EMOTION EXPRESSION & JOINT ATTENTION:

THE INFLUENCE OF AFFECT ON LANGUAGE LEARNING

By

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CHAPTER I

INTRODUCTION

Review of Critical Literature

Over the course of the second year of life, infants develop rapidly in their ability to engage in joint attention with communicative partners (Carpenter, Nagell, & Tomasello, 1998; Walden, Deak, Yale, & Lewis, under review). When engaged in joint attention, the infant and partner are simultaneously focused on the same object or event, while maintaining a shared awareness of the other person's mutual focus (Markus et al., 2000). Infants can either initiate a joint attention episode by attempting to direct a social partner's attention, or infants can respond to a partner's joint attention bid by visually following the direction of the partner's gaze, often reinforced by a head turn, verbalizations, or a communicative gesture such as a point (Corkum & Moore, 1998). The ability to respond to joint attention (RJA) is the earliest emerging form of joint attention (Scaife & Bruner, 1975), though several studies have found significant individual variability in the timing and development of RJA (Carpenter et al., 1998, Mundy & Gomes, 1998; Slaughter & McConnell, 2003). Unfortunately, little is known about specific variables that contribute to these individual differences in RJA development (Vaughn et al., 2003). Recently, several researchers have emphasized the potential role of infant emotionality in the development of joint attention abilities such as RJA (Dixon & Smith, 2000; Vaughn et al., 2003). Though many researchers have analyzed affect expressions within joint attention episodes (Mundy et al., 1992; Venezia et al., 2004), few studies have explored the possibility that certain aspects of infant emotionality outside of the context of joint engagement might be related to RJA development.

Previous theoretical accounts of joint attention development have tended to overlook affect in favor of social-cognitive processing explanations (Adamson & Russell, 1999; Vaughn et al., 2003). Indeed, much of the research on the development of joint attention has concentrated on RJA as early manifestations of intentional understanding and an awareness of others' minds (Baron-Cohen, 1991; Tomasello, 1995). While RJA has been found to be predictive of later social cognitive abilities, the developmental question of what factors predict or account for individual differences in RJA remains unanswered. Several researchers have noted that infants who frequently express or share positive affect might engage in more interactions with caregivers, which may facilitate subsequent joint attention and language (Adamson & Bakeman, 1985). An alternative possibility from research on linguistic development is that infants who maintain a more neutral affective state will have developmentally advanced RJA abilities. This hypothesis is based on a series of studies by Bloom and colleagues (1987, 1988), who observed that the more time one-year-old infants spent in neutral affective states, the earlier the onset of expressive language. Because RJA has been positively linked to language abilities (see Walden & Hurley, in press, for a review), affectively neutral infants may develop RJA earlier than more emotionally expressive infants.

Affect is often considered to be a temporary state of expression; operationally defined as behavioral manifestations of emotion that can be positive, negative, or neutral in valence (Bloom & Capatides, 1987). Infants differ noticeably in the valence and intensity of their affective expressions, and Bloom and Capatides found that these individual differences in expressivity were linked to advances in linguistic development. In their study, infants' affect expressions were observed in the laboratory at the age of the infants' first words (mean = 13.6 months). Affect was measured from observed facial, vocal, and postural expressions during a one-hour play session with the mother present; the age of the infants' first words was determined by their first use of one conventional word at least twice, as reported by parents. Bloom and Capatides found that the percentage of time spent in neutral affect was negatively correlated with age at first words ($r = -.70$, $p < .02$). In other words, the more time spent in non-neutral affect expression, the older the age of their first words.

In interpreting these results, Bloom and Capatides (1987) argue that emotional expression and language draw from the same finite pool of cognitive resources. According to their hypothesis, the processes involved in affect expression compete for the finite resources required for word learning. Researchers agree that, in the process of affect expression, infants engage in cognitive evaluations before generating and expressing emotions (Campos, Frankel, & Camras, 2004), and it is these evaluations that drain the infant's available cognitive resources (Bloom & Capatides, 1987). In contrast, neutral affect expression allows the infant to adopt a less effortful, contemplative reflective stance which frees the infant to allocate more cognitive effort to word learning (Bloom et al., 1988). Infants who experience more neutral affect may have more resources available to devote to learning because they expend less cognitive effort toward emotion generation and expression, relative to positively or negatively expressive infants.

Therefore, Bloom and Capatides propose that neutral affect expression facilitates language acquisition, whereas non-neutral affect expression impedes word learning.

If emotional expression drains the limited cognitive resources available to devote to learning words, it seems possible that emotional expression will similarly drain infants' cognitive resources available for joint attention. Responding to joint attention theoretically provides the infant with opportunities to establish direct word-referent associations by hearing a label provided by a communicative partner (e.g. "Look at the [label]!"), and visually following the direction of the partner's visual attention to locate the intended referent (Baldwin, 1995). Through recurrent interactive joint engagements, infants become better able to discern an adult's attentional focus and thus become more skilled at mapping verbal labels onto corresponding referents (Bakeman & Adamson, 1984). This association between RJA and language has been supported empirically; several studies have reported positive correlations between RJA and language abilities (Delgado et al., 2002; Morales et al., 2000a; Mundy & Gomes, 1998; Slaughter & McConnell, 2003). In light of the findings reported by Bloom and colleagues (1987, 1988), we hypothesized that infants who express more positive and negative affect will have less cognitive resources available to engage in RJA, and thus will be slower to develop both RJA and language. Conversely, infants who express more neutral affect will have more cognitive resources available to devote to RJA, and therefore will have more advanced RJA and linguistic abilities.

