The Role of Attachment, Maternal Scent and Home Environment on Infants' Quality of Sleep in Day Care context: A multiple case study approach

Rebeca D. Sandu

Leiden University

St. ID 1051407

Supervisors: R.Cárcamo

Prof. R. van der Veer

Abstract

Objective: The present exploratory study investigated the role of attachment, maternal scent, and quality of home environment on infant's quality of sleep in day care. The sample consisted of three infants, ranging between four and seven months of age. Mothers completed questionnaires regarding general information about themselves and the usual behavior of their infants. Interaction between mother and infant was assessed through the Attachment During Stress Scale (ADS). The Infant/Toddler HOME (IT-HOME) was used to measure the quality of home environment. An experimental procedure was conducted to evaluate infants' quality of sleep. T-shirts infused with their own maternal odor, another mother odor, and neutral odors were placed in the cribs during their morning nap. Video recordings were coded to assess the crying before sleep, total cry time, sleep duration, and caregiver intervention in each condition. The three securely attached infants involved in the study cried less before sleep and during the entire nap when exposed to the maternal odor, either from their own or other mothers, as compared with the neutral scent. However, they cried even less with the other mother odor compared with their own mother scent. In terms of sleep duration, two of the infants slept more with their own mother scent. The last baby, who showed a different pattern of sleep duration, had the lowest score on HOME. Several explanations are advanced to explain the preliminary findings and suggestions are made for future research.

Keywords: attachment, maternal scent, home environment, sleep

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1. Introduction

The number of day care centers in Chile has increased rapidly over the past years (Medrano, 2009). Investigating factors that can protect infants from possible adverse effects of their fulltime attendance in day care centers is becoming crucial. Therefore, the present multiple case study aims to explore the role of attachment, quality of home environment and maternal scent on the quality of sleep among three babies enrolled fulltime into day care.

Bowlby (1969) was the first to formulate the attachment theory, according to which children are biologically predisposed to use their parents as a haven of safety to provide comfort and protection when they are distressed, and as a secure base from which they can explore the world.

Even though several studies concluded on the detrimental effect of extensive non-maternal care on the child's attachment pattern in their first year of life (Belsky & Rovine, 1988; Gamble & Zigler, 1986), recent evidence shows the importance of considering family factors when trying to establish the influence of day care on children's attachment. Perhaps the strongest evidence investigating child care as a risk factor for the development of mother-child attachment relationship can be found in the NICHD Study of Early Child Care (NICHD Early Child Care Research Network, 2006). Results revealed no main effects of child care on attachment security, but significant interaction effects between child care and maternal characteristics. Children who experienced low maternal sensitivity and low responsiveness were more at risk to attachment insecurity when exposed to poor quality of care, extensive child care, and more than one care arrangement. In summary, under some circumstances, day care centers may represent a risk factor for children's well-being (Belsky, 1986).

Furthermore, research shows a significant difference between level of stress among infants in the home setting and those who attend day care centers, the latter exhibiting higher levels of cortisol (Vermeer & Van IJzendoorn, 2006). However, Larson, Gunnar, and Hertsgard (1991) found significant reductions of cortisol during morning naps among nine month old infants. Thus, day care can interfere with the infant's normal pattern of cortisol, but there might be factors that protect them, like a good quality of sleep.

1.1 Attachment and quality of sleep

Considering that both attachment and sleep play an important role in infant self- regulation (Aronen, Paavonen, Fjallberg, Soininen, & Torronen, 2000; Bowlby, 2006; Colin, 1996), it has been argued that, regardless of the maturational processes, sleep can be regulated by attachment.

In line with this argument, Benoit, Zeanah, Bocuher, and Minde (1992) found that the insecure adult attachment classification of mother's state of mind is related with their children's sleep difficulties. Taking into account the link between adult attachment and child attachment status (Bus & Van IJzendoorn, 1992; Ward & Carlson, 1995) we can infer how the match of the parent's own attachment classification and the child's attachment status can influence their quality of sleep.

Furthermore, Scher (2000) investigated sleep regulation, measured both by maternal report and actigraph measurements, as a function of attachment relationship. The results revealed that the infants' pattern of sleep, as reported by the mothers, did not differ significantly within the attachment classification. However, two significant associations between objective measures of sleep and attachment related behaviors were found. Specifically, proximity seeking was positively correlated with sleep duration, and higher scores on the avoidance scale were found to be negatively correlated with the number of awakenings. However, these significant associations resulted out of 20 comparisons, which raises the question of their reliability.

In addition, Scher and Asher (2004) examined the relation between Israeli infants' sleep-wake regulation and attachment security. The results did not show any significant association between attachment security, as measured by the Attachment Q-Sort, and the objective measures or maternal reports of sleep problems. However, the authors question the use of Attachment Q-Sort and the small sample size. In addition, the low incidence of insecure-avoidant children in the Israeli sample made it difficult to compare between insecure-avoidant and insecure-resistant children concerning sleep problems, while Scher (2001) argues that the relation between sleep patterns and attachment classification is the most evident because of their different attachment strategies.

Therefore, McNamara, Belsky, and Fearon (2003) analyzed sleep patterns among infants classified as insecure-avoidant and insecure-resistant. The results revealed that the insecure-avoidant infants presented fewer night awakenings and shorter mean duration of these episodes compared with the insecure-resistant. Furthermore, insecure-resistant infants were more likely to exhibit clinical sleep problems than insecure-avoidant infants both at 6 and 15 months. All together, the study indicates that sleep patterns are related to the attachment classification.

However, Keller, El Sheikh, Joseph, and Buckhalt (2008) did not find attachment as a predictor of quality of sleep among third graders. Nonetheless, when testing quality of sleep as a moderator between attachment classification and academic achievement, they found that better quality of sleep functioned as a protective factor for children's academic difficulties related to their attachment insecurity towards their parents. However, one could argue about the use of Inventory of Parent and Peer Attachment, which is a

self-report measure of the children's perception of their quality of their attachment towards their parents, which does not offer different attachment classifications (secure, insecure-avoidant, insecure-resistant) as the observational methods do. The results also revealed that insecure children could manage to have a good quality of sleep and one of the explanations given by the authors was that insecure children use sleep as a form of avoidance coping, thus diminishing the amount of time that otherwise would have to be spent with their parents.

