package is not presented in sequence)	4 – 5	46. Orientation: Handling Procedures
	4 – 5	**47. Alertness**
	4 – 5	**48. General Tone: Predominant Tone**
	4 – 5	**49. Motor Maturity**
	6 to 4-1	**50. Consolability With Intervention**
	1 – 6	51. Peak of Excitement
	1 – 6, With State 6 for at Least 15s	**52. Rapidity of Build-up**
	1 – 6	53. Irritability
	3 – 5	54. Spontaneous Activity
	3 – 5	55. Elicited Activity
	1 - 6	**56. Tremulousness**
	3 – 6	**57. Amount of Startle During Examination**
	1 – 6	**58. Lability of Skin Color as Infant Moves from States 1 to 6**
	1 - 6	**59. Lability of States**
	6 and 5 to 4 - 1	**60. Self-Quieting Activity**
	1 - 6	**61. Hand-to-Mouth Facility**
	1 - 6	62. First Predominant State
	1 – 6	63. Second Predominant State
	1 – 6	64. Postexamination-State Observation
	N/A	65. Order of Administration
Physiological	N/A	66. Labored breathing
		67. Nasal flaring
Autonomic	N/A	68. Sweating
		69. Spit-up
		70. Hiccoughing
		71. Sneezing
		72. Nasal stuffiness
		73. Yawning
CNS	N/A	74. Abnormal sucking
		75. Choreiform movements
		76. Athetoid postures and movements
		77. Tremors
		78. Cogwheel movements
		79. Startles
		80. Hypertonia
		81. Back arching
		82. Fisting
		83. Cortical thumb
		84. Myoclonic jerks
		85. Generalized seizures
		86. Abnormal posture
Skin	N/A	87. Pallor
		88. Mottling
		89. Paroxysmal Cyanosis (Lavidity)
		90. Overall cyanosis
		91. Circumoral cyanosis
		92. Periocular cyanosis
Visual	N/A	93. Gaze aversion during orientation
		94. Pull-down during orientation
		95. Fuss/cry during orientation

Packages	State required	Items
		96. Obligatory following during orientation 97. End point nystagmus during orientation 98. Sustained spontaneous nystagmus 99. Visual locking 100. Hyperalertness 101. Setting sun sign 102. Roving eye movements 103. Strabismus 104. Tight blinking 105. Other abnormal eye signs
Gastrointestinal	N/A	106. Gagging/choking 107. Loose stools, watery stools 108. Excessive gas, bowel sounds
State	N/A	109. High-pitch cry 110. Monotone-pitch cry 111. Weak cry 112. No cry 113. Extreme irritability 114. Abrupt state changes 115. Inability to achieve quiet awake state (state 4)

1.2 NNNS Materials

- standard 8-inch flashlight
- a red ball
- a red rattle
- a bell
- a foot probe
- head supports
- a watch
- the NNNS scoring form

1.3 NNNS Coding

The NNNS coding was done by the NNNS certified nurses. Inter-rater reliability was completed for 1 or 2 cases per month (**K** = .84–1.00). The coding of each self-regulation subscale items is as followed:

- 25. Pull to sit

This Item observed the extent that the newborn tries to maintain his/her head upright and how long the infant can do it. The highest score means newborn can maintain the head upright for 1 minute after seated. The lowest score means head lags or hypotonic and cannot sit up.

- 33. Cuddle in arm

- 34. Cuddle on shoulder

Item 33 and 34 are measure newborn's response to being held in alert state. The cuddliness is to see whether the newborn is able to initiate cuddling and can relax or mold, nestle, and cling to the experimenter, which enable the newborn to calm down and relax easier. The highest score means the newborn grasps and clings to the experimenter. The lowest score means the newborns resists being held, continuously pushing away.

- 43. Defensive response

This Item is to see newborn ability to adjust the environment be him/herself in the situation that his/her eyes and nose are covered lightly with a small cloth by the experimenter. The highest score means the newborn successfully removes the cloth by swiping at it. The lowest score means infant has no response.

- 47. Alertness

This Item measures newborn's alertness and responsiveness to stimuli. The score is indicated by the duration of the focused alertness and the latency of responsiveness. The highest score means the newborn always alert for most of examination; intensely and predictably alert. The lowest score means the newborn never alert and rarely or never responsive to direct stimulation.

- 48. General Tone: Predominant Tone

This item is to see newborn's tone. The newborn with typical tone is able to actively flex and extend the limbs which means that they can control their body to adjust internal and external arousal. The highest score means newborn's tone average when handle; lies with relaxed tone at rest. The lowest score means the newborn is hypertonic at rest (in flexion) and hypertonic all the time.

- 49. Motor Maturity

This item measures the quality of form of spontaneous and elicited arm movements by assessing smoothness versus jerkiness which reflecting the balance between flexors and extensors, and unrestricted versus restricted arcs. The highest score means the newborn's movement is smooth; unrestricted arcs of more than 90° all the time. The lowest score means the newborn has cogwheel-like jerkiness, over shooting of legs and arms in all directions.

- 50. Consolability With Intervention

This item measures the number of maneuvers the experimenter uses to bring the newborn from intensive crying to completely calm. The highest score is indicated by experimenter's face alone can completely calm the newborn. The lowest score means the newborn cannot console at all.

- 52. Rapidity of Build-up

This item measures the latency of first intense crying. The highest score means the newborn never upset. The lowest score means the newborn intensively cries at the very beginning and never be quiet enough to score this item.

- 56. Tremulousness

This item measures the number of times tremors of the newborn's limbs and chin are seen and in which state of the tremors are seen. This irritation may disrupt the newborn from sleeping or other activities. The highest score means no tremors. The lowest score means tremulousness is seen consistently and repeatedly in all states.

- 57. Amount of Startle During Examination

This item observes the number of newborn's startle. The highest score means no startles. The lowest score means ten or more startles, excluding Moro reflex.

- 58. Lability of Skin Color as Infant Moves from States 1 to 6

This item observes newborn's skin color changing. The highest score means skin color changes minimally during the examination. The lowest score means marked, rapid changes in skin color to very red and good color does not return during rest of examination, or newborn becomes pale and dusky during examination; color does not improve with handling.

- 59. Lability of States

This item measures the newborn's state performance over the examination period. Every definite state change over a recognizable period of at least 15 seconds is counted. The highest score means there are 3 to 5 state changes over the course of the examination. The lowest score means there are 0 to 2 state changes or more than 16 state changes over the course of the examination.

- 60. Self-Quieting Activity

This item measures the activity that newborn initiates in a crying or fussing state as an observable effort to quiet him/herself. The success of the activity is measured by an observational state change to calm state (state 4 or below) and persisting for at least 5 seconds. The highest score means newborn consistently quiets self for sustained periods and never needs console. The lowest score means newborn makes no attempt to quiet self and intervention always necessary.

- 61. Hand-to-Mouth Facility

This item measures the newborn's ability to bring hand to mouth as well as success in insertion. The hand-to-mouth is a reflex that newborn spontaneously attempts to control or comfort

him/herself when upset. The highest score means newborn's fist and/or fingers is inserted and the newborn sucks on them for 15 seconds or more. The lowest score means no attempt to bring hands to mouth.

The self-regulation subscale score is computed by NNNS scoring program.

1.4 NNNS Data reduction plan

Only self-regulation subscale score was used. The self-regulation subscale score is calculated by averaging scores (range from 1 to 9) from 15 items, include (Lester & Tronick, 2004).

2. Attractive toy placed behind a barrier (ATB)

The Attractive toy placed behind a barrier was used to measure child anger at 1-year-old time point. The test setting was modified from Laboratory temperament assessment battery (Lab-TAB) locomotor version 3.1 by Goldsmith & Rothbart (1999) to fit with Thai context. For example, a previous pilot study in Thailand found that Thai children in this age were too uncomfortable, if they were seated separately from their mother (Thanachotiwan, 2017). Therefore, in this study children were seated with their mother.

2.1 ATB Procedure

Two video cameras were used to record child's emotional reactivity, especially facial expression. One camera was placed to capture close-up facial expressions. Another camera was placed at the left side of the child. Child sat on mother's laps during the test. The test was divided into 3 trials. Each trial consisted of 15 seconds play phase and 30 seconds observed phase. The whole test was approximately 3 minutes long. Experimenter sat approximately 1 meter away to the child's left at the left side of the table. Before the beginning of the test, the experimenter informed mothers to try not to show their facial expression and to remain still during the test to keep maternal soothing at a minimum. The test began with experimenter showing how to play with the color rattle by shaking it, then let the child play freely with the rattle for 15 seconds (play phase). After 15 seconds, experimenter placed the Plexiglas on the table in front of the child and within the child's reach. The rattle was taken away at the end of the 15 seconds as well, and was placed behind the Plexiglas for 30 seconds. After first 30 seconds, the experimenter retrieved the rattle and started another trial all over again (play phase and observed phase). The rattle was returned to the

child after observed phase of the third trial to relieve any negative emotion that occurred during the test.

2.2 ATB Materials

- A colorful rattle
- 2 video cameras
- A Plexiglas barrier, size 31.25 cm x 40 cm
- Stopwatch

2.3 ATB Coding

Only observed phases were coded for this episode, and the coding begins when the experimenter releases his/her hand from the rattle after placing it behind the barrier. The observed episode was divided into 18 epochs, 5 seconds for each epoch. Child's intensity of facial anger, intensity of distress vocalization, intensity of struggling approach, and intensity of struggling withdrawal were coded as their anger expression in response to the eliciting frustration and anger event (see anger expression coding in Table 5). In case that some children were excessively frustrated, fussy, and could not cooperated with the administration, these children were coded with the highest anger expression score.

Table 5 Anger expression, coding, and observed behavior (modified from Goldsmith & Rothbart, 1999)

Anger expression	Coding	Behavior
Intensity of facial anger; *Examples of 3 facial regions movement,* *- Brows' inner corners are lower and drawn together* *- Eyes look tense or squinted* *- Mouth looks tense, wide open and squarish, or closes with lips pressed together*	0 1 2 3	No facial region shows codable movement Only 1 facial region shows codable anger movement, or expression is ambiguous Only 2 facial regions show codable anger movement, or movement is very clear in 1 facial region All 3 facial regions show codable anger movement, or coder has impression of strong anger
Intensity of distress vocalization	0 1 2 3 4 5	No distress Mild protest, may difficult to identify as hedonically negative Definite protest, limited to a short duration Longer protest, fussing, or mild intensity cry (rhythmic quality) Definite non-muted crying Full intensity cry, or scream (child is losing control)
Intensity of struggling approach	0 1 2 3 4	No movement towards barrier; C is passive Very low intensity of movement towards the barrier Moderate intensity of movement towards the barrier, High intensity movements towards the barrier Very high intensity of movement towards the barrier throughout the epochs, or child seems out of control
Intensity of struggling withdrawal	0 1 2 3 4	No movement towards barrier; C is passive Low intensity attempts to leave the chair 1 or 2 independent medium intensity attempts to leave the chair Repeated or higher intensity attempts to leave the chair Very high intensity of movement to leave the chair throughout the epochs, or child seems out of control

Inter-rater reliability of scoring was completed across three psychologists for 5 – 6 cases once a month. (**K** = .65-.95)

2.4 ATB Data reduction plan

This study adopted the data reduction plan from Planalp, Hulle, Gagne, & Goldsmith (2017). To create a composite score for all Lab-TAB's episodes in this study, first, *mean scores* of each anger expression item were calculated across 18 epochs, excluding epochs that could not see child's face clearly. Therefore, there are *4 anger expression mean scores*, which are (1) Intensity of facial anger mean score, (2) intensity of distress vocalization mean score, (3) intensity of struggling approach mean score, and (4) intensity of struggling withdrawal mean score. Second, peak reactivities (the highest intensity of expression) of the entire 18 epochs were coded for each anger expression item and were used as *peak scores*. Therefore, there are *4 anger expression peak scores*, which are (1) Intensity of facial anger peak score, (2) intensity of distress vocalization peak score, (3) intensity of struggling approach peak score, and (4) intensity of struggling withdrawal peak score. In case that the test could not be continued because the child refused by crying excessively, the highest anger scores were given to the child for the left test items. Finally, sum of all mean scores and peak scores were used for analysis as a composite score. The Cronbach's alpha of this measurement is .77, which indicates acceptable reliability. The higher score indicates more

intense and frequent occurrence of anger reactivity, and lower score indicates less intense and frequent occurrence of anger reactivity.

3. Early Childhood Behavior Questionnaire Short Form (ECBQ-sf)

The original ECBQ is a widely used parent-rating scale on child's temperamental behavior at age 18 – 36 months. The ECBQ subscales include *discomfort, fear, frustration/distress to limitation, motor activation, sadness, perceptual sensitivity, shyness, soothability, impulsivity, activity level, high intensity pleasure, sociablity, positive anticipation, inhibitory control, attention shifting, low intensity pleasure, cuddliness, attentional focusing* (Putnam, Gartstein, & Rothbart, 2006; Sukigara, Nakagawa, & Mizuno, 2015). However, the original version consists of 201 items and requires approximately 1 hour to finish all the questions, which is too exhaustive in research protocols (Putnam et al., 2010). The ECBQ-sf consists of 107 items. The ECBQ-sf is the shorten form of the original Early Childhood Behavioral Questionnaire (ECBQ) which consists of 201 items. The benefit of using ECBQ-sf instead of original ECBQ is that the short form has a smaller number of items but captures all factors and traits of child's temperament (Putnam et al, 2010). The ECBQ-sf was translated to Thai and backed translated by Suphasiree Chantavarin, Ph.D., lecturer from faculty of psychology, Chulalongkorn University, and has been reviewed by the SAWASDEE study's

principal investigators (Prof. Nancy Fiedler, Ph.D., and Assoc Prof. Panrapee Suttiwan, Ph.D.) and one of the developers of the ECBQ-sf (Prof. Samuel Putnam, Ph.D.)

3.1 ECBQ-sf Procedure

Mothers were asked to report on a 7-point Likert scale (1 = never; 4 = about half the time; 7 = always) about the frequency of specific child behaviors to a specific situation (e.g. “When s/he asked for something and you said “no”, how often did your child become frustrated?”; “When you mildly criticized or corrected her/his behavior, how often did your child get mad?”) Even though, this study uses only frustration/distress to limitations scale for analysis, mothers finished all the ECBQ-sf items.

3.2 ECBQ-sf Materials

- Thai version of Early Childhood Behavior Questionnaire – short form
- A pen

3.3 ECBQ-sf Coding

According to the scoring procedure document of ECBQ, the scores for items receiving a numerical response (do not include items marked "does not apply" or items receiving no response) from each

subscale was summed and divided by the number of items in the subscale that receiving a numerical response to yield a mean for the subscale score.

3.4 ECBQ-sf Data reduction plan

One trait of ECBQ-sf is the frustration/distress to limitations, which measures negative affect related to confinement, interruption of ongoing tasks or goal blocking and the internal consistency for the frustration/distress to limitations is acceptable (α = .78).

4. Emotional Availability Scale (EAS)

Emotional Availability Scale 4th edition (Biringen, 2008) was used to measure quality of mother-child interactions at 2 time-points (1-year-old, and 2-year-old). Two EAS coders have been trained and certified to use the EAS by the author of the EAS 4th edition to obtain satisfactory inter-rater reliability, and then between themselves once a month.

4.1 EAS Procedure

This test was separated into 2 parts, each part is 10 minutes long, and was assessed 2 times at child's age 1-year, and 2-year. First part was observed when mother brings the child to the laboratory room. This was to see if the mother can help the child play in the unfamiliar place and their interaction in the situation. The mother was

introduced and told that they could play freely with toys in the basket for 10 minutes, and they could play as they were at home. She was informed that their play would be recorded to see how the child usually plays. Then the experimenter left the room and started the clock. After 10 minutes the experimenter came back to the room and informed the mother to ask the child to clean up by putting the toys back in the basket. This was to elicit how the mother would guide the child to do something. Another part was observed when they had 10 minutes break during the laboratory session. This was to see their interaction when they became more familiar with the setting and the experimenter, and to see how the mother interacted with the child when they were not completely fresh. Therefore, the overall observation time was 20 minutes for each subject. The same set of toys were used across all ages. All the toys are usually found in their area, suitable for this age range, and can be applied many ways to play with the child.

4.2 EAS Materials

- a basket with toys (10 wooden blocks, a children soft book, 6 plastic fruits, a ball, a rattle)
- a video camera

4.3 EAS Coding

The direct scores range from 7 to 1. According to EA scale 4th edition manual (Biringen, 2008), the direct scores in EA scale system are construct based scales (See Table 6 for more information about the EA scale scoring system).

Table 6 EAS maternal dimensions, score range, Definition, and Example of observed behavior (modified from Biringen, 2008)

EA dimensions	Score range	Definition	Example
Maternal sensitivity	7 6 - 5.5	Highly sensitive Bland sensitive	- Genuine, congruence, relaxed, gentle, their connection is healthy and secure.
	5 – 4	Inconsistently sensitive/ apparently sensitive	- Apparent/unreal quality, sudden shift of behaviors, inconsistent
	3 - 2.5 2 – 1	Somewhat insensitive Highly insensitive	- Cool or detached, little or no connection, depressed withdrawn, traumatized affect
Maternal structuring	7 6 - 5.5	Optimal structuring Moderately structuring	- Providing guidance, or suggestion that move the child in an appropriate way, leading the child in a positive way
	5 – 4	Inconsistent structuring	- Inconsistent in providing guidance, try too hard that maternal loses the child from positive connection
	3 - 2.5 2 – 1	Somewhat unstructuring Non-optimal structuring	- Guidance, and appropriate leading is almost nonexistent
Maternal non-intrusiveness	7 6 - 5.5	Non-intrusiveness but emotionally present/available Generally, non-intrusiveness but sometimes benign forms of intrusiveness	- Waits for optimal breaks to enter interaction, rather than interrupting.
	5 – 4	Benign intrusiveness	- Verbally intrusive, a lot of don't
	3 - 2.5 2 – 1	Somewhat intrusive Intrusive	- Physically interrupt frequently, physically intrudes

EA dimensions	Score range	Definition	Example
Maternal non–hostility	7	Nonhostile	- Does not use any negative expression in voice, face, and behaviors
	6 - 5.5	Generally nonhostile	
	5 – 4	Covertly hostile	- There are subtle sign of stress or covert negative expression (e.g. huffing and puffing)
	3 - 2.5	Slightly overtly hostile	- Shows negative expression overtly
	2 – 1	Markedly and overtly hostile	

Inter-rater reliability was done across the two certified EAS psychologists for 5 – 6 cases once a month. The total inter-rater reliability cases are 20% of overall sample (ICC = .78 - .98).

4.4 EAS Data reduction plan

In this study, direct scores of maternal sensitivity, maternal structuring, maternal non-intrusiveness, and maternal hostility were analyzed as mediators in the study model.

5. Inhibitory control tasks

To assess child's self-regulation at 2-year-old time point, three inhibitory control tasks were used in this study, including (1) Crayon delay, (2) Snack delay, and (3) Prohibited toys task. The tests were administered in fixed order, starting with Crayon delay, Snack delay, and lastly Prohibited toys task. The child would have a 5-minute break between subtests for freshening. Mothers were always informed to not interact with the child during the test,

or if necessary, interact minimally such as telling the child to go back to the table.

5.1 Crayon delay (CD)

5.1.1 CD procedure

Child was seated on a chair at a child size table opposite the experimenter. Mother answered a questionnaire at another table with back turned to experimenter and child. If the child did not sit without the mother nearby, then mother could sit behind the child with clipboard and the questionnaire, and mother were informed that she could comfort the child to get back to the seat, but when the test starts no talking was allowed, and mother answered the questionnaire during the test. At the beginning of the test, child was invited to color, then experimenter put the opened box of crayons with a couple of crayons on the table and a paper within the child's reach. Experimenter explained "I need to go outside to find some things for a new game. Please do not touch the paper, crayons until I come back." After the instruction, experimenter left the child with crayons and paper for 60s, then came back to the room after 60s. Then the experimenter let the child coloring with crayons for 5 minutes.

5.1.2 CD Materials

- New box of crayons
- Blank paper
- A questionnaire (for the mother to do and not interrupt with the child.)
- 2 video cameras

5.1.3 CD Coding

Latency of the child touching the box. (range: 0-60): The experimenter starts the clock when the experimenter releases hand from the crayon. Higher score indicates that child can control their impulse and wait longer. Inter-rater reliability was done across three psychologists for 5 – 6 cases once a month. The total inter-rater reliability cases are 20% of the overall sample (ICC = .95 – 1.00).

5.2 Snack delay (SD)

5.2.1 SD procedure

This test consists of 4 trials with different delay times, which are 10s, 15s, 20s, and 30s, respectively. Prior to the test, child was seated on a chair at a child size table opposite to experimenter. Mother answered a questionnaire at another

table with back turned to experimenter and child. If child did not sit without mother nearby, then mother could sit behind the child with clipboard and the questionnaire, and mother was informed that she could comfort the child to get back to the seat, but when the test starts no talking allowed, and mother answered the questionnaire during the test.

When the setting was ready, the experimenter instructed the child "*Keep your hands on the table and wait to get the snack after the bell rings*". Put the snack under the transparent cup within the child reach, the bell was presented on the table, and was always in experimenter's control and out of the child reach. Starting the stopwatch when experimenter released hand from the cup, then experimenter waited for half of the delay times (5s, 7.5s,10s,15s), then lifted the bell but did not ring it. When the delay time for that trial was reached, experimenter rang the bell. Experimenter could encourage child, if he/she did not grab the snack after the bell rang. Starting next trial after child finished the snack. Experimenter reminded the instruction briefly to the child once again, started the trial following the same procedure with next delayed time.

