THE OCCURRENCE OF POSITIVE AFFECT AND THE CONTAGIOUS EMPATHIC REPSONSE TO LAUGHTER IN EARLY INFANCY

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Bachelor of Science in Psychology

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Stillwater, Oklahoma

2012

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July, 2016

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THE CONTAGIOUS EMPATHIC REPSONSE TO

LAUGHTER IN EARLY INFANCY

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ACKNOWLEDGEMENTS

I would first like to thank my graduate advisor, Dr. David Thomas, for his support throughout the duration of this project. I would also like to thank the members of my committee, Drs. Jennifer Byrd-Craven and James Grice for their time, their insight, and their suggestions regarding the present study. Additionally, I would like to recognize the graduate and undergraduate members of the Developmental and Psychophysiology Lab for their commitment to recruitment, data collection, coding, and data entry. Finally, I would like to thank my friends and family, especially my mother and father for their unfailing patience with me during this process, for providing financial support to fund the participant compensation costs, and for their constant moral support. Each of the above mentioned groups and individuals has been an integral part of this project and I owe its success to them.

Name: EVAN M. JORDAN

Date of Degree: JULY, 2016

Title of Study: THE OCCURRENCE OF POSITIVE AFFECT AND THE CONTAGIOUS EMPATHIC REPSONSE TO LAUGHTER IN EARLY INFANCY

Major Field: PSYCHOLOGY

Abstract: Emotional Contagion is defined as the unconscious converging of one's emotional state with another, suggesting that one can "catch" the emotions of another through vocal expressions, postures, and facial expressions (Hatfield et al., 1993). This phenomenon can be observed in adulthood, but also in infancy as early as the first 24 hours following birth. While negative emotional contagion has been studied in the form of contagious crying at various ages of infancy, positive emotional contagion has received very little attention.

The purpose of the present study was to observe the emotional reactions of forty-five infants at 5 and 10 months of age when they were presented with a stimulus of their peers displaying facial expressions and making vocalizations of positive affect. It was hypothesized that infants would react to the stimuli of positive emotions with expressions of positive affect and/or vocalizations of laughter. Additionally, it was hypothesized that the intensity and duration of both the expressions and the vocalizations would increase with age between assessments at 5 and 10 months. Due to the fact that this study was exploratory in nature, predictions of the outcome were based on infants' emotional responses to distress in contagious crying studies as well as the typical developmental timeline of positive emotions.

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CHAPTER I

INTRODUCTION

The phenomenon of emotional contagion is characterized by the tendency for emotional expressions in one individual to subsequently evoke similar expressions and experiences in a second individual (Hatfield, Cacioppo, & Rapson, 1992). In infants, emotional contagion is suggested to be a primitive form of empathy that is present prior to the development of more advanced forms that require a level of cognitive functioning not yet present. Various theories and explanations of the concept of emotional contagion have been suggested, with the majority of them depicting it as an automatic response of imitation (Hatfield, Cacioppo, & Rapson, 1993) involving the unintentional acquisition of another's mood-state (Hsee, Hatfield, Carlson, & Chemtob, 1990). However, research on the occurrence of emotional contagion in infancy is primarily limited to negative affect in the ability to "catch" another individual's emotions. More specifically, contagious crying, the reflexive crying response of an infant when exposed to the distressed cries of another infant, has been observed in infants of various ages within the first two years following birth (Geangu, et al., 2010; Martin & Clark, 1982; Sagi & Hoffman, 1976; Simner, 1971). In contrast, the research that looks at the emotional contagion of positive affect is minimal and confined only to its occurrence in adults (Brown, Brown, & Ramos, 1981; Chapman & Champan, 1974; Provine, 1992). Do infants have the same capacity to

greater insight into the concept of emotional contagion, and allow for a better understanding of the development of empathy in later life. This could in turn lead to an increased understanding of the role of emotional contagion and its effects on attachment behaviors in infancy as well as provide a pathway for observing early signs of autism in infants, both of which are ingrained in empathy research.

CHAPTER II

REVIEW OF LITERATURE

Emotional Contagion

Emotional contagion is defined as the automatic convergence of one's emotional state with that of another person and is referred to as a "contagion" due to the idea that one can "catch" the feelings and emotions of another through vocal expressions, postures, facial expressions, and instrumental behaviors (Hatfield et al., 1993). The catching of emotions of another individual can be seen in a three-step process in which an individual perceives the auditory cue or facial expression of another thus triggering their own auditory or facial mimicry of that expression. The neural receptors of the expression give feedback to the brain and the subsequent emotion is produced (Wild, Erb, & Bartels, 2001). This process highlights the underlying mechanisms vital to the occurrence of emotional contagion, including mimicry, facial feedback, and nervous system activity. These mechanisms are discussed in greater detail below.

Early investigators theorized that that conscious reasoning, analysis, and imaginations were necessary for the emergence of the phenomenon of emotional contagion (Hatfield, et al., 1993). However, the theory of the neurophysiological shift (Ainsfeld, 1982) which is discussed in more detail later, would support the idea that emotional contagion is an automatic response to the emotional state of another, rather

than a thought-out reasoning and analysis of the emotional condition of another infant. According to Ungerer (1990), the transition between automatic response and conscious reasoning between early infancy and later development is a continuous process, with the final result being the development of empathy.

The Role of Emotional Contagion in Empathy Development

The phenomenon of empathy has been characterized in a myriad of ways. Explanations have ranged from the use of cognitive processes that allow for understanding another's emotional state, to the affective response of actually feeling the emotions that another individual is experiencing (Moore, 1990). The absence of a confining definition has led to debate regarding which necessary cognitive components must be present in order for emotional responses to be truly empathic in nature, and which responses are merely innate reactions to the affect of others and set the stage for the development of empathy in later life. According to Decety and Jackson (2004) there are three main components that define empathy. The first is characterized by an emotional response to another individual's emotional state. This is often accompanied by the sharing of emotions with the other person. The second component involves perspective taking, which is the ability to understand the emotional experience or condition of another person. Perspective taking is a multidimensional skill that involves perceptual, social-cognitive and affective processes. An individual must first be able to visualize the perspective of another, followed by the identification and understanding of the reasoning behind a behavior, and finally surmise the feelings and emotions that the individual has as a result of the condition and behavior. The combination of these processes allows the individual to take on the perspective of another, which is critical, but

not singularly responsible for the ability of an individual to perform prosocial actions (Moore, 1990). The third and final element of the cognitive definition of empathy requires the ability to distinguish between the emotions of one's self and the emotions of another person, a process called self-other differentiation (Decety & Jackson 2004).