Few studies have analyzed hypotheses about affect expression and RJA outside of episodes of affect sharing within joint attention engagements (Mundy et al., 1992). The research that has explored the role of emotionality in RJA development has primarily focused on affect expression as a temperamental characteristic of the child. In these studies, the temperament dimension of smiling/laughter has commonly been used as a proxy for positive affect, whereas distress to novelty and distress to limitations have both been used as proxies for negative affect. Morales et al. (2000b) did not find any significant correlations between positive or negative affect dimensions of temperament at 6 months and gaze-following ability at 12 months. Similarly, Vaughn et al. (2003) did not find significant correlations between positive or negative temperament dimensions assessed at 9 months and gaze-following measured at either 9 or 12 months of age.

One limitation of these studies (Morales et al., 2000b; Vaughn et al., 2003) is that RJA was observed exclusively in response to gaze-following trials accompanied by calling the child's name. However, calling the child's name may not be an effective strategy for eliciting and directing an infant's attention. Walden, Deak, Yale, & Lewis (under review) found that providing a directing verbalization (e.g. "Look at that!") or pointing to the target object significantly increased the probability of re-directing a one-year-old infant's attention over gaze shifts with name called. In trials with a gaze shift and name called, infants' accurately followed the attention of the experimenter on 23% of the trials. Infants' accuracy significantly improved in response to trials with a gaze shift and directing verbalization (49%) and to trials with a gaze shift and a point (56%). Thus, Morales et al. (2000b) and Vaughn et al. (2003) may have underestimated RJA abilities in infants by measuring gaze-following in the absence of directing verbalizations or gestures.

The studies described above (Morales et al., 2000b; Vaughn et al., 2003) approached the question of infant emotional tendencies in a very different way than

Bloom and Capatides (1987). Bloom and Capatides defined affect as a temporary state and observed changes in affect expressions during a one-hour play session. Different results might be obtained when affect is defined as a trait-like characteristic of the child. Though neither of the two studies described above reported any significant correlations between specific dimensions of temperament and RJA (Morales et al., 2000b; Vaughn et al., 2003), affect observed within a structured setting might yield different yet informative results regarding RJA development. In addition, temperament measures are not informative about infants' tendencies to express neutral affect and subtle differences in neutral affect expression have a significant impact on language, as Bloom and Capatides observed, and may have a similar association with RJA. Therefore, individual differences in affect expression apart from global measures of temperament may provide useful insight into the factors that contribute to the development of RJA.

In the present study, affect was observed in response to the emotional messages of an adult directed toward a series of toys. Infants were presented with several unfamiliar toys, each accompanied by either a positive or negative affect message from an adult (e.g. "Fun toy!" or "Not a fun toy"). This measurement procedure was designed to elicit a range of emotional expressions in infants, whereas the unstructured setting in Bloom and Capatides (1987) may have restricted the range of possible opportunities for affect expression, especially negative affect (expressed only 2.6% of time). Our procedures also encouraged infants to engage in frequent cognitive evaluations because infants were confronted with an ambiguous toy along with an emotional message from a stranger, both of which might have caused infants to cognitively evaluate the situation. This context could be considered more demanding than a relaxed, less cognitively effortful setting such as the play session in Bloom and Capatides' study (Weiner-Margulies et al., 1996). Because Bloom and Capatides hypothesized that affect is expressed in response to cognitive evaluations, the affect measurement context employed in the present study might provide a more specific test of Bloom's hypothesis because affect expressions were observed in response to challenging and unfamiliar situations.

In summary, theoretical accounts have implicated several aspects of infants' emotionality as potential sources of individual differences in joint attention (Morales et al., 2000b; Mundy & Gomes, 1998; Vaughn et al., 2003), though few studies have successfully identified specific emotional factors that contribute to the development of RJA. However, there have been no observational studies designed to investigate interrelations between affect expression (positive, neutral, & negative), joint attention, and language. This study will observationally measure affect expression, RJA, and receptive and expressive language in infants 12- to 18-months-old. The goal of the present study is to determine whether an infant's tendency to express positive, neutral, or negative affect in response to the emotional message of an adult is associated with concurrent RJA and language abilities.

Research Questions

The current study addressed the following research questions regarding affect expression, responding to joint attention, and language ability:

1. Is the tendency to express neutral affect positively related to RJA?
2. Is the tendency to express neutral affect positively related to language?

Specific Hypotheses

1. Duration of time spent in neutral affect will be positively correlated with RJA.
2. Duration of time spent in neutral affect will be positively correlated with expressive and receptive language.
3. RJA will mediate the relationship between neutral affect and language.

CHAPTER II

METHODS

Participants

Nineteen 12- to 18-month-old infants participated in this study. Data from 3 infants were not included in the final sample due to experimenter error. The final sample included 16 infants (9 males, 7 females). The mean chronological age for these children was 15.31 months (SD = 1.78). Participating families were recruited as part of a larger longitudinal sibling study at the Vanderbilt Medical Center in Tennessee, and families received a fifty-dollar savings bond for their participation. All children were full-term, normal birth weight, and had at least one older sibling. Older siblings could not have any sensory or motor impairments or any identified metabolic, genetic, or progressive neurological disorders. In addition, participating families could not have a family history of autism or mental retardation in first degree relatives.