In summary, there is still controversy about the associations between attachment and sleep patterns, some studies showing evidence of the predictive role of attachment on sleep regulation, while others failing to do this.

1.2 Maternal scent as a soothing aid

Of course, infants who attend day care centers might improve their well-being by using familiar sleep aids that might decrease their anxiety when separated from their mother, for example, an object infused with their mother's odor.

Regarding the olfactory capacity among infants, evidence supports infants' recognition of familiar odors versus unfamiliar ones (Porter & Moore, 1981) and a preference towards certain odors, specifically of their own mother (Cernoch & Porter, 1985; Sullivan & Toubas, 1998; Varendi et al., 1994).

Trying to establish the clinical usefulness of maternal odor among newborns, Sullivan and Toubas (1998) found that the babies stopped crying when exposed to their own mother's or other mother's gown as compared with exposure to a clean or no gown. Similarly, Nishitani et al. (2008) examined the way newborns will react to their mother's milk odor when exposed to a routine medical procedure. The results showed that the odor from infants' own mother's milk had a calming effect on infants crying, grimacing, and motor activity. However, Burhnam, Goodlin-Jones, Gaylor, and Anders (2001) investigated the role of a T-shirt engrained with maternal odor as a sleep aid among infants ranging in age from three to twelve months. Although there was an increased interest among six months old infants in the odor-laden T-shirt, there was no significant relationship between the use of an odor-laden T-shirt and children's predisposition to self-sooth.

1.3. Quality of Home Environment and Sleep

Research shows the role of physical and social environmental factors in sleep disruptions. Environmental features like low temperatures, excessive noise or light, and uncomfortable sleeping surface can interfere with the quality of sleep (Ferber & Kryger, 1995). In addition, social aspects of the home environment, like family stress and maternal depression, were found to adversely affect sleep (Lozoff, Wolf, & Davis, 1985; Sadeh, Raviv, &Gruber, 2000). Furthermore, Spilsbury et al. (2005) investigated the link between home environment, as measured with Middle-Childhood Home Observation for Measurement of the Environment (MC-HOME), and sleep behavior among children aged eight to eleven. Results revealed that the Encouragement of Maturity subscale significantly predicted longer sleep duration and earlier bedtime. Moreover, the MC-HOME total score significantly predicted an increase in mean sleep duration among African-American children. To sum up, it appears that parenting style associated with an encouragement in maturity among children might promote healthier sleep behavior.

Overall, the purpose of the present study is to examine the influence of attachment, quality of environment, and maternal scent on infants' quality of sleep in the day care setting. There were three viewpoints that directed our investigation. First, the evidence of individual differences in sleeping behavior associated with the attachment classification. Second, the evidence of the effect of quality of home environment related to infant's quality of sleep. Last, the role of maternal odor on infant's soothing behavior, which proves the beneficial effect of recognition of maternal odor on infants' well-being.

Three individual cases were selected in order to explore the associations above mentioned. By exposing every baby to three experimental conditions, we could provisionally examine whether the presence of maternal scent was accompanied by a better quality of sleep. Moreover, the case studies may clarify the mechanisms through which attachment, quality of home environment and maternal scent impact the infants' sleep.

2. Method

2.1 Participants

After contacting the public day care provider from Chile, "Junta Nacional de Jardines Infantiles", informative brochures regarding the research intentions were sent to the day care centers. In accordance with the purpose of the study, three case studies were randomly selected from the sample of mothers who agreed to participate in the investigation. Given the multidimensional approach (assessment of

attachment, maternal scent, quality of home environment, and sleep quality) and the particularity of the present study (extensive childcare and low SES), we opted for an in-depth qualitative study of a limited number of children. This allowed us to discuss the results of different measurements in more detail and to provide the reader with the flavor of the situation. In the discussion we will come back to the advantages and disadvantages of qualitative case studies and experimental research with its conclusions based on the averages of large samples.

2.2 Measuring Instruments

2.2.1 Attachment. The Attachment During Stress Scale (ADS), developed by Massie and Campbell, was used to assess the mother-infant attachment pattern in infants from birth to 18 months. The ADS is currently utilized in Chile as a national screening device in public health to investigate the attachment pattern in infants and the need for subsequent intervention when the infants' development is at risk (Causadias, Stroufe,& Herreros, 2010).The procedure includes observation of both the mother and child behavior in mildly to moderately stressful situations. The ADS is composed of six observational indicators of attachment: gazing, vocalizing, touching, holding, affect and proximity. The observation takes place on each of these attachment indicators and each response is graded from 1 to 5, showing an increase in the mother-child involvement during a stress episode. The scores that fall between 1-2 and the score 5 signal an insecure attachment, while scores of 3 and 4 indicate a secure one. In the three case studies, one experienced rater coded the ADS episodes. The ADS Scale has been validated (Cárcamo, van IJzendoorn, Vermeer & van der Veer, submitted).

2.2.2 Quality of home environment. The HOME Inventory (Caldwell & Bradley, 1984) was used to assess the quality of the home environment. The HOME Inventory is composed of observation and a semi-structured interview through which the level of stimulation accessible to a child at home is measured. Taking into consideration that the age of infants from the present study ranges from 4 to 7 months, use was made of The Infant-Toddler HOME Inventory (IT-HOME). IT-Home consists of six subscales: Responsitivity, Acceptance, Organization, Learning Materials, Involvement and Variety. Each of them evaluates a different aspect of a child's environment and contains a number of items that are scored according to a glossary. The binary-choice items are summed and provide a total score, which can range from 1 to 45, the latter showing the highest quality of home environment. The HOME Inventory has been proved to be a valid instrument in the Chilean context (Correa, Herrera, & Mathiesen, 2001).