The first of these processes, the emotional response to the affective state of another, can be observed within the first hours of life in the form of contagious crying (see below). The remaining components of perspective taking and self-other differentiation are especially important when considering the role of emotional contagion in the development of empathy because they require an individual to consciously evaluate the emotional behaviors of another as well as understand that the emotions they feel are not necessarily their own, but often a result of the affect of others. Both of these components require complex cognitive processing skills that Thompson (1987) argues do not develop until about eighteen months of age. Prior to this time, it is theorized that infants may be unable to understand or unaware of the situation that led to this emotion in another and respond to it with acts of prosocial behavior, both of which are vital in order for emotional behavior to be considered empathic. Prior to the development of a level of cognitive functioning necessary for empathy, infants are able to demonstrate emotional contagion, which, by itself, is considered to be a more primitive form of empathy and can be categorized in the affective definition of empathic behavior (Cummings, et al., 1986; Moore, 1990).

Due to the fact that there are three elements that are essential to empathy and emotional contagion encompasses the first, it can be inferred that emotional contagion acts as a "building block" for the development of empathy. From the previously

mentioned literature, we could conclude that emotional contagion is present within the first 18 months of life and continues to develop into true forms of empathy as an infant's cognitive and behavioral capacities increase. If empathy is consistently developing, it is reasonable to expect that the individual differences observed in the contagious emotional responses of neonates would be seen in more advanced empathic behaviors in later life.

Empathy Includes Negative and Positive Emotion

Empathy and empathic behaviors including emotional contagion are typically construed as being related to negative affect, rather than something that occurs during both negatively and positively toned events. A response to the suffering or distress of another is characteristic of only one of the three subtypes of empathy known as empathic concern, which is thought to stem from reflexive responses to the distress of another individual (contagious crying). Empathic happiness and empathic cheerfulness, the remaining subtypes of empathy, focus on the positive emotions of individuals. Empathic happiness is distinguished from empathic cheerfulness in that the former is a response to the positive emotional reaction of another in the same way that empathic concern is the response to a negative reaction and both involve the mirroring of another's emotions (Decety, 2012). Empathic cheerfulness is the use of positive emotions to enhance the mood state of another and as a result, relieve their suffering or distress (Light, et al., 2009). Infants engage in what appears to be empathic cheerfulness with their mothers as early as four months of age. When mothers exhibit a still-face display, devoid of recognizable emotions, infants will make an attempt to engage their mothers through the

use of positive affect and catalyze a positive emotional state (Cohn, Campbell, & Ross, 1991).

Evidence supporting the encompassment of both negative and positive emotional responses resulting in empathy can be seen in physiological reactions of the Hypothalamic-pituitary-adreanal axis (HPA) and the sympathetic nervous system (SNS) to various types of social stressors. Laurent, Ablow, and Measelle (2012) found cortical stress responses in infants to be consistent across both threatening stress events intended to evoke a negative emotional response and stress events that were not negatively toned and intended only to elicit general emotional arousal.

For the scope of this study we will focus mainly on the subtypes of empathic concern and empathic happiness. While these two may appear to be fundamentally different, both are grounded in emotions that are present in the earliest stages of life. However, researchers' knowledge of their onset varies greatly between the two. While there is evidence that emotional contagion is a basic building block of empathic concern that is present from birth in the form of contagious crying (reviewed below), precursory knowledge of empathic happiness is not as prevalent in empirical research, which is key in understanding the concept of positive empathy. Due to the fact that empathy encompasses the ability to share and feel both negative and positive emotions, it is expected that positive emotional contagion should occur in addition to the occurrence of its negative counterpart. However, differences in the onset of the two forms of emotional contagion may stem from the underlying differences between the development of negative and positive emotions. The following literature will discuss the emergence of primitive forms of empathic concern and empathic happiness and the role that emotional

contagion plays within them. Furthermore, it will discuss the underlying mechanisms involved in emotional contagion, provide evidence and explanations for theories of both innate and learned emotional responses, and examine the similarities and differences between the responses of positive and negative affect and their subsequent emotions.

Contagious Crying in Infancy. One of the first differences that can be observed when comparing the onset of positive and negative emotional contagion is highlighted in the primitive displays of empathic concern through the phenomenon of contagious crying. Contagious crying is an affective response that refers specifically to the distress reaction that neonates give when exposed to the cries of other infants. The following literature provides evidentiary support that primitive forms of empathy are present in infancy and could be the results of innate processes present from birth. In early infancy the degree of intensity of responses to cries of distress varies from infant to infant. Although empathic responses vary in frequency and intensity between individuals, they can be observed in infants as early as a few hours after birth. A study by Simner (1971) examined the differences in response to different auditory stimuli on newborns of an average age of 70 hours old. The auditory stimuli in the first experiment included cries of a five and half month old female infant, white noise and a control of no noise. Simner (1971) found that infants exposed to the cries of the five-month-old female infant produced a cry response significantly more than the conditions in which white noise was played or no noise was present. A second experiment implemented the addition of a synthetic, computer generated cry and the cry of a newborn baby and the participant's own-recorded cry. These auditory stimuli resulted in infants crying significantly more to their own cries than the cries of another newborn, the cries of the five and half month old infant and the

synthetic cries, respectively. This indicates that infants were able to distinguish the difference between cries of an older infant and an infant more similar in age to themselves. An additional replication of this study was conducted on infants of an average of 34 hours old using the same audiotapes that Simner (1971) had implemented in his experiment. This observation of infants only thirty-four hours old yielded similar significant results and in these findings, Simner (1971) noted a trend in the data that suggested that infants would cry more to stimuli that was more congruent to an infant's own cries, but further research would indicate an entirely different response of an infant exposed to their own crying stimulus.