Materials

Responding to Joint Attention Stimuli

Thirty-two novel target objects were created. Pilot testing confirmed that none of the novel objects resembled any real objects that could possibly be labeled by children or adults. To provide labels for these objects, 32 novel words were also created. Adult pilot testing confirmed that none of the words sounded similar to any words in the English language. The novel words were used to label the novel target objects in a subset of RJA prompts. The RJA prompts were designed to elicit and direct the child's attention to varying degrees, using combinations of verbal and physical directives. The attentional cues consisted of various attention-eliciting and directing verbalizations such as gaze shifting, pointing, calling the child's name, and providing a label for a novel target object (see Table 1 for the 10 different RJA prompts).

Table 1: Responding to Joint Attention Prompts

Verbal Prompt	**Physical Cue**
silent	Gaze
silent	Gaze + Point
"Chris, Chris!"	Gaze
"Chris, Chris!"	Gaze + Point
"Chris, Chris- look at that!"	Gaze
"Chris, Chris- look at the Blicket!"	Gaze
"Chris, Chris- look at the Toma!"	Gaze + Point
"Look at that!"	Gaze
"Look at the Dawnoo!"	Gaze
"Look at the Koba!"	Gaze + Point

Children were tested in a 3.8 m x 5.3 m room. The target wall was assembled with three columns, spaced 2.1 m apart, and three rows, 89 cm apart, of clear plexi-glass shelves, such that the shelves created a three by three matrix (see Figure 1). Target objects were placed on 8 of these 9 shelves; in the middle column, bottom row position a video camera with zoom lens was mounted to record the child's face at eye-level. Two additional miniature surveillance cameras were mounted to the left of the first column and on the right of the third column. Both were positioned to be level with the middle row of stimuli in order to record the infants' head and upper body. A child-sized table (61 cm^2) was placed facing the target wall, centered opposite the middle column (see

Figure 2). A child's Rifton chair was set up behind the table facing the target wall. The experimenter sat on a small stool directly on either the child's right or left side.

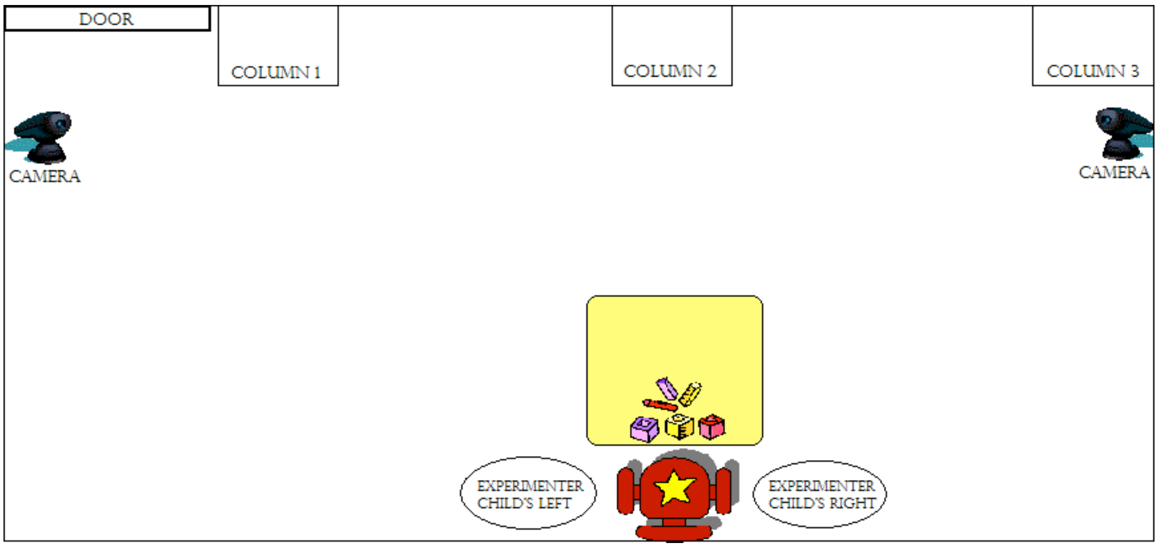

Figure 1: Overhead diagram of testing room.

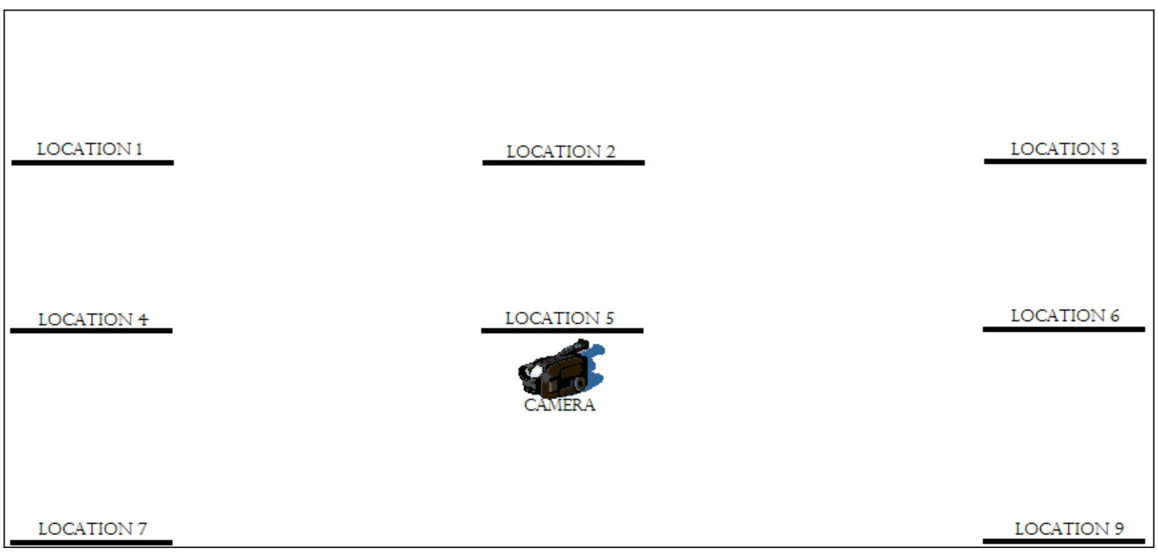

Figure 2: Diagram of RJA target location wall.