If child became fussy and grabbed the snack before experimenter had a chance to mention the bell and give instruction, do not grab the snack back but let the child have the snack, note as task failure. Experimenter reminded the child that he/she had to wait then starts over. If child cannot start Trial 1 (10s delay) and became task failure for 3 consecutive trials, then the test stop. If child already starts some trials but then become fussy and task failure for 2 consecutive trials, then the test stop.

After the test is done mother and child were asked to have a break outside the laboratory room for 5 minutes.

5.2.2 SD Material

- Bread stick
- Transparent cup
- Bell
- 2 video cameras

5.2.3 SD Coding

Start the clock when experimenter releases hand from the cup. Coding rules were set based on (1) child's approaching behavior to the snack, the lowest range of score

was coded if the child eats the snack, and (2) latency of the lowest score approaching behavior. Coding for each trial is as following rules (Spinrad et al., 2007):

- *Give 1 point*: Child ate the snack before E lifted the bell.

- *Give 2 points*: Child ate the snack after E lifted the bell.

- *Give 3 points*: Child touched the snack before E lifted the bell.

- *Give 4 points*: Child touched the snack after E lifted the bell.

- *Give 5 points*: Child touched the cup or the plate before E lifted the bell.

- *Give 6 points*: Child touched the cup or the plate after E lifted the bell.

- *Give 7 point*: Child waited until the bell rang.

- If child gets 7 points, add *1 extra point* for keeping hands on the table sometime during waiting time.

- If child gets 7 points, add *2 extra points* for keeping hands on the table during the entire waiting time.

In case that the test could not be continued because the child refused by crying excessively, the lowest scores were given to the child for the left test items.

Averaged latency of the child retrieving the snack from 4 trials were used for data analysis. The range of score can be 0 to 9, in which higher score indicates higher inhibitory control. Inter-rater reliability was done across three psychologists for 5 – 6 cases once a month. The total inter-rater reliability cases are 20% of the overall sample (**K** = .85 – 1.00).

5.3 Prohibited toy task (PTT)

5.3.1 PTT Procedure

i. Mother-prohibited phase

Prior to the test before they enter the laboratory room, experimenter instructs the mother 'This test will be around 20 minutes. There will be a shelf with three toys in the room. The child won't allow to play with them during the test. You need to prohibit the child from the toys on the shelf and encourage the child to play only with the wooden shapes for the first 10 minutes.', then experimenter let them enter the room, and experimenter will be outside.

ii. Observed child's internalization of prohibition phase

After the first 10 minutes, experimenter enters the room and has mother say to the child: "Please play with the wooden shapes while I am doing this questionnaire. Do not touch or play with any of the toys on that shelf". Mother does a questionnaire at a table with back turned to child. Mother does a questionnaire at a table with back turned to child. Before experimenter leaves the room said to the mother "Please do not interaction or repetition of the commands. You can comfort your child with minimum interaction, if they become fussy, or cry". Experimenter said "I will be back after 5 minutes", then leaves. After 1st 1 minute passed, an unfamiliar female enters the room and plays with toys on the shelf for 1 min, and then leaves. The child is left alone again for 3 minutes. When experimenter returns to the room, allow the child to play with the prohibited toys for 5 minutes.

5.3.2 PTT Materials

- A shelf with three very attractive toys (prohibited toys)
- Plain wooden shapes
- An unfamiliar female

- 2 video cameras

5.3.3 PTT Coding

Child's behavior was coded for each 60 5s segments, using six mutually exclusive codes ranging from highest level of internalization to lowest level of internalization (Harden, Duncan, Morrison, Panlilio, & Clyman, 2015; Kochanska, Coy, & Murray, 2001):

- Give 6 points: Child engaged in sorting activity

- Give 5 points: Child engaged in other activity

- Give 4 points: Child looked at toys without touching

- Give 3 points: Child began to touch the prohibited toys and stopped spontaneously, or touching for less than 2 s.

- Give 2 points: Child touched the forbidden toys in gently manner, did not remove them from the shelf, nor engage in dramatic play with them.

- Give 1 point: Child played with the toys, removed from the shelf, or engaged in dramatic play with forbidden toys (Deviation).

In case that the test could not be continued because the child refused by crying excessively, the lowest scores were given to the child for the left test items.

Inter-rater reliability was done across three psychologists for 5 to 6 cases once a month. The total inter-rater reliability cases are 20% of the overall sample (**K** = .84 – 1.00).

5.3.4 PTT Data reduction plan

According to Kochanska et al. (2001) First, each of the coded behaviors were averaged by dividing the aggregated number of the behavior by the number of coded epochs in which the child moves freely around the room (60 minus the number of epochs on the mother's lap). The higher score indicates higher inhibitory control.

Inhibitory control tasks Data reduction plan

The inhibitory control tasks data reduction plan was conducted in 2 steps.

First, the scores of the crayon delay, snack delay, and prohibited toy task, were transform into *z*-scores. The correlations among the three inhibitory control tasks were more than .3 (see Table

7). the Kaiser-Meyer-Olkin measure of sampling adequacy was .64, which the commonly recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (3) = 79.59, p < .001). The communalities ranged from .53 - .58. These indicators suggested reasonable factorability.

Table 7 Correlation between inhibitory control tasks

	Crayon delay	Snack delay	Prohibited toy task
Crayon Delay	1		
Snack Delay	.370**	1	
Prohibited Toy Task	.317**	.326**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Second, principal component analysis was used to create a composite score. Initial eigen values indicated that the first factor can explain 55.83% of the variance, and only the first factor had an eigen value greater than 1.0. The factor-loadings across the three inhibitory control tasks ranged from .73 - .76, in which a minimum criterion of having a primary factor loading of .4 or above. Therefore, the composite score for inhibitory control tasks was the sum of the *z*-score of the three inhibitory control tasks. The Cronbach's alpha was .60. The Cronbach's alpha is sensitive to number of items. More items tend to improve Cronbach's alpha (Taber, 2018), so the Cronbach's

alpha .60 should be acceptable for internal consistency for only 3 items.

Plan of analysis

The data of this study were analyzed in 2 sections. Primarily, descriptive statistics were presented for 1-month, 1-year, and 2-year measures, including mean and SD of newborn self-regulation at 1 month old, child anger at 1 year and 2 years old, maternal sensitivity at 1 year and 2 years old, maternal structuring at 1 year and 2 years old, maternal non-intrusiveness at 1 year and 2 years old, maternal non-hostility at 1 year and 2 years old, and child self-regulation at 2 years old, as same as, the potential covariates, such as prenatal exposure to pesticide, location where the child was raised, family SES, and amount of time that mother spend with the child daily. Moreover, the attrition rates throughout the course of the investigation were reported. The t-test and chi-square were used to compared between completers (participants who complete all the evaluation time points) and noncompleters on all variables (Bridgett et al., 2011; Eisenberg et al., 2010). Correlation analysis of relations amongst the study variables and potential covariates were presented.

Secondly, the self-regulation developmental path from 1-month-old to 2-year-old and its mediators was explored with structural equation modeling (SEM)

using R program, lavaan package. The confirmatory factor analysis was used in verifying the existence of the latent variables construct.

Chapter 3

Result

The data were analyzed in 2 sections. The first section is preliminary analysis, including participants dropout and missing report, completers and non-completers comparison, descriptive statistics, and correlation analysis. The second section is structural equation model of the proposed model.

Preliminary analysis

This study collected participants' data in 3 time-points: 1 month old (Time 1), 1 year old (Time 2), and 2 years old (Time 3). The total sample size of this study is 322 mother-child dyads. Twenty-three dyads (7.14% of the total sample size) dropped out of the study due to missing sessions at both 1 and 2 years old. Therefore, *the total of **299** dyads were used for data analysis* in this study. However, from 299 dyads, there were 80 dyads who have some missing data due to missing a visit or missing data from some assessments. The missing data in this study were treated using full information maximum likelihood (FIML), an effective technique to deal with missing data in structural equation model by formulating the parameter estimates of the missing data from other variables in the sample data (Enders & Bandalos, 2001; Gustavson, Soest, Karevold, & Røysamb, 2012).

Participants' dropout or missing are common in longitudinal study. The missing and dropout rate approximately 30% is commonly reported in longitudinal

studies (Gustavson et al., 2012). However, there are concerns about bias of participants' missing data. For example, if missing participants are mostly found in low-income participants relative to higher income, this may bias the result of the study. Therefore, the *t*-test and chi-square were used to compared demographic data between completers (participants who complete all the measurements of all 3 time points) and non-completers (23 participants who dropout and 80 participants who missing some data). In this study, there were 219 completers (68.01% of the total sample size) and 103 non-completers (31.99% of the total sample size). Results from *t*-test and chi-square showed that there was no difference in demographic background between completers and non-completers as shown in Table 8 (more information about non-completers: dropout and missing are in Appendix 3).

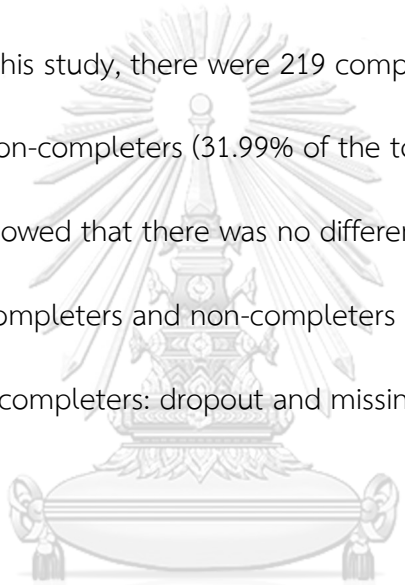


Table 8 Completers and non-completers comparison (N = 322)

Variables		Completers (n = 219)		Non-completers (n = 103)			
		n (%)	M (SD)	n (%)	M (SD)	*t*-test (*p*-value)	Chi-square (*p*-value)
Mothers' age (year)			25.01 (5.28)		25.05 (5.31)	-.06 (*ns*)	-
Mothers' education (year)			8.30 (4.42)		7.23 (5.10)	1.83 (*ns*)	-
Income			10,633.57 (8514.38)		10,656.70 (7978.33)	-.0.2 (*ns*)	-
Child's gender	Boy	108 (49.32)		52 (50.49)		-	.04 [a] (*ns*)
	Girl	111 (50.68)		51 (49.51)			
Location	CT	153 (69.86)		63 (61.17)		-	2.40 [b] (*ns*)
	FA	66 (30.14)		40 (38.83)			

ns = nonsignificant, $p > .05$, [a] = 2x2 Chi-square (boys and girls x completers and non-completers), [b] = 2x2 Chi-square (Chomthong and Fang x completers and non-completers)

In sum, the dataset that was analyzed in this study excluded participants who dropped out. Therefore, the total of 299 participants were included in the analysis. The missing data in this study were treated using full information maximum likelihood (FIML).

The child's age and child's gender at 3 time points are reported in Table 9. Child's gender across the 3 age points were approximately 50% boys and 50% girls.

Table 9 Descriptive statistics of sample size, child's age, and child's sex of 1 month old, 1 year old, and 2 years old (N = 299)

Variables		1 month old			1 year old			2 years old		
		n (%)	M (SD)	range	n (%)	M (SD)	range	n (%)	M (SD)	range
Child's age (days)			34.71 (3.86)	25 – 50 days		365.36 (14.86)	347 – 425 days		728.93 (15.41)	691 – 799 days
Child's gender	Boy	149 (49.8)			136 (48.57)			133 (49.44)		
	Girl	150 (50.2)			144 (51.43)			136 (50.56)		

Descriptive statistics of the study variables and potential covariates are shown in Table 10. The average score of NNNS's self-regulation subscale for this sample is 6.08; this score indicates that self-regulation at 1 month old of this sample is in the normal developmental range based on a US sample (Provenzi et al., 2018).

Child anger at 1 year old in this study range from 0 to 26, which indicated a wide range of emotional reactivity. The possible maximum of child anger at 1 year old is 32, so none of the children in this study met the maximum score. Most studies report mean in *z*-score, and did not report range of the score neither (e.g., Gagne & Goldsmith, 2011; Planalp et al, 2017). Therefore, there is a limitation of comparing the score with previous study.

According to Biringen (2008), the range of each dimension of emotional availability in this study indicated a wide range of maternal quality. However, none of the mothers in this study got the lowest scores that showed traumatized interaction

with the child. The average scores of maternal sensitivity dimension at both 1 year and 2 years old indicated that on average mothers in this study are in a range of inconsistent sensitive response to their child. Maternal structuring mean scores were less than 4 at both ages, which indicates relative lack of structure. Maternal non-intrusiveness mean scores were approximately 5, indicated benign intrusiveness. Maternal non-hostility mean scores indicated that on average mothers in our study were non-hostile.

The score of child self-regulation at 2 years old was calculated by averaging the z-score of 3 inhibitory control tasks, including Crayon delay, Snack delay, and Prohibited toy task. The means, SD, and range of each inhibitory control observational measurements are also reported in Table 10.

The sample in this study were from agricultural areas and worked on farms. The children in this sample were potentially exposed to neurotoxicants in pesticide, which have been found to adversely impact neurodevelopment (Eskenazi et al., 2007). Therefore, the descriptive statistics of the sum of dialkylphosphates (pesticide) across prenatal period are reported in Table 10, along with other potential covariates.

Table 10 Means, Standard deviation, and range of study variables and covariates

	N^	Mean	*SD*	range
Study variables				
1. newborn self-regulation_1m	298	6.08	.58	4.58 - 7.36
2. Child anger_1y	280	12.94	4.98	0.00 - 26.00
3. Maternal sensitivity_1y	249	4.70	1.12	2.00 - 7.00
4. Maternal structuring_1y	249	3.81	1.50	1.00 - 7.00
5. Maternal non-intrusiveness_1y	249	4.97	1.31	1.50 - 7.00
6. Maternal non-hostility_1y	249	5.64	1.23	2.50 - 7.00
7. Child anger_2y	268	4.55	1.17	1.00 - 7.00
8. Maternal sensitivity_2y	268	4.50	1.10	2.00 - 7.00
9. Maternal structuring_2y	268	3.81	1.31	1.00 - 7.00
10. Maternal non-intrusiveness_2y	268	5.26	1.11	2.50 - 7.00
11. Maternal non-hostility_2y	268	5.49	1.06	2.50 - 7.00
12. child self-regulation_2y[a]	269	-0.00	.75	-1.45 – 1.40
12.1 Crayon delay_2y	263	32.28	25.39	0.00 - 60.00
12.2 Snack delay_2y	266	4.63	2.61	1.00 - 9.00
12.3 Prohibited toy task_2y	268	3.10	1.40	1.00 - 5.71

	N^	Mean	*SD*	range
Covariates				
1. Pesticide (nmol/L)	299	4.63	.66	3.75 – 7.96
2. Mom with Child_1y (hours)	177	20.48	4.87	0 - 24
3. Mom with Child_2y (hours)	268	20.05	5.44	0 - 24
4. Income (baht)	289	10,578.83	8476.48	1000 – 58,333

^ = The sample sizes of each test were not equal because of dropout and missing data, 1m = at 1 month old, 1y = at 1 year old, 2y = at 2 years old, Pesticide = the sum of dialkylphosphates, Mom with Child = Hours that mother spent with child per day. [a] = An average of Crayon delay, Snack delay, and Prohibited toy task's *z* – score.

To investigate the correlations between study variables and to find potential covariates, the zero-order Pearson's correlations and Spearman Rho's correlations are presented in Table 11. The correlations between study variables showed that there were no significant correlations between newborn self-regulation at 1 month old and other study variables. Child self-regulation at 2 years old is negatively correlated with the child anger at 1 year old and is positively correlated with the maternal non-intrusiveness at 1 year old, child anger at 2 years old, maternal structuring at 2 years old, maternal non-intrusiveness at 2 years old, and maternal non-hostility at 2 years old. The correlations within the same variables across 1 and 2 years old (see correlations with underlines) showed that child anger at 1 year old positively correlated with child anger at 2 years old. Maternal sensitivity at 1 year old positively correlated with maternal sensitivity at 2 years old. Maternal structuring at 1 year old positively correlated with maternal structuring at 2 years old. Lastly, maternal non-hostility at 1 year old positively correlated with maternal non-hostility

at 2 years old. Additionally, the maternal sensitivity, maternal structuring, maternal non-intrusiveness, and maternal non-hostility tended to moderately correlate with each other concurrently (see correlations in the triangles).

To investigate the potential covariates (see correlations in the rectangle), correlations between covariates and predictor (newborn self-regulation at 1 month old) as well as outcome (child self-regulation at 2 years old) were examined at $p <$ .1. The correlations showed that mother's education in years and location were potential covariates. The mother's education in years correlated with both newborn self-regulation at 1 month old and child self-regulation at 2 years old. The location correlated with both newborn self-regulation at 1 month old and child self-regulation at 2 years old. Another potential covariate is the pesticide, which correlated with many child variables, including newborn self-regulation at 1 month old, child anger at 1 year old, and child anger at 2 years old. Therefore, prenatal pesticide exposure (the sum of dialkylphosphates), mother's education in years, and location were used as three covariates in the study model.

Table 11 Zero-order correlations between the study variables and covariates

	1. Newborn SR 1m	2. C.anger 1y	3. M.sensitivity 1y	4. M.structuring 1y	5. M.non-intrusive 1y	6. M.non-hostility 1y	7. C.anger 2y	8. M.sensitivity 2y	9. M.structuring 2y	10. M.non-intrusive 2y	11. M.non-hostility 2y	12. Child SR 2y
Study variables												
One-month-old												
1. Newborn self-regulation	1											
One-year-old												
2. Child anger	.04	1										
3. Maternal sensitivity	.04	.10	1									
4. Maternal structuring	.10	.11	.62**	1								
5. Maternal non-intrusiveness	.05	.09	.45**	.09	1							
6. Maternal non-hostility	.00	-.02	.56**	.26**	.51**	1						
Two-Year-old												
7. Child anger	-.06	.14*	.02	.02	.02	-.01	1					
8. Maternal sensitivity	-.02	.05	.13*	.12	.04	.13*	.01	1				
9. Maternal structuring	-.01	.15*	.20**	.20**	-.01	.13	.02	.70**	1			
10. Maternal non-intrusiveness	-.08	.08	.02	-.04	.09	.13*	-.04	.42**	.17**	1		
11. Maternal non-hostility	-.02	.07	.03	.01	.04	.13*	.03	.53**	.22**	.50**	1	
12. Child self-regulation	-.02	-.12*	.05	-.00	.16*	.09	-.04	.15*	.16*	.15*	.17**	1
Covariates												
13. Pesticide (nmol/L)	.13*	-.14*	-.11^	-.17**	-.05	-.01	-.12*	-.06	-.06	-.08	-.02	.09
14. Child gender[a, b]	.03	.11	.09	.13*	.02	.08	-.10	.05	.13*	-.02	.06	.02
15. Mom with child_1y	-.02	.08	-.04	-.01	-.00	-.06	.06	-.06	-.04	-.02	-.03	-.01
16. Mom with child_2y	.00	-.01	.02	-.02	.02	.03	.08	-.04	-.04	.03	.03	.10
18. Income (Baht)	-.06	-.07	-.02	.02	-.08	-.08	.01	.06	.13*	-.07	-.06	-.06
18. Mother's education (year)	-.15*	.12*	.12^	.14*	.01	.01	.13*	.23**	.21**	-.01	.04	-.20**
19. Location[a, c]	.24***	.00	.02	-.04	.16*	.11	.01	-.12	-.08	-.09	-.07	.39***

^$p < .1$, *$p < 0.05$ level. ** $p < 0.01$ level. *** $p < .001$

1m = at 1 month old, 1y = at 1 year old, 2y = at 2 years old, SR = self-regulation, Mom with child = Hours the mother spent with her child per day, [a] = Spearman's rho, [b] = Child gender (boy = 1, girl = 2), [c] = Location (Chomthong = 1, Fang = 2).

Covariates (continue)	13. Pesticide	14. Child gender	15. Mom with child_1y	16. Mom with child_2y	18. Income	18. Mother's edu	19. Location
13. Pesticide	1						
14. Child gender[a]	-.07	1					
15. Mom with child_1y	-.12	.10	1				
16. Mom with child_2y	.13*	-.00	.26**	1			
18. Income	.08	-.02	-.05	-.06	1		
18. Mother's education	-.26***	-.13*	.08	-.15*	.16**	1	
19. Location[a]	.35***	-.07	-.14	.15*	-.10	-.52***	1

^$p < .1$, *$p < 0.05$ level. ** $p < 0.01$ level. *** $p < .001$

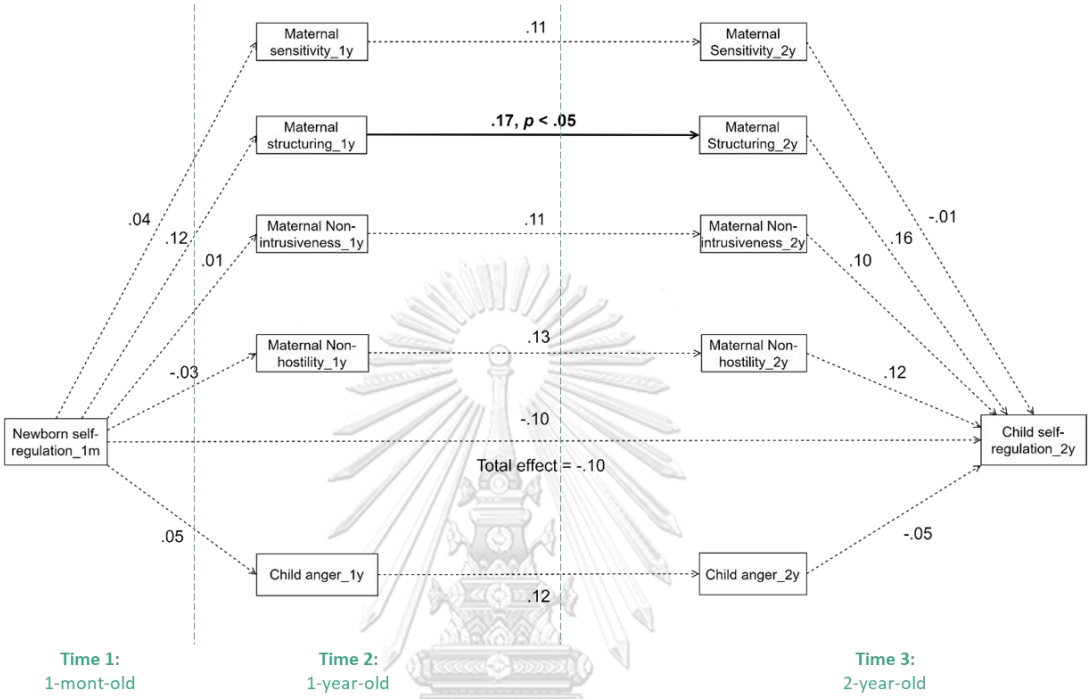
1m = at 1 month old, 1y = at 1 year old, 2y = at 2 years old, SR = self-regulation, Mom with child = Hours the mother spent with her child per day, [a] = Spearman's rho, [b] = Child gender (boy = 1, girl = 2), [c] = Location (Chomthong = 1, Fang = 2).