An additional study extended the aforementioned findings to determine if responses to the crying stimuli were peer and species specific in addition to substituting a different audio recording to determine if the effect found in the previous studies would still occur. Martin and Clark (1982) demonstrated the effect of crying in response to the crying stimulus of another infant in addition to observing the differences in response to an infant hearing their own cry and the cry of another species. When exposed to the cries of another infant, Martin and Clark (1982) replicated the significant main effect in neonates of an average age of eighteen hours old. Interestingly, they found that when infants are exposed to recordings of their own distress cries, they responded with fewer instances of crying providing evidence that infants are able to make the distinction between their own distress and the distress of a peer of similar age. Furthermore, infants that were crying prior to the start of their own crying stimulus would cease their distressed behavior when exposed to the auditory stimuli. Additional auditory cues of older eleven-month-old infant cries and the cries of infant primates did not elicit a

distress response in the subjects. This suggests that there are vocal cues present in the cries of infants similar in age to the neonate subjects that prompt a distress response, but that these same cues are not present in non-peer infants and infants of non-human species. Martin and Clark's (1982) findings are indicative of the ability for some form of empathic reaction to take place within the first days of birth, whether it is primitive or mature empathy. Additionally, it draws into question Thompsons (1987) theory of an infant's inability to engage in self-other differentiation, a core component to mature empathy. However, due to the young age of the neonatal participants it can be argued that the previously mentioned studies by Simner (1971), Sagi and Hoffman (1976), and Martin and Clark (1982), are more closely related to primitive emotional contagion rather than mature empathy.

The aforementioned experiments have focused on the occurrence of contagious crying within the first 70 hours following birth. However, Hoffman (2000) hypothesized that contagious crying dissipates at approximately six months of age due to a learned increase in emotion- regulation. A more recent study observed the emotional responses in infants of 1, 3, 6, and 9 months of age in order to determine if contagious crying could be observed beyond the first days postnatal (Geangu et al., 2010). Using a crying stimulus of a three-month infant in pain, results of this study found that infants of all ages between one and nine months exhibited similar levels of distress as indicated by their vocal and facial expressions. This discredits Hoffman's (2000) hypothesis that the emotional response of contagious crying would cease at six months of age as they gained the ability to regulate their emotions. In fact, infant participants responded more quickly

with cry vocalizations at the age of six and nine months when compared to the three-month-old infants.

Laughter in Infancy. While contagious crying and general negative affect occurs within hours after birth, laughter does not appear until later in development. Additionally, positive emotionality tends to increase in both frequency and intensity throughout the development of the infant (Rothbart, 1989; Sallquist, et al., 2010). The onset of the first forms of positive affect (smiling) do not occur in infants until 4 to 6 weeks after birth, most likely only after a neurological shift has taken place (Ainsfeld, 1982). Subsequently, laughter does not occur in infancy until approximately 4 months after birth (Sroufe & Waters, 1976).

The positive affect of laughter differs from crying in that laughter is a social vocalization and requires the stimulus of another individual (Provine, 2004) while crying can come about from several forms of distress. While media stimuli can still elicit laughter, a study by Provine and Fischer (1989) found that adult participants are 30 times more likely to laugh when in the presence of another individual compared to being alone. This is consistent with the theory of audience effects (Jones & Raag, 1989; Jones, Collins, & Hong, 1991) related to the occurrence of social smiling, which is discussed in greater detail below.

Similar to other attributes exhibited by infants, parental influences are present in the development and display of positive emotion (Bridgett et al., 2013). The amount of positive affect displayed by the parents has a direct effect on an infant's tendency to display positive affect of smiling and laughter (Feldman, 2003; Oveis, Gruber, Keltner, Stamper, Boyce, 2009). Furthermore, infants of mothers with a history of postpartum

depression are less likely to have expressions of positive emotion during interactions with with their mothers (Forbes, Cohn, Allen, & Lewinsohn, 2004). This suggests that mothers that exhibit high levels of emotional expression may be able to model and reinforce early positive expressions in their infants and therefore increase their susceptibility to "catch" the laughter of another individual and converge with that individual emotionally.

Emergence of Social Smiling

Social smiling is the first display of positive emotion that an infant produces and it allows us to investigate precursors of positive empathy, specifically empathic happiness. While neonatal distress is exhibited at birth, true positive affect expressions are not observed in infants until approximately five weeks after birth (Jones, 2008). Prior to this time, infants will display behaviors indicative of smiling during sleep or periods of drowsiness, but are not directed towards another person or object and can therefore not be considered a social behavior (Jones, 2008; Sroufe & Waters, 1976). Prior to the onset of social smiles, infants can engage in forms of imitation and facial mimicry that resemble smiles, but these "smiles" are considered to be fleeting and not a true form of positive expression (Wormann, Holodynski, Karner, Keller, 2012). For example, Meltzoff and Moore (1983) found that infants produce a variety of imitation behaviors starting within two weeks of birth. Tongue protrusions, in addition to movement in the brow region, appear at two weeks of age and increase in complexity as the developmental process continues. The frequency and intensity of these behaviors vary among infants. Theoretical implications of these behaviors range from early associative learning to innate releasing mechanisms, but are not linked to the development of the social smile.

There are various types of smiles, some more associated with positive affect than others. Duchenne smiles are characterized by contractions of the orbicularis oculi muscle and the raising of the corners of the mouth as a result of contractions in the zygomaticus major muscle and are affiliated with positive affect and indicate genuine happiness or enjoyment (Messinger, Fogel, Dickson, 1999). In contrast, non-Duchenne smiles lack the constriction of the orbicularis oculi muscle, more commonly referred to as “crow’s feet”. In infancy non-duchenne smiles typically precede Duchenne smiles, but often occur consecutively (Messinger et. al, 2008). This suggests that these two smiles may be related on a continuum of positive emotional responses. Interestingly, Duchenne smiles often involve smiling in addition to mouth opening. These smiles, known as Duplay smiles, tend to occur more often in infants that are engaged with their mothers and are hypothesized to be a precursor to the onset of laugher, which could be crucial to the development of positive emotional contagion, as we will discuss later (Messinger et al, 2008).