Affect Expression Stimuli

Concealed Toy

Eight novel toys served as the stimuli for this procedure (e.g., a ball covered with suction cups, a squishy gel-filled tube). Each toy was presented underneath a small square towel.

Toy Barrier

Eight toys were created, each consisting of a base and four removable parts (e.g., a wooden base with four pegs). The toys were piloted with infants 12 - 18 months of age to ensure that the pieces were easy to remove and manipulate.

Language Assessment Materials

The Mullen Scales of Early Learning (MSEL) provides a comprehensive measure of both mental and motor ability in young children across five domains: Gross Motor, Fine Motor, Visual Reception, Receptive Language, and Expressive Language (Mullen, 1995). The MSEL has good internal, test-retest, and inter-scorer reliability, as well as excellent construct validity (Mullen, 1995). Children's abilities were assessed for all five scales, however for this analysis, only receptive and expressive language performance was applicable.

Procedures

Children were seated at a child-sized table located on the opposite wall of the center of the target wall display. Each child was buckled into a child-sized chair (Rifton) placed directly behind the table facing the target wall. For 3 of the 16 children, one parent was present and sat in a low chair with the child on his or her lap, such that the child was seated at the same position and height at the table as those without a parent present. If present, parents were asked not to interact with their child and to keep their eyes closed and hands at their sides through all procedures. The children participated in a series of procedures as part of the larger longitudinal study; three of those procedures were used for this study.

Responding to Joint Attention Measures

For the responding to joint attention (RJA) procedure, the child was given age-appropriate toys to play with while seated at the table. The experimenter sat on a short stool on the right or left side of the child. After ensuring that the child was visually engaged with the toys, the experimenter delivered a series of prompts designed to elicit and direct the child's attention to varying degrees (see Table 1). For each trial, the experimenter gave the appropriate prompt and held the physical position and facial expression constant for 10 seconds. After completing one set of prompts, the experimenter moved to the other side of the child and repeated the same set of prompts on the opposite side to control for side of presentation. The prompt orders in each set were randomized across all participants. Toys were refreshed as needed by the experimenter to maintain the child's engagement. This procedure was repeated 30 – 45 minutes later with a second series of prompts. The procedure for the second set of prompts was the exact same, and all prompts were also presented on both sides.

Affect Expression Measures

Affect was measured during four procedures. These procedures took place in the same experimental room described in the RJA procedures; however the experimenter and child sat across from each other at the table. The experimenter sat across and to the right of the child.

Concealed Toy

The experimenter was brought a novel toy covered by a square towel. The experimenter peeked under the cover and gave either a positive or negative message with the appropriate facial expression, vocal tone, and postural cues while removing the pieces of the toy from the base and putting them in the clear box. For the positive message, the experimenter exclaimed, "Fun toy to play with!" in a spirited vocal tone with positive facial expressions and laid the covered toy in front of the child. For the negative message, the experimenter flatly stated, "Not a fun toy" in a monotone voice with negative facial expressions before laying the covered toy in front of the child. Each time the child made eye contact with the experimenter, the message was repeated with the same vocal tone and facial expressions. This procedure lasted 30 seconds. The order of the affect message presentation was counterbalanced across participants. The toy barrier procedure followed the concealed toy procedure.

Toy Barrier

The experimenter was brought a novel toy with a base and multiple pieces along with a clear box. The experimenter gave either a positive or negative message with the appropriate facial expression, vocal tone, and postural cues while removing the pieces of the toy from the base and putting them in the clear box. For the positive message, the experimenter exclaimed, “Oh fun toy! This is a fun toy to play with!” in a spirited vocal tone with positive facial expressions, while cheerfully tossing the parts of the toy into the box. For the negative message, the experimenter flatly stated, “Not a fun toy. This is not a fun toy to play with” in a monotone voice with negative facial expressions, while gloomily placing the parts in the box. Once all the parts were in the box, the experimenter delivered the message again and moved the box and the base of the toy within the child’s reach on the table. Each time the child made eye contact with the experimenter, the message was repeated with the same vocal tone and facial expressions. This procedure lasted for 60 seconds. After a few minutes, the concealed toy procedure was repeated with the other affect message and a new toy, followed by the second toy barrier procedure.

Language Measures

The Mullen Scales of Early Learning were administered to each child by a trained experimenter. The Mullen assesses receptive and expressive language separately. See Table 2 for the constructs, measures, and variables used in this study.

Table 2: Constructs, Observational Measures, & Variables

Construct	*Observational Measure*	*Variables*
Responding to Joint Attention (RJA)	RJA Procedure	Proportion of correct looks to target/total number of prompts received
Affect Expression	Concealed Toy Procedures (2*) Toy Barrier Procedures (2*) **one positive and one negative message*	Duration of Positive Affect Duration of Neutral Affect Duration of Negative Affect
Language	Mullen Scales of Early Learning	Receptive Age Equivalent Expressive Age Equivalent

Coding & Reliability

Videotapes of all the procedures were converted into digital format and observational data was collected using ProcoderDV software (Tapp, 2003). This software allowed for the onset and offset of RJA trials and affect procedures to be recorded with single frame accuracy before coding. For both coding systems, observers were trained using ten tapes that were selected because they presented trainees with ambiguous and difficult to code trials. During training, each observer's coded file was compared with a consensus coded file. Consensus files were created by two experienced coders after coding independently and then discussing any discrepancies. For both coding systems, coders were trained to an established standard ($\kappa > .60$).

