The Red River Psychology Journal

PUBLISHED BY THE MSUM PSYCHOLOGY DEPARTMENT

ISSUE: 2015 VOLUME: 1

The Role of Attachment in the Emotional Facial Scanning Patterns in Infant-Mother Dyads.

Kelsey Ihringer.
Minnesota State University Moorhead

Abstract. The ability to read emotional expressions is essential for establishing and maintaining relationships. Several studies have investigated a connection between attachment style and the ability to interpret emotion on faces. This 3x8 mixed design study collected data on 27 infant-mother dyads to examine a possible relationship between attachment style and the ability to discriminate facial expressions of emotion. Infants ages five- to seven-months old and their mothers viewed angry, sad, happy, and neutral facial expressions while their gaze was recorded using infra-red eye tracking. Mothers' parental and romantic attachment styles were calculated using two surveys. Undergraduate students participated to gather further data on attachment patterns. Most participants were found to have secure attachments. These participants had similar scanning patterns that may reinforce negativity bias or gaze-aversion when viewing threatening stimuli. More research is necessary to understand the effect of insecure attachments in facial scanning patterns and overall ability to interpret emotion. These results may have important implications for the study of attachment and the socioemotional development of infants.

Keywords: infant-mother attachment, gaze, facial expression

The ability to discriminate facial expressions of emotion develops early and continues to mature throughout infancy and childhood (Hunnius et al, 2001; Nelson et al, 2006). As infants mature, their attention to faces relies less on obvious visual features, such as contrast, and more on the social context in which the expression was formed. As their attention to facial expressions matures, infants continue to focus on primary features of the face (Nelson et al, 2006). Newborns have an immediate affinity towards faces and face-like images (Goren et al, 1975; Nelson et al, 2006). Weeks after birth, infants scan faces by identifying the most emotionally meaningful areas: The eyes and mouth (Hunnius & Geuze, 2004). Around three months of age, infants begin discriminating between concrete emotions and show a preference for happy facial expressions (Hunnius & Geuze, 2004; Hunnius et al, 2011; Montague & Walker-Andrews, 2001; Striano & Liszkowski, 2005; Vaish et al, 2008). After four months, infants alter their gaze patterns towards faces depending on the emotional expression portrayed (Montague & Walker-Andrews, 2001). Around six-months old, infants can reliably discriminate between varying intensities of displayed emotions (Striano et al, 2002). The first six months of an infant's life depict incredible socioemotional development; such swift maturity signals not only its importance, but the need to quantify how infants learn to read emotion and the consequences to having this development interrupted.

The period between five and seven months-of-age marks a significant transition in infants' gaze patterns while viewing emotional expressions. At this point, infants respond to different facial expressions behaviorally and physiologically in such a way that confirms an advanced understanding of the information each emotional expression transmits (Hunnius et al, 2011; Montague & Walker-Andrews, 2001). Some researchers theorize that infants are biologically predisposed to read facial expressions (Hunnius et al, 2011; Vaish et al, 2008). Many believe that newborn affinity to faces reflects this. For example, in conjunction with Darwinian theory, infants demonstrate a survivalist method of reacting to threatening facial expressions in that they allocate more attention to the stimuli while avoiding the inner features of the face (Hoehl et al, 2010; Leppa¨nen & Nelson, 2009; Peltola, 2009; Vaish et al, 2008). While it may be an evolutionary trait developed to ensure survival when threats are present, Pollak et al (2009) suggest that this shift in development rather highlights a major developmental accomplishment: Adept social learning and emotion perception skills.

Many studies have explored how social learning guides infants' ability to understand emotional facial expressions. Infants increasingly use referential learning throughout their first year, which Striano and Rochat (2000) suggest signifies "a major milestone of social cognitive capacities indexing primitive understanding that people have intentions directed to the outside world" (p. 254). For example, infants' event-related potential (ERP) responses at six and nine months-of-age demonstrate differentiation between fearful and neutral faces when referencing a neutral object (Hoehl et al, 2010). Infants demonstrate inherent social intelligence through complex mental processes that are involved in the task of social referencing. First, the infant must interpret social cues through another's facial expressions before modifying their own behavior.