Anisfeld (1982) defined the occurrence of social smiling as "an infant with an initially expressionless face examines the face of another person, his face and eyes then light up, and the corners of his mouth pull upward". This is observed as early as four to six weeks after birth for full term infants, only after a neurophysiological shift has taken place (Anisfeld, 1982; Wormann et. al, 2012). This shift is characterized by an increased control over their head movements and the ability to maintain a gaze for longer time periods when compared to younger infants. The ability of infants to hold their visual gaze for longer periods of time is positively correlated with more face-to-face interactions with

their primary care givers, which in turn leads to an increase in the frequency and duration of social smiling (Wormann et. al, 2012).

Infants tend to engage in social smiling more frequently during interactions with their primary caregivers than they do with strangers or other members of the family (Brooks-Gunn, Lewis, 1981). However, is the emergence of social smiling due to an expression of emotion, an imitation response to the smile of the mother, or a combination of the two? Infants mimic facial expressions of emotion shortly after birth and continue throughout their lives. At times, these imitations are nearly instantaneous (Hatfield et al., 1993). The ability for infants to quickly and accurately imitate the expressions of others suggests that certain behaviors are reflexive and hardwired in the brain from birth and that a certain behavioral stimulus (smiling) in the parent "releases" this behavior in the infant (Meltzoff & Moore, 1977). Interestingly, even when a “full” smile is not produced, subjects that observe happy facial expressions showed increased muscular activity over the zygomaticus major (cheek) muscle region, which is characteristic of Duchenne smiles.

In an effort to determine whether the development of social smiling is innate as opposed to learned through environmental cues, Anisfeld (1982) conducted a study that compared the time lines of social smiling between full term and pre-term infants. While full term infants typically demonstrated social smiling around the fifth week after birth, pre-term infants did not exhibit the same pattern. In fact, results of this study provided evidence that both pre-term and full term infants began to develop social smiling patterns at similar developmental periods, approximately 45 weeks after their conception. This indicates that a certain level of maturation must occur prior to the ability for an infant to

produce true positive facial expression. This is consistent with the theory that a neurophysiologic shift in development must occur prior to the onset of the social smile (Anisfeld, 1982; Wormann et al., 2012).

Social vs. Emotional. While the social smile is most often interpreted as an outward sign of happiness or positive affect, it is possible that the social intentions behind a smile are at times separate from the emotional feelings of the individual producing the smile. In a study by Jones and Raag (1989), 18-month-old infants were observed during a free play session to determine if having an audience present would affect the frequency of their smile production. Infants tended to smile more at attentive mothers as opposed to inattentive mothers, but the attentiveness did not affect the number of smiles that were directed towards the toys in either condition. Additionally, when a stranger was introduced to the condition in which mothers were inattentive, the infant would begin directing their smile towards the attentive stranger rather than the inattentive mother. These results indicate that an audience effect does exist in infants as early as 18 months of age. An additional study conducted with 10-month-old infants also found that the frequency of smile production was not affected by the attentiveness of the mother, but the frequency of smiles directed towards the mother was greater for attentive mothers compared to those in the inattentive condition. (Jones, Collins, Hong, 1991). This indicates that an audience effect would still occur in infants that are less socialized. Lack of change in the production of smiles directed towards toys, coupled with the occurrence of an audience effect in each of these studies would suggest that the production of a social smile is distinct from emotional smiling.

All in all, the development of the smile is a complicated process. The complexity of the smile continues to increase and become more indicative of a social smile following the developmental shift occurring between four and five weeks of age. Furthermore, the production of a smile will eventually diverge and result in the emergence of either social or emotional smiles, or both in congruence with one another. Prior to its development infants tend to engage in primitive forms of emotional behavior known as imitation and mimicry. In the following section, the role these imitative behaviors play in the development of the social smile is discussed.

Motor Mimicry and Feedback

As previously mentioned, feedback from facial expressions and vocalizations can be a powerful catalyst in producing emotion in individuals. This occurs not only in infancy, but also continues into adulthood. During social interaction, people tend to automatically mimic the emotional expressions of other individuals (Chartrand & Bargh, 1999; Neumann & Strack, 2000). This unintentional imitation is referred to as motor mimicry (Neumann & Strack, 2000). The synchronies of behaviors affect the emotional experiences of the person doing the mimicking through feedback. According to Darwin (1965), the ability to experience emotion is shaped by changes in skeletal musculature and interpretations of a person's own facial expressions, vocalizations, and postures. People will then make inferences about their about their own emotional state based on their emotional expressions, a process called conscious self-perception (Hatfield et al., 1993; James & Bresler, 1992). This theory of conscious self-perception is important to the concept that mimicry and imitative behaviors are underlying mechanisms of emotional contagion, due to the fact that the imitation of the emotional expression of

another will trigger the display of that expression in the observer and the corresponding emotion will be produced. Interestingly, when a person is prevented from mimicking the facial expressions of another, he or she is unable to identify facial emotions or accurately detect the emotion of the other individual (Pfeifer et al., 2008). This suggests that the mimicry of another's emotional expression is crucial to the understanding of their emotional state and therefore to the ability to empathize with others.

Vocal mimicry, like facial mimicry, is also an automatic response that occurs on a moment-to-moment basis during interactions with others. In a study observing 20-minute dyadic conversations, partners unconsciously matched the rhythm of speech, length of vocalizations latency to respond between turns speaking, and the average duration of pauses taken (Cappella & Planalp, 1981). Vocal mimicry is not unique to adults, but is also observed in infants. Caregivers begin talking to their children as early as minutes after birth and these vocal interactions are crucial to the developmental process on cognitive, linguistic, social, and emotional levels. Infants signal to their primary caregivers through non-linguistic vocalizations and are typically responded to by the primary caregivers with language vocalizations. These mutually contingent, or "turn taking" vocalizations continuously reinforce the response of the other, and aid in the development of both language acquisition and socialization (Bornstein et al., 2015). Humans, even in infancy, have the ability to detect emotions through the vocalizations of others (Loui et al., 2013; Scherer, 1995) and early evidence of this can be observed in newborn infants during contagious crying. During this crying reaction, infants will often match pitch with the cries of other infants in the same way that adults will match rhythm and length of vocalizations (Webster, Steinhardt, & Senter, 1972). While the previously

mentioned literature on contagious crying highlights the occurrence of mimicry in the form of negative affect, it should not be overlooked that imitation of positive affect is also present. In fact, a study conducted by Termine and Izard (1988) observed the imitative response of an infant to the facial and vocal cues of its mother. Results indicated that infants mimic joyful expressions from their mothers more often than sad expressions and furthermore, were observed averting their gaze from their mothers when expressions of sadness were exhibited.