Study model analysis

In the final section, the self-regulation developmental path from 1 month to 2 years old and their mediators were explored with structural equation modeling (SEM), using R program, lavaan package, bootstrap = 5000. The full information maximum likelihood (FIML) was used as the missing data treatment.

From the proposed model in Figure 4, all the variables were analyzed as observed variables and were controlled for prenatal pesticide exposure, mother's education in years, and location.

Figure 4 The proposed study model with standardized path coefficients of direct effects and total effect.



Fit indices: $\chi^2(45, N = 299) = 708.333$, $p = .000$, CFI = .166, SRMR = .135, RMSEA = .222 with 90% CI [208, .237].

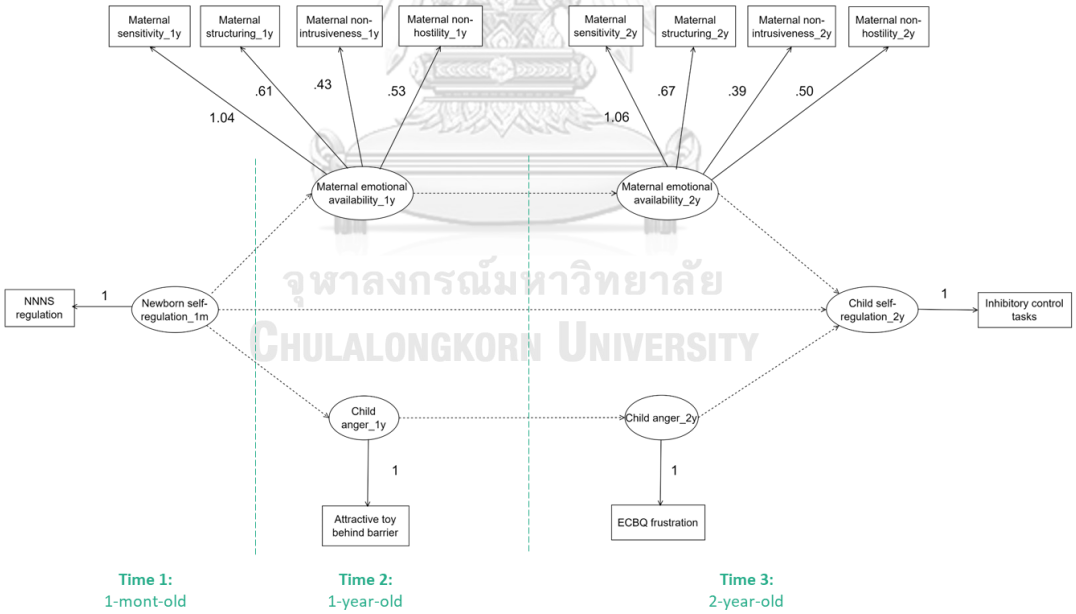
**This model controlled for prenatal pesticide exposure, mother's education in years, and location.*

Form the proposed model analysis (Figure 4), the fit indices of the model indicated unacceptable fit, which made this model's result unreliable, $\chi^2(45, N = 299) = 708.333$, $p = .000$, CFI = .166, SRMR = .135, RMSEA = .222 with 90% CI [208, .237].

Therefore, a revised study model was investigated. Modification indices suggested that maternal sensitivity, maternal structuring, maternal non-intrusiveness, and maternal non-hostility should be analyzed as latent variables at both 1-year-old

and 2-year-old. This might be because all the maternal emotional availability dimensions are based on how the mother provided emotional availability responses to the child. In addition, the correlations between maternal emotional availability dimensions are also correlated with each other (see triangles in Table 11). So, all the dimensions can load into one overall maternal emotional availability. A confirmatory factor analysis revealed acceptable fit between measurement model and the data, $\chi^2(43, N = 299) = 164.127$, $p = .000$, CFI = .831, SRMR = .070, RMSEA = .097 with 90% CI [.082, .113], as shown in Figure 5.

Figure 5 The first revised measurement model with factor loadings

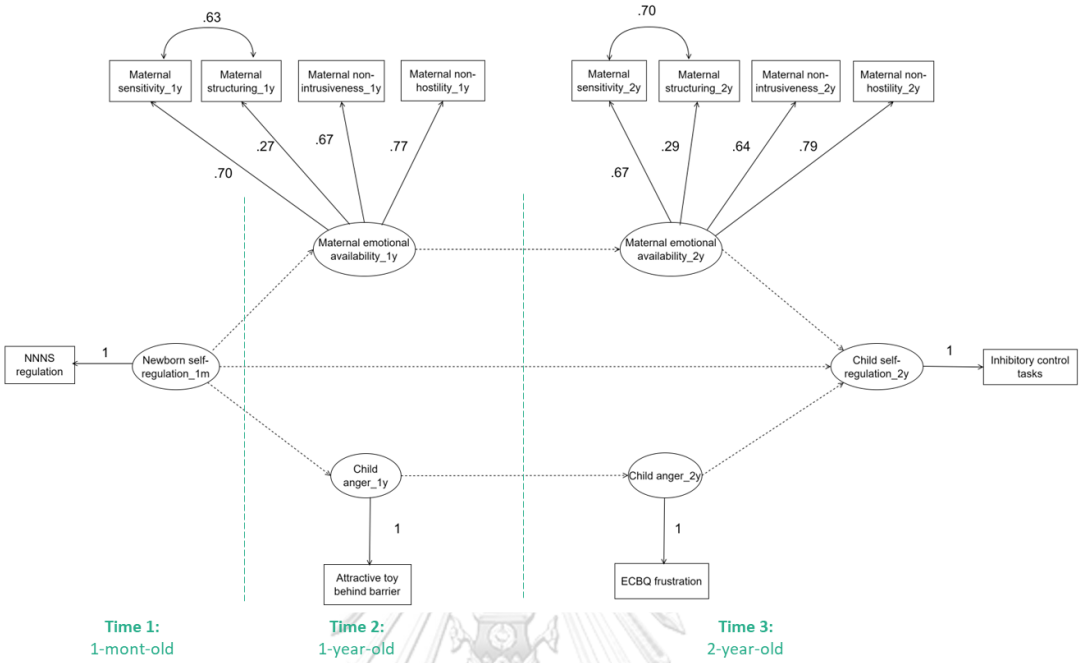


Fit indices: $\chi^2(43, N = 299) = 164.127$, $p = .000$, CFI = .831, SRMR = .070, RMSEA = .097 with 90% CI [082, .113].

**This model controlled for prenatal pesticide exposure, mother's education in years, and location.*

However, an inspection of modification indices suggested that estimating a parameter of residual covariance between maternal sensitivity and maternal structuring for both 1-year-old and 2-year-old would improve the model fit. This may be because sensitivity is a basis for good structuring. For example, mother would not get a high score on structuring if she was not sensitive enough to adjust her guidance based on the child's behavior. After estimating a parameter of residual covariance between maternal sensitivity and maternal structuring for both 1-year-old and 2-year-old, the expected correlations between maternal sensitivity and maternal structuring were .63 at 1 year old and .70 at 2 years old. The second revised measurement model yielded an acceptable global fit, $\chi^2(41, N = 299) = 63.094$, $p = .015$, CFI = .969, SRMR = .047, RMSEA = .042 with 90% CI [.019, .062] (Hu & Bentler, 1999), as shown in Figure 6.

Figure 6 The second revised measurement model with factor loadings and correlations between measurement residuals

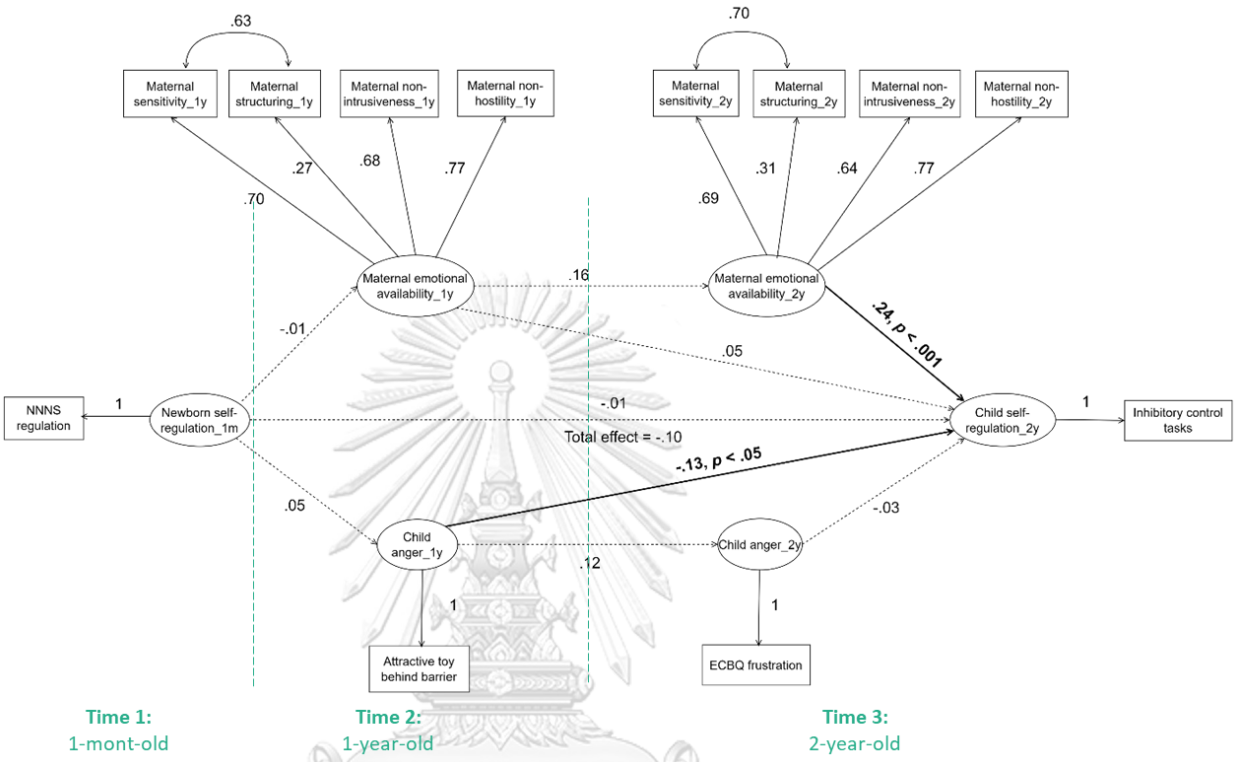


Fit indices: $\chi^2(41, N = 299) = 63.094$, p = .015, CFI = .969, SRMR = .047, RMSEA = .042 with 90% CI [019, .062].

**This model controlled for prenatal pesticide exposure, mother's education in years, and location.*

Therefore, the second revised measurement model was used in the final revised study model analysis to examine the association between newborn self-regulation at 1 month to child self-regulation at 2 years. In addition, to examine associations from mediators at 1 year old to the outcome, paths from mediators at 1 year to child self-regulation at 2 years were added into the revised study model as well (Figure 7).

Figure 7 The final revised study model with standardized path coefficients of direct effects and total effect, factor loading, and the correlation between measurement residuals.



Fit indices: $\chi^2(66, N = 299) = 119.956$, $p = .000$, CFI = .934, SRMR = .060, RMSEA = .052 with 90% CI [037, .067], $R^2 = 25.7\%$.

**This model controlled for prenatal pesticide exposure, mother's education in years, and location.*

Figure 7 shows the results of the final revised study model with an acceptable global fit, $\chi^2(66, N = 299) = 119.956$, $p = .000$, CFI = .934, SRMR = .060, RMSEA = .052 with 90% CI [.037, .067]. From the final revised study model analysis (Figure 7), two regression paths in this model were statistically significant and in the expected direction. The modification indices did not suggest any further regression paths. First, higher level of child anger at 1 year old predicted lower level of child

self-regulation at 2 years old. Second, lower level of maternal emotional availability at 2 years old predicted lower level of child self-regulation at 2 years old. Additionally, covariates in this study model had significant associations with some study variables. The location (Chomthong = 1, Fang = 2), was positively and significantly associated with maternal emotional availability at 1 year old, and child self-regulation at 2 years old. The prenatal pesticide exposure was not significantly associated with any study variables. Table 12 presented all path coefficients of the revised study model.

However, it showed that newborn self-regulation at 1 month old had no association with child self-regulation at 2 years old, and 4 mediators (i.e., child anger temperament at 1 year old and 2 years old and maternal emotional availability at 1 year old and 2 years old) were not mediators between newborn self-regulation at 1 month old and child-self-regulation at 2 years old in this model. The maternal emotional availability at 1 year old had no association with maternal emotional availability at 2 years old. Similarly, child anger at 1 year old had no association with child anger at 2 years old.

The coefficient of determination (R^2) indicates that 25.7% of the variance in child self-regulation at 2 years old can be explained by its predictors and covariates in the revised study model.

Table 12 Path coefficients, unstandardized estimations, standard error, standardized estimations, and 95% confident interval of revised study model.

Path coefficients	Estimate	*SE*	*p* - value	β	95% CI
Revised study model					
Newborn self-regulation_1m -> Child anger_1y	.40	.52	.44	.05	[-.65, 1.42]
Newborn self-regulation_1m -> Maternal EA_1y	-.01	.11	.94	-.01	[-.21, .20]
Newborn self-regulation_1m -> Child anger_2y	-.13	.12	.26	-.07	[-.36, .10]
Newborn self-regulation_1m -> Maternal EA_2y	-.03	.10	.74	-.03	[-.23, .16]
Newborn self-regulation_1m -> Child self-regulation_2y	-.12	.07	.11	-.09	[-.26, .03]
Child anger_1y -> Child anger_2y	.03	.02	.12	.12	[-.01, .06]
Child anger_1y -> Child self-regulation_2y	**-.02**	**.01**	**.046**	**-.13**	**[-.04, .00]**
Maternal EA_1y -> Maternal EA_2y	.16	.10	.12	.16	[-.03, .37]
Maternal EA_1y -> Child self-regulation_2y	.04	.08	.56	.05	[-.11, .20]
Child anger_2y -> Child self-regulation_2y	-.02	.04	.59	-.03	[-.10, .06]
Maternal EA_2y -> Child self-regulation_2y	**.24**	**.07**	**.000**	**.24**	**[.11, .38]**
Covariates					
Pesticide -> Child anger_1y	-.99	.52	.06	-.13	[-2.09, -.00]
Pesticide -> Child anger_2y	-.18	.13	.19	-.10	[-.45, .07]
Pesticide -> Maternal EA_1y	-.13	.10	.22	-.11	[-.33, .07]
Pesticide -> Maternal EA_2y	.01	.09	.95	.01	[-.17, .18]
Pesticide -> Child self-regulation_2y	-.09	.08	.27	-.08	[-.22, .08]
Mother education -> Child anger_1y	**.15**	**.07**	**.04**	**.14**	**[.01, .30]**
Mother education -> Child anger_2y	.03	.02	.11	.13	[-.01, .07]
Mother education -> Maternal EA_1y	.03	.01	.05	.18	[.00, .06]
Mother education -> Maternal EA_2y	.01	.02	.72	.04	[-.02, .04]
Mother education -> Child self-regulation_2y	-.00	.01	.90	-.01	[-.02, .02]
Location -> Child anger_1y	1.11	.81	.17	.10	[-.44, 2.74]
Location -> Child anger_2y	.28	.19	.15	.11	[-.01, .66]
Location -> Maternal EA_1y	**.49**	**.17**	**.003**	**.29**	**[.17, .82]**
Location -> Maternal EA_2y	-.19	.16	.23	-.12	[-.49, .11]
Location -> Child self-regulation_2y	**.72**	**.12**	**.000**	**.44**	**[.50, .96]**
Indirect					
Newborn SR_1m -> Child anger_1y -> Child anger_2y -> Child SR_2y	-.00	.00	.79	-.00	[-.00, .00]
Newborn SR_1m -> Maternal EA_1y -> Maternal EA_2y -> Child SR_2y	-.00	.01	.95	-.00	[-.01, .01]
Newborn SR_1m -> Child anger_1y -> Child SR_2y	-.01	.01	.52	-.01	[-.04, .01]
Newborn SR_1m -> Child anger_2y -> Child SR_2y	.00	.01	.71	.00	[-.01, .02]
Newborn SR_1m -> Maternal EA_1y -> Child SR_2y	-.00	.01	.97	-.00	[-.02, .02]

Path coefficients	Estimate[a]	*SE*	*p* - value	β[b]	95% CI
Newborn SR_1m -> Maternal EA_2y -> Child SR_2y	-.01	.03	.76	-.01	[-.06, .04]
Total effect	-.13	.07	.08	-.10	[-.27, .02]

[a] = unstandaradized estimations, [b] = standardized estimations, Bold indicates statistically significant path coefficients.

In sum, this study model, which consisted of 6 study variables and 3 covariates, found that lower level of child anger temperament at 1 year old and higher quality of mother-child interaction, indicated by maternal emotional availability at 2 years old, are significant predictors of higher level of child self-regulation at 2 years old. However, the child anger temperament and the quality of mother-child interaction at both ages were not the mediators of relation between the newborn self-regulation and child self-regulation at 2 years old.

Chapter 4

Discussion

The goal of this study was to investigate the association between newborn self-regulation at 1 month old and child self-regulation at 2 years old, with the child anger temperament and quality of mother-child interaction at 1 year and 2 years of age as mediators for child self-regulation.

We observed that lower child anger temperament at one year predicted higher self-regulation at 2 years and higher quality of mother-child interaction at two years also predicted better child self-regulation at two years. Furthermore, exploration of different cultures within our study also revealed differences in self-regulation at two years that can inform understanding of different parenting approaches. However, newborn self-regulation did not predict child self-regulation at two years and was not significantly associated with child anger temperament or quality of mother-child interaction at one or two years of age in this study model. Moreover, quality of mother-child interaction at one year and child anger temperament as reported by the primary caretaker at 2 years were not significantly associated with child self-regulation at 2 years.

Thus, the hypothesized mediation model was not supported by our data. However, our study findings are congruent with previous studies. For instance,

Geeraerts, Backer, & Stifter, (2020) found that infants with lower negative emotional reactivity combined with highly sensitive caregiving predicted better self-regulation at preschool age. Similarly, Kim & Kochanska (2012) found that highly negative emotion combined with unresponsive relationship with the mother were risk factors for lower child self-regulation.

Interestingly as we controlled the location variable, we found that location where the children were raised in this sample had significant association with quality of mother-child interaction at 1 year old and child self-regulation at 2 years old. The participants who lived in Fang seemed to have higher levels of quality of mother-child interaction and child self-regulation. This may be because of cultural differences between these 2 locations. This does not mean that living in more rural area would benefit children's self-regulation and other cognitive outcomes later in life. But to suggest that the difference between urban, suburban, and rural characteristics of their lifestyles and environments should be investigated further to understand its effect on child self-regulation. Some studies found that children who grew up in disadvantaged environments could be outperforming children in advantaged environment on self-regulation tasks, especially inhibitory control (Mousavi, & Gharibzadeh, 2022). For example, Lamm et al. (2018) found that Cameroonian Nso preschoolers, who lived in rural Cameroonian Nso farming family, could perform inhibitory control delayed task better than the urban German middle-class. They also suggested that mothers in Cameroonian Nso were more focused on

hierarchical relational socialization goals which supported the child's ability to inhibit their behavior more than child-centered parenting from German middle-class mothers. From these findings we can see that children who lived in disadvantaged and more hierarchical relational socialization goals, seemed to have better inhibitory control. So, the children who live in the hierarchical relational socialization may be advantaged in at least one basic dimension of self-regulation and executive function.

Therefore, if these children can access stimulating environments that promote other dimensions of self-regulation and executive function (i.e., cognitive flexibility and working memory), these children may be longitudinally outperforming children from socio-economic advantaged environments. Because they are calmer and can inhibit themselves better, they may be more ready to learn and improve further cognitive skills.

Newborn self-regulation did not predict child anger temperament, maternal emotional availability at both ages, and child self-regulation at 2 years old. This might be for several reasons. Newborn self-regulation scores from this sample are mostly in the range of normal development based on data from a US sample (Provenzi et al. 2018). When comparing the normative data with the scores in our study, the mean score of Thai newborn self-regulation is higher. The minimum and maximum scores of this study are higher than the scores from the normative data as well. This may indicate that newborns in our sample are at less risk for lower

neurobehavioral self-regulation at birth. Consequently, the NNNS measurement may be more effective to discriminate between newborns with normal development and newborns with developmental risk (e.g., preterm, low birth weight, or birth complication).