Responding to Joint Attention

RJA scores reflect the accuracy with which infants responded to the experimenter's cues. Coders blind to the verbal prompts watched each trial and designated one of the eight target locations or an alternate looking pattern as the infant's primary focus in each trial. For each 10 second trial, coders chose one of three options: 1) one of the 8 possible target locations, 2) visual scan (i.e. rapid scanning of the target wall without fixating on any target), or 3) other look (e.g., looks to toys, experimenter, self, etc.). Codes were determined by the child's initial visual orienting response unless the child clearly referred back to the experimenter and then visually oriented to a new target location after re-referencing the experimenter. Codes for each trial were later compared to the actual target location referred to in the prompts. If the code matched the target location, a score of 1 was given for that trial. If the code was vertically adjacent to the target location, a score of 0.5 was given for that trial (e.g., child looked at location 3, but the target was 6). This compensated for the fairly small visual angle between vertically adjacent target locations, which made it difficult for coders to distinguish between them. If the infants' code was scan, other look, or if the code was not vertically adjacent to the target, a score of 0 was given for that trial. Each participant received a total of 10 prompts, each repeated twice, for a total of 20 coded trials; however 2 infants received 19 trials. To control for the number of prompts received, the number of correct looks to target were divided by the total number of RJA trials.

Trained observers coded 16 tapes and four tapes (25%) were randomly selected to be coded by a second observer. Agreement was estimated by weighted kappa, which was selected because weighted kappa corrects for chance agreements while also taking into account that some disagreements are considered more serious than others (Bakeman, 2000). For coding RJA, we regarded disagreements between vertically adjacent codes to be less serious than other disagreements. Weighted kappas were calculated at the participant level; average agreement between coders was $\kappa_{wt} = .85$. Intraclass correlation coefficients (ICCs) were calculated to estimate reliability; the reliability coefficient for RJA .98.

Affect Expression

Affect from the four procedures was coded using a partial interval time sampling method. Intervals were five seconds in length for a total of 36 coded intervals. Judgments were made every 5 seconds and were based on the infant's facial and verbal expressions during the interval. Coders viewed each 5-second interval and judged whether 1) the child was displaying positive, neutral, or negative affect, 2) the session was terminated early due to experimenter error, or 3) the session was terminated early due to child upset. Thus, a code was assigned to each of the 36 intervals. Intervals that were coded as terminated early due to child upset were considered negative affect intervals for analysis. Positive affect was coded for slight smiles involving just the muscles around mouth and broad smiles involving facial muscles around the mouth and eyes/upper cheeks. Neutral affect was coded for intervals in which facial expressions appeared neutral, indicating interest or curiousity, but positive or negative affect expressions were not present during the interval. Negative affect was coded for intervals including frowns, scowls, furrowed brows, and periods of crying.

The duration of positive affect was estimated by totaling the intervals coded as positive and then dividing by the number of intervals coded. The neutral and negative affect duration variables were both calculated similarly (Table 2). Trained observers coded 16 tapes; four tapes (25%) were randomly selected to be coded by a second observer. Cohen's kappa was used to estimate agreement for each of the four participants coded by the second observer; average agreement between coders was $\kappa = .87$. The reliability coefficients (ICCs) were as follows: .92 for positive affect, .95 for neutral affect, and .98 for negative affect.

Language Variables

Age equivalent scores from the Mullen Scales of Early Learning were used as measures for receptive and expressive language (Table 2).

CHAPTER III

RESULTS

Descriptive Statistics

Responding to Joint Attention

The mean proportion of correct hits on the responding to joint attention (RJA) measure was .34 (maximum possible score = 1). This value is not surprising given that joint attention abilities are developing throughout the second year of life. RJA was positively correlated with chronological age, though this correlation did not reach significance (r = .38, $p = .14$).

Table 3. Descriptive Statistics

	M	*SD*	*Range*	*Skewness*	*Kurtosis*
RJA Proportion of Correct Hits	0.34	0.14	0.05 - 0.55	-0.36	-0.39
Duration of Positive Affect	0.11	0.12	0.0 - 0.44	1.50	2.9
Duration of Neutral Affect	0.81	0.15	0.56 - 1.0	-0.36	-1.00
Duration of Negative Affect	0.08	0.12	0.0 - 0.31	1.20	-0.16
Receptive Age Equivalent (months)	15.94	3.59	9 - 23	0.09	-0.34
Expressive Age Equivalent (months)	15.06	1.53	12 - 18	0.01	0.22

Affect Expression

Children spent the majority of time in neutral affect expression. On average, time spent in neutral affect expression was 81%. The mean percentage of time spent in positive affect expression was 11%, whereas the mean percentage of time spent in negative affect expression was only 8% (see Table 3). These results are similar to Bloom

& Capatides (1987), who reported that children spent 84.6% of the time in neutral affect expression, 12.5% in positive, and 2.6% in negative. As expected, the percentage of time spent in negative affect expression was higher for our procedures than for Bloom & Capatides' play session (8 versus 2.6%). In addition, the standard deviation of duration of neutral affect in the present study was almost twice that reported by Bloom & Capatides (.15 versus .08). The procedures used in this study seem to have had the desired effect, in that they produced more variability in affect expressions.