Emotional expressions of pain, laughter, smiling, embarrassment, disgust, and discomfort (Bavelas et. al, 1987) can appear and disappear at a surprising speed (125-200 ms) and are mimicked across a range of situations (Haggard & Issacs, 1966). Furthermore, the mimicry of these expressions is often an instantaneous response that can be, at times, so subtle that is not visible to the naked eye, but is only measurable by EMG procedures (Cacioppo, Tassinary, Fridlund, 1990). No matter the subtlety of these imitative behaviors, the importance of understanding the underlying concept of mimicry and feedback should not be overlooked due to the fact that the automatic mimicry of facial expressions and vocalizations could be a learning tool for more advanced forms of empathy in later development.

Neurological Substrate

The processes underlying empathetic reactions are not only cognitive in nature, but also neuronal. Cortical brain cells called mirror neurons collectively make up the Mirror Neuron System (MNS). This specialized system extends to multiple regions of the brain acting as preparatory motor neurons for an individual to perform an observed action (Ocampo & Kritikos, 2011; Casile, 2013) and serving as a neurological substrate for

processing emotional information including empathic behavior (Pfeifer et al., 2008). Neurons on the mirror system will fire both when performing and observing an action or feeling an emotion (Enticott, Johnston, Herring, Hoy, Fitzgerald, 2008). Through the activation of the MNS, emotions of others can be reflected in the observer, allowing them to take on the emotional state of the acting individual.

In anterior regions of the insula, one of the many areas that encompass the mirror system, connections to the limbic system provide the neural network responsible for emotion. The catching of emotions of another individual can be seen in a three step process in which (1) an individual perceives the facial or vocal expression of another triggering their own mimicry of that expression, (2) the neural receptors of the emotional expression give feedback to the brain and (3) the subsequent emotion is produced (Wild, Erb, & Bartels, 2001). It is argued that one can never truly understand the emotional state of others until one can experience the feelings of another individual first hand during the process of perspective taking (Decety & Jackson, 2004). The neural mechanism that the MNS provides allows us to take the perspective of the emotional state of others via the understanding of our own emotions because of mirroring, which is a requirement for the ability to empathize with others (Pfeifer& Dapretto, 2009). Additional evidence to support this claim can be found in a study that tested the relationship between self-reported tendencies to empathize and the activity of mirror neurons of 16 children as they imitated and observed various facial expressions. Tendency to empathize was evaluated via the Interpersonal Reactivity Index (IRI; Davis, 1983), which assesses both cognitive and emotional components of empathy, including empathic concern, personal distress, and perspective taking. Activity of the MNS was recorded via fMRI scanning during the

observation and imitation portion of the study. Scores on the Interpersonal Reactivity Index evaluating the tendency for these children to empathize had a strong positive correlation with the activation of mirroring neurons, suggesting that they are able to feel the emotions that others feel.

Additionally, it is theorized that the mirror neuron system is central to the ability for humans to imitate the actions of others (Uithol, Rooij, Bekkering, Haselager, 2011). The capacity for mirror neuron activity during imitative actions is important in that it sets the stage for humans to develop skills through the observation and execution of actions and emotions that they observe in others. The early occurrence of imitative behaviors in infancy has led many researchers to hypothesize that the mirror system is indeed, innate to humans and therefore must be the same for infants and adults (Ramachandran, 2011).

Shimada and Hirachi (2006) provided evidence that these imitative behaviors are linked to the same mirror system that adults use to match observed and executed actions. Through the use of near-infrared spectroscopy (NIRS), they found that the same motor cortical regions that activated when an adult observed or performed an action also activated with infants between the ages of six and seven months when an infant either performed an action or watched an experimenter perform the same action.

Activation of the cortical regions in infants differs from that of adults in that infant neurons will fire both when an action is transitive and intransitive, whereas adult mirror neurons will only fire when an action is goal directed (Turati et al., 2013) suggesting that the complexity of the mirror response increases throughout development. Further evidence of developmental maturation of the mirror system was observed in a study by Turati et al. (2013) in which they used electromyography (EMG) recordings to

investigate the response of mirror mechanisms in 3- and 6-month-old infants. Using recordings of adults performing actions where they bring an object to either their mouth (pacifier) or their head (lego), they recorded the infants' muscle responses to the actions for both ages. While both ages of infants exhibited a response, the motor response in 3 month olds was less specific and responded to movements that were both goal oriented (pacifier toward the mouth) and not directed towards a specific goal (Lego toward the head). In contrast, 6-month-old infants' responses changed when the action was not goal directed and showed an increased response when the movement of the adult involved the mouth muscles. This difference could be because 3-month-old infants have not mastered the observed actions and therefore do not have the full understanding of the action that is necessary in order to respond properly. Furthermore, only actions that are present in the motor repertoire of the observer have the capacity to elicit the activation of the MNS.

With this in mind, it is reasonable to suggest that the mirror neuron system is present in early stages of development, but undergoes a process of gradual refinement. The discovery of the mirror system's role in emotional contagion has given researchers a basis on which to conclude that the ability to empathize with others is an innate capacity that strengthens during the developmental period, as opposed to a learned ability to facilitate positive social and emotional interactions.