Usually, NNNS studies grouped newborns into NNNS profiles, rather than using the individual NNNS scales. Additionally, the mean score of newborn self-regulation in this study is comparable to self-regulation mean scores of newborns in normal development profile from other studies (Liu et al., 2010; Parikh et al., 2022; Sucharew et al., 2012). One reason is because we included subjects who were not at risk for developmental delay (i.e., gestation more than 32 weeks, weight after birth is more than 1,500 grams, and healthy, no anomaly). Second, measurements of self-regulation at birth and at 2 years old tap different aspects of self-regulation. NNNS self-regulation capture the newborn's capacity to organize motor activity, physiology, and state, to keep him/herself in calm state (Lester & Tronick, 2004). In constrast, self-regulation at 2 years requires children to inhibit impulsive responses, listen to instruction, and keep the instruction in mind to follow the instruction correctly. The self-regulation at 2 years old requires more cognitive abilities than newborn self-regulation which was more about physiological and state modulation.

Therefore, this finding suggested that it may be more effective to observe all aspects of the child's characteristics and neurodevelopmental signs to study its

impact on later mother-child interaction and developmental outcomes such as difficult temperament or self-regulation.

Discontinuity of child anger temperament at 1 year old and 2 years old

Our study found no association between child anger at one and two years. This might be because the measurements of child anger differ between one and two years. Child anger at 1 year was measured by direct observation but child anger at 2 years was parent-report.

As mentioned earlier using parent-report might be capturing more of the reporter's perception toward the child, rather than the level of child anger itself. Additionally, parent-reports provide an overall view across many situations, but the direct observation measures child's behavior in a specific situation. Previous studies also found inconsistency between using parent-report and direct observation (Gagne & Goldsmith, 2011; Planalp et al., 2017). So, if the goal of a study is to assess the child's general emotional expression in daily life or in general situations, it may be appropriate to measure by parent-report. However, this study focused on child's temperamental intensity of anger reactivity that will impact child self-regulated ability. So, the direct observation of child anger reactivity in a specific situation was preferred. Furthermore, the variables in this model were measured by direct observation. The main result of this study model found that direct observation of

child anger at 1 year predicted child self-regulation at 2 years, but the prediction could not be found from the parent-report to child self-regulation at 2 years.

Therefore, we suggested for further study that will focus on child's behavior or emotional reactivity should use direct observation in a situation that induce the same emotional aspect (i.e., goal-blocking situation) for all participants and across all time points. Then, we can see the consistent result from the same aspects of behaviors, which may have a clearer picture of the relations between child anger temperament and child self-regulation.

Continuity and discontinuity between quality of mother-child interaction at 1 and 2 years old

When looking at the correlation matrix (see table 11 in chapter 3) between each dimension of maternal emotional availability, 3 dimensions (maternal sensitivity, maternal structuring, and maternal non-hostility) were positively correlated across time.

Maternal non-intrusiveness was not correlated between 1 year old and 2 years old. Further investigation of paired *t*-test found that the quality of maternal sensitivity significantly decreased from 1 to 2 years old, $t(223) = 2.06$, $p < .05$. In contrast, the quality of maternal non-intrusiveness increased from 1 to 2 years old, $t(223) = -2.23$, $p < .05$. No difference was found between 1 and 2 years old in maternal structuring and maternal non-hostility, suggesting that maternal structuring

and maternal non-hostility tend to be stable from one to two years of age. However, this study found no association between the maternal emotional availability between one and 2 years old.

The decrease of maternal sensitivity score and increase in maternal non-intrusiveness suggested that mothers in this sample tended to be less responsive and less involved with the child at 2 years old. The mothers were less responsive and uninvolved resulting in lower scores on maternal sensitivity. The less responsive and uninvolved means that mother had less chance to be intrusive as well, so they got higher non-intrusiveness scores (Biringen, 2008).

These findings suggested that maternal behaviors toward the child could change across time. This may be due to child's developmental changes as well. When the child was 1 year old, mother might need to be more responsive and use more physical control to help or manage the child's behavior. However, at 2 years old, the child has more autonomy and can help him/herself to do things, so some mothers may be less involved and show less support. This change of the maternal emotional availability of some mothers may be relevant to the association between maternal emotional availability at 2 years to child self-regulation at 2 years old. Presumably, mothers who have consistently high emotional availability may confer advantages for child self-regulation. Mothers who provide lower emotional availability at 1 year old but get better at 2 years old may also improve child self-

regulation. Mothers who drop their quality of emotional availability may result in child's lower self-regulation. And mothers who show low emotional availability from the beginning at 1 year old may be most disadvantageous to the child self-regulation. Acknowledging the effect of pattern of change on child self-regulation may be helpful for designing effective interventions for each group. Moreover, these patterns of change may somehow be relevant to child anger temperament. Presumably, mothers who are with a highly anger reactivity child may decrease their sensitivity and involvement with the child.

The continuity and discontinuity of quality of mother-child interaction, measured by EAS, in this study expanded the age-relevance of mother-child interaction from previous studies (Biringen et al., 2000; Bornstein et al., 2010), on how maternal emotional availability continues or changes across 1 year and 2 years of age. So, we suggested that future research direction should investigate different patterns of change in maternal emotional availability which may differently effect the child self-regulation.

Correlations between child anger temperament and quality of mother-child interaction

Further investigation on the correlations between child anger temperament and quality of mother-child interaction (see table 11 in chapter 3) found that there was a small positive and significant correlation between child anger at 1 year and maternal structuring at 2 years ($r = .15$, $p < .05$). This positive correlation suggests that

higher child anger at 1 year old correlated with slightly better score of maternal structuring at 2 years old. However, the predictive association between child anger at 1 year old and overall quality of mother-child interaction at 2 years old was not observed in the full model. The positive correlation between child anger and maternal structuring is unexpected. Because previous studies found that child difficult temperament, including anger, tended to associate with less quality of mother-child interaction (Laukkanen et al., 2014; Shiner & Caspi, 2003). However, the correlation found in this study may suggest some potential relation between early child anger reactivity and later quality of mother-child interaction, especially maternal structuring. One potential assumption is that mothers of higher anger reactive child may have more experience dealing and guiding the child. So, in the long-term these mothers may gradually develop more effective strategies to guide their child. The moderating effects of infant anger temperament in the association between mother-child interaction at 1 year old, mother-child interaction at 2 years old, and child self-regulation at 2 years old are recommended for future study.

Even though, this study was performed with children in SAWASDEE study who were selected as healthy with emphasis on pesticide exposure as the predictor. However, results in this study clearly revealed that the prenatal pesticide exposure did not have any impact on child anger temperament or self-regulation during the first 2 years of life (see Table 12). Therefore, this study's findings may generalize and can apply to other healthy rural Thai infants. The measurements used and the

results of comparison in this study are from primarily western and US samples. This, thus, study suggesting that the direct observational measurements' protocol in this study was valid and can be used with Thai children. The results from this study may contribute to more data of child anger temperament, mother-child interaction, and development of child self-regulation in Thai culture. However, the participants in this study were limited to low income, agricultural, and rural families. This sample is homogeneous and lacks data from other socio-economic groups, occupations, and locations. Therefore, future study should explore with a broader range of participants.

In sum, these findings from the revised study model suggested that low level of child anger reactivity at 1 year old and high level of quality of mother-child interaction at 2 years old were the temperamental and maternal nurturing factors of better child self-regulation. These effects could be found even when controlled for prenatal pesticide exposure, mother's level of education, and cultural differences from where the child was raised. Additionally, the findings suggested valid assessments, normative data of Thai rural families and early time-points to assess or intervene the child temperamental risk and parental risk factors of child self-regulation.

Chapter 5

Conclusions, Limitations, and Suggestions

Purpose of this study

To study the mediating effect of child anger temperament and quality of mother-child interaction on the relation between newborn self-regulation to later self-regulation at 2 years old

Study variables

1. Predictor

The predictor of this study is newborn self-regulation measured when the child was 1 month old. This was to assess child's nature of self-regulated ability.

2. Mediators

The mediators in this study consist of 4 variables

2.1 Child anger temperament at 1 year old - This was to assess child anger reactivity at 1-year-old time point as a mediator in a developmental path of newborn self-regulation to child self-regulation at 2 years old.

2.2 Child anger temperament at 2 years old - This was to assess child anger reactivity as a mediator at 2-year-old time point in a developmental path of newborn self-regulation to child self-regulation at 2 years old.

2.3 Maternal emotional availability at 1 year old - This was to assess quality of mother-child interaction at 1-year-old time point, as a mediator in a developmental path of newborn self-regulation to child self-regulation at 2 years old.

2.4 Maternal emotional availability at 2 years old - This was to assess quality of mother-child interaction at 2-year-old time point as a mediator in a developmental path of newborn self-regulation to child self-regulation at 2 years old.

3. Outcome

The outcome of this study is child self-regulation measured when the child was 2 years old. This was to assess child self-regulated ability as the outcomes of long-term intrinsic (newborn self-regulation and child anger temperament) and extrinsic (quality of mother-child interaction) influences.

Research Hypothesis

The relation between newborn self-regulation and child's later self-regulation at 2 years old is mediated by child anger temperament and quality of mother-child interaction.

Participants

This study is a part of the Study of Asian Women and their Offspring's Development and Environment Exposure (SAWASDEE Study), which is a prospective

birth cohort study designed to examine the impact of prenatal exposure to OPs on infant neurodevelopment. The participants of this study were 322 mother-infant dyads. They were 160 boys (49.7%) and 162 girls (50.3%). Among 322 mother-child dyads, 216 dyads (67.1%) lived in Chomthong district, Chiangmai. The other 106 dyads (32.9%) lived in Fang district, Chiangmai.

Measurements

The measurements in this study consist of 7 measurements as follows:

1. Newborn self-regulation – measured by self-regulation subscale of NICU Network Neurobehavioral Scale (NNNS; Lester & Tronick, 2004)

2. Child anger temperament at 1 year old – measured by Attractive toy behind a barrier (ATB) episode of Laboratory temperament assessment battery (Lab-TAB) locomotor version 3.1 (Goldsmith & Rothbart, 1999)

3. Child anger temperament at 2 years old – measured by Frustration/distress to limitation subscale of Early Childhood Behavior Questionnaire Short Form (ECBQ-sf; Putnam, Gartstein, & Rothbart, 2010)

4. Quality of mother-child interaction at 1 year old and 2 years old – measured by Maternal dimensions of Emotional availability scale (EAS) 4th edition (Biringen, 2008)

5. Child self-regulation at 2 years old consists of 3 battery tests:

5.1 Crayon delay (Joyce et al., 2016)

5.2 Snack delay (Kochanska et al., 2001, Spinrad et al., 2007)

5.3 Prohibited toy task (Harden et al., 2015; Kochanska et al., 2001)

Procedures

1. Inclusion and exclusion - 1,291 pregnant women who presented at Chomthong hospital or Fang hospital, in Chiangmai Province were screened for their first antenatal care. Participants that were eligible for the study after delivery were *322 healthy mother-infant dyads*.

2. The participants were reminded of the appointment for each visit 1 month before and 1 day before the appointed date.

3. Session procedure were conducted, following the procedure for each age visit.

4. Lastly, participants were appointed to the next visit and received the compensation.

Data analysis

The descriptive statistics, completers and non-completers comparison, and correlation analysis were explored. The self-regulation developmental path from 1 month old to 2 years old and their mediators were explored with structural equation modeling (SEM), using R program, lavaan package, bootstrap = 5000. The full information maximum likelihood (FIML) was used as the missing data treatment.

Results

The total sample size of this study is 322 mother-child dyads. The attrition rate was 13.04% of overall subjects at 1 year old and 16.46% at 2 years old. In this study, the total of 299 dyads were included in analysis, and missing data were treated with full information maximum likelihood (FIML).

This study found association between child anger temperament at 1 month old and child self-regulation at 2 years old was found (β = -.13, p < .05). Moreover, an association between the quality of mother-child interaction at 2 years old and child self-regulation at 2 years old was found (β = .24, p < .001), even when controlled for prenatal pesticide exposure, mother's education, and locations (R^2 = 25.7%). However, the mediated model was not support by the data. No association between the newborn self-regulation to later child self-regulation at 2 years old. In addition, child anger temperament at 1 year and 2 years, and quality of mother-child interaction at 1 year and 2 years were not mediators between newborn self-regulation and self-regulation at 2 years old.

Limitations and suggestions

1. The NNNS latent profile analysis is recommended to be used to distinguish the characteristics of neurodevelopment as a nature of newborns, rather than using only a subscale score.

2. Even though this study's findings may generalize and can apply to other healthy rural Thai infants. However, the participants in this study were limited to low income, agricultural, and rural families. Therefore, future study should explore with more type of participants to establish normative data that can be apply for Thai populations.

3. This study used direct observation at 1 year old, but mother-report questionnaires to assess child anger temperament at 2 years old, which did not associate to child self-regulation at 2 years old. Future study should use a direct observational measurement to assess child anger temperament at both 1-year and 2-year time points. This is to clarify further information about how child anger temperament at both 1 year and 2 years effect on child self-regulation.

4. The moderation effect of child anger temperament on the relations of mother-child interaction, and child self-regulation, as well as moderation effect of mother-child interaction on the relation between child anger temperament and child self-regulation should be investigated further.

5. Further study should be investigated to child cognitive development outcomes later after 2 years old. The inhibitory control is just a fundamental of child self-regulation at early age. When children grow older the definition of self-regulation ability becomes more complex and need more cognitive function to perform more strategic and effective self-regulation, such as effortful control, planning, or cognitive

shifting. The further investigation will provide the full picture of the benefit of protecting the child from the risk factors at early stages.

6. This study suggested that associations between different patterns of change in quality of mother-child interaction and the development of child self-regulation should be studied further.

7. This study suggested that 1 year old might be a sensitive period for assessing the temperamental and maternal factors in development of child self-regulation. Future research on preventive early intervention for high anger child should be developed, such as quality of mother-child interaction enhancement program and effective parenting strategies for child anger control.

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REFERENCES

Appendix 1

Certificate of Ethical Clearance

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เอกสารเลขที่ 51/2562

เอกสารรับรองโครงการศึกษาวิจัยในมนุษย์
โดย
คณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่
ขอรับรองว่า

โครงการวิจัย: ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการดำเนินของการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด: การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย
(รหัสโครงการวิจัย : 21/59)

หัวหน้าโครงการวิจัย: ดร.ทิพวรรณ ประภามณฑล

สังกัด: สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่

ได้รับการพิจารณาให้ขยายเวลาในการศึกษาวิจัยตั้งแต่วันที่ **31 ตุลาคม 2562** ถึงวันที่ **30 ตุลาคม 2563**

รายการเอกสารที่รับรอง มีดังนี้

	รายการเอกสาร	**ฉบับที่/วันที่**
1.	โครงร่างการวิจัยฉบับสมบูรณ์ (ฉบับภาษาอังกฤษ)	1/2 ตุลาคม 2559
2.	แบบเสนอโครงร่างการวิจัยเพื่อขอรับการพิจารณาเชิงจริยธรรม (ฉบับภาษาไทย)	13/18 พฤาภาคม 2562
3.	เอกสารชี้แจงอาสาสมัครหญิงตั้งครรภ์และบุตร (ฉบับภาษาไทย)	11/1 กุมภาพันธ์ 2562
4.	เอกสารชี้แจงอาสาสมัครสามีหรือคู่สมรสของอาสาสมัครหญิงตั้งครรภ์ (ฉบับภาษาไทย)	2/27 มิถุนายน 2560
5.	เอกสารแสดงภาพเสมือนจริงการเก็บตัวอย่างเส้นผม (ฉบับภาษาไทย)	1/13 พฤศจิกายน 2560
6.	แบบคัดกรองอาสาสมัคร (ฉบับภาษาไทย)	3/17 กรกฎาคม 2561
7.	แบบสัมภาษณ์พื้นฐาน (สัมภาษณ์ทันทีหลังจากลงทะเบียน) (ฉบับภาษาไทย)	1/2 ตุลาคม 2559
8.	แบบสอบถามทางด้านความรู้ ทัศนคติและการใช้สารฆ่าศัตรูพืชและสัตว์ (KAPs) (ฉบับภาษาไทย)	2/5 กันยายน 2560
9.	เอกสารสรุปการนัดของโครงการ (ฉบับภาษาไทย)	4/1 กุมภาพันธ์ 2562
10.	สมุดบันทึกอาสาสมัคร (ฉบับภาษาไทย)	3/22 สิงหาคม 2561

รายการเอกสาร	ฉบับที่/วันที่
11. แผ่นพับประชาสัมพันธ์โครงการ (ฉบับภาษาไทย)	2/31 มกราคม 2561
12. เอกสาร First Trimester Questionnaire (ฉบับภาษาไทย)	1/25 กันยายน 2560
13. เอกสาร Second Trimester Questionnaire (ฉบับภาษาไทย)	1/25 กันยายน 2560
14. เอกสาร Third Trimester Questionnaire (ฉบับภาษาไทย)	1/25 กันยายน 2560
15. แบบสอบถามอาสาสมัครสามีหญิงตั้งครรภ์ (ฉบับภาษาไทย)	1/27 มิถุนายน 2560
16. บัตรนัด (ฉบับภาษาไทย)	2/31 มกราคม 2561
17. แบบสอบถามวัดภาวะสุขภาพจิต (ฉบับภาษาไทย)	1/14 มีนาคม 2561
18. แบบสอบถามก่อนการตรวจวัดพัฒนาการโครงการสวัสดี (ฉบับภาษาไทย)	1/30 พฤษภาคม 2561
19. แบบสอบถามก่อนการตรวจวัดพัฒนาการโครงการสวัสดี (ฉบับภาษาอังกฤษ)	1/30 พฤษภาคม 2561
20. เอกสาร Initial Childhood Exposure Questionnaire (ฉบับภาษาไทย)	1/8 สิงหาคม 2561
21. เอกสาร Initial Childhood Exposure Questionnaire (ฉบับภาษาอังกฤษ)	1/8 สิงหาคม 2561
22. เอกสาร Follow-up Childhood Exposure Questionnaire (ฉบับภาษาไทย)	1/8 สิงหาคม 2561
23. เอกสาร Follow-up Childhood Exposure Questionnaire (ฉบับภาษาอังกฤษ)	1/8 สิงหาคม 2561
24. แบบประเมินพฤติกรรมทารก (ฉบับภาษาไทย)	2/23 สิงหาคม 2561
25. แบบประเมินพฤติกรรมเด็กเล็ก (ฉบับภาษาไทย)	2/23 สิงหาคม 2561
26. แบบสอบถามข้อมูลพื้นฐานของอาสาสมัคร Intake (ฉบับภาษาไทย)	2/5 กันยายน 2560

(ลงชื่อ).....

(รองศาสตราจารย์ ดร.นิมิตร มรกต)

ประธานคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์

(ลงชื่อ).....

(ศาสตราจารย์ นายแพทย์ขวัญชัย ศุภรัตน์ภิญโญ)

ผู้อำนวยการสถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่

เอกสารเลขที่ 63/2563

เอกสารรับรองโครงการศึกษาวิจัยในมนุษย์
โดย
คณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่
ขอรับรองว่า

โครงการวิจัย: ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการดำเนินของการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด: การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย
(รหัสโครงการวิจัย : 21/59)

หัวหน้าโครงการวิจัย: ดร.ทิพวรรณ ประภามณฑล

สังกัด: สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่

ได้รับการพิจารณาให้ขยายเวลาในการศึกษาวิจัยตั้งแต่วันที่ **31 ตุลาคม 2563** ถึงวันที่ **30 ตุลาคม 2564**

รายการเอกสารที่รับรอง มีดังนี้

	รายการเอกสาร	**ฉบับที่/วันที่**
1.	แบบเสนอโครงร่างการวิจัยเพื่อขอรับการพิจารณาเชิงจริยธรรม (ฉบับภาษาไทย)	14/28 สิงหาคม 2562
2.	สมุดบันทึกอาสาสมัคร (ฉบับภาษาไทย)	3/22 สิงหาคม 2561
3.	แบบสัมภาษณ์ Follow-up Childhood Exposure Questionnaire (ฉบับภาษาไทย)	1/8 สิงหาคม 2561
4.	แบบสัมภาษณ์ Follow-up Childhood Exposure Questionnaire (ฉบับภาษาอังกฤษ)	1/8 สิงหาคม 2561

รายการเอกสาร	ฉบับที่/วันที่
5. แบบประเมินพฤติกรรมทารก (ฉบับภาษาไทย)	2/23 สิงหาคม 2561
6. แบบประเมินพฤติกรรมเด็กเล็ก (ฉบับภาษาไทย)	2/23 สิงหาคม 2561

(ลงชื่อ).....