2.2.3 Quality of Sleep. The infants' naptimes were videotaped and rated independently by two trained coders. Indicators of sleeping behavior, as collected from other studies regarding sleep among infant (Nishitani et al., 2009), were analyzed by the coders. These include: Cry before sleep (the amount of time baby cries before falling asleep), Total Cry time (the amount of cry time during the entire footage), Sleep time (the number of seconds the baby sleeps during the video), and the Caregiver Intervention (number of seconds of caregiver intervention). With regards to the cry behavior, the coding involved analysis of the footage by second and the behavior was indexed when it lasted/stopped for more than 5 seconds. When the infants were taken out of the crib, the coding stopped until they were put again in their crib, and subsequently, in contact with the t-shirt.

2.2.4 Background and child behavior information. Mothers completed a general questionnaire which offered general information about themselves and their children's behavior, such as his or her daily behavior or sleeping behavior.

2.3 Procedure

To asses the mother-child attachment relationship, the mother and her infant were videotaped at home in three different situations: 1) feeding; 2) changing diapers; and 3) free play. Each segment of footage lasted approximately three minutes and after the data collection at home, they were codified by one expert coder with the ADS Scale. The procedure of IT-HOME consisted of fifteen minutes of filming the home environment, followed by fifteen minutes of observation of the mother-infant interaction and ending with half an hour of interviewing the mother.

Regarding sleep, the video camera, which was setup on a tripod, was used to record infant's morning sleep at the day care center. The video recording took place in each of the three conditions: with a T-shirt from own mother, with a T-shirt from another mother, and with a neutral T-shirt. After wearing the T-shirt three nights in a row, minimizing the use of perfume, the mother delivered the T-shirt sealed in a plastic bag at the day care center. In the case of the T-shirt from another mother, the procedure was the same, except that the researchers were the ones who brought it to the day care center. For the last condition, the researchers washed the T-shirt with a neutral detergent, placed it in sealed plastic bag, and then left it at the day care. Depending on the different conditions, the researchers placed the T-shirt over the mattress that the infant was usually sleeping on just before his morning nap. When the infant was about to sleep, the video camera was placed in front of his crib. Accordingly, the time when he was put in

the crib was written down. Similarly, the researchers noted the time when the infant woke up and was taken out of the crib by the caregiver.

3. Results

3.1 The case studies

Case 1.

Background information .

Clara is a 25 years old mother of two children whose ethnic origin is Mapuche. Her second baby takes part in the present study. From the general questionnaire, we found out that the baby is seven months old and he has attended a public day care center for four months, approximately forty hours a week. With respect to the usual behavior of the baby, the mother asserts that he is not difficult to manage when he encounters problems or when he is upset; in addition, he easily adapts to new environments, responds positively toward new persons and toys, and enjoys the company of his mother. When asked about the degree to which she thinks her child is being difficult (Very easy- Normal- Very difficult), she claimed that he belong to the normal category.

Concerning the sleep behavior of the baby, the mother reported him having a normal sleep pattern and not using any pacifiers or sleep aids to ease his sleep. In addition, the mother did not think that at that moment her baby presented any sleep problems. In line with the experimental procedure, the focus was also on questions related to the first nap of the baby. The mother characterized the sleep during morning hours as calm, without major movements, and with a duration of about 1-2 hours. Regarding the arrangement of the sleep, the mother's report sustains that the baby is sleeping in the parents' room and four to seven times a week in their own bed, during the night.

ADS .

First assessment of the ADS involved the observation of the dyad while the mother was feeding the baby. There is eye contact between the mother and infant for a certain part of the filming, during which we can

clearly see a positive affect of the infant toward his mother and vice versa. Also, the baby seems to enjoy it when the mother talks with him by smiling and occasionally vocalizing to her. However, the behavior of the mother shifts between anxiety, as evidenced mostly when the infant refuses to eat, and pleasure, when she vocalizes and smiles to him in order to ease the feeding process. In addition, there is a noticeable restriction of the exploration behavior of the baby during the meal, given that the mother limits his attempt of playing with the spoon for which he has expressed interest.

The second assessment involved the event of changing diapers, during which the mother showed rarely tension, strong vocalization with her baby, and a playful disposition, all of these making the event a positive experience for the baby. We can observe from the footage that the baby is not stressed by the change of diapers and communicates with the mother, either vocalizing (imitating the sound the mother makes) or looking at her face and smiling in response to the mother's behavior.

The last assessment involved observing the dyad's interaction during playtime. The contact between the mother and her baby is characterized by enthusiasm and intense communication. The mother is in constant proximity with her infant, expressing a positive affect and frequently vocalizing with him. In addition, she often reaches toward and touches the infant, her actions making the baby happy and willing to participate in the interaction. However, the mother appears to be less attentive when the child is interested in another toy, thus occasionally she is not following her child's lead. With regards to the baby, he enjoys playing with his mother, staying in close proximity with her and responding with excitement during the interaction.

In sum, the ADS video footages show Clara as a sensitive mother, who interacts with her baby in a way that makes him happy and wanting to be involved in the interaction. She keeps in close contact with her baby and shows him positive affect during the entire assessment. Even when the situation is more stressful, such as during the feeding episode, she manages to cope with the potential tension and diminishes the stress by showing positive and sensitive affect towards her baby. As to the infant, he is excited by his mother, vocalizing and wishing to be in frequent contact with her. He rarely shows tension during the entire assessment and demonstrates a degree of well-being in contact with his mother.

Consequently, the expert coder in the Attachment During Stress Scale evaluated the baby's attachment classification as a secure one.

HOME .

In this section we will present both the scores of each subscale and the total score of HOME procedure.

I. Responsivity. Results revealed a maximum score (11 out of 11) for the degree of the mother's responsiveness. The interview, as well as the observation, showed that the mother allows her baby to involve in "messy" play, responds to his vocalizations or names the objects from the environment to ease his understanding. Moreover, she often praises her child and kisses him during the visit. Last, she speaks in a way that her child can easily understand.

