TEMPERAMENTAL NEGATIVE AFFECT IS ASSOCIATED TO JOINT ATTENTION IN 9 AND 12 MONTHS OLD INFANTS

Hanna Forss
Syventävien opintojen kirjallinen työ
Tampereen yliopisto
Lääketieteen yksikkö
Infant Cognition Laboratory
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Ohjaajat: Linda Forssman PhD and Jukka Leppänen PhD

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Ensimmäinäisen elinvuotensa aikana lapsi oppii monia sosiaalisia taitoja ja käyttäytymismalleja. Jaettu tarkkaavaisuus on eräs hyvin perustavanlaatuinen taito, johon monet muut sosiaaliset taidot, kuten kieli ja sosiaalinen kompetenssi pohjautuvat. Jaettu tarkkaavaisuus voidaan jakaa jaettuun tarkkaavaisuuteen vastaamiseen (RJA, responding to joint attention) ja jaetun tarkkaavaisuuden aloittamiseen (IJA initiating joint attention). Yleensä jaettu tarkkaavaisuus alkaa näkyä lapsen käyttäytymisessä ensimmäisen elinvuoden loppupuolella ja jaettuun tarkkaavaisuuteen vastaamiskäyttäytyminen tavallisesti kehittyy ennen aloittamiskäyttäytymistä.

On esitetty, että lapsen tempperamentilla olisi vaikutusta lapsen jaetun tarkkaavaisuuden taitojen kehittymiseen. Tempperamentti eli synnynnäinen emotionaalinen reagointitapa ja kyky säädellä tunteita ja käyttäytymistä, saattaisi esimerkiksi vaikuttaa siihen millaisia kokemuksia lapselle syntyy sosiaalisissa tilanteissa ja sitä kautta tuoda erilaisen mahdollisuuden harjoitella jaetun tarkkaavaisuuden taitoja.

Tässä tutkielmassa selvitettiin jaetun tarkkaavaisuuden (jaettuna RJA- ja IJA-käyttäytymiseen) ja tempperamentin yhteyttä 78 9- tai 12-kuukautta vanhan lapsen otoksen avulla. 9-kuukauden ikäisten ryhmässä jaettuun tarkkaavaisuuteen vastaaminen oli yhteydessä tempperamenttipiirteeseen negatiivinen affektiivisuus.

Yhteys negatiivisen affektiivisuuden ja jaetun tarkkaavaisuuden välillä on raportoitu kirjallisuudessa aikaisemminkin. Tämä tutkielma tuo heikkoa tukea hypoteesille, että lapsen tempperamentilla on yhteys jaetun tarkkaavaisuuden taitojen kehittymiseen.

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1 INTRODUCTION

The ability to attend to social cues and stimuli in early life plays a crucial role in infants' learning about their environment and is fundamental for their subsequent social development. Already newborn infants are highly motivated to attend to social stimuli and take part in social interactions. This is, for example, seen in their preference to attend to human face stimuli over non-face stimuli and in their ability to imitate facial expressions of a social partner (De Schuymer, De Groote, Striano, Sthal & Roeyers, 2011). In early infancy, children are able to engage in dyadic joint attention interactions with one social partner, such as exchanging gazes, taking turn making sounds or mouth movements (Legerstee, 2009). The development of dyadic joint attention abilities is followed by the ability to engage in triadic joint attention interactions where the infant and a social partner share attention between each other and an object or event.

Researchers have distinguished two categories of triadic joint attention skills: i) the ability to respond to joint attention (RJA), and ii) the ability to initiate joint attention (IJA) (Eilan, Hoerl, McCormack & Roessler, 2005; Mundy, Sullivan & Mastergeorge, 2009). For example, in a social situation IJA can be expressed by bringing something new to the attention of a social partner by pointing to or showing an object. RJA, in turn, can be expressed by responding to this social bid by attending to the object presented for example by turning ones head to the direction indicated.