(รองศาสตราจารย์ ดร.นิมิตร มรกต)
ประธานคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์

การปฏิบัติหลังการรับรอง

1. โปรดส่งรายงานความก้าวหน้าของการวิจัยอย่างน้อยปีละครั้ง
2. ต้องขอต่ออายุก่อนเอกสารรับรองโครงการวิจัยสิ้นสุดอายุประมาณ 3 เดือน หากจะดำเนินการวิจัยต่อ
3. หากจะแก้ไขเปลี่ยนแปลงในข้อมูลผู้ป่วยหรือใบยินยอมหรือโครงการวิจัย ต้องขออนุมัติก่อนเว้นแต่ว่าเป็นเรื่องเร่งด่วนเพื่อสวัสดิภาพของอาสาสมัคร
4. หากมีข้อมูลใหม่หรือเหตุการณ์ใดๆ ที่อาจมีผลต่ออัตราส่วนระหว่างผลประโยชน์/ความเสี่ยงของการศึกษาวิจัย ให้รายงานต่อคณะกรรมการโดยรีบด่วน
5. การเบี่ยงเบน/ฝ่าฝืนโครงการวิจัย ต้องแจ้งคณะกรรมการจริยธรรมการวิจัยทุกครั้ง
6. โปรดส่งรายงานการสิ้นสุดโครงการวิจัยภายใน 3 เดือน หลังจากโครงการวิจัยเสร็จสิ้นลงแล้วหรือเอกสารรับรองโครงการวิจัยสิ้นสุดลง
7. หากเกิดเหตุการณ์ไม่พึงประสงค์ adverse drug reactions ที่ร้ายแรงและไม่คาดคิดต้องรายงานให้คณะกรรมการฯ ทราบทันที

การปฏิบัติหลังการรับรอง

1. โปรดส่งรายงานความก้าวหน้าของการวิจัยอย่างน้อยปีละครั้ง
2. ต้องขออนุมัติขยายเวลาก่อนเอกสารรับรองโครงการวิจัยสิ้นสุดอายุประมาณ 3 เดือน หากจะดำเนินการวิจัยต่อ
3. หากจะแก้ไขเปลี่ยนแปลงในข้อมูลผู้ป่วยหรือใบยินยอมหรือโครงการวิจัย ต้องขออนุมัติก่อนเว้นแต่ว่าเป็นเรื่องเร่งด่วนเพื่อสวัสดิภาพของอาสาสมัคร
4. หากมีข้อมูลใหม่หรือเหตุการณ์ใดๆ ที่อาจมีผลต่ออัตราส่วนระหว่างผลประโยชน์/ความเสี่ยงของการศึกษาวิจัย ให้รายงานต่อคณะกรรมการโดยรีบด่วน
5. การเบี่ยงเบน/ฝ่าฝืนโครงการวิจัย ต้องแจ้งคณะกรรมการจริยธรรมการวิจัยทุกครั้ง
6. โปรดส่งรายงานการสิ้นสุดโครงการวิจัยภายใน 3 เดือน หลังจากโครงการวิจัยเสร็จสิ้นลงแล้วหรือเอกสารรับรองโครงการวิจัยสิ้นสุดลง
7. หากเกิดเหตุการณ์ไม่พึงประสงค์ adverse drug reactions ที่ร้ายแรงและไม่คาดคิดต้องรายงานให้คณะกรรมการฯ ทราบทันที

๔.๒.๒
๓๙

บันทึกข้อความ

ส่วนราชการ สถาบันวิจัยวิทยาศาสตร์สุขภาพ โทร ๓๖๑๙๘ ต่อ ๓๖๐
ที่ อว ๘๓๙๓(๒๗)/ ๗๔๐๙ **วันที่** ๑๕ ตุลาคม ๒๕๖๒
เรื่อง ผลการพิจารณาของคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
เรียน ผู้อำนวยการสถาบันวิจัยวิทยาศาสตร์สุขภาพ

ตามที่ สถาบันวิจัยวิทยาศาสตร์สุขภาพได้เสนอขอพิจารณาการปรับปรุงแก้ไขและเพิ่มเติมโครงการวิจัยภายหลังได้รับการรับรองจากคณะกรรมการฯ ของโครงการวิจัย "ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการดำเนินของการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด: การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย(Impact of prenatal insecticide exposure on neurodevelopmental trajectories in a Thai birth cohort: building exposure science and neurodevelopmental research capacity in Thailand)" **(รหัสโครงการวิจัย: 21/59)** โดยมี ดร.ทิพวรรณ ประภามณฑล เป็นหัวหน้าโครงการวิจัย ตามรายละเอียดบันทึกข้อความสถาบันวิจัยวิทยาศาสตร์สุขภาพ ที่ อว ๘๓๙๓(๒๗)/๒๐๙๗ ลงวันที่ ๒ กันยายน ๒๕๖๒ นั้น

จากการประชุมคณะกรรมการฯ ครั้งที่ ๙/๒๕๖๒ วันที่ ๒๖ กันยายน ๒๕๖๒ คณะกรรมการฯ มีมติ ดังนี้

๑. เห็นชอบการปรับปรุงแก้ไขและเพิ่มเติมโครงการวิจัย
๒. เห็นชอบเอกสารดังนี้
   ๒.๑ แบบเสนอโครงร่างการวิจัยเพื่อขอรับการพิจารณาเชิงจริยธรรม ฉบับที่ ๑๔ วันที่ ๒๘ สิงหาคม ๒๕๖๒ (ฉบับภาษาไทย)
   ๒.๒ เอกสารชี้แจงอาสาสมัครหญิงตั้งครรภ์และบุตร ฉบับที่ ๑๒ วันที่ ๒๘ สิงหาคม ๒๕๖๒ (ฉบับภาษาไทย)
   ๒.๓ เอกสารสรุปการนัดของโครงการ ฉบับที่ ๕ วันที่ ๒๘ สิงหาคม ๒๕๖๒ (ฉบับภาษาไทย)
๓. ขอให้ชี้แจงว่าการถอนตัวของอาสาสมัคร จากเหตุการณ์ไม่พึงประสงค์ ๕๖ คน เกี่ยวเนื่องกับอะไร

จึงเรียนมาเพื่อโปรดทราบ และโปรดแจ้งให้ผู้เกี่ยวข้องได้รับทราบ เพื่อพิจารณาดำเนินการในส่วนที่เกี่ยวข้องต่อไปด้วย จักขอบคุณยิ่ง

(รองศาสตราจารย์ ดร.นิมิตร มรกต)
ประธานคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
สถาบันวิจัยวิทยาศาสตร์สุขภาพ

บันทึกข้อความ

ส่วนราชการ สถาบันวิจัยวิทยาศาสตร์สุขภาพ **โทร** ๐๖๑๓๕๘ ต่อ ๓๖๐
ที่ อว ๘๓๙๓(๒๗)/๐๑๐๔ **วันที่** ๑๔ มกราคม ๒๕๖๔
เรื่อง ผลการพิจารณาของคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
เรียน ผู้อำนวยการสถาบันวิจัยวิทยาศาสตร์สุขภาพ

ตามที่ สถาบันวิจัยวิทยาศาสตร์สุขภาพ ได้เสนอพิจารณาการปรับปรุงแก้ไขและชี้แจงเพิ่มเติมโครงการวิจัยตามข้อเสนอแนะของคณะกรรมการฯ (หนังสือผลพิจารณาของคณะกรรมการฯ ที่ อว 8393(27)/2842 ลงวันที่ 25 ธันวาคม 2563) ของโครงการวิจัย "ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการดำเนินของการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด: การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย(Impact of prenatal insecticide exposure on neurodevelopmental trajectories in a Thai birth cohort: building exposure science and neurodevelopmental research capacity in Thailand)" **(รหัสโครงการวิจัย: 21/59)** โดยมี ดร.ทิพวรรณ ประภามณฑล เป็นหัวหน้าโครงการวิจัย ตามรายละเอียดบันทึกข้อความสถาบันวิจัยวิทยาศาสตร์สุขภาพ ที่ อว 8393(27)/2866 ลงวันที่ 29 ธันวาคม 2563 นั้น

คณะกรรมการฯ ได้พิจารณาแล้วมีมติ ดังนี้

1. เห็นชอบการชี้แจงและปรับปรุงแก้ไข
2. เห็นชอบเอกสาร ดังนี้
   2.1 แบบเสนอโครงร่างการวิจัยเพื่อขอรับการพิจารณาเชิงจริยธรรม ฉบับที่ 15 วันที่ 23 พฤศจิกายน 2563 (ฉบับภาษาไทย)
   2.2 ภาคผนวก 21 รูปแบบและตัวอย่างการประเมินพัฒนาการเด็ก (ฉบับภาษาไทย)
   2.3 เอกสารชี้แจงและแสดงความยินยอม (เพิ่มเติม) สำหรับการบันทึกภาพและเสียง ฉบับที่ 1 วันที่ 28 สิงหาคม 2563 (ฉบับภาษาไทย)
   2.4 ADDENDUN: Consent to Audio-/Visually Record Subjects version dated 18 February 2020 (ฉบับภาษาอังกฤษ)
3. รับทราบเอกสาร IRB MODIFICATION APPROVAL version 21 July 2020 (ฉบับภาษาอังกฤษ)

จึงเรียนมาเพื่อโปรดทราบ และโปรดแจ้งให้ผู้เกี่ยวข้องได้รับทราบ เพื่อพิจารณาดำเนินการในส่วนที่เกี่ยวข้องต่อไปด้วย จักขอบคุณยิ่ง

(รองศาสตราจารย์ ดร.นิมิตร มรกต)
ประธานคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
สถาบันวิจัยวิทยาศาสตร์สุขภาพ

เลขานุการ
- เพื่อโปรดทราบ
- เห็นควรแจ้งโครงการวิจัยเพื่อทราบต่อไป
๑๔ ม.ค. ๒๕๖๔
- ทราบ
- ดำเนินการตามเสนอ ๑๔ ม.ค. ๒๕๖๔

Appendix 2

Consent Form

เอกสารชี้แจงอาสาสมัครหญิงตั้งครรภ์และบุตร

โครงการวิจัย

"ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด : การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย หรือ โครงการสวัสดี"

โครงการวิจัยจะแนะนำข้อมูลของโครงการวิจัยเพื่อประกอบการตัดสินใจของท่านในการเข้าร่วมเป็นอาสาสมัครของโครงการนี้ ซึ่งท่านสามารถตัดสินใจอย่างอิสระและสามารถปรึกษาครอบครัวหรือคนใกล้ชิดเกี่ยวกับการเข้าร่วมโครงการของท่าน วัตถุประสงค์ของโครงการนี้ เพื่อจะศึกษาสุขภาพของหญิงตั้งครรภ์และบุตรจนกระทั่งอายุ 3 ปี ที่มีการสัมผัสสารฆ่าแมลงขณะทำงานเกษตรกรรม ซึ่งการสัมผัสดังกล่าวนี้อาจส่งผลกระทบต่อสุขภาพของท่านและบุตรได้

โครงการวิจัยได้ทาบทามท่านให้เข้าร่วมโครงการเนื่องจากท่านมีคุณสมบัติตรงตามเกณฑ์ของโครงการวิจัย ได้แก่ มีอายุครรภ์ในขณะนี้น้อยกว่า 20 สัปดาห์ มีอายุอยู่ในช่วง 18 - 40 ปี มีบัตรประจำตัวประชาชน หรือบัตรแสดงสิทธิการใช้บริการโรงพยาบาล และอาศัยในพื้นที่วิจัยมากกว่า 6 เดือน ดังนั้น โครงการวิจัยจึงอยากจะเชิญท่านและบุตรเข้าร่วมเป็นอาสาสมัครของโครงการนี้ ซึ่งจะเริ่มตั้งแต่ขณะที่ท่านตั้งครรภ์นี้ไปจนกระทั่งบุตรคลอดและมีอายุ 3 ปี

ต่อไปนี้จะเป็นรายละเอียดวัตถุประสงค์และสิ่งที่ท่านต้องปฏิบัติหากท่านตัดสินใจเข้าร่วมโครงการวิจัยนี้

<u>ทำไมต้องทำโครงการวิจัยนี้ ?</u>

การสัมผัสสารฆ่าแมลงที่ใช้ในทางเกษตรกรรมอาจก่อให้เกิดความเสี่ยงต่อสุขภาพของท่านและบุตร โครงการวิจัยนี้จะศึกษาผลกระทบของการสัมผัสสารดังกล่าวในช่วงที่ท่านตั้งครรภ์และช่วงที่บุตรของท่านมีอายุถึง 3 ปี ผลของโครงการวิจัยนี้จะช่วยให้นักวิจัยเข้าใจปัญหาสุขภาพที่เกิดจากการสัมผัสสารฆ่าแมลงระหว่างตั้งครรภ์ได้ดีขึ้น และจะให้ประโยชน์ต่อชุมชนและสังคม โดยเฉพาะหญิงตั้งครรภ์และบุตรที่จะเกิดมา

โครงการวิจัยนี้ได้รับการสนับสนุนจากสถาบันสุขภาพแห่งชาติของประเทศสหรัฐอเมริกา ซึ่งนักวิจัยไม่ได้รับเงินค่าตอบแทนใดๆ จากผลการวิจัยของโครงการนี้

โครงการวิจัยนี้ได้ผ่านการอนุมัติให้ดำเนินงานจากคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์ สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่ และคณะกรรมการจริยธรรมการวิจัยในคน มหาวิทยาลัยเอมมอรี ประเทศสหรัฐอเมริกา เรียบร้อยแล้ว

<u>มีใครที่เข้าร่วมโครงการวิจัยนี้บ้าง ?</u>

โครงการวิจัยนี้ จะรับอาสาสมัครหญิงตั้งครรภ์พร้อมสามี และบุตรจำนวน 400 คน ใน 2 อำเภอของจังหวัดเชียงใหม่ ได้แก่ จอมทอง และฝาง

หากท่านตัดสินใจจะเข้าร่วมเป็นอาสาสมัครของโครงการวิจัยนี้ ท่านจะต้องปฏิบัติดังต่อไปนี้

- มาตามนัดฝากครรภ์ของโรงพยาบาลเพื่อตอบแบบสัมภาษณ์ : ในช่วงที่ท่านตั้งครรภ์ เจ้าหน้าที่โครงการวิจัยจะขอนัดท่านตามนัดฝากครรภ์ของโรงพยาบาลจำนวน 5 ครั้ง ได้แก่ เมื่อท่านเริ่มเข้าโครงการครั้งแรก และเมื่ออายุครรภ์เท่ากับ 16, 28, 32 และ 36 สัปดาห์ ขึ้นอยู่กับนัดของโรงพยาบาล ในแต่ละครั้ง เจ้าหน้าที่โครงการวิจัยจะถามแบบสัมภาษณ์ท่านเกี่ยวกับข้อมูลทั่วไป การบริโภคอาหาร ประวัติการตั้งครรภ์และสุขภาพของท่าน และความคิดเห็น ทัศนคติ และวิธีการใช้สารฆ่าแมลง และเมื่อท่านคลอดบุตร โครงการวิจัยจะขอข้อมูลจากแพทย์เกี่ยวกับรายละเอียดของการคลอดบุตรของท่าน หากพบว่าท่านมีปัญหาสุขภาพ เจ้าหน้าที่โครงการวิจัยจะให้แพทย์วินิจฉัยและให้การรักษาท่านทันที
- เก็บตัวอย่างปัสสาวะ: ในช่วงที่ท่านตั้งครรภ์ โครงการวิจัยจะขอเก็บตัวอย่างปัสสาวะในแต่ละครั้งที่ท่านมาตามนัดฝากครรภ์ของโรงพยาบาล คือ เก็บตัวอย่างปัสสาวะ เมื่อเข้าร่วมโครงการวิจัยครั้งแรก และเมื่อมาตามนัดของโรงพยาบาลในช่วงอายุครรภ์ 16, 20, 28, 32 และ 36 สัปดาห์ เจ้าหน้าที่โครงการวิจัยจะแจกภาชนะเก็บตัวอย่างและอธิบายวิธีการเก็บตัวอย่างปัสสาวะให้แก่ท่าน จากนั้นจะแช่เย็นเพื่อนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ
- เก็บตัวอย่างเลือด: โครงการวิจัยจะขอเก็บตัวอย่างเลือดจากท่านทั้งหมด 4 ครั้ง ได้แก่ เมื่อท่านเริ่มเข้าโครงการครั้งแรก และเมื่ออายุครรภ์เท่ากับ 20 และ 32 สัปดาห์ และตัวอย่างเลือดจากสายสะดือเมื่อท่านคลอดบุตร โดยแต่ละครั้งจะเก็บประมาณ 3 ช้อนชา ในการเจาะเลือดจะทำโดยพยาบาลที่มีความชำนาญ ท่านมีโอกาสจะเกิดอาการเจ็บ เลือดออก ช้ำจากการเจาะเลือด อาการบวมบริเวณที่เจาะเลือดหรือหน้ามืด และโอกาสจะเกิดการติดเชื้อบริเวณที่เจาะเลือดซึ่งพบได้น้อยมาก เนื่องจากผู้วิจัยใช้อุปกรณ์การเจาะเลือดใหม่และปลอดเชื้อ ซึ่งพยาบาลจะติดเทปติดแผลให้ท่าน ในการเก็บเลือดจากสายสะดือ จะเก็บเลือดขณะที่ตัดสายสะดือในห้องคลอด ตัวอย่างเลือดนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ
- เก็บตัวอย่างเส้นผม: โครงการวิจัยจะเก็บตัวอย่างเส้นผมบริเวณท้ายทอย (occipital position) จำนวนประมาณ 100 เส้น โดยการแบ่งกระจุกผมเป็นมัดเล็ก ๆ ตั้งแต่ 2 กระจุกขึ้นไป แล้วตัดให้ชิดกับรากผมมากที่สุด จำนวน 3 ครั้ง เมื่อเข้าร่วมโครงการวิจัยครั้งแรก และ เมื่ออายุครรภ์ 20 และ 32 สัปดาห์ เพื่อจะนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ
- เก็บตัวอย่างจุลินทรีย์: โดยทั่วไปร่างกายของเราจะมีจุลินทรีย์อาศัยอยู่ตามธรรมชาติ เมื่อได้รับสารพิษอาจทำให้จุลินทรีย์เหล่านี้ก็ส่งผลกระทบต่อท่าน โครงการวิจัยจะขอเก็บตัวอย่างจุลินทรีย์จากเนื้อเยื่อกระพุ้งแก้ม ช่องคลอดและทวารหนักของท่านไปตรวจเพื่อศึกษาผลกระทบที่เกิดจากการสัมผัสสารพิษของท่าน ซึ่งอาจส่งผลต่อพัฒนาของบุตรท่าน โครงการวิจัยจะขอเก็บตัวอย่างจากเนื้อเยื่อจากกระพุ้งแก้ม ช่องคลอดและทวารหนักจำนวน 3 ครั้ง ได้แก่ เมื่อท่านเริ่มเข้าโครงการครั้งแรก และ

เมื่ออายุครรภ์ 20 และ 32 สัปดาห์ขึ้นอยู่กับนัดของโรงพยาบาล ในแต่ละครั้ง การเก็บตัวอย่างเนื้อเยื่อกระพุ้งแก้มจะใช้ไม้พันสำลีเช็ดที่กระพุ้งแก้มทั้ง 2 ข้าง ประมาณ 4–5 ครั้ง ส่วนการเก็บตัวอย่างนั้นจะเก็บโดยให้ท่านใช้สำลีพันไม้กวาดบริเวณผนังช่องคลอดและทวารหนักด้วยตนเอง โดยพยาบาลโครงการวิจัยที่มีความชำนาญคอยดูแลและให้คำแนะนำ อย่างไรก็ตาม หากท่านไม่ยินยอม โครงการวิจัยจะไม่เก็บตัวอย่างจุลินทรีย์จากท่าน

- <u>เก็บตัวอย่างขี้เทา</u>: โครงการวิจัยจะขอเก็บขี้เทาจากบุตรของท่านจากผ้าอ้อมที่ท่านใช้ ขี้เทาเป็นสารที่สะสมในลำไส้ของทารกขณะอยู่ในครรภ์ ซึ่งสามารถนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการได้
- <u>เก็บตัวอย่างรก</u>: โครงการวิจัยจะขอเก็บรกของบุตรท่านขณะที่อยู่ในห้องคลอด จะทำโดยพยาบาลผู้ชำนาญการและจะไม่รบกวนกระบวนการคลอด ตัวอย่างรกที่ได้จะถูกส่งไปเก็บรักษา ณ สถาบันวิจัยวิทยาศาสตร์สุขภาพ เพื่อนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ
- <u>มาตามนัดหลังคลอดเพื่อตรวจพัฒนาการและตอบแบบสัมภาษณ์</u>: โครงการวิจัยจะตรวจพัฒนาการของบุตรของท่านตั้งแต่แรกเกิด และจะขอให้ท่านมาตามนัดเพื่อตรวจพัฒนาการหลังคลอดจนกระทั่งบุตรของท่านอายุ 3 ปี ซึ่งรวมทั้งหมด 7 ครั้ง ได้แก่ เมื่อเด็กมีอายุ 1, 4, 7, 12, 18, 24, และ 36 เดือน โดยการตรวจพัฒนาการจะมีการประเมินการทำงานของระบบประสาทและพฤติกรรมของเด็กด้วยวิธีการประเมินที่ได้มาตรฐาน โดยนักจิตวิทยาที่มีความเชี่ยวชาญ ในการมาตรวจพัฒนาการเจ้าหน้าที่โครงการวิจัยจะถามแบบสัมภาษณ์ท่านเกี่ยวกับข้อมูลการรับสัมผัส การดูแลบุตร และพฤติกรรมของบุตร
- <u>เก็บตัวอย่างปัสสาวะของบุตร</u>: โครงการวิจัยจะขอเก็บตัวอย่างปัสสาวะจากบุตรของท่านโดยใช้ผ้าอ้อมสำเร็จรูป ในทุกครั้งที่มาตรวจพัฒนาการ จำนวน 8 ครั้ง ได้แก่ ช่วงคลอด 1-3 วัน จำนวน 1 ครั้ง และช่วงหลังคลอด จำนวน 7 ครั้ง เมื่อบุตรอายุ 1, 4, 7, 12, 18, 24, และ 36 เดือน เพื่อนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ
- <u>เก็บตัวอย่างเส้นผมของบุตร</u> : โครงการวิจัยจะขอเก็บตัวอย่างเส้นผมจากบุตรของท่าน ในทุกครั้งที่มาตรวจพัฒนาการ จำนวน 8 ครั้ง ได้แก่ ช่วงคลอด 1-3 วัน จำนวน 1 ครั้ง และช่วงหลังคลอด จำนวน 7 ครั้ง เมื่อบุตรอายุ 1, 4, 7, 12, 18, 24, และ 36 เดือน โดยพยาบาลโครงการวิจัยที่มีความชำนาญ เพื่อนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ (หากบุตรของท่านมีสภาพร่างกายไม่พร้อมหรือท่านเกิดความไม่สบายใจในการเก็บเส้นผม ท่านสามารถปฏิเสธการเก็บตัวอย่างเส้นผมให้แก่ทางโครงการได้)
- <u>เก็บน้ำนม</u>: โครงการวิจัยจะขอเก็บน้ำนมของท่านจำนวน 4 ครั้ง ได้แก่ เมื่อบุตรของท่านอายุ 1, 4, 7 และ 12 เดือน ครั้งละประมาณ 2 ช้อนชา ตัวอย่างน้ำนมจะนำไปวิเคราะห์สารฆ่าแมลงและสารพิษอื่น ๆ ในห้องปฏิบัติการ
- <u>การวัดระยะห่างระหว่างช่องทวารกับอวัยวะสืบพันธุ์ (AGD)</u> : โครงการวิจัยจะขอวัดระหว่างช่องทวารกับอวัยวะสืบพันธุ์ของบุตรของท่าน โดยเจ้าหน้าที่โครงการวิจัย ได้แก่ ช่วงคลอด 1-3 วัน จำนวน 1 ครั้ง และช่วงหลังคลอดเมื่อบุตรอายุ 1, 4, 7, 12, 18 และ 24 เดือน เพื่อนำไปประเมินผลจากการรับสัมผัสสารฆ่าแมลงและสารพิษอื่น ๆที่เด็กได้รับ