II. Acceptance (5 out of 8). This scale revealed that there is no physical punishment during the visit or overt hostility toward the baby. Also, the mother does not criticize the baby. However, at times, she interferes and restricts the child's actions, an aspect that was visible during feeding time (as discussed above). Moreover, the family does not own a pet, nor do they have ten books available in the house.

III. Organization (4 out of 6). The subscale showed that the child is regularly taken out of the house, for example, he accompanies his mother at the groceries shop, and he is medically examined on a regular basis. In addition, he has a special place where he can play. However, when the mother is busy, he does not have many other caregivers to rely on. In addition, the play environment does not seem safe.

IV. Learning Materials (8 out of 9). The child's environment includes toys that foster different areas of his development, except complex eye-hand coordination ones, such as Lego blocks.

V. Involvement (4 out of 6). The mother involves the child in her actions by constant talking with him. Next, she supports her child's development by taking an active encouraging role in his attempt to explore the environment and keeps him in her visual range. Still, she lacks in providing and assisting the child to discover new challenging toys.

VI. Variety (2 out of 5). The father is involved to some extent in the care of his child. Moreover, the family regularly visits their relatives. But, the child does not have any books of his own and, subsequently, the parents do not read to him. Finally, the child does not eat together with his parents.

To sum up, the IT-HOME total score for the first case study was 34, which falls into the upper quartile, given that the maximum score is 45.

Sleep .

Table 1 shows the indicators of quality of sleep of case 1 in each experimental condition (own maternal scent, other maternal scent, and neutral scent).

First, in terms of *cry before sleep*, we can observe (see Table 1.) that the baby cries the least amount of time when exposed to other maternal scent, followed by own maternal scent, and cries the most in the neutral condition. Secondly, we notice a similar pattern for the *total cry time*, the infant crying less during the entire video footage in the presence of maternal scent (either from his own mother or the other mother) and the most when sleeping with the neutral t-shirt. In terms of *sleep time*, the baby sleeps a higher quantity of time in the presence of his own maternal scent, then decreases in the condition of other maternal scent, and last, in the neutral scent setting. However, the table shows us that when the baby sleeps with his own maternal scent he wakes up more often and requires more caregiver intervention than in the neutral condition.

Table 1. *Effect of Maternal Scent on Sleep Quality (case 1)*

	T-shirt		
Quality of sleep (sec.)	Own	Other	Neutral
Cry before sleep	181	0	301
Cry time (total)	192	0	301
Sleep time	5884	4349	2092
Number of times baby wakes up after falling asleep	6	3	0
Out of crib	57	0	0
Caregiver Intervention	764	310	498

Case 2.

Background information .

Fiona (20 yrs. old) is the mother of two children, whose ethnic origin is Chilean. Her second baby (5 months old) is participating in the present study. The general questionnaire revealed that he has been attending fulltime a public day care center for about one month, approximately twenty- five hours per week. With regards to the usual behavior of the baby, she stated that the baby can be easily upset and when this happens, he is crying/ whining to a large extent. Also, the baby enjoys the company of his mother, he likes playing with her and he searches for her to be held in her arms. When asked about the degree to which she thinks her child is being difficult (Very easy- Normal- Very difficult), she claimed that he belongs to the normal category.

Concerning the usual sleep behavior, the baby does not have yet a sleep pattern. Moreover, he does not use any pacifier or sleep aids as ways to ease his sleep. When questioned if her baby does or does not have sleep problems, the mother reported that he has no sleep problems.

Information about the morning nap revealed that the baby's sleep is characterized by low motor activity and lasts about thirty minutes. In addition, the baby sleeps in the same room and bed as the parents.

ADS .

The first episode of the ADS assessment involved the feeding time. We can notice during the interaction that the mother frequently looks at the child's face and holds her comfortably so she can easily feed. In addition, she is constantly and gently touching her on her head, and at time she vocalizes to her, especially when she seems stressed or fussy. The infant seems relaxed and, while eating, she regularly touches his mother.

Secondly, the changing diapers episode showed the mother as being mostly calm, smiling and every now and then communicating with her child. She comforts her child when she exhibits distress, such as in the last part of the footage, when the child is crying. Therefore, she picks her up and kisses her, which had a soothing effect on the child. During the probe, the infant vocalizes at time with his mother, and occasionally looks at her. She is also interested in discovering new things that are near her, such as her shoe, and she feels at ease doing that. Also, she signals her mother through mild crying when she wants to be comforted, and she relaxes when her mother attends her needs.

The last video was comprised of the interaction during play. The mother was regularly looking and paying attention to her child's behavior. She was in close proximity with the baby, adjusting her child's positions so she could play easier. She frequently vocalized to her daughter and played with her, expressing a positive affect during the entire footage. One of the important things to mention is the mother's availability to follow her baby's lead. For example, when her child looks at some toys, the mother accompanies her in the exploration by being there, and not interfering with the baby's own discovery moment. The girl enjoys playing both by herself and with her mother. She looks and follows her mother's face, and sometimes vocalizes back to her. Most of the footage the baby is expressing a positive disposition.

Summing up, Fiona can be described as a mother who understands the need for and balance between attachment and exploration. She is responsive to her baby at times when the child feels stressed, by comforting and gently holding her. Moreover, she is calm and most of the time smiling to her daughter. From the child's perspective, she occasionally gazes at her mother and interacts with her by smiling back and making short sounds. She feels secure to explore the environment with her mother around her.

In conclusion, the expert coder in the ADS assessment evaluated the second baby as a securely attached child.

HOME.

I. Responsivity (11 out of 11). Through interviewing and observing the mother, the scale revealed maximum score in terms of responsivity. Not only the mother supported her child's exploration by allowing her to engage in "messy play", but she was constantly talking and being affectionate with the baby. In addition, the mother expressed positive feelings toward her baby and she was regularly praising her.

II. Acceptance (8 out of 8). The mother's acceptance was visible through her way of interacting with her child. She did not use criticism or physical punishment as a way of reacting to her baby's behavior. Instead, she let the infant carrying the actions he was involved in and not restricting or interfering with her. In addition, the family had a pet and also disposed of books which they could read to their infant.