The developmental appearance of joint attention skills has been examined in many studies. RJA and IJA behaviors seem to follow different developmental trajectories, although there are also individual variations in both the timing and order of appearance for these behaviors (Mundy et al. 2007). In general, responding to social cues (i.e., RJA) seems to emerge before infants show the ability to initiate social cues (i.e., IJA) (Beuker, Rommelse, Donners & Buitelaar, 2013). The first signs of RJA behaviors are typically seen from the age of 6 months (Senju & Csibra 2008), whereas IJA behaviors are normally first expressed around 9 to 12 months of age (Meltzoff & Brooks 2007). The differences in the developmental timing of RJA and IJA behaviors may be understood from a neurological perspective. Mundy and Newell (2007) argue that RJA and IJA have their origin in two different attentional network systems that both starts to develop during the first year, but at different time points. They suggest that the posterior attention system (e.g., parietal and superior temporal cortices) begins to develop during the first months of life and is primarily involved in passive orienting attention to salient stimuli and supports the emergence of RJA behaviors. They

further argue that the anterior attention system (e.g., frontal eye fields, prefrontal association cortices, orbitofrontal cortex and anterior cingulate), which start to develops later, are primarily involved in IJA behaviors, such as goal-directed volitional attention shifts.

Joint attention is a fundamental skill when infants learn to understand the intentions behind other individual's behavior (e.g., Charman, Baron-Cohen, Swettenham, Baird & Cox, 2000) and is also an important mechanism for acquiring other more sophisticated social abilities, such as language acquisitions and verbal communication (Colonnesi, Stams, Koster & Noom, 2010; Mundy, Block, Vaughan van Hecke, Delgago & Perlade, 2007) and for learning to understand social-emotional expressions (Nowakowski, Tasker & Schmidt, 2012; Vaughan Van Hecke, Mundy, Acra, Block & Gomez, 2007). For example, word learning may take place when infants point to new objects and the caregiver simultaneously names these objects (de Villiers Rader & Zukow-Goldring, 2012). A study on 6- to 8-month-old children showed that an increased ability to respond to pointing cues (i.e. RJA) is positively related to subsequent vocabulary acquisition (Morales, Mundy, Delgago, Yele & Messinger, 2000). Also, children who developed early in initiating (IJA) behaviors have shown a relatively greater gain of vocabulary later (Beuker et al. 2013). Further, infants' attention to their caregivers' affective states and reactions in social situations may teach the child valuable information. For instance, a fearful response from the caregiver when the infant approaches a hot stove may teach the infant that a hot stove is potentially dangerous (Begus & Southgate 2012).

It has been proposed that individual differences in typically developing children's joint attention skills may in part be explained by variations in temperamental traits (Salley & Dixon, 2007; Todd & Dixon, 2010; Vaughan, Mundy, Block, Burnette & Delgado, 2003). According to Rothbart and colleagues (e.g., Rothbart & Derryberry 1981), temperament is defined as an individual's level of emotional reactivity and ability to self-regulate his or her behavior and emotional expressions. Further, individual differences in temperament are generally believed to have a strong genetic and neurobiological basis and are manifested already in early infancy (De Peuw & Mervielde, 2010). One potential mechanism that could explain how temperamental differences leads to individual differences in joint attention behaviors is that children with different temperamental profiles may differ in their motivation to engage in social situations and also encounter different social environments. For example, children with high positive affectivity and extraversion might be more frequently exposed to situations of social interactions that help them to develop joint attention skills faster, whereas children with a reticent or fearful temperament may be exposed to fewer

opportunities for social interaction and thereby have delays or difficulties in the development of joint attention skills (Todd & Dixon, 2010). There are a number of correlational studies that are consistent with this suggestion. In a study by Todd and Dixon (2010) they found that 11-month-olds with high negative affect to show less RJA behaviors. Further, negative affectivity has also been associated with less IJA behaviors in 21-month-old children (Salley &Dixon, 2007). Finally, research by Vaughan et al. (2003) found that 9-month-olds who were high in positive emotionality (smiling) also expressed a higher amount of IJA behaviors.