Expressions of positive and negative affect were rare and the distributions of both variables were extremely positively skewed (1.5 and 1.2, respectively). The distribution of neutral affect expression was not skewed to an extreme degree (-.36). Based on the recommendation of Cohen, Cohen, West, & Aiken (2003) for proportions, the positive and negative affect variables were submitted to the arcsine transformation for data analysis. For ease of comprehension, the proportion of time spent in neutral affect was also submitted to the same arcsine transformation. The distribution of the transformed negative affect variable remained positively skewed (.75), though less so than the untransformed variable (1.2). This is most likely due to the number of zero values for the negative affect variable; half of the participants did not display any negative affect. Because negative affect was expressed so infrequently and the transformed variable remained skewed, negative affect was transformed from a continuous into a dichotomous variable for subsequent analyses; a zero was coded if the child did not display any negative affect ($n = 8$), one was coded if the child displayed negative affect ($n = 8$).

Correlation and regression analyses were performed using both the untransformed and the transformed variables; all analyses yielded similar patterns of results for both sets of data. Correlations involving both types of affect variables (transformed and untransformed) are reported below, however for simplicity, the regression results are presented for the transformed affect variables only.

Language

The mean receptive age equivalent score for the sample was 15.94 months, and the mean expressive age equivalent score was 15.06 months.

Correlation Analysis

Affect Expression & RJA

Untransformed Variables

Because the affect coding system was mutually exclusive and exhaustive, the three affect variable proportions summed to one. Thus, neutral affect expression was significantly negatively correlated with both positive and negative affect expression (r = -.66; r = -.63, both $p < .01$). Positive and negative affect expression were not correlated (r = -.2, $p > .05$).

There was a significant negative correlation between neutral affect expression and RJA (r = -.63, $p < .01$). The correlation between positive affect and RJA approached significance (r = .48, $p = .06$). Negative affect was not significantly correlated with RJA (r = .33, $p > .05$).

Transformed Variables

Dichotomizing the negative affect variable reduced the collinearity between the affect variables as they no longer summed to one. Neutral affect was negatively correlated with positive affect (r = -.73, *p* < .01), however neutral affect was no longer correlated with the negative affect (r = -.4, *p* > .05). Positive and negative affect were uncorrelated (r = -.2, *p* > .05).

The transformed affect variables showed the same correlational pattern with RJA as the untransformed variables (see Table 4). Again, there was a significant negative correlation between neutral affect and RJA (r = -.69, p < .01). The transformed positive affect variable was significantly correlated with RJA performance were correlated (r = .59, *p* < .05). The dichotomized negative variable was not significantly correlated with RJA (r = .40, *p* > .05). The only correlation that was not significant prior to transformation, but became significant after the arcsin transformation, was the correlation between positive affect and RJA.

Table 4. Correlation Analysis

	RJA Proportion	Positive Affect	Neutral Affect	Negative Affect	Receptive Age Equiv.	Expressive Age Equiv.
RJA Proportion of Correct Hits	1.00					
Positive Affect *(arcsin)*	.59*	1.00				
Neutral Affect *(arcsin)*	-.69**	-.73**	1.00			
Negative Affect *(dichotomous)*	.40	-.20	-.37	1.00		
Receptive Age Equivalent	.33	.25	-.03	-.09	1.00	
Expressive Age Equivalent	.32	.19	-.03	.13	.09	1.00

* p < .05, ** p < .01 (two-tailed)

RJA & Language

Receptive and expressive age equivalent scores on the Mullen were both non-significantly correlated with RJA ($r = .33$, $p = .2$; $r = .32$, $p = .2$; respectively).

Affect Expression & Language

None of the untransformed affect variables were significantly correlated with either the receptive or expressive age equivalent scores on the Mullen; this was also true for the transformed affect variables (see Table 4).

Regression Analysis

Predictors of RJA

Chronological age was included in each regression equation because of Bloom et al.'s (1988) findings that non-neutral affect expressions increased with age for later word learners, but not for early word learners. Thus, we wished to control for the effects of age on both positive and negative affect as well as RJA in order to determine whether the affect variables shared a unique association with RJA, apart from variance associated with age.

Predicting RJA from CA

Chronological age alone was used to predict RJA. CA was not significantly correlated with RJA ($r = .38$, $p = .14$), and the multiple correlation from the regression was also not significant ($R = .38$, $F = 2.41$, $p > .05$). Adjusted R^2 is reported because of the relatively small sample size. Age alone only accounted for 8.6% of the variance in

RJA (R^2 = .15). The standard partial regression coefficient for CA was not significant (β = .38, t_{14} = 1.55, $p > .05$, two-tailed).

Predicting RJA from CA & Positive Affect

Second, age and positive affect were included to predict RJA. The joint effects of age and positive affect yielded a significant multiple correlation (R = .64, F = 4.38, $p < .05$). Age and positive affect together accounted for 31% of the variance in RJA (R^2 = .40). The change in R^2 after including positive affect in the regression equation with CA was .26 (F = 5.56, $p < .05$). The standardized partial regression coefficients indicated that only positive affect made a significant contribution to the prediction of RJA when variance associated with CA was considered (β = .53, t_{13} = 2.36, $p < .05$, two-tailed). Thus, positive affect significantly predicted RJA after controlling for CA.