Further, the infant's learning atmosphere is considered a significant influence on its socioemotional development. Several studies have explored the ability to read facial expressions of emotion when raised without a primary caregiver. Because these infants may have more limited interaction with adult social behavior, they were predicted to demonstrate a delayed ability to read emotional expressions compared to infants raised with their biological parents (Nelson et al, 2006). Contrary to researcher hypotheses, children reared in institutions performed similarly to non-institutionalized children in discriminating between different facial expressions of emotion (Nelson et al, 2006; Jeon et al, 2010). They displayed similar neural processing of these facial expressions and similar looking patterns in their preference for novel facial expressions (Jeon et al, 2010). On the contrary, Pollak et al (2000) found that compared to a control group, infants and young children raised in abusive environments had delayed abilities to recognize and differentiate neutral and sad emotions, while having heightened perception for threatening expressions of emotion (Pollak et al, 2000). These mixed results demonstrate the need for further research on the socioemotional development of infants with varying environmental supports.

Infants' mothers are fundamental environmental supports and are estimated to play key roles in socioemotional development. Because they are typically the primary caregivers in Western society, mothers interact the most with their infants and become the primary model for social interaction. Mothers are typically more emotionally available to their infants than fathers (Volling et al, 2002). As such, previous research has explored how mothers' own socioemotional competencies affect her infants' development. It is predicted that 50-

80% of mothers in the United States experience *maternity blues*, which affects the mother's emotional availability and quality of interaction with her infant (Nagata et al, 2000). Nagata et al (2000) note a negative correlation between the strength of maternity blues and core maternal attachment. Interestingly, infants would adapt to their mothers' expressions of depression by exhibiting helplessness (Cohn & Tronick, 1983; Nagata, 2000). This suggests that because infants reacted strongly to brief drastic negativity, then long-term exposure may jeopardize infant social development.

Several studies have investigated a connection between attachment style and the ability to interpret emotion on faces. Attachment is theorized to affect behavior, emotion regulation, and the perception of emotions (Fraedrich et al, 2010). Individuals with secure and insecure attachments scan faces differently; it appears that those with anxious-avoidant and secure attachments scan faces longer and in hyper-vigilant ways, whereas those with preoccupied and avoidant attachments are more avoidant with their gaze patterns (Dewitte & Houwer, 2008; Fraedrich et al, 2010; Steele et al, 2008). This research suggests that securely attached individuals may be more socially competent because they direct greater attention to reading emotions (Fraedrich et al, 2010; Steele et al, 2008). An infant's attachment to its mother provides it with internal working models (IWMs) to form expectations, specifically to the mother's responsiveness and emotional availability (Fraedrich et al, 2010; Bowlby, 1969; Spangler & Zimmerman). Securely attached mothers perform better than insecurely attached mothers at processing and classifying facial expressions and allocate more attention to scanning faces (Ainsworth et al, 1978). On a neurobiological level, mothers with insecure attachments show more activity in the right hemispheres of their brains when interpreting an emotional expression, which may reflect certain encoding inefficiencies in mothers with insecure attachments (Ainsworth et al, 1978). Securely attached mothers show an overall heightened sensitivity to emotion, as well as sensitivity and responsiveness to their infants' needs (Ainworth et al, 1978; Ainsworth, 1979; Fraedrich et al, 2010). Ainsworth elaborates that when a mother consistently responds to her infant, the infant is able to form expectations of her behavior and feel secure in their permanence (Ainsworth, 1979). It is stressed that the mother is not the only person with whom the attachment with the infant is developed (Ainsworth, 1979; Ainsworth et al, 1978), however when secure, its strength overpowers any effect from the father's insecure attachment with the child (Volling et al, 2002). A securely attached mother and her infant are predicted to better interpret emotions and maintain relationships; these two skills logically feed into each-other. Just the opposite can be predicted for infant-mother dyads with insecure attachments; their socioemotional competency will fall behind their securely attached counterparts.