- การเยี่ยมบ้าน: ทางเจ้าหน้าที่โครงการวิจัยขอไปเยี่ยมบ้าน จำนวน 2 ครั้ง คือ ในขณะที่บุตรของท่านอายุ 12 เดือน และ 24 เดือน เพื่อประเมินพัฒนาการของเด็กจากวิธีการเลี้ยงดูบุตร พฤติกรรมจริงขณะเข้าเยี่ยม และประเมินระดับเศรษฐานะของครอบครัว โดยการเยี่ยมบ้านในแต่ละครั้งจะรบกวนเวลาของผู้ปกครอง ประมาณ 30 นาที
- การถ่ายรูป: โครงการวิจัยจะขอถ่ายรูปจำนวน 2 ครั้ง โดยขอถ่ายรูปท่านในวันที่ท่านเข้าร่วมโครงการ เพื่อเป็นการเก็บข้อมูลอาสาสมัคร โดยรูปของท่านจะไม่ถูกเผยแพร่สู่สาธารณะ และขอถ่ายรูปท่านและบุตรเพื่อจัดทำของที่ระลึกของโครงการให้แก่ท่าน

โครงการวิจัยนี้ จะขอนัดท่านช่วงตั้งครรภ์ประมาณ 6 ครั้ง ขึ้นอยู่กับนัดโรงพยาบาล ช่วงคลอด 1 ครั้ง ช่วงหลังคลอด 7 ครั้ง และเยี่ยมบ้าน 2 ครั้ง ดังสรุปในตารางที่ 1 และในแต่ละครั้งที่นัด อาจจะใช้เวลาประมาณครึ่งชั่วโมงถึง หนึ่งชั่วโมงครึ่ง

ตารางที่ 1 สรุปการนัดเมื่อท่านเข้าร่วมโครงการวิจัย

ช่วงเวลา		วัตถุประสงค์การนัด	สถานที่	เวลาที่ใช้
ระหว่างตั้งครรภ์ 6 ครั้ง	เมื่อมาฝากครรภ์ครั้งแรก	- สัมภาษณ์การสัมผัสสารฆ่าแมลงของอาสาสมัครและบุตร - เก็บตัวอย่างเลือด ปัสสาวะ เส้นผม เยื่อบุกระพุ้งแก้ม เนื้อเยื่อช่องคลอดและทวารหนักของท่าน	โรงพยาบาล	1 ชั่วโมงครึ่ง
	เมื่ออายุครรภ์ 16 สัปดาห์	- สัมภาษณ์การสัมผัสสารฆ่าแมลงของอาสาสมัครและบุตร - เก็บตัวอย่างปัสสาวะของท่าน	โรงพยาบาล	1 ชั่วโมง
	เมื่ออายุครรภ์ 20 สัปดาห์	- เก็บตัวอย่างเลือด ปัสสาวะ เส้นผม เยื่อบุกระพุ้งแก้ม เนื้อเยื่อช่องคลอดและทวารหนักของท่าน	โรงพยาบาล	1 ชั่วโมงครึ่ง
	เมื่ออายุครรภ์ 28 สัปดาห์	- สัมภาษณ์การสัมผัสสารฆ่าแมลงของอาสาสมัครและบุตร - เก็บตัวอย่างปัสสาวะของท่าน	โรงพยาบาล	1 ชั่วโมง
	เมื่ออายุครรภ์ 32 สัปดาห์	- สัมภาษณ์การสัมผัสสารฆ่าแมลงของอาสาสมัครและบุตร - เก็บตัวอย่างเลือด ปัสสาวะ เส้นผม เยื่อบุกระพุ้งแก้ม เนื้อเยื่อช่องคลอดและทวารหนักของท่าน	โรงพยาบาล	1 ชั่วโมงครึ่ง
	เมื่ออายุครรภ์ 36 สัปดาห์	- สัมภาษณ์การสัมผัสสารฆ่าแมลงของอาสาสมัครและบุตร - เก็บตัวอย่างปัสสาวะของท่าน	โรงพยาบาล	1 ชั่วโมง
คลอดและหลังคลอด 1-3 วัน	คลอดและหลังคลอด 1-3 วัน	- เก็บตัวอย่างเลือดจากสายสะดือของทารก (ในห้องคลอด) - เก็บตัวอย่างรก (ในห้องคลอด) - ประวัติการคลอดจากโรงพยาบาล - เก็บตัวอย่างขี้เทา (ในห้องคลอดหรือขณะพักฟื้นหลังคลอด) - เก็บตัวอย่างปัสสาวะบุตรจากผ้าอ้อม - เก็บตัวอย่างเส้นผมของทารก - การวัดระยะห่างระหว่างช่องทวารกับอวัยวะสืบพันธุ์	โรงพยาบาล	1 ชั่วโมง

ช่วงเวลา		วัตถุประสงค์การนัด	สถานที่	เวลาที่ใช้
หลังคลอด 7 ครั้ง	เมื่อบุตรของท่านอายุ 1 เดือน	- สัมภาษณ์เกี่ยวกับภาวะสุขภาพจิต - เก็บตัวอย่างน้ำนมจากท่าน - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - การวัดระยะห่างระหว่างช่องหว่างกับอวัยวะสืบพันธุ์ - ประเมินพัฒนาการบุตร (ความสนใจ)	บ้านสวัสดี	1 ชั่วโมง
	เมื่อบุตรของท่านอายุ 4 เดือน	- สัมภาษณ์เกี่ยวกับการดูแลบุตร - เก็บตัวอย่างน้ำนมจากท่าน - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - การวัดระยะห่างระหว่างช่องหว่างกับอวัยวะสืบพันธุ์ - ประเมินพัฒนาการบุตร (ความสนใจ)	บ้านสวัสดี	2 ชั่วโมง
	เมื่อบุตรของท่านอายุ 7 เดือน	- สัมภาษณ์เกี่ยวกับการดูแลบุตรและการรับสัมผัส - เก็บตัวอย่างน้ำนมจากท่าน - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - การวัดระยะห่างระหว่างช่องหว่างกับอวัยวะสืบพันธุ์ - ประเมินพัฒนาการบุตร (ความสนใจ)	บ้านสวัสดี	2-3 ชั่วโมง
	เมื่อบุตรของท่านอายุ 12 เดือน	- สัมภาษณ์เกี่ยวกับการดูแลบุตร - เก็บตัวอย่างน้ำนมจากท่าน - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - การวัดระยะห่างระหว่างช่องหว่างกับอวัยวะสืบพันธุ์ - ประเมินพัฒนาการบุตร (ความสนใจ, ความจำ)	บ้านสวัสดี	2-3 ชั่วโมง
	เมื่อบุตรของท่านอายุ 18 เดือน	- สัมภาษณ์เกี่ยวกับการดูแลบุตรและการรับสัมผัส - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - การวัดระยะห่างระหว่างช่องหว่างกับอวัยวะสืบพันธุ์ - ประเมินพัฒนาการบุตร (ความสนใจ, ความจำ, ความไวในการตอบสนองและเก็บข้อมูล)	บ้านสวัสดี	2-3 ชั่วโมง
	เมื่อบุตรของท่านอายุ 24 เดือน	- สัมภาษณ์เกี่ยวกับการดูแลบุตร - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - การวัดระยะห่างระหว่างช่องหว่างกับอวัยวะสืบพันธุ์ - ประเมินพัฒนาการบุตร (ความสนใจ, ความจำ)	บ้านสวัสดี	2-3 ชั่วโมง

ช่วงเวลา		วัตถุประสงค์การนัด	สถานที่	เวลาที่ใช้
	เมื่อบุตรของท่านอายุ 36 เดือน	- สัมภาษณ์เกี่ยวกับการดูแลบุตร - เก็บตัวอย่างปัสสาวะบุตร - เก็บตัวอย่างเส้นผมบุตร - ประเมินพัฒนาการบุตร (ความสนใจ, ความจำ)	บ้านสวัสดี	2-3 ชั่วโมง
การเยี่ยมบ้าน	เมื่อบุตรของท่านอายุ 1 ปี และ 2 ปี	- สัมภาษณ์เกี่ยวกับการดูแลบุตร - เยี่ยมบ้าน สังเกตวิธีการดูแลบุตร - สัมภาษณ์	บ้านอาสาสมัคร	1 ชั่วโมง

<u>โครงการวิจัยจะนำตัวอย่างและข้อมูลของท่านและบุตรไปใช้ในอนาคตหรือไม่ ?</u>

ข้อมูลที่ได้จากการวิเคราะห์ตัวอย่างเลือด ปัสสาวะ เส้นผม เยื่อบุกระพุ้งแก้ม เนื้อเยื่อช่องคลอด เนื้อเยื่อทวารหนัก ชิ้นเทา รก และน้ำนม ของท่านและบุตร จะถูกนำไปใช้ในงานวิจัยในอนาคต ซึ่งจะเป็นประโยชน์แก่นักวิจัยในการศึกษาผลกระทบต่อสุขภาพจากการสัมผัสสารฆ่าแมลงและสารพิษอื่น ๆ อย่างไรก็ตาม ท่านและบุตรอาจไม่ได้รับประโยชน์โดยตรงจากข้อมูลชุดดังกล่าว หากท่านเข้าใจดีและยินยอม โครงการวิจัยจะขอเก็บข้อมูลและตัวอย่างชีวภาพของท่านและบุตรเพื่อใช้ในการศึกษาในอนาคต โครงการวิจัยจะเก็บโดยการใช้รหัสแทนและไม่เปิดเผยชื่อ หรือข้อมูลใด ๆ ที่จะสามารถทราบว่าเป็นท่านและบุตร

หากมีการนำข้อมูลและตัวอย่างของท่านไปใช้ในอนาคตนอกเหนือจากในโครงการนี้ โครงการวิจัยจะขออนุญาตจากคณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์ สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่ และคณะกรรมการจริยธรรมการวิจัยในคน มหาวิทยาลัยเอมมอรี ประเทศสหรัฐอเมริกาก่อนนำไปใช้ และจะไม่มีการนำไปใช้ในเชิงพาณิชย์

<u>ท่านและบุตรจะต้องเข้าร่วมโครงการนานเท่าใด?</u>

โครงการวิจัยจะเริ่มตั้งแต่ท่านตั้งครรภ์จนกระทั่งบุตรของท่านอายุ 3 ปี

<u>ท่านสามารถหยุดการเข้าร่วมโครงการได้หรือไม่?</u>

การเข้าร่วมในโครงการฯครั้งนี้เป็นไปโดยความสมัครใจ หากท่านไม่สมัครใจจะเข้าร่วมการศึกษาแล้ว ท่านสามารถหยุดหรือถอนตัวได้ตลอดเวลา การขอหยุดหรือถอนตัวออกจากโครงการวิจัยจะไม่มีผลต่อการดูแลรักษาของท่านและบุตรแต่อย่างใด ในการตอบคำถามแบบสัมภาษณ์ ท่านมีสิทธิ์จะไม่ตอบคำถามบางคำถามที่ท่านไม่ต้องการตอบได้หรือต้องการหยุดการตอบแบบสัมภาษณ์ได้

<u>ท่านและบุตรจะมีความเสี่ยงและความลำบากที่อาจจะเกิดขึ้นในการเข้าร่วมโครงการหรือไม่ ?</u>

ท่านมีโอกาสจะเกิดอาการเจ็บ เลือดออก ช้ำจากการเจาะเลือด อาการบวมบริเวณที่เจาะเลือดหรือหน้ามืด และโอกาสจะเกิดการติดเชื้อบริเวณที่เจาะเลือดซึ่งพบได้น้อยมาก เนื่องจากผู้วิจัยใช้อุปกรณ์การเจาะเลือดใหม่และปลอดเชื้อ และท่านอาจเสียเวลาในการตอบแบบสัมภาษณ์ หรือไม่สบายใจที่จะตอบในบางคำถาม

ท่านอาจเกิดอาการข้างเคียง หรือความไม่สบาย นอกเหนือจากที่ชี้แจงในเอกสารฉบับนี้ ซึ่งเป็นอาการที่ไม่เคยพบมาก่อน ท่านควรแจ้งผู้ทำวิจัยให้ทราบทันทีเมื่อเกิดความผิดปกติเพื่อความปลอดภัยของท่านเอง

หากท่านปฏิเสธการเก็บตัวอย่างใดๆ ก็ตาม จะไม่ส่งผลเสียต่อสิทธิการรักษาทางการแพทย์ของท่านและบุตร

หากท่านมีข้อสงสัย เกี่ยวกับความเสี่ยงที่อาจได้รับจากการเข้าร่วมในโครงการวิจัย ท่านสามารถสอบถามจากผู้ทำวิจัยได้ตลอดเวลา

หากมีการค้นพบข้อมูลใหม่ ๆ ที่อาจมีผลต่อความปลอดภัยของท่านและบุตรในระหว่างที่ท่านเข้าร่วมในโครงการวิจัย ผู้ทำวิจัยจะแจ้งให้ท่านทราบทันที เพื่อให้ท่านตัดสินใจว่าท่านและบุตรจะอยู่ในโครงการวิจัยต่อไปหรือจะขอถอนตัวออกจากการวิจัย

ท่านมีค่าใช้จ่ายในการเข้าร่วมโครงการนี้หรือไม่ ?

ท่านไม่ต้องเสียค่าใช้จ่ายใด ๆ ทั้งสิ้น

ท่านจะได้รับประโยชน์อะไรบ้างจะการเข้าร่วมโครงการนี้ ?

ท่านและครอบครัวอาจไม่ได้รับประโยชน์โดยตรงจากการเข้าร่วมโครงการวิจัยนี้ แต่ข้อมูลที่ได้จากการเก็บตัวอย่างจากท่านและบุตรจะเป็นประโยชน์สุขภาพหญิงตั้งครรภ์และทารกของประเทศไทยต่อไป

ในแต่ละครั้งที่ท่านมาตามนัดของโครงการวิจัย ท่านได้รับการสนับสนุนค่าเดินทางครั้งละ 300 บาท และท่านจะได้รับคำแนะนำและเอกสารความรู้เกี่ยวกับพัฒนาการของเด็กและการหลีกเลี่ยงการสัมผัสสารเคมีฯเข้าสู่ร่างกาย และบุตรของท่านจะได้รับของเล่นเล็ก ๆ น้อย ๆ จากทางโครงการวิจัยเมื่อมาตรวจพัฒนาการตามนัดของโครงการวิจัย

ท่านมีทางเลือกหรือไม่ หากไม่ต้องการเข้าร่วมโครงการวิจัยนี้ ?

ท่านสามารถตัดสินใจได้อย่างอิสระว่าจะเข้าร่วมหรือไม่เข้าร่วมโครงการวิจัยนี้ โดยไม่กระทบต่อสิทธิในการรักษาพยาบาลของท่านและบุตรแต่อย่างใด ท่านยังคงสามารถรับบริการของทางโรงพยาบาลได้ตามปกติ

ข้อมูลของท่านและบุตรจะเป็นความลับหรือไม่ ?

ข้อมูลของท่านและบุตรจะถูกเก็บเป็นความลับ การนำเสนอข้อมูลที่ได้จากการโครงการวิจัยเป็นไปเพื่อประโยชน์ทางวิชาการเท่านั้น ข้อมูลจะถูกเปิดเผย เป็นภาพรวม ไม่มีการเปิดเผย ชื่อ-นามสกุล ที่อยู่ของผู้ร่วมโครงการวิจัยเป็นรายบุคคล เอกสารที่เกี่ยวข้องกับท่านและบุตรจะถูกเก็บเป็นความลับโดยจำกัดบุคคลที่เข้าถึง เอกสารจะถูกเก็บในตู้ซึ่งใส่กุญแจล็อกของโครงการวิจัยเป็นอย่างดี ซึ่งเมื่อสิ้นสุดโครงการวิจัยแล้ว 5 ปี จะทำลายเอกสารด้วยเครื่องย่อยเอกสาร ส่วนตัวอย่างเลือด ปัสสาวะ ชิ้นเทา เส้นผม เนื้อเยื่อ รก และน้ำนม จะไม่มีข้อมูลส่วนตัวของท่าน โดยจะเก็บในตู้แช่ซึ่งใส่กุญแจล็อกของห้องปฏิบัติการ จะถูกทำลายภายในระยะเวลา 5 ปี หลังสิ้นสุดโครงการด้วยวิธีการกำจัดขยะติดเชื้อ ของสถาบันวิจัยวิทยาศาสตร์สุขภาพ และคณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ และมหาวิทยาลัยเอมมอรี ประเทศสหรัฐอเมริกา

ผลการวิจัยของโครงการจะนำไปใช้อย่างไร ?

ผลที่ได้จากโครงการวิจัยจะนำไปตีพิมพ์ในวารสารวิชาการเพื่อเผยแพร่ และจะมีการจัดการประชุมเพื่อสรุปและเผยแพร่ผลการวิจัย

หากท่านมีข้อสงสัยหรือคำถามเกี่ยวกับงานวิจัย สามารถถามใครได้บ้าง?

หากท่านมีข้อสงสัยหรือคำถามใด ๆ เกี่ยวกับการศึกษานี้ หรือต้องการคำอธิบายเพิ่มเติม สามารถติดต่อ

ดร.ทิพวรรณ ประภามณฑล
สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่
110 ถ. อินทวโรรส ต. ศรีภูมิ อ. เมือง จ. เชียงใหม่
โทรศัพท์ 053 -942508 ต่อ 312 หรือ 319

หากมีข้อสงสัยเกี่ยวกับสิทธิในฐานะเป็นอาสาสมัครของโครงการ สามารถติดต่อได้ที่

คณะกรรมการพิทักษ์สิทธิ์สวัสดิภาพและป้องกันภยันตรายในการวิจัยกับมนุษย์
สถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่
โทรศัพท์ 053-936148 ต่อ 263

ท่านมีข้อสงสัยหรือคำถามเพิ่มเติมหรือไม่?

ท่านยินดีที่จะเข้าร่วมโครงการวิจัยนี้หรือไม่?

1. ยินดี (ลงนามแสดงความยินยอมเข้าร่วมโครงการด้วยความสมัครใจ)
2. ไม่ยินดี (จบการทาบทาม)

หนังสือแสดงความยินยอมการเข้าร่วมโครงการวิจัย (สำหรับอาสาสมัครหญิงตั้งครรภ์)

โครงการวิจัย "ผลกระทบของการรับสัมผัสสารซ่าแมงตั้งแต่ในครรภ์ต่อการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด: การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย หรือ โครงการสวัสดี"

ข้าพเจ้า นาง / นางสาว.....

ที่อยู่.....