Predicting RJA from CA & Negative Affect

Age and negative affect were included to predict RJA. The joint effects of age and negative affect yielded a non-significant multiple correlation (R = .56, F = 2.99, $p > .05$). Age and negative affect together accounted for 21% of the variance in RJA (R^2 = .32). The change in R^2 after adding negative affect to the regression equation with CA was .17 (F = 3.19, $p > .05$). Including negative affect in the regression equation with CA slightly increased our ability to predict RJA, but negative affect and CA did not significantly predict RJA better than CA alone. The standardized partial regression coefficients for CA and negative affect were not significant (CA: β = .40, t_{13} = 1.73, $p > .10$, two-tailed; Negative affect: β = .41, t_{13} = 1.79, $p < .10$, two-tailed).

Predicting RJA from CA, Positive, & Negative Affect

Multiple regression analysis was conducted to predict RJA score from chronological age (CA), positive affect (arcsin), and negative affect (dichotomous). Examining the joint effects of all three predictor variables yielded a significant multiple correlation (R = .82, F = 8.17, $p < .01$), indicating that children who were older and expressed more positive affect and any amount of negative affect tended to have higher RJA scores. After adjusting for the relatively small sample size, the combined effects of positive and negative affect with chronological age accounted for 59% of the variance in RJA ($R^2 = .67$). The change in R^2 after adding negative affect to the equation including positive affect and CA was .27 (F = 9.8, $p < .01$).

The results of the regression analysis indicate that the two affect predictor variables acted in cooperative suppression, in that each affect variable suppressed irrelevant variance in the other variable. The effect of combining the variables together in the regression equation enhanced both variables' predictive relationship with RJA, which is evident from inspection of the partial correlations and standardized coefficients (Cohen et al., 2003). The partial correlations for both of the affect variables with RJA, after controlling for the effects of the other predictor variables, were higher than their respective zero-order correlations (see Table 5), which is one indicator of suppression. The standardized regression coefficients for both affect variables were also larger than their respective correlations with RJA. This pattern of results was not found for the CA variable. Thus, the affect variables behaved as cooperative suppressors; together they accounted for significantly more variance in RJA than either positive or negative affect alone (Tzelgov & Henik, 1991). These results clearly demonstrate that positive and negative affect both significantly contribute to RJA ability.

The coefficients for both affect variables were significant: positive affect $\beta = .63$ ($t_{12} = 3.61$, $p < .01$, two-tailed); negative affect $\beta = .53$ ($t_{12} = 3.13$, $p < .01$, two-tailed). The standardized coefficient for CA was not significant ($\beta = .23$, $t_{12} = 1.34$, $p > .05$, two-tailed). Positive and negative affect together significantly predicted infants' responding to joint attention ability, and both variables were better predictors of RJA in combination than independently.

Table 5. Linear Regression Predicting RJA

Predictor Variable	Partial correlation with RJA	Standardized regression coefficient (β)
Equation 1: CA (Adj. R-square = .086)		
Chronological Age	.38	.38
Equation 2a: CA & Positive Affect (Adj. R-square = .311)		
Chronological Age	.29	.24
Positive Affect *(arcsin)*	.55*	.53*
Equation 2b: CA & Negative Affect (Adj. R-square = .210)		
Chronological Age	.43	.40
Negative Affect *(dichotomous)*	.44	.41
Equation 3: CA, Positive Affect, & Negative Affect (Adj. R-square = .589)		
Chronological Age	.36	.23
Positive Affect *(arcsin)*	.72**	.63**
Negative Affect *(dichotomous)*	.67**	.53**

* p < .05, ** p < .01

CHAPTER IV

DISCUSSION

The purpose of the present study was to examine Bloom's hypothesis about affect and language, and to extend this hypothesis to responding to joint attention, a skill that is theoretically and empirically related to language acquisition (Baldwin, 1995; Delgado et al., 2002; Morales et al., 2000a). Following Bloom's hypothesis, we predicted that neutral affect would be positively correlated with language. We also predicted that neutral affect would be similarly associated with better RJA. The results did not support these hypotheses; neutral affect expression was not significantly correlated with either receptive or expressive language ability. Moreover, neutral affect expression was significantly negatively correlated with responding to joint attention ability. Multiple regression revealed that positive and negative affect together predicted responding to joint attention, beyond the effects of chronological age. Positive and negative affect were each stronger predictors of RJA when combined than when analyzed independently.

Adamson & Russell (1999) argue that the achievement of joint attention can be rephrased as "the accomplishment of integrating *engagement* with social partners with *interest* in objects." However, much of research on joint attention tends to overlook affect in favor of a more skill-based approach (Morales, Mundy, Crowson, Neal, & Delgado, 2005), which focuses on joint attention as a precursor to theory of mind or as a predictor of language ability (Morales et al., 2000a; Mundy & Gomes, 1998; Tomasello, 2003). Many of these studies assume that individual differences in the capacity to engage in joint attention are primarily affected by both maturational and environmental processes (Morales et al., 2000a). As Trevarthen & Aitken (2001) point out, the development of joint attention in infancy is accompanied by changes in physical size, perceptual acuity, and motor strength, in addition to developments in interactional style with others. Surprisingly, we found that maturation, indexed by age, is not predictive of RJA; that is, older infants did not tend to have higher RJA scores than younger infants. Instead, between 12- to 18-months of age, our results suggest that individual differences in emotional expressivity are better predictors of RJA than chronological age. The results of the present study highlight the importance of analyzing joint attention within a developmental framework that integrates analysis of affect and attention.