Previous research confirms negative social implications of lasting insecure attachments. By four months-of-age, securely-attached infants display more varied, expressive facial behavior than infants with insecure attachments (Steele et al, 2008). At six years-of-age, and to a lesser effect at age eleven, infant-mother attachment security is positively correlated with accuracy to which children can judge emotional expressions (Steele et al, 2008). Children with insecure attachments are more likely to exhibit higher levels of aggressiveness (Lyons-Ruth, 1996) and are predicted to be at more risk of developing behavior problems due to poorer social skills (Volling et al, 2002; Ainsworth, 1979). Steele et al (2008) also found that infants' attachment style predicted how the child recognized and judged emotional expressions at six years-of-age. Although this study is limited by its time-frame, it would be beneficial to continue developing an

understanding of these lasting effects from infancy.

The current study explores the relationship between attachment style and infant ability to discriminate facial expressions of emotion. It is predicted that adults and infant-mother dyads with insecure attachment styles will show a different pattern of scanning behavior compared to participants with secure attachment styles. In particular, insecure attachment may be related to an avoidant style of gaze to negative or threatening facial expressions. These results may have important implications for the study of attachment, especially the socioemotional development of infants.

Method

Participants

Infant-mother dyads were recruited in the first phase of this study. Twenty-seven infants between the ages of five and seven months-old (mean age 24 weeks, 16 males) and their mothers (mean age 30 years) participated in the first phase of this study. Dyads were recruited through the mail with an informational postcard and offered small gifts for participation. Most mothers identified themselves as Caucasian, with the exception of one mother who identified herself as "other Asian". One dyad consisted of twins; consequently the mother's gaze data was duplicated to match both infants. Data from additional three dyads were dropped due to poor calibration or infant fussiness. All mothers reported that they were currently in a committed relationship.

The second phase involved the recruitment of twenty-seven female undergraduate Psychology students from Minnesota State University-Moorhead. It was anticipated that participants from this pool would vary in their attachment patterns. Students were recruited from a sign-up board near the Psychology department and offered extra credit in their courses for participation. Undergraduates identified themselves as mostly Caucasian, with the exception of four undergraduates who identified themselves as black, Chicano, or Middle-Eastern (mean age 22 years). Only females were recruited because 1) the majority of psychology undergraduates at this particular university are female, and 2) it reduced the confounding variable of sex. Data from an additional seven undergraduates was dropped due to poor calibration or unmet criteria of currently being in a relationship.

All participants were treated in accordance with the American Psychological Association's ethical code (American Psychological Association, 2002).

Procedure

Infants and their mothers participated in the first phase of the study. The details of the study were described to the mother and she provided informed consent for herself and her infant. She was calibrated to the Tobii X120 infrared eye-tracker and her eye movements were recorded while she viewed eight photographs depicting sadness, happiness, anger, and neutrality in random order. Next, while sitting on her lap, the infant was similarly calibrated to the eye-tracker and viewed the same photographs in a random order. Cartoons remained on stand-by to capture and retain the infant's attention. The mother completed her three surveys after gaze data were collected. The mother was given the option to hold her infant or allow assistant researchers to hold him/her while she completed these surveys. Mothers were debriefed and compensated for their time with small gifts.

Undergraduate students participated in the second phase of the study and followed identical procedures as the mothers in the first phase with minor modifications. Undergraduates only completed two surveys as the PMAS was not applicable. Instead of small gifts, undergraduate students were offered extra credit for their psychology courses.

Results

Twenty-seven mothers completed two questionnaires that measured their romantic and maternal attachment styles: The PMAS (Nagata et al, 2000) and the Adult Romantic Attachment Questionnaire (Fraley et al, 2000). All mothers scored securely in their attachment styles for both questionnaires. Twenty-seven female undergraduate students completed the Adult Romantic Attachment Questionnaire (Fraley et al, 2000). As predicted, there was more variety in their attachment styles: Six undergraduates scored insecurely in their attachment styles (four preoccupied, one fearful-avoidant, and one dismissive-avoidant). The remaining 21 undergraduate participants scored securely in their attachment styles.