โปรดทำเครื่องหมาย ✓ ในช่อง ใช่ หรือ ไม่ใช่ เพื่อแสดงความยินยอมการเข้าร่วมโครงการวิจัย			
1.	ผู้วิจัยได้เป็นผู้อธิบายเกี่ยวกับความเสี่ยงที่อาจจะเกิดจากการเข้าร่วมโครงการ หรือผลประโยชน์ที่ข้าพเจ้าอาจได้รับอย่างละเอียด ข้าพเจ้าเข้าใจข้อมูลทั้งหมดแล้ว ผู้วิจัยได้ตอบคำถามและข้อสงสัยต่าง ๆ ของข้าพเจ้าด้วยความเต็มใจจนข้าพเจ้าพอใจแล้ว	☐ ใช่	☐ ไม่ใช่
2.	ข้าพเจ้าเข้าใจดีว่าการเข้าร่วมโครงการวิจัยเป็นไปโดยความสมัครของข้าพเจ้าซึ่งตัดสินใจเองโดยอิสระ และสามารถขอหยุดหรือถอนตัวจากการศึกษานี้โดยไม่กระทบต่อสิทธิอันพึงมีของข้าพเจ้า	☐ ใช่	☐ ไม่ใช่
3.	ข้าพเจ้ายินดีให้โครงการวิจัยเก็บตัวอย่างเลือด ปัสสาวะ ขี้เทา เส้นผม รก และน้ำนม ตลอดจนข้อมูลการตรวจสุขภาพอื่น ๆ ของข้าพเจ้าและบุตรตามรายละเอียดในเอกสารชี้แจงอาสาสมัคร ฉบับที่ 12 วันที่ 28 สิงหาคม 2562	☐ ใช่	☐ ไม่ใช่
4.	ข้าพเจ้ายินดีให้โครงการวิจัยเก็บตัวอย่างเชื้อแบคทีเรียเยื่อบุกระพุ้งแก้มตามรายละเอียดในเอกสารชี้แจงอาสาสมัคร ฉบับที่ 12 วันที่ 28 สิงหาคม 2562	☐ ใช่	☐ ไม่ใช่
5.	ข้าพเจ้ายินดีให้โครงการวิจัยเก็บตัวอย่างแบคทีเรียจากเนื้อเยื่อช่องคลอดตามรายละเอียดในเอกสารชี้แจงอาสาสมัคร ฉบับที่ 12 วันที่ 28 สิงหาคม 2562	☐ ใช่	☐ ไม่ใช่
6.	ข้าพเจ้ายินดีให้โครงการวิจัยเก็บตัวอย่างแบคทีเรียจากเนื้อเยื่อทวารหนักตามรายละเอียดในเอกสารชี้แจงอาสาสมัคร ฉบับที่ 12 วันที่ 28 สิงหาคม 2562	☐ ใช่	☐ ไม่ใช่
7.	ข้าพเจ้ายินดีให้โครงการวิจัยใช้ข้อมูลประวัติการคลอด ประวัติของบุตรข้าพเจ้า จากเวชระเบียนของโรงพยาบาลได้	☐ ใช่	☐ ไม่ใช่
8.	ข้าพเจ้ายินดีให้โครงการวิจัยถ่ายรูปข้าพเจ้าและบุตรได้	☐ ใช่	☐ ไม่ใช่
9.	ข้าพเจ้ายินดีให้โครงการเข้าเยี่ยมบ้านเมื่อบุตรข้าพเจ้าอายุครบ 12 และ 24 เดือนเพื่อสอบถามข้อมูลเกี่ยวกับสิ่งแวดล้อมของที่พักอาศัยและสังเกตพฤติกรรมการเล่นของบุตรข้าพเจ้าได้	☐ ใช่	☐ ไม่ใช่
10.	ข้าพเจ้ายินดีเข้าร่วมโครงการวิจัยนี้ด้วยความสมัครใจ	☐ ใช่	☐ ไม่ใช่
11.	ข้าพเจ้ายินดีให้บุตรของข้าพเจ้ารับการทดสอบของโครงการวิจัยโดยการสังเกตพฤติกรรมเมื่ออายุ 1 เดือน และประเมินปฏิกิริยาที่มีต่อของเล่นและรูปภาพเมื่อบุตรข้าพเจ้าอายุ 4, 7, 12, 18, 24 และ 36 เดือน รวมถึงกิจกรรมอื่นๆ ของโครงการวิจัยตามรายละเอียดที่ระบุไว้ข้างต้น	☐ ใช่	☐ ไม่ใช่
12.	ข้าพเจ้ายินดีให้บุตรของข้าพเจ้ารับการวัดระยะห่างระหว่างช่องทวารกับอวัยวะสืบพันธุ์ เมื่อหลังคลอด 1-3 วัน และเมื่อบุตรข้าพเจ้าอายุ 1, 4, 7, 12, 18 และ 24 เดือน	☐ ใช่	☐ ไม่ใช่
แสดงความยินยอมในการให้เก็บข้อมูลและตัวอย่างชีวภาพเพื่อใช้ในงานวิจัยอื่น ๆ ในอนาคต			
1.	ข้าพเจ้ายินดีให้โครงการวิจัยเก็บข้อมูลและตัวอย่างเลือด ปัสสาวะ เส้นผม เชื้อแบคทีเรียจากเยื่อบุกระพุ้งแก้ม เนื้อเยื่อช่องคลอด เนื้อเยื่อทวารหนัก รก และน้ำนม ของข้าพเจ้าเพื่อใช้ในงานวิจัยอื่นๆ ในอนาคต	☐ ใช่	☐ ไม่ใช่
2.	ข้าพเจ้ายินดีให้โครงการวิจัยเก็บข้อมูลและตัวอย่างปัสสาวะ เส้นผม และขี้เทา ของบุตรของข้าพเจ้าเพื่อใช้ในงานวิจัยอื่น ๆ ในอนาคต	☐ ใช่	☐ ไม่ใช่

_____	_____	_____
ชื่ออาสาสมัครหญิงตั้งครรภ์	ลายมือชื่อ หรือลายพิมพ์นิ้วมือ	วันที่
_____	_____	_____
ชื่อสามีของอาสาสมัครหญิงตั้งครรภ์	ลายมือชื่อ หรือลายพิมพ์นิ้วมือ	วันที่
_____	_____	_____
ชื่อพยาน (ในกรณีที่อาสาสมัครไม่สามารถอ่านหนังสือได้)	ลายมือชื่อ	วันที่
_____	_____	_____
ชื่อเจ้าหน้าที่โครงการวิจัย	ลายมือชื่อ	วันที่

เอกสารชี้แจงและแสดงความยินยอม (เพิ่มเติม) สำหรับการบันทึกภาพและเสียง

โครงการวิจัย
"ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด : การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย หรือ โครงการสวัสดี"

เนื่องจากท่านได้แสดงความยินยอมเข้าร่วมโครงการวิจัย "ผลกระทบของการรับสัมผัสสารฆ่าแมลงตั้งแต่ในครรภ์ต่อการพัฒนาระบบประสาทในกลุ่มเด็กไทยแรกเกิด: การเสริมสร้างศักยภาพการวิจัยด้านวิทยาการการรับสัมผัสและการพัฒนาระบบประสาทในประเทศไทย หรือ โครงการสวัสดี" ซึ่งมี ตร. เดน่า บาร์ จากมหาวิทยาลัยเอมมอรีเป็นหัวหน้าโครงการวิจัยหลัก และมี ตร. ทิพวรรณ ประภามณฑล จากสถาบันวิจัยวิทยาศาสตร์สุขภาพ มหาวิทยาลัยเชียงใหม่เป็นหัวหน้าวิจัยในพื้นที่ ขณะนี้ โครงการวิจัยประสงค์จะขอความยินยอมจากท่านในการบันทึกภาพและเสียงเป็นวิดีทัศน์ขณะประเมินพัฒนาการบุตรของท่านเพื่อนำไปประกอบการให้คะแนนการประเมิน โดยการประเมินพัฒนาการบุตรของท่านทั้งหมดถือเป็นส่วนหนึ่งของโครงการวิจัยนี้

ข้อมูลไฟล์ภาพและเสียงการประเมินพัฒนาของบุตรของท่านอาจจะมีภาพของท่านและบุตร อย่างไรก็ตาม ไฟล์ภาพและเสียงจะถูกเก็บเป็นความลับ โดยไฟล์ภาพและเสียงที่ถูกบันทึกไว้จะถูกเก็บในคอมพิวเตอร์ของโครงการวิจัยและต้องใช้รหัสผ่านในการเข้าถึง และไฟล์ดังกล่าวจะถูกทำลายเมื่อสิ้นสุดโครงการวิจัย การนำเสนอข้อมูลที่ได้จากการโครงการวิจัยเป็นไปเพื่อประโยชน์ทางวิชาการเท่านั้น จะไม่มีการเปิดเผยหรือใช้เพื่องานวิจัยอื่นๆ

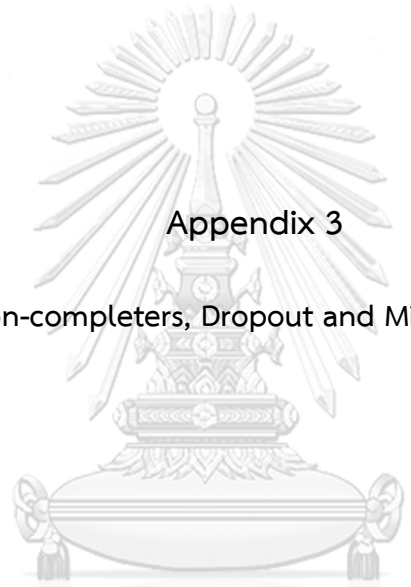
การลงนามในเอกสารฉบับนี้จะแสดงว่าท่านยินยอมให้นักวิจัยของโครงการวิจัยนี้บันทึกภาพและเสียงขณะประเมินพัฒนาบุตรของท่าน โครงการวิจัยจะนำไฟล์ภาพและเสียงของท่านและบุตรไปใช้ประโยชน์อื่นๆ โดยไม่ได้รับการยินยอมจากท่านอย่างเป็นลายลักษณ์อักษร

การแสดงความยินยอมให้บันทึกภาพและเสียง

_____	_____	_____
ชื่ออาสาสมัคร	ลายมือชื่อ หรือลายพิมพ์นิ้วมือ	วันที่
_____	_____	_____
ชื่อพยาน (ในกรณีที่อาสาสมัครไม่สามารถอ่านหนังสือได้)	ลายมือชื่อ	วันที่
_____	_____	_____
ชื่อเจ้าหน้าที่โครงการวิจัย	ลายมือชื่อ	วันที่

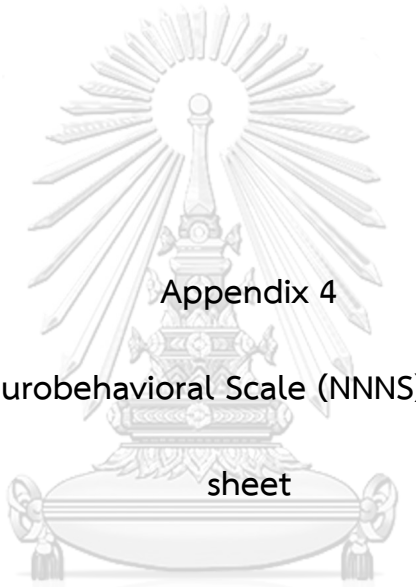
Appendix 3

Completers, Non-completers, Dropout and Missing data comparison



Appendix 3 Overall participants, Completers, Non-completers, Dropout and Missing data comparison

Variables		Overall		Completers		Non-completers					
						Total		Dropout		Missing	
		n (%)	M (SD)	n (%)	M (SD)	n (%)	M (SD)	n (%)	M (SD)	n (%)	M (SD)
Sample size		322 (100)		219 (68.01)		103 (31.99)		23 (7.14)		80 (24.84)	
Mothers' age (year)			25.02 (5.28)		25.01 (5.28)		25.05 (5.31)		24.91 (5.59)		25.09 (5.27)
Mothers' education (year)			7.96 (4.66)		8.30 (4.42)		7.23 (5.10)		6.39 (5.48)		7.48 (4.99)
Income			10,640.78 (8338.05)		10,633.57 (8514.38)		10,656.70 (7978.33)		11,800.00 (7134.36)		10,321.33 (8223.00)
Child's gender	Boy	160 (49.69)		108 (49.32)		52 (50.49)		12 (3.72)		40 (12.42)	
	Girl	162 (50.31)		111 (50.68)		51 (49.51)		11 (3.42)		40 (12.42)	
Location	CT	216 (67.08)		153 (69.86)		63 (61.17)		12 (3.73)		51 (15.84)	
	FA	106 (32.92)		66 (30.14)		40 (38.83)		11 (3.42)		29 (9.01)	



Appendix 4

NICU Network Neurobehavioral Scale (NNNS) Procedure and Score sheet

The NNNS began with *preexamination observation* of respiration, color and tone. If the infant was sleeping, *habituation* items were administered. If not, the administration was continued with *unwrap and supine* package. The administration ended with *postexamination observation*. The NNNS was recommended to be administered in the same order for all infants; however, if the required state was not met, the examiner rearranged the package order, but maintained the items order within the package.

NNNS Materials

- standard 8-inch flashlight
- a red ball
- a red rattle
- a bell
- a foot probe
- head supports
- a watch
- the NNNS scoring form

NNNS Coding

The NNNS coding was done by the NNNS certified nurses.

NNNS Data reduction plan

Only self-regulation subscale score was used. The self-regulation subscale score is calculated by averaging scores (range from 1 to 9) from 15 items, include (Lester & Tronick, 2004). Inter-rater reliability was completed for 1 or 2 cases per month (**K** = .84–1.00).

- 25. Pull to sit

This Item observed the extent that the newborn tries to maintain his/her head upright and how long the infant can do it. The highest score means newborn can maintain the head upright for 1 minute after seated. The lowest score means head lags or hypotonic and cannot sit up.

- 33. Cuddle in arm

- 34. Cuddle on shoulder

Item 33 and 34 are measure newborn's response to being held in alert state. The cuddliness is to see whether the newborn is able to initiate cuddling and can relax or mold, nestle, and cling to the experimenter, which enable the newborn to calm down and relax easier. The highest score means the newborn grasps and clings to the experimenter. The lowest score means the newborns resists being held, continuously pushing away.

- 43. Defensive response

This Item is to see newborn ability to adjust the environment be him/herself in the situation that his/her eyes and nose are covered lightly with a small cloth by the experimenter. The highest score means the newborn successfully removes the cloth by swiping at it. The lowest score means infant has no response.

- 47. Alertness

This Item measures newborn's alertness and responsiveness to stimuli. The score is indicated by the duration of the focused alertness and the latency of responsiveness. The highest score means the newborn always alert for most of examination; intensely and predictably alert. The lowest score means the newborn never alert and rarely or never responsive to direct stimulation.

- 48. General Tone: Predominant Tone

This item is to see newborn's tone. The newborn with typical tone is able to actively flex and extend the limbs which means that they can control their body to adjust internal and external arousal. The highest score means newborn's tone average when handle; lies with relaxed tone at rest. The lowest score means the newborn is hypertonic at rest (in flexion) and hypertonic all the time.

- 49. Motor Maturity

This item measures the quality of form of spontaneous and elicited arm movements by assessing smoothness versus jerkiness which reflecting the balance between flexors and extensors, and unrestricted versus restricted arcs. The highest score means the newborn's movement is smooth; unrestricted arcs of more than 90° all the time. The lowest score means the newborn has cogwheel-like jerkiness, over shooting of legs and arms in all directions.

- 50. Consolability With Intervention

This item measures the number of maneuvers the experimenter uses to bring the newborn from intensive crying to completely calm. The highest score is indicated by experimenter's face alone can completely calm the newborn. The lowest score means the newborn cannot console at all.

- 52. Rapidity of Build-up

This item measures the latency of first intense crying. The highest score means the newborn never upset. The lowest score means the newborn intensively cries at the very beginning and never be quiet enough to score this item.

- 56. Tremulousness

This item measures the number of times tremors of the newborn's limbs and chin are seen and in which state of the tremors are seen. This irritation may disrupt

the newborn from sleeping or other activities. The highest score means no tremors. The lowest score means tremulousness is seen consistently and repeatedly in all states.

- 57. Amount of Startle During Examination

This item observes the number of newborn's startle. The highest score means no startles. The lowest score means ten or more startles, excluding Moro reflex.

- 58. Lability of Skin Color as Infant Moves from States 1 to 6

This item observes newborn's skin color changing. The highest score means skin color changes minimally during the examination. The lowest score means marked, rapid changes in skin color to very red and good color does not return during rest of examination, or newborn becomes pale and dusky during examination; color does not improve with handling.

- 59. Lability of States

This item measures the newborn's state performance over the examination period. Every definite state change over a recognizable period of at least 15 seconds is counted. The highest score means there are 3 to 5 state changes over the course of the examination. The lowest score means there are 0 to 2 state changes or more than 16 state changes over the course of the examination.

- 60. Self-Quieting Activity

This item measures the activity that newborn initiates in a crying or fussing state as an observable effort to quiet him/herself. The success of the activity is measured by an observational state change to calm state (state 4 or below) and persisting for at least 5 seconds. The highest score means newborn consistently quiets self for sustained periods and never needs console. The lowest score means newborn makes no attempt to quiet self and intervention always necessary.

- 61. Hand-to-Mouth Facility

This item measures the newborn's ability to bring hand to mouth as well as success in insertion. The hand-to-mouth is a reflex that newborn spontaneously attempts to control or comfort him/herself when upset. The highest score means newborn's fist and/or fingers is inserted and the newborn sucks on them for 15 seconds or more. The lowest score means no attempt to bring hands to mouth.

NNNS Score Sheet (example page 1 of 5)

Form 412-NZ NICU Network Neurobehavioral Scale (NNNS) Page 1 of 5

ID: Site: วันที่คลอด / /

Evaluator การคลอด NL C/S GA คลอด วันที่ประเมิน / / Age

Part I-Examination

A. Pre-Examination Observation

1. Initial state observation

B. Habituation (States 1 and 2)

2. Response decrement to light

3. Response decrement to rattle

4. Response decrement to bell

C. Unwrap and Supine

5. Posture (States 1-5)

6. Skin color (States 1-5)

7. Skin texture: Is infant in States 1-5 ○ 1-yes ○ 0-No

If yes:

a. Desquamation ○ 1-yes ○ 0-No

b. Excoriations – abrasions ○ 1-yes ○ 0-No

c. Loose skin ○ 1-yes ○ 0-No

d. Deep creases around the eyes and nose ○ 1-yes ○ 0-No

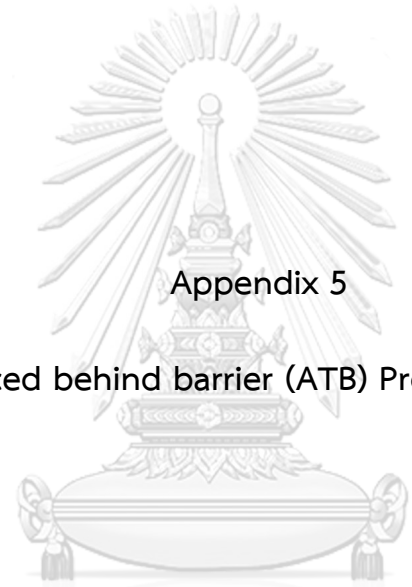
8. Movement (State 1-4)

9. Response decrement to tactile Stimulation of the foot (States 1-3)

D. Lower Extremity Reflexes (States 3-5)

If asymmetry, describe the less optimal side:

10. Plantar grasp		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R
11. Babinski		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R
12. Ankle colonus		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R
13. Leg resistance		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R
14. Leg recoil		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R
15. Power of active leg movements		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R
16. Popliteal angle		○ 1-↓L	○ 2-↑L	○ 3-↓R	○ 4-↑R



Appendix 5

Attractive toy placed behind barrier (ATB) Procedure and Score Sheet

Two video cameras were used to record child's emotional reactivity, especially facial expression. One camera was placed to capture close-up facial expressions. Another camera was placed at the left side of the child. Child sat on mother's laps during the test. The test was divided into 3 trials. Each trial consisted of 15 seconds play phase and 30 seconds observed phase. The whole test was approximately 3 minutes long. Experimenter sat approximately 1 meter away to the child's left at the left side of the table. Before the beginning of the test, the experimenter informed mothers to try not to show their facial expression and to remain still during the test to keep maternal soothing at a minimum. The test began with experimenter showing how to play with the color rattle by shaking it, then let the child play freely with the rattle for 15 seconds (play phase). After 15 seconds, experimenter placed the Plexiglas on the table in front of the child and within the child's reach. The rattle was taken away at the end of the 15 seconds as well, and was placed behind the Plexiglas for 30 seconds. After first 30 seconds, the experimenter retrieved the rattle and started another trial all over again (play phase and observed phase). The rattle was returned to the child after observed phase of the third trial to relieve any negative emotion that occurred during the test.

ATB Materials

- A colorful rattle
- 2 video cameras

- A Plexiglas barrier, size 31.25 cm x 40 cm
- Stopwatch

ATB Coding

Only observed phases were coded for this episode, and the coding begins when the experimenter releases his/her hand from the rattle after placing it behind the barrier. The observed episode was divided into 18 epochs, 5 seconds for each epoch. Child's intensity of facial anger, intensity of distress vocalization, intensity of struggling approach, and intensity of struggling withdrawal were coded as their anger expression in response to the eliciting frustration and anger event. In case that some children were excessively frustrated, fussy, and could not cooperated with the administration, these children were coded with the highest anger expression score.