The purpose of this study was to investigate the association between individual differences in temperament traits and joint attention skills in 9- and 12-month-old children, as this is a developmental time period where rapid development of joint attention skills takes place. As infants develop fast during this time window, the two age groups were kept separate to see if there are differences between age groups. In addition to the inclusion of two age groups, this study extended previous research by using a relatively larger sample size than has been used in previous research. The study focused on the relations between negative and positive temperament dimensions and the abilities to initiate and respond to joint attention. Based on previous work (Todd & Dixon, 2010; Salley & Dixon, 2007; Vaughan et al., 2003), it was predicted that children who were rated high on the negative affect dimension would display less developed joint attention behaviors, whereas children who were rated high on the positive affect dimension would display more developed joint attention behaviors.

2 METHODS

2.1 Participants

The total sample consisted of 78 typically developing Finnish children living in the area of a University town Tampere. All children were healthy, born full-term, and had a birth weight > 2500 gr. Sixty of the participants were 9-months old (*M* = 282.5 days, *SD* = 5.0, 50 % females) and 18 participants were 12-months old (*M* = 363.5 days, *SD*= 8.0, 38.9 % females). Infants accepted to the study were within two weeks from the target age (maximum of two weeks older or younger). In all participating families, all parents had at least finished compulsory school, 67.5 % has at least a high school education, and 57.0 % of the parents had at least a collage education. The

recruitment was done in two steps. Initially families living in the area with a child of appropriate age were contacted with a letter describing the study and an invitation to participate. Personal (i.e., name and birth date) and addresses data of the potential participants were obtained from the Population Information System (law 21.8.2009/661 30 § allows the use of Population Information System for Academic Research). Families who had indicated an interest to participate with their child (i.e., those who have responded to the recruitment letter by the opt-in letter) were contacted over the phone. During the initial contact by phone, verbal consent and a telephone pre-screening consisting of yes-no questions was conducted to ascertain that the child met the inclusion criteria for the study (full-term birth, normal birth weight, and no history of visual or neurological abnormalities). If the child met the inclusion criteria and the family was interested in participating in the research study, they were then scheduled for a visit to the laboratory. Written informed consent was obtained from all parents prior to the study. The study was approved by the local ethics committee.

2.2 Materials & Procedure

At the laboratory visit, the children's ability to initiate and respond to joint attention behaviors was assessed during a structured observation method based on the Early Social Communication Scale (ESCS; Mundy, Delgado, Block, Venezia & Hogan, 2003). During the joint attention assessment, the child was seated on his/her parent's lap, facing the experiment leader (EL). The child's behavior during the assessment was recorded with two video cameras placed so that the child was always recorded face-on from two different angles (see Figure 1). A trained coder coded all dependent joint attention variables off-line and inter-rater reliability was established by having a second trained coder independently code 62.1 % of the assessments (Cohen's Kappa values are given below for each subtask). The temperamental profiles were based on temperamental rating (as explained below).