A 3x8 mixed design one-way ANOVA on observer (infant, mother, & undergraduate) and facial expression (two each of happy, sad, angry, & neutral). Figure 1 illustrates the significant effect of facial expression, $F(7, 72)=17.72$, $p<0.01$, and that gaze patterns were consistent across different age groups. Overall, the longest gaze times corresponded to the angry and neutral facial expressions, with the shortest gaze times to sad faces.

To further explore the main effect of expression, gaze times were analyzed according to specific areas of the face (eyes, nose, & mouth), defined as areas of interest (AOIs), in a 3x8 mixed design ANOVA. There was an overall effect of AOI, $F(2,315)=13.113$, $p<0.01$, with longest gaze on eyes in all expressions. Also, there was a significant interaction between AOIs and expression, $F(6,632)=7.058$, $p<0.01$. Specifically, sad faces elicited longer gaze towards the mouth whereas angry faces elicited longer gaze towards the nose. Figure 2 shows heat maps of total gaze time for all eight facial expressions viewed by infants, mothers, and students.

Because all infant-mother dyads from this sample were securely attached, a 2x8 one-way ANOVA analyzed a possible effect of attachment on gaze patterns for only the sample of undergraduates. Since a small percentage of the undergraduate sample represented the three types of insecure attachments, they were grouped together in a collective "insecure" cluster. Figure 3 illustrates no significant effect of attachment, $F(1, 25)=0.736$, $p=0.399$. However, data indicated that securely attached individuals tended to gaze longer at facial expressions overall. Undergraduates displayed similar gaze patterns, including longer gaze times towards neutral and angry expressions.

Discussion

The current study explored how attachment styles in infancy and adulthood influence patterns of visual scanning of different facial expressions. The majority of participants scored securely in their romantic attachment styles. Although no mothers scored insecurely in either attachment style, it is noteworthy that both questionnaires—the Romantic Attachment questionnaire (Fraley et al, 2000) and the PMAS (Nagata et al, 2000)—were consistent in their assessments. Because data from mother-infant dyads reflects similar gaze patterns in infancy and adulthood, and because of the lack of data from insecurely attached dyads, attachment may still be a possible influence on these visual scan patterns. Further research on the interaction between socioemotional development and attachment styles is recommended.

Securely attached participants, both undergraduates and infant-mother dyads, portrayed comparable gaze patterns. The gaze patterns of these participants depict an affinity towards neutral and angry emotional expressions, which may reflect a *negativity bias* found in previous research. It has been suggested that infants beyond six-months old, as an evolved survival function, show preference towards negative facial expressions (Eisenbarth & Alpers, 2011; Jeon et al., 2010;

Vaish et al., 2008). Researchers allude to preference of novelty in explaining the negativity bias in infants: "if young infants typically had positive everyday interactions, then their evaluative neutral point […] would shift closer to positive evaluations[, making] subsequent negative interactions stand out and demand more attention and resources" (Vaish et al., 2008, p 392). However, this explanation falls short in describing how, in this study, six-month old infants and their securely attached thirty-year old mothers viewed differing facial expressions in statistically similar ways. Because these gaze patterns are similar across a large span of development, novelty and survival inadequately describes the purpose of the negativity bias and attachment style may hold in inherent key.

Also noteworthy are how participants differentiated their attention to various parts of the face according to its portrayed emotion. As expected, greater overall gaze was directed towards the eyes regardless of expressed emotion (Hunnius et al, 2011; Eisenbarth & Alpers, 2011). The second-longest viewed feature was the mouth; because the mouth also carries significant emotional information, its focus was predicted. More gaze time was attributed to the mouth region of sad expression and less to the mouth in angry faces despite similarities in mouth openness and area. Surprisingly, participants spent the least amount of time viewing the faces depicting sadness. This finding is contradictory to the negativity bias. Research focusing on the effect of maternal depression revealed infant gaze aversion; following the negativity bias, infants whose mothers did not experience depression gazed longer at the relatively novel expression of sadness (Montague & Walker-Andrews, 2001). Maternal depression was not measured nor were there differences between securely and insecurely attached participants in their gaze patterns when viewing sad stimuli.