III. Organization (4 out of 6). The home environment involved other caregivers in case the mother could not attend her child's needs. Also, the infant was frequently taken out off the house for

walks. Although her environment is safe, the infant does not have a special place where to play. Moreover, she is not taken on a regular basis to the doctor.

IV. Learning Materials (6 out of 9). The infant's environment contains toys which support her physical development, but lacks in cuddling toys, such as a teddy bear, or learning facilitating toys, for example, a table and chairs.

V. Involvement (4 out of 6). The mother talks with her baby whenever she is doing households activities and she also keeps her under her visual surveillance. She consciously supports the developmental growth of the infant, but makes available fewer toys which could challenge her learning.

VI. Variety (0 out of 4). The subscale revealed that there is a limited variety in the family environment, e.g., the father does not involve in the childcare of his infant or that there is no children literature available for the baby.

In conclusion, the IT-Home total score for the second case study was 33, which falls into the second quartile (median), given that the maximum score is 45.

Sleep .

Table 2 shows the indicators of quality of sleep of case 2 in each experimental condition (own maternal scent, other maternal scent, and neutral scent).

Table 2. *Effect of Maternal Scent on Quality of Sleep (case 2)*

	T-shirt		
Quality of sleep (sec.)	Own	Other	Neutral
Cry before sleep	95	9	126
Cry time	146	9	187
Sleep time	4548	1450	1415
Number of times baby wakes up after falling asleep	2	2	0
Out of crib	485	0	96
Caregiver Intervention	86	26	326

From Table 2 we see that the baby cried the least when exposed to other maternal scent, followed by his own mother's scent, and that he was most reactive when sleeping with the neutral t-shirt. In a similar way, we find this pattern for the *total cry time*, meaning that the baby registered the most reactive behavior, in terms of crying and fussing, when the neutral t-shirt was placed in his crib compared with the other two conditions. In addition, he needed more caregiver intervention when he slept in the absence of any maternal scent, and least with scent from another mother. However, both the conditions that involved maternal scent registered more awakening times than in the neutral condition.

Case 3 .

Background information .

Sonia (19 yrs. old) is the third mother participating together with her baby (4 months old) in our study, whose ethnic origin is Mapuche. Through the general questionnaire, the mother reported that the baby was enrolled fulltime at a public day care center since he was three months old. The usual behavior of the baby was described by the mother as being difficult to alleviate when the child is upset and the extent to which he cries or whines is high. Also, he changes his mood very often and does not react positively when being changed. However, he responds with excitement to new persons/environments. Furthermore, he likes being around his mother, playing with her and being held by her. When asked about the degree to which she thinks her child is being difficult (Very easy- Normal- Very difficult), she claimed that he subscribes to the normal category, but inclining toward the difficult type. With respect to the baby's sleep behavior, the mother reported no sleep pattern for him. Moreover, while he uses a pacifier all the time, he does not sleep with any sleep aid. During the first morning nap, the baby has an agitated sleep which lasts for approximately two hours. Finally, the baby's sleeping arrangement involves the room of his parents where he shares the same bed for four to seven times per week.

ADS .

The ADS assessment started with the feeding episode. Concerning the mother, she showed the entire footage sensitivity toward her baby through frequently long and short gazing at his face, vocalizing and gently touching him while breastfeeding. Not only was she often speaking with him, but she was also being affectionate in response to his attempt to communicate with her. Next, the baby was not just eating

but also enjoying the time with his mother. For example, he tried to be in touch with her by trying to reach her hand. He seemed to like whenever the mother talked with him since he responded to her with short utterances.

During the changing diapers episode, the mother was constantly talking with her baby, an aspect which relieved the possible stress that the baby might have experienced. She was paying attention to whatever thing her baby would look at and verbalizing its name. For example, she observed that her child was looking at the Mickey Mouse's picture and she named it for him. She was being positive and rarely exhibiting tension. On the child's side, he is looking at times at his mother and smiles at her. In addition, he is also interested in other things from the environment. He shows intermittent moderate anxiety and pleasure during the probe, and rarely vocalizes to his mother.

The last video footage showed the mother-infant interaction during playtime. One thing worth mentioning about the play was the way the mother positioned the child to play with her. Specifically, she placed the child on her lap, in an open position, thus facilitating the communication between them. She was regularly gazing at him and trying to involve him in the interaction, by talking with him and being considerate of his wishes. The child was smiling back at the mother's attempts to speak with him and he was often looking at her. Moreover, he was occasionally touching her and repeatedly following the mother with his eyes.

To sum up, Sonia revealed through these video footages that she pays attention to her child's signals, reads them accurately, and responds to them in a proper way. She looks at her child and realizes when he is interested in something. Consequently, she vocalizes to him and she tenderly touches him, showing him affection and understanding of his needs. She is available to the baby by being in frequent proximity and physical contact with him. Taking into account the child's overall behavior, he rarely pulled away from the mother's contact and he was in contact with her, either by following her bodily or with his eyes.

Having summarized this, the expert in coding for ADS assessed this dyad as being a securely attached one.

HOME .

I. Responsivity (9 out of 11). The mother was in frequent verbal contact with her baby, responding to his various utterances or naming objects from the environment when he would pay attention to them. Moreover, her voice had a calm and positive tone when talking about her

infant. However, she would restrict the child from getting involved in "messy" plays and she refrained from complementing her child's abilities during the visit.

II. Acceptance (6 out of 8). The mother does not physically punish the child nor does she exhibit any hostility towards the child. Moreover, she is not restricting her child's behavior. Yet, the family does not have literature for children or a pet.

III. Organization (4 out of 6). The child is taken regularly to the doctor as well as for walks. Even though he has his own place where he can play, the environment did not seem safe. Moreover, when his mother is busy, there are no other caregivers that can substitute for her.

IV. Learning Materials (6 out of 9). The infant has toys which concern his physical development and also others which facilitate his learning. However, both the simple and complex eye-hand coordination toys are missing from his play setting.

V. Involvement (3 out of 6). Although the mothers actively supports the developmental advance of her baby and makes sure he is in a visible place, she verbally involves him to a less extent while doing house duties. Moreover, she does not provide him with toys that can help the child to develop new abilities.