Attachment Security

The ability to express emotions is important because it allows people to be understood by other individuals. Even the slightest muscular movements, such as the mimicking of facial expressions that are not visible to the naked eye, allow people to make connections and understand the meaning in situations. Darwin (1872; 1965)

illustrates that both humans and animals have the ability feel emotion and those emotions guide the expressions and behaviors of the person or animal that feel them, in addition to supplying a motive for action. However, in his work on *The Expressions of Emotions in Man and Animal*, Darwin (1965) suggests that emotional expression was not evolved for the purpose of expression, but for some other utility entirely. He further states that any expressions that have lost their utility are no longer for use and are merely habitual movements. It is therefore necessary to provide alternative explanations as to the adaptiveness of facial mimicry and other emotional expressions.

It has been theorized that the attachment relationship between an infant and their primary caregiver provides a platform for the understanding and regulating of emotions in infants and older children (Bowlby, 1989). When caregivers are responsive to the cries of their infants, the infants are more likely to learn to regulate their emotions through the soothability demonstrated by their mothers (Panfile & Laible, 2012). Links between attachment security and empathy have been observed, finding that children that experience secure attachment were rated as more empathetic and exhibited a greater empathetic response to distressed peers (Kestenbaum, Farber, Sroufe, 1989). Furthermore, it has been theorized that insecure attachment can lead to an increase in negative emotionality due to the lack of response from primary caregivers to the infants' distress (Weinfield, Sroufe, Egeland, & Carlson, 1999; Cassidy & Saver, 1999). This could be due, in part, to the mediating effects of emotion regulation. Infants that experience higher maternal responsiveness to their distress cries are more likely to learn methods for regulating their emotions and become securely attached. This in turn would enable children to respond more empathically to others (Davidov & Grusec, 2006).

In addition to aiding in emotion regulation, early forms of synchronization and mimicry between a mother and infant could provide a basis for the development and degree of secure attachment between the two, while lack of secure attachment could lead to a reduction in appropriate affective responses. According to Bowlby (1969), attachment patterns are formed early in infancy through consistent interactions with primary caregivers. During this period, if the primary caregiver is unable to produce or inhibit the affect arousal of their infant, the infant is more likely to develop an avoidant attachment style as opposed to secure attachment (Bowlby, 1989). Emotional synchrony between a primary caregiver and their infant allows the infant to become confident in the availability of the mother and allows the infant to make predictions of the mother's behavior based on previous reciprocal emotional responses, which facilitates the attachment process (Rochat & Striano, 1999). While the emotional responsiveness that results from a secure attachment style may result in an increased response towards peers and other adults, it does not appear that it translates into greater empathic concern towards the primary caregiver overall. In a recent study, female infants were observed at 16 months of age during interactions with their mothers. Mother's and experimenters pretended to have injured themselves and the empathic concern of the infants was assessed. Levels of empathic response did not vary between infants with secure and insecure attachment patterns when the mother feigned injury, however, infants with secure attachment patterns responded more empathetically towards the distress simulations of the experimenter than did the infants with insecure attachment patterns (van der Mark, IJzendoorn, & Bakermans-Kranenburg, 2002).

Additionally the patterns of attachment can have an effect on emotional responsiveness past infancy and into adulthood. A study by Sonnby-Borgström and Jõnsson (2004) found that adults with a dismissive-avoidant attachment style scored significantly lower on the emotional empathy test and mimicked emotional expressions less often than individuals that were not dismissive-avoidant. Furthermore, dismissive-avoidant individuals tended to produce positive facial expressions when presented with a stimulus of negative facial expressions, while non-dismissive-avoidant participants more often mimicked the facial expressions they observed.

Infants use the information learned through attachment relationships to develop working models of social interactions that they can use with individuals other than their primary caregivers. Attachment with primary caregivers provides infants with a safe environment to explore and understand their emotions for future reference (Bowlby, 1989). Moreover, infants with responsive caregivers respond more often with emotionally positive reactions during social interactions (Jones, 2008). Through attachment relationships with the primary caregiver, they learn to exhibit positive affect in order to establish and maintain social interactions with others (Abraham & Kerns, 2013). Therefore, while the ability to converge with another emotionally may be an unconscious process, the ability to do so is also controlled by the responsiveness of the caregiver to emotional affect in infancy.

Infant caregiver attunement is not only responsible for behavioral synchrony, but for physiological synchrony as well (Adam, 2006; Waters, West, & Mendes, 2014). In a recent study by Waters et al. (2014), mothers were exposed to both negative and positive social evaluations after a stressful event while their infants waited in a second room and

were not exposed to the stressor. Regardless of the type of social evaluation (positive versus negative) infants and mothers displayed synchronized physiological responses through heart rate upon reunion with one another, suggesting that interactions between the infant and mother will produce matched physiological reactions regardless of whether or not the infant experienced the initial stressor. This physiological synchrony can also be observed through adrenocortical attunement. Stenius et al. (2008) found baseline cortisol of mothers and their 6-month-old infants to be positively correlated across the course of a day. Overall levels of attachment between the mother and primary caregiver also have an effect on cortisol levels, with securely attached children that have responsive caregivers showing lower levels of cortisol in response to a stressful social event compared to insecurely attached children's response to the same event (Gunnar & Donzella, 2002). Taken together, this literature provides an understanding of the importance of the infant caregiver attachment relationship to emotional regulation and responding and provides evidence that the attachment relationship is not just manifested through behavioral responding, but physiological responding as well.

Social Referencing. An infant's perception of the emotional state of their mother can also play a role in both the attachment pattern and emotional responsiveness of the infant. Social referencing is a cognitively advanced response to the emotions of another individual, especially the primary caregiver (Hutman & Dapretto, 2009). Within the first year following birth, infants begin to examine the emotional expressions of their mothers and use that information to make decisions on how to respond emotionally in a given situation. Infants often reference their caregivers when they are introduced to a novel situation, or encounter a new person or toy (Feinman & Lewis, 1983). This was first

believed to occur at 10 months of age (Feinman & Lewis, 1983), however, a study by Walden and Ogan (1988) observed the development of social referencing in 40 infants between the ages of 6 months and 22 months old when introduced to new toys. It was found that younger infants referenced their primary caregivers more often than older infants. Additionally, the younger infants were more likely to reference their caregivers when they displayed expressions of positive affect, while older infants were more likely to look at their caregivers when they were displaying expressions of fear. Referencing of the caregivers' emotional reactions to the toy stimulus impacted the likelihood that the infant would play with the toy. In addition to the results found by the aforementioned study, Haviland and Lelwica (1987) found that infants as young as 10 weeks of age are able to distinguish between maternal facial expressions of sadness, anger, and happiness so long as both auditory and visual cues were used. These findings suggest that the ability to distinguish between emotions develops throughout infancy and fewer cues are required to recognize emotions as the infant increases in age.