Insecure attachment did not appear to play a role in the analysis of gaze patterns. Due to the small sample of insecurely attached adults, this study is limited in its ability to draw conclusions about the role of attachment in facial expression discrimination. An inadequate representation of the three subtypes (preoccupied, dismissing-avoidant, and fearful-avoidant) inhibit the ability to review further effects. Previous research has found that these subtypes exhibit distinct differences in gaze patterns (Dewitte & Houwer, 2008; Fraedrich et al, 2010; Steele et al, 2008). Researchers have hypothesized that children adapt their face scanning techniques according to the needs of a hostile or neglectful environment. To combine the gaze patterns from six participants who scored insecurely, in different subtypes, into a general "insecure" group may have failed to capture these differences. If a caregiver is unpredictable, depending on their attachment pattern, children will develop a *hyper-vigilant* gaze pattern to more accurately interpret their feelings and intents (Pollak et al., 2000; Steele et al, 2008). Although no significant differences were found in gaze patterns, adults with insecure attachments were found to spend less time observing each emotion presented. This finding may reflect such a hyper-vigilant style in that their higher skill in reading emotion necessitated a smaller window of time to review each expression.

Avoidance is another theory that may explain these differences in gaze patterns between securely and insecurely attached participants, as well as the overall lowest gaze times directed towards expressions of sadness. Inherent in this study is further evidence that infants are highly emotionally mature after five-months old. They no longer simply discriminate between emotional expressions, but change their gaze behavior according to the emotion presented in very similar ways to college-aged and older adults. Previous research found that adults will selectively fixate on the inner features of a less threatening face, as is seen in the AOIs for expressions of happiness, but will deviate for

more threatening expressions (Hunnius et al., 2011). The AOIs for angry faces show less focused, more sporadic, gazes that are consistent with this theory.

This study holds certain limitations that may have skewed data. The most noticeable limitation is the lack of insecurely attached participants. The methods used in recruitment may have skewed the pool of eligible participants. Because college students were recruited from the Psychology Department and were offered extra credit in their courses for participating, they may have been familiar with attachment theory and the questionnaire provided. Further, dyads were required to visit campus and complete two questionnaires regarding their relationships with their significant others and their infant. Such an intrusion in privacy may not have suited individuals with insecure attachments, deferring those away from the sample. Additionally, the stimuli itself may have contributed to the surprising data regarding the sad facial expression. These naturalistic samples were not standardized and so features other than the facial expression (size of face, color, contrast, unfamiliar race to this largely Caucasian population) may have captured or reduced attention, especially with infant participants.

Securely attached participants, from infancy to adulthood, presented similar gaze patterns when viewing emotional facial expressions. Results indicated a possible negativity bias or gaze aversion. Further research is necessary to review the effect of insecure attachments on facial scanning behavior.

References

Ainsworth, M. D. S. (1979). Infant-Mother attachment. *American Psychologist, 34(10)*, 932-937.

Ainsworth, M., Blehar, M., Waters, E., & Walls, S. (1978). Patterns of attachment: A psychological study of the strange situation. Hilldale, NJ: Erlbaum.

Cohn, J. F., & Tronick, E. Z. (1983) Three month-old infants' reaction to simulated maternal depression. *Child Development,* 54, 185-193.

Dewitte, M., & de Houwer,J. (2008). Adult attachment and attention to positive and negative emotional face expressions. *Journal of Research in Personality,* 42, 498-505.

Eisenbarth, H., & Alpers, G. W. (2011). Happy mouth and sad eyes: Scanning emotional facial expressions. *Emotion, 11(4)*, 860-865.

Fraedrich, E. M., Lakatos, K., & Spangler, G (2010). Brain activity during emotion perception: the role of attachment representation. *Attachment & Human Development, 12(3)*, 231- 248.