VI. Variety (1 out of 5). Besides the fact that the family keeps contact with their relatives, the family's variety lacks in terms of father involvement in childcare, availability of children literature or times when the child eats together with his parents.

In conclusion, the IT-HOME total score for the third dyad was 29, which falls into the second quartile (median), given that the maximum score is 45.

Sleep .

Table 3 shows the indicators of quality of sleep of case 3 in each experimental condition (own maternal scent, other maternal scent, and neutral scent).

Table 3. *Effect of Maternal Scent on Quality of Sleep (case 3)*

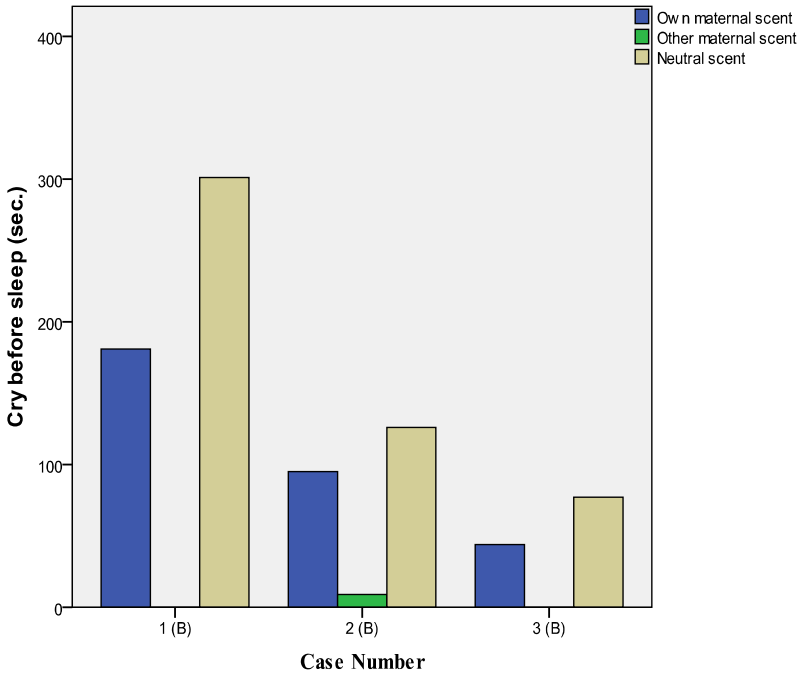
	T-shirt		
Quality of Sleep (sec.)	Own	Other	Neutral
Cry before sleep	44	0	77
Cry time	50	0	145
Sleep time	1080	1392	2101
Number of times baby wakes up after falling asleep	1	1	2
Out of crib	216	0	223
Caregiver Intervention	120	0	672

Table 3 shows that the lowest amount of time the baby cried before falling asleep is when he was exposed to another mother's scent, then to his own mother's scent, and last, in the neutral condition. Likewise, he cried more the entire footage when he slept without any maternal scent, and least in the presence of the other mother's odor. Yet, his sleep time registered a longer duration in the neutral setting as compared with the other two conditions. Furthermore, the intervener had a more active role when the baby was not accompanied by any maternal scent, either from his own mother or from another one.

3.2. Attachment, Maternal Scent and Quality of Sleep

Regarding attachment classification, all three cases were classified as secure (B).

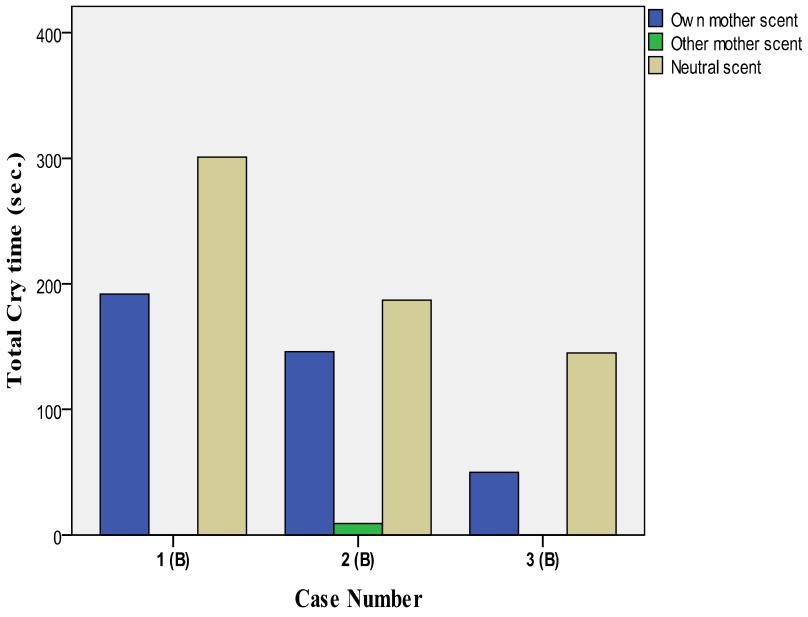
Regarding *crying before sleep*, the babies cried the least before they fell asleep when they had in their sleeping arrangement the t-shirt infused with other maternal scent. However, they registered less crying before sleep with their own maternal odor as compared with the neutral condition (Figure 1.)



Note. B reflects the secure attachment classification

Figure 1.Crying before sleep among all three infants in each condition.

In terms of *total cry time*, in each case there is a pattern of less cry when babies are exposed to maternal scent (either own mother or other mother) as compared with the neutral condition, where they cried the most, regardless of the case. In addition, the condition where the babies sleep with the t-shirt from another mother appears to be the one where they exhibit the least cry and fussing behavior.



Note. B reflects the secure attachment classification

Figure 2. Total amount of cry time among all three infants in each condition.

Concerning the amount of sleep, the first (1) and the second (2) infant slept the most in the presence of their own maternal scent. On the other hand, the third infant (3) slept the most in the neutral condition and least in the own maternal condition (Figure 3).