Lack of emotional response by a caregiver while being referenced by their infant also affected the willingness of infants to explore novel situations. A study of forty 15-month-old infants found that when the mother was emotionally unresponsive to a situation and did not attend to her infant, the infant was less likely to explore new situations, stayed closer in proximity to its mother, and was less active overall than infants whose mothers emotionally attended the situation (Sorce & Emde, 1981). These findings suggest that social referencing can also play a role in the attachment style of the infant towards its mother and that the emotional displays of the mother impact the overall emotional responsiveness of their infant.

Present Study

Emotional contagion is important in that is a building block to more mature forms of empathic behavior. Pro-social behavior, a core concept of empathy, is essential to the ability to form close relationships, maintain friendships, and survive within a social world through the understanding of another's emotional state. In addition to personal relationships, these skills are also necessary for success in the workplace. Understanding emotional contagion and the mechanisms behind it will allow for a greater understanding of the development of these behaviors. The observation of the phenomenon of emotional contagion in infancy may give insight into the future behaviors of individuals and their ability to empathize with others. More specifically, the understanding of positive emotion early in the developmental period is important for understanding future emotional behaviors of an individual. In fact, individuals with low levels of positive emotionality in toddlerhood were found to have higher levels of depressive behaviors, suggesting that positive emotion is critical to the development of emotion and behavior (Hayden, Klein, Durbin, & Olino, 2006). Both empathic happiness and empathic concern are related to positive emotion, because empathic happiness can bring about empathic concern (Decety, 2012). A study by Young, Fox, and Zahn-Waxler (1999) assessed infants at 4 months old and again at 2 years old. Infants who demonstrated high positive affect at 4 months old subsequently displayed a higher degree of distress (empathic concern) towards another's distress.

The basis for this exploratory study stemmed from the theory that both positive and negative emotional contagion should occur in infancy because empathy is thought to encompass both sides of emotion, and emotional contagion is a "building block" of

empathy. However, differences in the development of positive and negative emotions have been outlined above. In addition to these differences, the theory of a negativity bias in emotional contagion has been proposed (Vaish, Grossmann, Woodward, 2008), suggesting that emotional contagion is more likely to result from negative emotions than positive ones (Rozin & Royzman, 2001). A study by Mumme and Fernald (2003) found that one-year-old infants demonstrated a greater response toward scenarios consisting of fearful cues than to scenarios with happy cues. They also displayed more negative affect when exposed to the fear scenario compared to the neutral condition that consisted of a novel toy, but did not show more positive affect in the happy condition when compared to the neutral condition. These results demonstrate that a negativity bias is present in infants at least as early as the first year of life. Therefore, it was expected that the positive emotional responses in this study would not occur with the same level of intensity, as did the contagious crying studies.

The purpose of the present study aimed to determine whether the phenomenon of contagious laughter, or the contagion of any form of positive affect, is present in infancy in the same way that contagious crying occurs. This was achieved through the behavioral observation of infants who were exposed to a stimulus of positive emotional affect at two different ages of infancy. Positive affect stimuli consisted of laughter audio recordings, and audio-video recordings of infant laughter. Additionally, a baseline condition of high contrast, geometric patterns and shapes without audio provided a condition on which to compare the previous two conditions. With the aforementioned literature in mind, it was hypothesized that infants would mimic the facial expressions and vocalizations that are elicited by the stimulus and would subsequently "catch" the

emotion associated with those expressions, therefore converging emotionally with the stimulus. Furthermore, it was hypothesized that the audio-video stimulus would elicit greater levels of positive affect when compared to the audio-only condition and the control condition due to the social entities that are often required to produce laughter (Provine, 2004). Finally, it was predicted that the audio-only condition would be more likely to evoke strong positive affect when compared to the control condition with geometric moving shapes, which acted as the baseline condition for which to compare responses toward the other two stimuli.

Additionally, it was hypothesized that the duration and intensity of positive affective responses would increase between the two ages of observation. In other words, younger infants would show signs of positive affect (e.g. lighting of the eyes, turning up of the corners of the mouth), but few accounts of laughter would occur. Older infants would likely laugh with greater intensity and for a longer duration compared to their responses at the younger age of assessment. This is consistent with the research by Sallquist et al. (2010) and Sroufe and Waters (1976) that the ability to laugh and smile strengthens during development.

Finally it was hypothesized that infant-mother dyads who display a more secure attachment pattern would be more likely to display a positive emotional response and that as the level of attachment between the infant and mother increased, the intensity and duration of the infants' positive emotional displays would also increase. This is consistent with the theory that links between attachment security and empathy have been observed and more securely attached children are more likely to respond empathically to the distress of their peers (Kestenbaum, Farber, Sroufe, 1989). This hypothesis is further

supported by the theory that insecure attachment can lead to an increase in negative emotional responding due to a lack of response to the infants' distress by the primary caregiver (Weinfield, Sroufe, Egeland, & Carlson, 1999; Cassidy & Saver, 1999).