Fraley, R. C., Heffernan, M. E., Vicary, A. M., & Brumbaugh, C. C. (2011). The experiences in close relationships—relationship structures questionnaire: A method for assessing attachment orientations across relationships. *Psychological Assessment,* 23(3), 615-625.

Goren, C. C., Sarty, M., & Wu, P. Y. K. (1975). Visual following and pattern discrimination of face-like stimuli by newborn infants. *Pediatrics, 56(4)*, 544-549.

Jeon, H., Moulson, M. C., Fox, N., Zeanah, C., & Nelson, C. A. (2010). The effects of early institutionalization on the discrimination of facial expressions of emotion in young children. *Infancy,* 15*(2)*, 209-221.

Hazan, C. & Shaver, P. (1987). Romantic love conceptualized as an attachment process. *Journal of Personality and Social Psychology,* 52*(3),* 511-524.

Hoehl, S., & Striano, T. (2010). The development of emotional face and eye gaze processing. *Developmental Science, 13(6)*, 813-825.

Hunnius, S., de Wit, T. C. J., Vrins, S., von Hofsten, C. (2011). Facing threat: Infants' and adults' visual scanning of faces with neutral, happy, sad, angry, and fearful emotional expressions. *Cognition and Emotion, 25(2)*, 193-205.

Hunnius, W., & Geuze, R. H. (2004). Developmental changes in visual scanning of dynamic faces and abstract stimuli in infants: A longitudinal study. *Infancy, 6(2)*, 231-255.

Lyons-Ruth, K. (1996). Attachment relationships among children with aggressive behavior problems: The role of disorganized early attachment patterns. *Journal of Consulting and Clinical Psychology, 64(1)*, 64-73.

Montague, D. P. F., & Walker-Andrews, A. S. (2001). Peekaboo: A new look at infants' perception of emotion expressions. *Developmental Psychology, 37(6),* 826-838.

Nagata, M., Nagai, Y., Sobajima, H., Ando, T., Nishide, Y., & Honjo, S. (2000). Maternity blues and attachment to children in mothers of full-term normal infants. *Acta Psychiatr Scand*, 101, 209-217.

Nelson, C. A., Parker, S. W., & Guthrie, D. (2006). The discrimination of facial expressions by typically developing infants and toddlers and those experiencing early institutional care. *Infant Behavior & Development,* 29, 210-219.

Nere, M. (2014). Adult attachment behavior on facial detection of emotion. *The Red River Psychology Journal,* 1, online.

Niedenthal, P. M., Brauer, M., Robin, L., & Innes-Ker, A. H. (2002). Adult attachment and the perception of facial expression of emotion. *Journal of Personality and Social Psychology,* 82*(3)*, 419-433.

Peltola, M. J., Leppanen, J. M., Maki, S., & Hietanen, J. K. (2009). The emergence of enhanced attention to fearful faces between 5 and 7 months of age. *Social Cognitive and Affective Neuroscience*, 4, 134-142.

Pollak, S. D., Cicchetti, D., Hormung, K., & Reed, A. (2000). Recognizing emotion in faces: Developmental effects of child abuse and neglect. *Developmental Psychology, 36(5)*, 679-688.

Pollak, S. D., Messner, M., Kistler, D. J., & Cohn, J. F. (2009). Development of perceptual expertise in emotion recognition. *Cognition,* 110, 242-247.

Propper, C., & Moore, G. A. (2006). The influence of parenting on infant emotionality: A multi- level psychobiological perspective. *Developmental Review,* 26, 427-460.

Stahl, D., Parise, E., Hoehl, S., & Striano, T. (2010). Eye contact and emotional face processing in 6-month-old infants: Advanced statistical methods applied to event-related potentials. *Brain & Development*, 32, 305-317.

Steele, H., Steele, M., & Croft, C. (2008). Early attachment predict emotion recognition at 6 and 11 years old. *Attachment & Human Development, 10(4)*, 379-393.