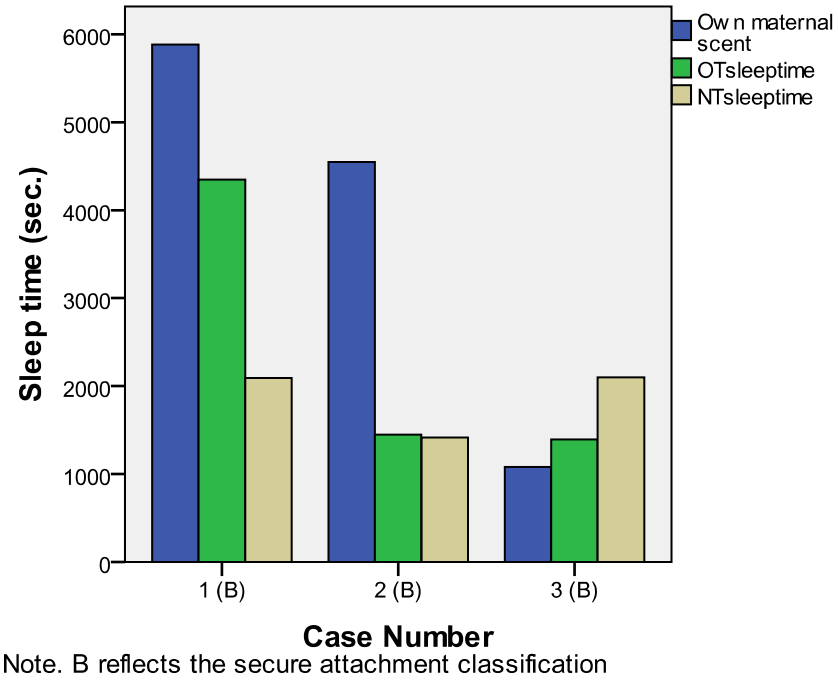


Figure 3. Sleep duration among all three infants in each condition.

With regards to the amount of time the babies needed caregiver intervention, the pie (Figure 4) shows that the babies needed more assistance during their nap time when they slept with no maternal odor (neutral condition). Moreover, the condition which required the least childcare intervention was when the babies napped with the t-shirt infused with another's mother's odor.

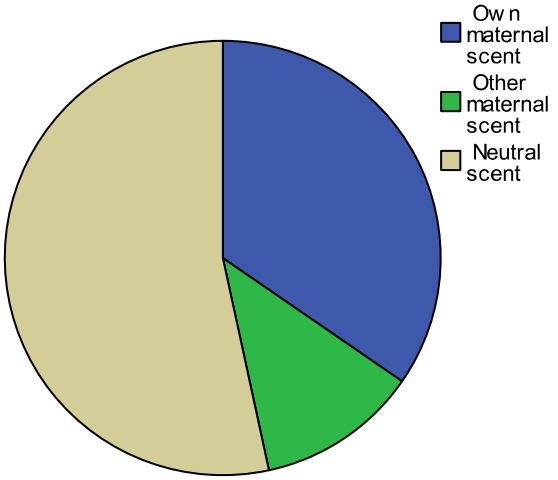


Figure 4. Caregiver intervention in each experimental condition.

3.3 HOME and Sleep

The HOME procedure showed that the first baby scored the highest (34), followed by the second infant (33) and last, the third baby (29). From the HOME manual we find out that the scores can fall into the lowest quartile (11.25), the middle half (22.5) and the upper quartile (33.75), given that the maximum score is 45 (Caldwell & Bradley, 1984). The scores which fall into the lowest quartile define environments that can put at risk the child's development. Therefore, while the first infant fell into the upper quartile, the other two infants fell into the median quartile.

In an attempt to explore potential relations between home environment and quality of sleep, we investigated the charts above. After the analysis, we could notice that the third baby, who had the lowest quality of home environment, slept less in comparison with the other two cases. In addition, his pattern of sleep differed from the other two babies, meaning that while the first two cases slept longer in the presence of maternal odor, the third baby registered the longer amount of sleep time in the absence of any maternal scent.

Therefore, we conducted an analysis of the HOME subscales, in order to detect any similarities between the first two cases which differentiate them from the last case. Consequently, we found that the third baby scored less (9) on the Responsivity subscale compared with the other two cases which scored maximum (11). However, in terms of crying time (either total or before sleep), the third baby showed, regardless of condition, less amount of time crying compared with the other two babies.

Furthermore, when comparing case 1 with case 2 we observed that in both crying before sleep and total crying time, the second baby was less reactive than the first baby. After analyzing their HOME scores

from each subscale, we discovered that the second infant had a higher score (8) on the Acceptance subscale than the first one (5). Yet, when looking at the sleep time, the first baby had a higher mean duration of sleep comparing with the second baby. Subsequently, the Home subscale comparison detected a difference between them in terms of Learning Materials and Variety, first baby scoring higher (8, 2) than the second one (6, 0).

4. Discussion

This present multiple case study looked into the possible relations between attachment, maternal scent, and quality of home environment on sleep quality among three infants attending fulltime day care in Chile. Our findings were as follows.

First, all three babies were securely attached to their mothers, regardless of their extensive early child care. This finding is congruent with the NICHD study (2006), which found that prolonged hours in day care do not as such predict attachment security, but only in interaction with maternal features, such as maternal sensitivity. Therefore, the present study's further exploration concerned findings specific to the secure attachment pattern.

Secondly, all three securely attached cases exhibited a similar pattern of sleep in the experimental conditions. Specifically, in terms of crying before sleep and total cry time, the infants manifested lower rates of crying when exposed to maternal scent, either in the presence of their own maternal or another maternal scent, as compared with the neutral odor. The finding is in line with the results of Sullivan and Toubas (1998), who found that gowns infused with maternal scent, both from their own or another mother, had a soothing effect on newborns' crying behavior as opposed to a clean gown. Thus, in this respect, our study again confirms the existing literature.