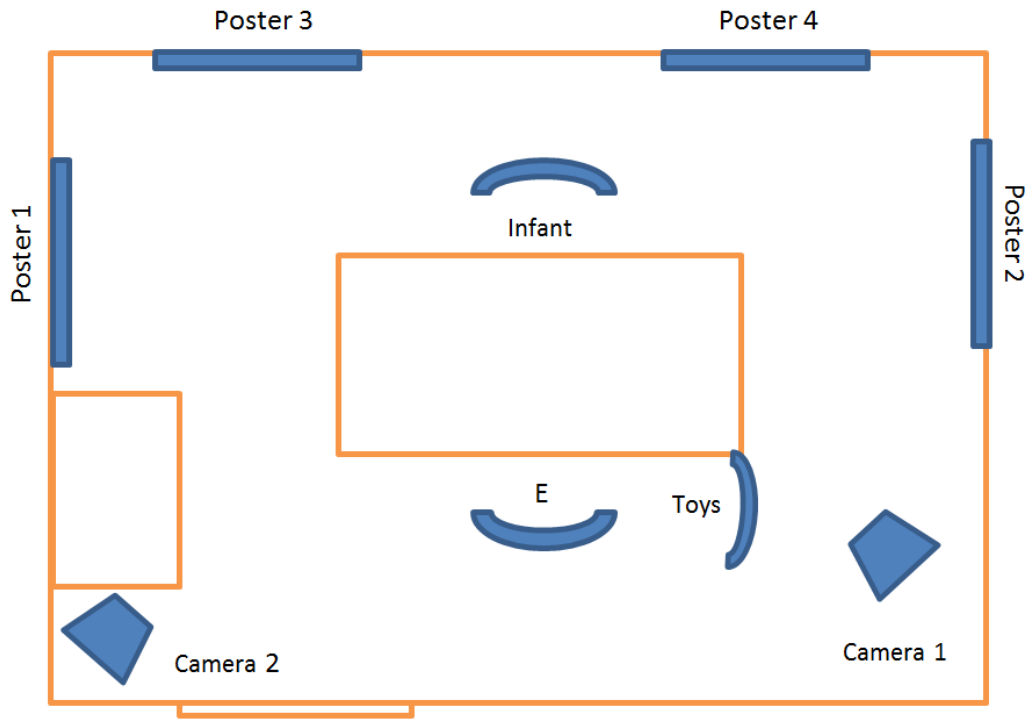

Figure 1. Drawing illustrating the set-up of the testing room. Two cameras recorded the testing sessions from a left and right angle. Toys used in the testing session were placed on a chair next to the EL and were out of view from the infant on the other side of the table. The numbering of the posters demonstrates the order of pointings to the posters in the gaze following task.

Responding to Joint Attention (RJA). RJA was assessed with two tasks: the *Gaze Following Task* and the *Book Presentation Tasks*. In the *Gaze Following Task*, the EL looked and pointed for 6 s in turn to four objects (located 90 and 135 visual degrees to the left, right, left-behind, and right-behind of the child). Two sets of four gaze/pointing trials were presented at different times during the assessment. Each trial started with the EL gaining eye-contact with the child while pointing to her nose with her index finger. Then the EL turned her torso clearly toward the poster and pointed to it with elbow close to the body and said the name of the child. After 3 seconds, the EL looked back to the child and reestablished eye contact and then continued to point for 3 seconds. The pointing hand was kept still while looking back at the child. After each pointing trial the EL named the main object on the poster ("There was a lion" or "Did you see the lion?"). The child's performance was coded as the proportion of trials in which the child looked to the correct poster (see Figure 2 for a screen shot of this task). Interrater reliability was obtained using Spearman correlations. Rho for the *Gaze Following Task* was 0.99.

In the *Book Presentation Task* three pages from a children's picture book were presented. Each double-page was first presented with a question "What do you see?" and then the infant was given 10 seconds to look at the pictures. After 10 seconds looking time, the EL pointed to one picture in turn on each page of the double-page for six seconds. When pointing to a picture on the first page or each double-page EL said the name of the infant in order to capture his/her attention. The *Book Presentation Task* was coded for proportion of correct looks to where the EL was pointing. Spearman's Rho for the *Book Presentation Task* was 0.77 (P<0.001).

In order to obtain a combined measure of RJA behaviors, number of correct looks from the *Gaze Following* were divided by the number of succesfull trials and the number of correct looks in *Book Presentation* tasks were added. Spearmans Rho for RJA was 0.93 (P<0.001).

Initiating joint attention (IJA). IJA was coded during the *Object Spectacle Task* and as number of pointing behaviors to any object in the room from the start to the end of the assessment. In the *Object Spectacle Task* the child was presented with an activated toy (e.g., a mechanical puppy toy) for 6 s that was placed on the table, but out of the child's reach. After 6 s had elapsed the child was then allowed to manipulate the toy briefly. The child was presented with the same toy three times in a row. A total of three different toys were presented at different times during the assessment (see Figure 2 for a screen shot of this task). The *Object Spectacle Task* was coded for the following IJA behaviors: alternating eye-contact between activated toy and the test-person (number of eye-contact during 6 seconds of presentation), making eye-contact while manipulating the toy (number of eye-contact during 10 seconds of play with the toy), showing the toy to the test-person (number of showing times during 10 seconds of play with the toy). At all times the number of infants' pointing behaviors to any object in the room (when test-person was not pointing to exclude imitation) was coded as IJA (Pointing or Pointing with Eye contact, pointing behaviors were combined). Spearman's Rho for IJA behaviors were: alternating = 0.94 (P<0.001); eye contact = 0.92 (p<0.001), pointing =0.94 (p<0.001). Showing and making bids to caregiver were also coded but excluded from the analysis due to poor reliability. By combining scores of *Alternating*, *Eye Contact* and *Pointing* IJA was formed (see Mundy et al. 2003). Spearman's Rho for IJA was 0.91 (p<0.001).