Striano, T., Brennan, P. A., & Vanman, E. J. (2002). Maternal depressive symptoms and 6- month-old infants' sensitivity to facial expressions. *Infancy, 3(1)*, 115-126.

Striano, T., & Liszkowski, U. (2005). Sensitivity to the context of facial expression in the still face at 3-, 6-, and 9-months of age. *Infant Behavior & Development, 28(1)*, 10-19.

Striano, T., & Rochat, P. (2000). Emergence of selective social referencing in infancy. *Infancy,* 1*(2)*, 253-264.

Vaish, A., Grossmann, T., & Woodward, A. (2008). Not all emotions are created equal: The negativity bias in social-emotional development. *Psychological Bulletin, 134(3)*, 383- 403.

Volling, B. L., McElwain, N. L., Notaro, P. C., & Herrera, C. (2002). Parents' emotional availability and infant emotional competence: predictors of parent-infant attachment and emerging self-regulation. *Journal of Family Psychology, 16(4)*, 447-465.

Figure 1. The effect of facial expression and observer on gaze time

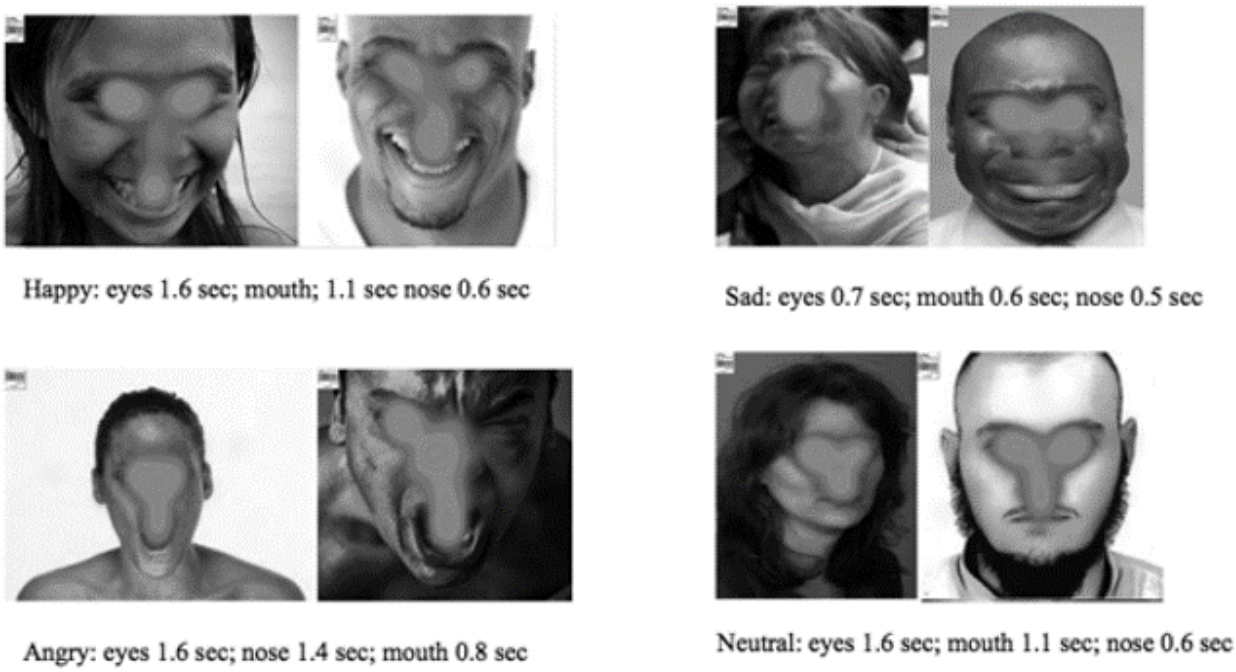


Figure 2. Warmer colors indicate longer fixations; Average gaze (secs) is indicated below each photo.