However, a distinction was noticeable between the conditions related to maternal scent. Explicitly, the babies cried less when exposed to another maternal odor compared with the one from their own mother. One might propose, since newborns have not yet developed a preference for any attachment figure, they react similarly to an odor either from their own mother or another mother (Sullivan & Toubas, 1998). However, according to Bowlby's attachment theory, after three months of age, the infants have the ability to establish a preference for an attachment figure, which is the case in this study. Therefore, we suggest that when the babies are exposed to their own maternal odor, they recognize it and, as a response, they attempt to elicit attachment related behaviors from their mothers by crying to a higher extent than in the situation of non familiar maternal odor. This could explain why the babies who slept with the other

mother's t-shirt had fewer caregiver interventions. Conversely, babies in the neutral condition were assisted the most during their nap time.

With regards to the sleep time, in the first two cases, we found out that the babies had a longer mean duration of sleep when they were accompanied by their own maternal scent and the lowest when they slept with the no odor t-shirt. Therefore, as opposed to crying behavior, sleep duration appears to increase in the presence of the own maternal smell. Accordingly, it might be that other factors account for the influence of own maternal odor on sleep duration, such as quality of home environment.

Therefore, we examined the quality of the home environment in relation to variations in sleep duration. Since the third case had the lowest sleep duration as compared with the two other cases, we inspected any differences between them. Interestingly, we observed that the quality of home environment was the lowest for the last baby, specifically in terms of mother's responsiveness and the degree the parent actively engages in the child's learning and the supporting of mature behavior. This is consistent with Spilsbury's findings (2005), which showed that parental behavior supportive of maturing behavior has an effect on school aged children's duration of sleep. Possibly, parents who foster independence in their infants, like assisting them and providing them with opportunities that can help them form new skills, have an influence on their self-regulation. This, in turn, can influence their sleep duration.

There are important strong points of this exploratory study which should be noted. First, through the multiple case study we had the opportunity to characterize in depth a phenomenon, quality of sleep, by understanding the cases in their contexts, at home, and in a particular situation, the day care setting. Moreover, the presence of multiple cases allowed us to separately analyze the infants and then, relating them in order to find similar patterns. With regards to the particular situation, the cases were selected based on their fulltime attendance to day care centers. Specifically, the babies were attending day care centers which were part of a national programme (Junata Nacional de Jardines Infantiles) for Chilean families who live in poverty. Therefore, this multiple case study made possible the investigation of factors that can buffer the influence of extensive professional child care on the quality of sleep among at risk babies. Secondly, the experimental design permitted the investigation of the beneficial use of maternal odor on infant's quality of sleep. Having the babies sleep in each condition (own mother, other mother, neutral) helped us analyze and compare the infant's reaction to them, and subsequently, establish the maternal odor's usefulness on their sleep. Thirdly, the multidimensional approach of factors that might impact the infant's sleep available in our study gave a more complete picture of the phenomenon. Explicitly, the study looked into the role of attachment, quality of home environment and maternal scent in order to explore their possible relation to quality of sleep. Fourth, the methodology of the study

involved the use of standardized measures, which increased the validity of the results. Fifth, the ADS assessment made possible the attachment classification of the babies who were younger than one year and applied in different settings than a laboratory. Last, the age of the babies, which ranged from four to seven months of age, allowed the distinction of maternal odor's influence on infant's quality of sleep according to their developmental stage. As such, if maternal odor, regardless of the source, has a similar effect on newborns, our study shows that this changes with their age.

Concerning the limitations of the study, the generalizability is the first aspect that should be mentioned. Even though a case study provides insights into a specific phenomenon and suggests possibly fruitful hypotheses to explore in future quantitative research, the extent to which we can generalize the results to the population is limited. Explicitly, the findings concerned securely attached children who were attending fulltime day care centers and came from poor families. Secondly, the procedure with regards to the smell conditions suffered changes which could have affected the results. Specifically, there were variations in the procedure due to the ways infants are taken care of in Chilean day care centers. For example, infants do not always have a designated place to sleep, such as a separate room, which means that they have shared rooms for both play and sleep. As a result, the infant's sleep can be affected by the presence or noise of other children. Moreover, the intense caregiver intervention made the video recording difficult since babies were often taken out of the crib to be comforted. In this case, the coding stopped until the baby was put again in contact with the odor. Thirdly, in accordance with attachment theory, infants elicit attachment behaviors when they feel stressed. Even though the Attachment During Stress Scale is a national screening device used in Chile for detecting attachment patterns, it is not entirely clear whether the level of stress that babies experience is high enough to trigger attachment behaviors when the instrument is applied in their home environment. Finally, the absence of the insecure attachment classification limited the exploration of infant's quality of sleep as a function of their attachment.

With regards to future directions, further studies should include babies who differ in their attachment classification in order to observe any possible resulting variations in their quality of sleep. In addition, inclusion of a broader age range might provide an additional perspective of sensitive periods to maternal odor. Furthermore, measure of the cortisol level can support the findings of the beneficial use of maternal scent related to cry behavior and sleep duration, as observed in this study. Also, the experimental procedure could be improved by adapting it to the Chilean context, such as spacing out a place in the room for recording in order to restrict the potential influence of other children's presence. Another future direction would be to change the infused T-shirts with softer objects, such as teddy bears, which babies can use as sleep aids. In view of Piaget's developmental stages, infants around six months of age start to be more focused on exploring the environment than their own body. Subsequently, they might stay more

in contact with a teddy bear infused with their maternal odor, thus potentially affecting the children's sleep to a higher extent as compared with a t-shirt placed on their mattress. Moreover, since an object can be moved easier, the babies can be taken out of the crib together with the object in case of caregiver intervention. As a result, they will be more exposed to the maternal scent as compared with the frequent interruptions that occur during a caregiver intervention.

This multiple case study suggested that maternal scent has a potentially soothing effect on the crying behavior of three securely attached babies enrolled fulltime in day care. Moreover, the findings suggest that babies are more comforted by the smell of another mother as compared with their own mother. These results indicate that the influence of maternal odor might be related to the infant's developmental stage of attachment. However, longitudinal assessments in a larger sample are needed to explore and confirm these preliminary findings.

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