Figure 2. The views from the two cameras in the testing room. On the left the EL is pointing to the first poster. Infant is responding by turning her head (RJA). On the right is an example of initiating joint attention (IJA) where the infant is pointing to the toy while retaining eye contact with the EL.

Temperament Ratings. The assessment of the children's' temperament was based on parental ratings using the Infant Childhood Behavior Questionnaire-Revised (IBQ-R; Garstein & Rothbart 2003; Rothbart, 1981). The parents were given the questionnaire at the end of the testing and asked to fill it in at home and return it with a pre-paid envelope within two weeks. IBQ-R-short form is composed of 90 questions. Parents were asked to evaluate their child's behavior in different day to day situations during last week prior to filling the questionnaire in a 1-7 scale where 1 = "never does this" and 7 = "always does this" or x = " does not apply". The questions were for example: "How often during the last week did the infant lay or sit quietly during feeding?" The answers were used to calculate six temperament dimensions: activity level, soothability, distress to limitations, fearfulness, smiling and laughter and duration of orienting. Using these six dimension further dimensions of negative affect and positive affect were calculated, as advised in the original publication of the scale (Garstein & Rothbart 2003; Rothbart, 1981). Negative affect was composed of temperamental dimension of Distress to limitation and Fear whereas Positive affect was composed of Smiling and Laughter, Duration of orienting, Soothability and Activity.

2.3 Statistical analysis

All the variables were found to be normally distributed (Skewness and Kurtosis for all variables was between -1 and 1), thus parametric tests were used. To clarify the associations between joint

attention behaviors (RJA and IJA) and temperament (negative and positive affect), Pearson's product-moment correlations were conducted. The data was analyzed using SPSS 20.

3 RESULTS

Descriptive statistics for the joint attention and the temperament measures for the 9- and 12-month-olds are presented in Table 1. There was an outlier in IJA in the sample of 12-months-olds (2,5 SD higher score than mean in IJA). The outlier was removed from the correlational analysis of IJA (N=17).

Table 1. Description of mean values and standard deviation for the temperament and joint attention measure for the 9-and 12-month-old.

	9-month-olds (N=59)	12-month-olds (N=18)
	M (*SD*)	*M* (*SD*)
RJA	4.21 (1.42)	5.03 (1.50)
IJA	11.71 (4.92)	12.72 (6.67)
Negative Affect	3.04 (0.55)	3.47 (0.62)
Positive Affect	4.19 (0.56)	4.38 (0.51)

Pearson correlations of RJA and IJA with Temperamental Negative affect and Positive affect were conducted in order to clarify the relations between joint attention behaviors and temperamental differences in the two age groups. For the 9-month-olds, a significant negative correlation was found between RJA and temperamental negative affect, r =-.32, p = .015 (N = 58), whereas there we no significant correlations between negative affect and IJA (r = .12, p = .380), positive affect and RJA (r = -.07, p = .609), and positive affect and IJA (r = .19, p = .160). For the 12-month-olds there were no significant correlations between negative affect and RJA (r = .15, p = .554, N=18), positive affect and RJA (r = -.08, p = .765, N=18), positive affect and IJA (r = --0.13, p = .609, N= 17) and negative affect and IJA (r = .39, p = .121, N=17). One participant had to be removed from analysis of IJA from the 12-months-old group, as she was clearly an outlier.