There are, however, several limitations to the present study. One limitation is that the affect measurement context in this study was very different from that in Bloom's studies. In Bloom & Capatides (1987), affect was measured in an unstructured and relaxed environment, whereas in this study the context was highly structured and designed to elicit a range of both positive and negative expressions. The rationale for this experimental design was based on our operational definition of affect as a temporary state, but one that is stable across situations that require a comparable level of cognitive effort. We therefore assumed that our measure of affect would generalize across similar contexts, but not to more relaxed settings such as toy play, which is deemed less cognitively challenging (Weiner-Margulies, Rey-Barboza, Cabrera, & Anisfield, 1996). It may be that we did not find a positive correlation between neutral affect and expressive language because of this discrepancy in measurement context. An additional limitation is that we observed affect for a relatively short period of time (3 minutes), whereas Bloom

& Capatides (1987) observed affect for a full hour. To resolve these issues, future research incorporating affect observations for longer periods of time, across several contexts that require varying levels of cognitive effort, could help clarify this contradiction. It is possible that infant affect expressions measured in certain contexts are differentially associated with expressive language ability.

The procedures in the present study introduced an emotional element that was not present in Bloom's studies. The infants in this study may have reacted differently, and perhaps uncharacteristically, to our procedures than they would have in a less emotional environment. A possible measurement context that would be cognitively demanding but not emotionally challenging, would be to observe affect during a novel word learning task. This context would encourage children to engage in cognitive evaluations and might prove to be an optimal measurement context for affect during language learning.

The results of the present study reveal that positive and negative affect expression are significantly associated with better RJA. One interpretation of these findings is that emotionally expressive infants are more motivated to actively engage in dyadic and triadic interactions with others (Trevarthen & Aitken, 2001). Spinrad & Stifter (2002) found that infants at both emotional extremes (negative or positive) tended to have mothers who frequently "intruded" upon their children's activities, such as by introducing a new toy or redirecting attention to another object. These same maternal behaviors are examples of joint attention bids. In other words, the more emotionally expressive infants received more environmental stimulation, including joint attention bids, from their caregivers. Spinrad & Stifter (2002) suggest that mothers of negative infants may provide constant stimulation in order to soothe the infants, which may mean more opportunities to respond to joint attention for negative infants than for more neutral infants.

In contrast, mothers of positive infants may engage more with their infants simply because it is pleasing to do so. Infants who express more positive affect may readily engage social partners and have more opportunities to respond to joint attention, and thus could be exposed to new words more often than less positive infants (Adamson & Bakeman, 1985). However, another possibility is that interactive and engaging caregivers will offer more opportunities for RJA, and infants will express more positive affect as a result of these frequent and affectionate joint attention exchanges (Trevarthen & Aitken, 2001). Thus, it might be that sensitive and affectionate caregivers elicit more positive affect from their infants, and these caregivers also initiate more joint attention with their infants. Unfortunately, because of the correlational nature of the present study, we cannot distinguish between these two possibilities. Future studies utilizing longitudinal designs would allow researchers to disentangle these two potential pathways of influence to determine if positive affect expression predicts RJA, or if the amount of RJA prompts provided by caregivers predicts positive affect expression.

An alternative interpretation is that emotionally expressive infants may initiate more joint attention with caregivers. This can often start a turn-taking game where the child directs the adults' attention, the adult directs the child's attention, and so on (Newland, Roggman, & Boyce, 2001). Thus, joint attention initiated by the infant (IJA) can lead to opportunities for the infant to respond to joint attention (RJA). An interesting future route for investigation would be to test whether emotionally expressive infants initiate more joint attention than more neutral infants. In addition, IJA can be categorized into declarative and imperative acts (Liszowski, Carpenter, Henning, Striano, & Tomasello, 2004). It may be that positive infants engage in more declarative IJA behaviors (i.e. pointing to share interest), whereas negative infants may engage in more imperative IJA behaviors (i.e. pointing to request a toy). Vaughn et al. (2003) found that smiling and distress to limitations on the IBQ was positively correlated with IJA. Thus, positive and negative dimensions of temperament were similarly associated with better IJA but unfortunately, the researchers did not distinguish between declarative and imperative IJA acts. By analyzing the different forms of IJA behavior in positively and negatively expressive infants, we can better understand the individual differences in emotionality that contribute to joint attention development.

Our findings add to the limited research on affect expression, responding to joint attention, and language. Current studies using temperament as a proxy for affect have found mixed results, but these inconsistencies could be due to methodological differences. Both Morales et al. (2000b) and Vaughn et al. (2003) used versions of the Early Social Communication Scales (ESCS) to measure RJA. In Morales et al. (2000b), RJA was assessed by only three gaze-following trials, whereas Vaughn et al. presented infants with eight gaze-following trials. In both studies, the tester said the child's name to elicit their attention. In the current study, the RJA eliciting and directing prompts were more variable and gave infants multiple opportunities to disengage and shift the focus of their attention.

In summary, these results revealed that positive and negative affect expression together significantly predicted responding to joint attention in 12- to 18-month-old infants, whereas chronological age did not predict RJA ability in this sample. This finding adds to the growing literature on the dynamic interactions between the developing infant and the caregiving environment, and how these interactions influence the development of social cognitive skills such as joint attention. From a transactional view of early development, the results raise many intriguing questions about how individual differences among infants affect the interactions between infants and caregivers (Adamson, McArthur, Markov, Dunbar, & Bakeman, 2001; Markus, Mundy, Morales, Delgado, & Yale, 2000). By integrating affect and attention in future research, we can supplement and challenge our knowledge of the emergence and development of joint attention, which currently does not incorporate concomitant developments in emotional expression during the first two years of life (Adamson & Russell, 1999).

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