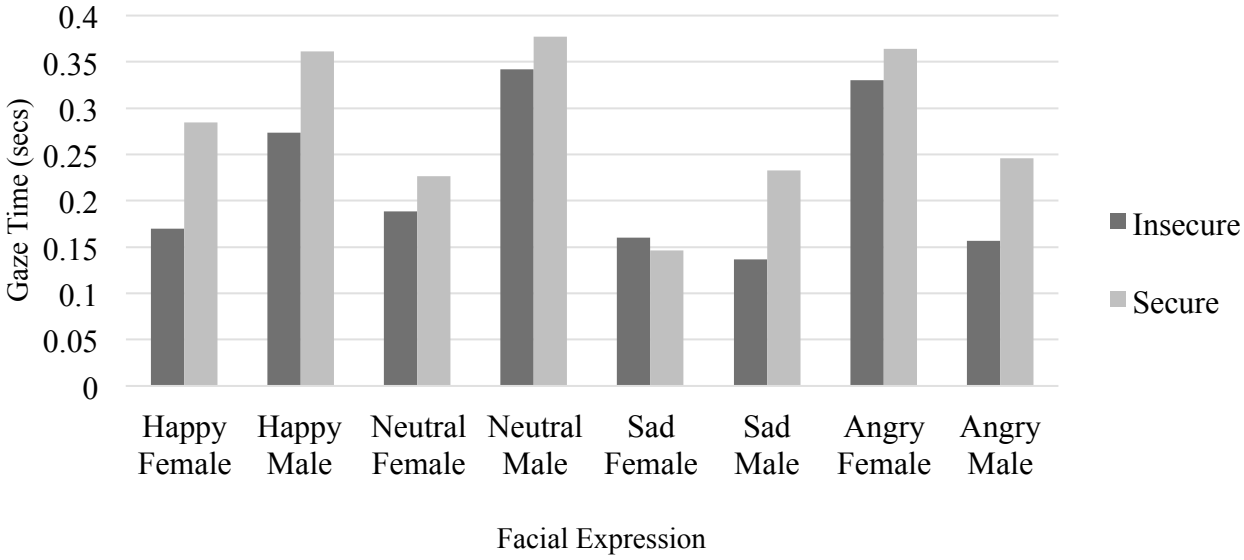
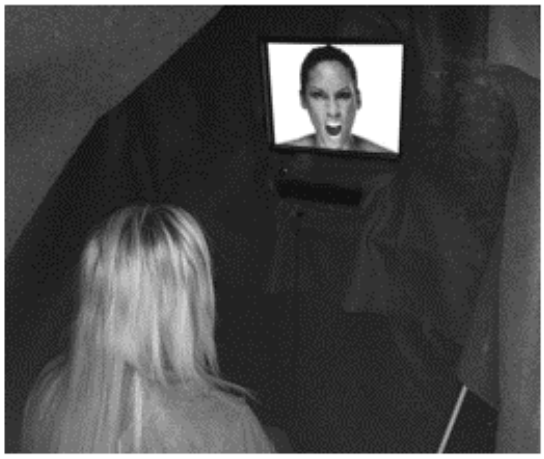
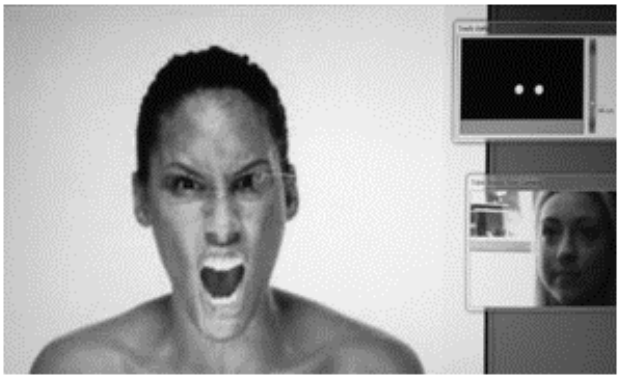


Figure 3. The effect of student attachment patterns and facial expression on gaze time

Appendix A





Participants were seated in a dark enclosure at eye-level with the Tobii X120 infrared eye-tracker while the images of facial expressions were presented above (left). The researcher could monitor progress on the other side of the enclosure while the presentation continued (right).