4 DISCUSSION

The purpose of this study was to examine the associations between temperamental variation in positive and negative affectivity and RJA and IJA behaviors observed in a laboratory assessment of 9- and 12-month-old children. Based on previous studies (Todd & Dixon, 2010; Salley & Dixon, 2007; Vaughan et al., 2003) both the negative and positive dimensions of temperament were expected to be associated with joint attention behaviors, but in opposite directions – i.e., negative affectivity was expected to be related with a lower display of joint attention behaviors whereas positive affectivity was expected to be related with a higher display of joint attention behaviors. Only partial support was found for these hypotheses. As expected a negative correlation was found between temperamental negative affect and RJA behaviors in 9-months-old but no significant associations were found between positive affectivity and joint attention. In 12-months-olds group there were no significant results. These results suggest an association between negative affectivity and RJA, but this finding is not consistent as it was not observed in the data from 12-months-old infants.

The association between RJA and temperamental negative affect in 9-month-old group presented in this study is consistent with previous work where negative affectivity has been associated with reduced observations of joint attention. Todd and Dixon (2010) conducted a study with 11 months-olds and found that infants high in negative affect engaged to fewer count of RJA behaviors. However, although 9-months-olds in the present study are convergent with this result, the data from 12-months-olds did not support this finding as the association between RJA and negative affect was not significant in the 12-month-old age group. Also, low observations of IJA behaviors have been reported to associate with high negative affect as Salley and Dixon (2007) found negative affectivity to be inversely predictive of high level IJA behaviors (frequency of pointings) with 21 months old children. In the present study there were no significant correlations with temperament and IJA.

Negative emotionality may be related to lower count of joint attention behaviors and this might have implications to later development. Negative emotionality, on its own, seems to have consequences to individuals' later life and mental well-being. There is evidence that childhood negative emotionality and later neuroticism in adulthood are related to psychopathological conditions such as depression and anxiety. Individuals high in neuroticism seem to have a

tendency for an attentional bias for threatening scenes. Though, it is also demonstrated that temperamental effortful control might regulate the link between negative emotionality and psychopathology as children who are able to actively and voluntarily control their attention may be able to pull out their attention from frightening scenes and thus be less exposed to them. (De Pauw & Mervielde 2010)

Temperamentally negatively affective children may succeed poorly in novel situations such as laboratory settings compared to more positively emotional children. This might be one of the reasons why negative affectivity has been linked to less joint attention in many studies: it might be more difficult for negatively emotional children to interact with unfamiliar adults. On the other hand, Gredebäck, Fikke and Melinder (2010) showed that infants under 8 months old followed the gaze of a strange adult more often than they followed the gaze of their mother showing a preference for strangers. This, however, does not give any light on the possible differences infants may have due to their temperamental profile.

There were no signs in this study that positive affectivity would be correlated to increased amount of joint attention behaviors in either of the age groups. Vaughan et al. (2003) showed that positive emotional reactivity was associated with higher scores of IJA in 9-months-olds. This finding was not supported in the present study.

The size of the data in 12-months-olds is a limitation to these findings and may explain why the significant correlation between RJA and negative affect in 9-months-old group is not seen in 12-months-old group. As the data for this study was collected from two separate studies and the main goal of these studies was not to assess the questions presented here, the sizes of the age groups became very uneven. Also when comparing different age groups, it might be more informative to make a longitudinal than a cross-sectional study, as was conducted here. Although the kappa for separate joint attention measures were average or good, the Kappa for combined joint attention measures were relatively low. This reduces the credibility of the study. It also needs to be considered that out of eight correlations done in this study only one was significant. The possibility that this result is due to chance has to be considered, especially because the p-value for the significant correlation (.015) is not significant if a Bonferroni-corrected p-value is used (.00625 for 8 comparisons).

In summary, the present results provide weak evidence to suggest that temperamental negative emotionality is linked to the variation in development of joint attention skills, especially to RJA. Positive emotionality on the other hand seems to be much more weakly associated to JA. As joint attention has an impact on such important skills as for example language development (Colonnesi et al. 2010) and social competence (Vaughan van Hecke et al. 2007) these findings are potentially important. On the other hand, it is still unclear how far-reaching these associations are in the course of child's development, especially given that the correlations between temperament and joint attentions skills were, overall, relatively weak. More research needs and perhaps more fine-grained measures of temperament (for example, observational instead of questionnaire based) are needed to find out if these associations have any impact on development in child's later life.

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