Table Anger expression, coding, and observed behavior (modified from Goldsmith & Rothbart, 1999)

Anger expression	Coding	Behavior
Intensity of facial anger; *Examples of 3 facial regions movement,* *- Brows' inner corners are lower and drawn together* *- Eyes look tense or squinted* *- Mouth looks tense, wide open and squarish, or closes with lips pressed together*	0 1 2 3	No facial region shows codable movement Only 1 facial region shows codable anger movement, or expression is ambiguous Only 2 facial regions show codable anger movement, or movement is very clear in 1 facial region All 3 facial regions show codable anger movement, or coder has impression of strong anger
Intensity of distress vocalization	0 1 2 3 4 5	No distress Mild protest, may difficult to identify as hedonically negative Definite protest, limited to a short duration Longer protest, fussing, or mild intensity cry (rhythmic quality) Definite non-muted crying Full intensity cry, or scream (child is losing control)
Intensity of struggling approach	0 1 2 3 4	No movement towards barrier; C is passive Very low intensity of movement towards the barrier Moderate intensity of movement towards the barrier, High intensity movements towards the barrier Very high intensity of movement towards the barrier throughout the epochs, or child seems out of control
Intensity of struggling withdrawal	0 1 2 3 4	No movement towards barrier; C is passive Low intensity attempts to leave the chair 1 or 2 independent medium intensity attempts to leave the chair Repeated or higher intensity attempts to leave the chair Very high intensity of movement to leave the chair throughout the epochs, or child seems out of control

ATB Score Sheet

Subject# _____ Scorer _____
Subject Name _____ Date Scored _____
DOV_____ Episode Order _____

Attractive Toy Scoring

EC: 2,2

		Trial 1							Latency to anger		
5 s Epochs	Camera	1	2	3	4	5	6	Avg.	T1		s
Time Begin/End	Cam1								T2		s
	Cam2								T3		s
1. Intensity of facial anger (0-3)	Cam1								Latency to sadness		
	Cam2								T1		s
2. Intensity of facial sadness (0-3)	Cam1								T2		s
	Cam2								T3		s
3. Intensity of distress vocalizations (0-5)	Cam1										
	Cam2								Interest in toy:		
4.1 Intensity of approach struggle (0-4)	Cam1								Baseline state:		
	Cam2								Parent behavior:		
4.2 Intensity of withdrawal struggle (0-4)	Cam1								Missing episode code:		
	Cam2								# of observed epochs:		
5. Presence of bodily sadness 0=no 1=yes	Cam1										
	Cam2										

		Trial 2						
5 s Epochs	Camera	1	2	3	4	5	6	Avg.
Time Begin/End	Cam1							
	Cam2							
1. Intensity of facial anger (0-3)	Cam1							
	Cam2							
2. Intensity of facial sadness (0-3)	Cam1							
	Cam2							
3. Intensity of distress vocalizations (0-5)	Cam1							
	Cam2							
4.1 Intensity of approach struggle (0-4)	Cam1							
	Cam2							
4.2 Intensity of withdrawal struggle (0-4)	Cam1							
	Cam2							
5. Presence of bodily sadness 0=no 1=yes	Cam1							
	Cam2							

		Trial 3						
5 s Epochs	Camera	1	2	3	4	5	6	Avg.
Time Begin/End	Cam1							
	Cam2							
1. Intensity of facial anger (0-3)	Cam1							
	Cam2							
2. Intensity of facial sadness (0-3)	Cam1							
	Cam2							
3. Intensity of distress vocalizations (0-5)	Cam1							
	Cam2							
4.1 Intensity of approach struggle (0-4)	Cam1							
	Cam2							
4.2 Intensity of withdrawal struggle (0-4)	Cam1							
	Cam2							
5. Presence of bodily sadness 0=no 1=yes	Cam1							
	Cam2							

Appendix 6

Emotional Availability Scale (EAS) Procedure and Score Sheet

This test was separated into 2 parts, each part is 10 minutes long, and was assessed 2 times at child's age 1-year, and 2-year. First part was observed when mother brings the child to the laboratory room. This was to see if the mother can help the child play in the unfamiliar place and their interaction in the situation. The mother was introduced and told that they could play freely with toys in the basket for 10 minutes, and they could play as they were at home. She was informed that their play would be recorded to see how the child usually plays. Then the experimenter left the room and started the clock. After 10 minutes the experimenter came back to the room and informed the mother to ask the child to clean up by putting the toys back in the basket. This was to elicit how the mother would guide the child to do something. Another part was observed when they had 10 minutes break during the laboratory session. This was to see their interaction when they became more familiar with the setting and the experimenter, and to see how the mother interacted with the child when they were not completely fresh. Therefore, the overall observation time was 20 minutes for each subject. The same set of toys were used across all ages. All the toys are usually found in their area, suitable for this age range, and can be applied many ways to play with the child.

EA Materials

- a basket with toys (10 wooden blocks, a children soft book, 6 plastic fruits, a ball, a rattle)
- a video camera

EA Coding

The direct scores range from 7 to 1. According to EA scale 4th edition manual (Biringen, 2008), the direct scores in EA scale system are construct based scales

Table EA maternal dimensions, score range, Definition, and Example of observed behavior (modified from Biringen, 2008)

EA dimensions	Score range	Definition	Example
Maternal sensitivity	7	Highly sensitive	- Genuine, congruence, relaxed, gentle, their connection is healthy and secure.
	6 - 5.5	Bland sensitive	
	5 – 4	Inconsistently sensitive/ apparently sensitive	- Apparent/unreal quality, sudden shift of behaviors, inconsistent
	3 - 2.5	Somewhat insensitive	- Cool or detached, little or no connection, depressed withdrawn, traumatized affect
	2 – 1	Highly insensitive	
Maternal structuring	7	Optimal structuring	- Providing guidance, or suggestion that move the child in an appropriate way, leading the child in a positive way
	6 - 5.5	Moderately structuring	
	5 – 4	Inconsistent structuring	- Inconsistent in providing guidance, try too hard that maternal loses the child from positive connection
	3 - 2.5	Somewhat unstructuring	- Guidance, and appropriate leading is almost nonexistent
	2 – 1	Non-optimal structuring	
Maternal non-intrusiveness	7	Non-intrusiveness but emotionally present/available	- Waits for optimal breaks to enter interaction, rather than interrupting.
	6 - 5.5	Generally, non-intrusiveness but sometimes benign forms of intrusiveness	
	5 – 4	Benign intrusiveness	- Verbally intrusive, a lot of don't
	3 - 2.5	Somewhat intrusive	- Physically interrupt frequently, physically intrudes
	2 – 1	Intrusive	
Maternal non–hostility	7	Nonhostile	- Does not use any negative expression in voice, face, and behaviors
	6 - 5.5	Generally nonhostile	
	5 – 4	Covertly hostile	- There are subtle sign of stress or covert negative expression (e.g. huffing and puffing)
	3 - 2.5	Slightly overtly hostile	- Shows negative expression overtly
	2 – 1	Markedly and overtly hostile	

EA Score Sheet

Subject ID: _____ EA age: _____ Date of Scoring: _____

Sensitivity 1. Affect: _____

2. Perception: _____

3. Timing: _____

4. Flexibility: _____

5. Acceptance: _____

6. Interaction: _____

7. Conflict: _____

Direct Score: _____

Structuring 1. Guidance: _____

2. Success: _____

3. Amt. of Structuring: _____

4. Limit Setting: _____

5. Firm: _____

6. Verbal & Nonverbal: _____

7. Adult Role: _____

Direct Score: _____

Non-Intrusiveness 1. Follow C: _____	Non-Hostility 1. No Neg Face/Voc: _____
2. Entry: _____	2. No Disrespect: _____
3. Commands: _____	3. No Separation: _____
4. Talking: _____	4. Not Lose Cool: _____
5. Teaching: _____	5. No Frightening: _____
6. Interferences: _____	6. Silences: _____
7. Feel Intrusive: _____	7. Theme: _____
Direct Score: _____	**Direct Score:** _____

EMOTIONAL AVAILABILITY (EA)® System
CERTIFICATE OF RELIABILITY

(Level 1: BASIC)

Certification: In 2020, ***Pimjuta Nimmapirat*** participated in an EA training (no less than 24 hours for EA Scales & Attachment Screener/EA Zones), completed the criterion/reliability cases for the 4th edition of the Emotional Availability (EA) Scales, and has achieved an acceptable level of reliability with our standard codes for a period of two years from the date below. Please know that across participants, this process establishes a minimum level of percent agreement with our standard codes and that you need to establish adequate reliability in your own sample with another certified coder before you start coding on your own. Double coding hard-to-score cases on your own sample (per your judgment) is also highly recommended

Scope of use: This certificate does not give permission to train any others either in your facility or elsewhere, or to share/show any videotapes from Biringen. You are also not allowed to distribute any copies of the manual, in whole or in part. This certification allows the investigator to score cases in one's own studies or projects only (not for a fee in others' projects/studies). We provide a service of help on hard-to-score cases, when feasible for us, on a case-by-case basis.

Citation of the system in your work: The proper citation for the 4th edition is, as follows:
Biringen, Z. (2008). *The Emotional Availability (EA) Scales and EA Zones Evaluation: Infancy/early childhood version; middle childhood/youth versions; therapist/interventionist/professional manual; couple relationship manual* (4th ed.), Boulder.

And,
Biringen, Z., Derscheid, D., Vliegen, N., Closson, L., & Easterbrooks, M.A. (2014). Emotional Availability (EA): Theoretical background, empirical research using the EA Scales and clinical implications. *Developmental Review, 34,* 114-167.

Recommendation for additional training in the future: Re-activation of the certificate is recommended in 2 years maximum, with the potential to move to a higher skill of use (Level II), based on our viewing & scoring of a small number of your cases that you also have scored or another process we find useful. Please let us know when you are interested in that.

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Date: March 18, 2020

Appendix 7

Early Childhood Behavioral Questionnaire – short form (ECBQ-sf)

Thai version of Early Childhood Behavioral Questionnaire – short form (example page 1 of 7)

แบบประเมินพฤติกรรมเด็กเล็ก(ECBQ) V.2-23 August 2018 รหัสอาสาสมัคร_____

แบบประเมินพฤติกรรมเด็กเล็ก (ECBQ Short Form - Thai Version)

ชื่อเล่นเด็ก: _____ เพศ: ☐ หญิง ☐ ชาย อายุ: ____ ปี ____ เดือน ____ วัน

วันเกิดเด็ก: _____ วันที่ตอบแบบสอบถาม: _____

ผู้ตอบแบบสอบถามมีความสัมพันธ์กับเด็ก: ☐ พ่อ ☐ แม่ ☐ อื่น ๆ (ระบุ) _____

อายุพ่อ: _____ ปี อายุแม่: _____ ปี จังหวัดที่อยู่อาศัย: _____

ระดับการศึกษาสูงสุดพ่อ: _____ แม่: _____

รายได้รวมของครอบครัว: (โดยประมาณ) _____ บาท/เดือน

คำชี้แจง:

ขอให้ท่านประเมินความถี่ในการแสดงพฤติกรรมของบุตรของท่านในช่วง 2 สัปดาห์ที่ผ่านมา

ในช่อง "**สถานการณ์นี้ไม่เกิดขึ้น (NA)**" จะใช้เมื่อบุตรของท่านไม่ได้พบกับสถานการณ์ดังกล่าวในช่วง 2 สัปดาห์ที่ผ่านมา (เช่น ในสถานการณ์ *"แสดงความกังวลเมื่อต้องใช้ลิฟต์ หรือ บันไดเลื่อน"* หากในช่วง 2 สัปดาห์ที่ผ่านมาพ่อแม่ไม่ได้พาเด็กขึ้นลิฟท์หรือบันไดเลื่อนให้ตอบ NA) ซึ่งจะแตกต่างกับ "ไม่ทำเลย" เนื่องจาก "ไม่ทำเลย" คือ ในช่วง 2 สัปดาห์ที่ผ่านมา บุตรของท่านพบกับสถานการณ์นั้นแต่ไม่แสดงพฤติกรรม (เช่น บุตรของท่านได้เข้าลิฟท์หรือใช้บันไดเลื่อน แต่บุตรของท่านไม่แสดงท่าทางกังวล)

ในช่วง 2 สัปดาห์ที่ผ่านมา บุตรของท่านแสดงพฤติกรรมเหล่านี้บ่อยเพียงใด	ไม่ทำเลย	แทบจะไม่ทำ	น้อยมาก	น้อย	ปานกลาง	บ่อย	บ่อยมาก	สถานการณ์นี้ไม่เกิดขึ้น
เมื่อถึงเวลาเข้านอน หรือนอนกลางวัน								
1. มีอาการงอแง	1	2	3	4	5	6	7	NA
เมื่ออยู่ในที่สาธารณะ (เช่น ร้านขายของชำ แล้วมีคนไม่รู้จัก เดินเข้ามาหาเด็ก)								
2. ขยับตัวหนี และหลีกเลี่ยงจากบุคคลนั้น	1	2	3	4	5	6	7	NA
3. เกาะติดหนึบกับผู้ดูแล	1	2	3	4	5	6	7	NA
ขณะทำกิจกรรมทั่วไปในแต่ละวัน								
4. ใช้นิ้วมือเคาะ หรือดีดเบา ๆ หรือเคาะสิ่งของอื่น	1	2	3	4	5	6	7	NA
5. ทำท่าไม่สบายใจ เวลาถุงเท้าหลุดเลื่อนไม่พอดีเท้า	1	2	3	4	5	6	7	NA
6. ทำท่าไม่ชอบใจ เวลาที่มือสกปรกหรือเหนียวเหนอะหนะ	1	2	3	4	5	6	7	NA
7. รับรู้ถึงเสียงเบา ๆ เช่น เสียงแอร์ หรือตู้เย็นที่เริ่มทำงาน	1	2	3	4	5	6	7	NA
8. กระพริบตาบ่อย ๆ	1	2	3	4	5	6	7	NA

Appendix 7

Crayon Delay Procedure and Score Sheet

Child was seated on a chair at a child size table opposite the experimenter. Mother answered a questionnaire at another table with back turned to experimenter and child. If the child did not sit without the mother nearby, then mother could sit behind the child with clipboard and the questionnaire, and mother were informed that she could comfort the child to get back to the seat, but when the test starts no talking was allowed, and mother answered the questionnaire during the test. At the beginning of the test, child was invited to color, then experimenter put the opened box of crayons with a couple of crayons on the table and a paper within the child's reach. Experimenter explained "I need to go outside to find some things for a new game. Please do not touch the paper, crayons until I come back." (น้อง ... คะ เดี๋ยวคุณครูจะออกไปหยิบของข้างนอก น้อง ... ห้ามจับสีเทียนกับกระดาษบนโต๊ะเลยนะคะ รอคุณครูกลับมาก่อนนะคะ") After the instruction, experimenter left the child with crayons and paper for 60s, then came back to the room after 60s. Then the experimenter let the child coloring with crayons for 5 minutes.

CD Material

- New box of crayons
- Blank paper
- A questionnaire (for the mother to do and not interrupt with the child.)
- 2 video cameras

CD Coding

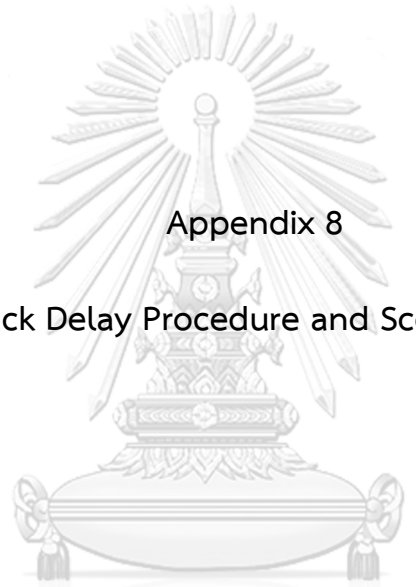
Latency of the child touching the box. (range: 0-60): The experimenter starts the clock when the experimenter releases hand from the crayon. Higher score indicates that child can control their impulse and wait longer.

Crayon Delay Score Sheet

Subject ID	Exp	Age in month_24M	Date_24M (dd/mm/yyyy)	Datecode_24M (dd/mm/yyyy)	Start to Touch in video	Latency of response (sec)

Appendix 8

Snack Delay Procedure and Score Sheet



This test consists of 4 trials with different delay times, which are 10s, 15s, 20s, and 30s, respectively. Prior to the test, child was seated on a chair at a child size table opposite to experimenter. Mother answered a questionnaire at another table with back turned to experimenter and child. If child did not sit without mother nearby, then mother could sit behind the child with clipboard and the questionnaire, and mother was informed that she could comfort the child to get back to the seat, but when the test starts no talking allowed, and mother answered the questionnaire during the test.

When the setting was ready, the experimenter instructed the child "*Keep your hands on the table and wait to get the snack after the bell rings*" ("เอามือวางบนโต๊ะตรงนี้ รอเสียงระฆังดัง กริ๊ง ๆ ถึงกินขนมได้นะคะ). Put the snack under the transparent cup within the child reach, the bell was presented on the table, and was always in experimenter's control and out of the child reach. Starting the stopwatch when experimenter released hand from the cup, then experimenter waited for half of the delay times (5s, 7.5s,10s,15s), then lifted the bell but did not ring it. When the delay time for that trial was reached, experimenter rang the bell. Experimenter could encourage child, if he/she did not grab the snack after the bell rang. Starting next trial after child finished the snack. Experimenter reminded the instruction briefly to the child once again, started the trial following the same procedure with next delayed time.

If child became fussy and grabbed the snack before experimenter had a chance to mention the bell and give instruction, do not grab the snack back but let the child have the snack, note as task failure. Experimenter reminded the child that he/she had to wait then starts over. If child cannot start Trial 1 (10s delay) and became task failure for 3 consecutive trials, then the test stop. If child already starts some trials but then become fussy and task failure for 2 consecutive trials, then the test stop.

After the test is done mother and child were asked to have a break outside the laboratory room for 5 minutes.

SD Material

- Bread stick
- Transparent cup
- Bell
- 2 video cameras

SD Coding

Start the clock when experimenter releases hand from the cup. Coding for each trial as following rules (Spinrad, Eisenberg, & Gaertner, 2007):

- *Give 1 point*: Child ate the snack before E lifted the bell.

- *Give 2 points*: Child ate the snack after E lifted the bell.

- *Give 3 points*: Child touched the snack before E lifted the bell.

- *Give 4 points*: Child touched the snack after E lifted the bell.

- *Give 5 points*: Child touched the cup or the plate before E lifted the bell.

- *Give 6 points*: Child touched the cup or the plate after E lifted the bell.

- *Give 7 point*: Child waited until the bell rang.

- If child gets 7 points, add *1 extra point* for keeping hands on the table sometime during waiting time.

- If child gets 7 points, add *2 extra points* for keeping hands on the table during the entire waiting time.

In case that the test could not be continued because the child refused by crying excessively, the lowest scores were given to the child for the left test items. Averaged latency of the child retrieving the snack from 4 trials were used for data analysis. The range of score can be 0 to 9, in which higher score indicates higher inhibitory control.

Snack Delay Score sheet

Subject ID	Exp	Age in month_24M	Date_24M (dd/mm/yyyy)	Datecode_24M (dd/mm/yyyy)	Trial 1	Trial2	Trial3	Trial4	Average

Appendix 9

Prohibited Toy Task Procedure and Score Sheet

1. Mother-prohibited phase

Prior to the test before they enter the laboratory room, experimenter instructs the mother “This test will be around 20 minutes. There will be a shelf with three toys in the room. The child won’t allow to play with them during the test. You need to prohibit the child from the toys on the shelf and encourage the child to play only with the wooden shapes for the first 10 minutes.” (“กิจกรรมนี้จะใช้เวลาประมาณ 20 นาทีนะคะ โดย 10 นาทีแรก คุณแม่เป็นคนห้าม ไม่ให้น้องเล่นของเล่นบนชั้นวางตลอด 10 นาทีเลยนะคะ แต่คุณแม่ชวนน้องเล่นของเล่นไม้บนโต๊ะได้ค่ะ พอครบ 10นาทีแรก เดี๋ยวคุณครูจะกลับมานะคะ”), then experimenter let them enter the room, and experimenter will be outside.

2. Observed child’s internalization of prohibition phase

After the first 10 minutes, experimenter enters the room and has mother say to the child: “Please play with the wooden shapes while I am doing this questionnaire. Do not touch or play with any of the toys on that shelf” (“ครบเวลา 10 นาทีแล้วนะคะ ต่อไปจะขอคุณแม่บอกน้องว่า ‘ห้ามเล่นของเล่นบนชั้นวาง ให้เล่นกับของเล่นไม้นะ’ แล้วคุณแม่ไปนั่งหันหลังให้น้อง ทำแบบสอบถามที่โต๊ะนะคะ). Mother does a questionnaire at a table with back turned to child. Before experimenter leaves the room said to the mother “Please do not interaction or repetition of the commands. You can comfort your child with minimum interaction, if they become fussy, or cry”. Experimenter said “I will be back after 5 minutes”), then leaves. (ก่อนผู้วิจัยออกจากห้องบอกคุณแม่ว่า “หลังจากนี้คุณแม่ไม่คุยกับน้องแล้วนะคะ ถ้าน้องร้องไห้งอแงคุณแม่ปลอบน้องได้บ้าง แต่พยายาม

คุยยกับน้องให้น้อยที่สุดนะคะ”). After 1st 1 minute passed, an unfamiliar female enters the room and plays with toys on the shelf for 1 min, and then leaves. The child is left alone again for 3 minutes. When experimenter returns to the room, allow the child to play with the prohibited toys for 5 minutes.

PTT Materials

- A shelf with three very attractive toys (prohibited toys)
- Plain wooden shapes
- An unfamiliar female
- 2 video cameras

PTT Coding

Child’s behavior was coded for each 60 5s segments, using six mutually exclusive codes ranging from highest level of internalization to lowest level of internalization (Harden, Duncan, Morrison, Panlilio, & Clyman, 2015; Kochanska, Coy, & Murray, 2001).

- Give 6 points: Child engaged in sorting activity

- Give 5 points: Child engaged in other activity

- Give 4 points: Child looked at toys without touching

- Give 3 points: Child began to touch the prohibited toys and stopped spontaneously, or touching for less than 2 s.

- Give 2 points: Child touched the forbidden toys in gently manner, did not remove them from the shelf, nor engage in dramatic play with them.

- Give 1 point: Child played with the toys, removed from the shelf, or engaged in dramatic play with forbidden toys (Deviation).

In case that the test could not be continued because the child refused by crying excessively, the lowest scores were given to the child for the left test items.

Prohibited toy task Score Sheet

Subject ID	Exp	Age in month_24M	Date_24M (dd/mm/yyyy)	Datecode_24M (dd/mm/yyyy)	Start time (cam1/cam2)	Epoch 1	Epoch 2	Epoch 3	Epoch 4	Epoch 5	Epoch 6	Epoch 7	Epoch 8	Epoch 9	Epoch 10	....	Epoch 60

VITA

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