CHAPTER III

METHODOLOGY

Participants

Participants were 41 infants (13 males and 28 females) and their mothers observed in the Developmental and Psychophysiology Laboratory at Oklahoma State University. This sample size was estimated using an *a priori* Gpower analysis that was based on data from a previously mentioned study that compared contagious crying responses between the ages of 8 and 10 months of age (Roth-Hanania et al., 2011), which had an effect size (ES) of .54, which is a medium ES according to Cohen's conventions (1988). With an alpha = .017 and power = .80, the estimated sample size needed for the current within-group comparison was approximately N=45. Three infants did not return for their 10-month appointment and the Condition Stimulus procedure was aborted for one participant at the 10-month appointment at the request of the mother due to excessive crying. After attrition, a final sample size of 41 infants was tested. All of the infants were full-term and healthy (17 caesarian sections and 24 natural births). Participants were first assessed at the age of five months (M = 22.71 weeks, SD = 1.93) and again at 10 months of age (M = 43.79 weeks, SD = 1.52). Maternal ages ranged between 24 and 40 years (M = 30.54). Maternal ethnicity was reported with 88% being Caucasian, 2.5% Native American, 2.5% Hispanic, 2.4% Asian, and 5% claiming multiple ethnicities. Paternal

ethnicity was also reported with 86% being Caucasian, 5% Native American, 5% Asian, and 4.8% claiming multiple ethnicities. Ninety percent of the maternal participants were married, 5% were single, and 5% were not married but were in a relationship with the father of the child. Reports of maternal education level indicated that 50% had completed post-graduate work, 36% were college graduates, 7% were votech graduates, and 7% had completed some college. Reports of paternal education level indicated that 33% had completed post-graduate work, 36% were college graduates, 5% were votech graduates, 21% completed some college, and 5% completed some votech. The majority of caregivers (67%) had a monthly income of over $4000, with 12% of caregivers claiming to receive some form of state or federal financial assistance.

Sample age justifications. Ages of 5 and 10 months were chosen specifically due to the developmental markers that occur prior to each age. As previously mentioned, laughter does not occur in infants until approximately 4 months after birth (Sroufe & Waters, 1976). Five months was chosen as the first assessment age to ensure that infants would have reached the developmental stage in which laughter occurs and reduce the chance of excluding participants that had not yet started laughing. Additionally, infants are more likely to be able to support the weight of their own heads at this age, which is necessary in order for the infants to maintain their gazes and attention towards the video monitor while sitting in the chair. In order to test the hypothesis that the frequency and intensity of positive affect displays increase throughout development (Rothbart, 1989; Sallquist, et al., 2010), an older assessment age was chosen. The second assessment age of 10 months was chosen due to the fact that infants typically begin to crawl between the ages of 6 and 9 months (NHS, n.d.) and 10 months was chosen to reduce the chance of

excluding participants that had not yet reached this milestone. The onset of locomotion triggers changes in perception and emotional development (Anderson, et al., 2013). As the infant's ability to crawl increases, the need for emotional communication increases and they are subsequently more prone to engage in social referencing (Campos, 2000). These developmental changes would possibly affect the frequency and intensity of the positive emotional responses in crawling infants.

Recruitment. Participants were recruited through the use of flyers distributed across the university campus, local childcare facilities, and other infant/caregiver organizations located in and around Stillwater, OK. Newspaper advertisements describing the study were also used in order to increase awareness. Participants of this study were treated in accordance with the regulations of the Institutional Review Board of Oklahoma State University (see Appendix G).

Primary Caregiver Materials and Measures

Demographic questionnaire. During the first assessment that occurred when the infants were 5 months of age, primary caregivers were administered a demographic questionnaire in order to collect general information regarding the infants and the members of their immediate families. Gender and age were recoded for each member of the family. Additionally, information on income level, marital status, number of siblings, and parental education level was gathered (see Appendix E).

Maternal Attachment Inventory (MAI). The MAI (see Appendix F) is 26-item scale that provides a measure of maternal affectionate attachment with their infants and indicates general thoughts, feelings, and situations that new mothers will experience. Responses to each of the 26 items are scored on a 4-point Likert scale with a score of 1

indicating that the behavior "almost never" occurs and a score of 4 indicating that the behavior "almost always" occurs. Therefore, the sum of scoring can range from 26 to 104. Previous reports (Muller, 1994; Wilkinson & Scherl, 2006) of internal consistency have ranged from adequate (α=0.76) to high (α=0.90).

Behavioral Measures of Emotional Responsiveness

AFFEX. The coding of emotional contagion videos focused on positive emotion, but negative affect was also coded. Each individual 10-minute video was coded. However, coding only took place during the three 2-minute conditions during which a stimulus was presented. This made for a maximum of six minutes of coded video, but in some cases may have been shorter in duration due to the temperament and cooperation of the infant and primary-caregiver. Each of the 2-minute segments were divided and coded in 20-second epochs to reduce coder error. A lamp was switched on and off simultaneously with the stimulus to signal to the coder when to begin and end coding of the infant's affect. Baseline state (the emotional state of the infant prior to the start of the stimulus), latency to first positive emotional response, total duration of emotional response, peak intensity of emotional response, number of total emotional responses directed towards the stimulus, and total number of looks toward the mother were recorded. Ratings of each emotional reaction were based on the AFFEX scaling system (Goldsmith, & Rothbart, 1999), but adapted to fit the current needs of the study (See APPENDIX C). The AFFEX scaling system operationally defines five major emotional expressions including, anger, fear, sadness, joy, and interest. For the current study, emotions of anger, fear and sadness were grouped to define negative emotional reactions,

and joy and interest were grouped to define positive emotional reactions to the stimulus. The scale divides the face to be coded into three major regions, including the forehead/brow region, eyes/nose/cheeks region, and the mouth/lips/chin region, and details specific movements in each of these three segments. Based on facial movement in these divided regions, emotional response was rated on a five-point Likert scale with a rating of 1 indicating none of the facial regions showing codable movement and a rating of 5 indicating an overt emotional response of at least two facial regions showing codable movement. (A more detailed description of this rating system can be found in APPENDIX C).

Apparatus and stimulus

The current study took place in a small, sound reducing room, while researchers observed from an adjacent observation room. The room contained a 6'x6' foam floor mat, a stationary infant chair, a lamp, a 28-inch video monitor with speakers, and a video camera with only video recording capabilities. The chair used allowed for the infant to sit up facing the video monitor and restricted movement in order to keep constant visual contact on the infant's face with the video camera. The primary caregiver was seated on the foam floor mat with her infant seated in the chair next to her. Although the caregiver was seated next to the infant, she was instructed to remain in the infant's peripheral vision while the stimulus was playing to prevent distraction from the video monitor. They both were approximately 85 centimeters away from the video monitor and camera, the latter being hidden behind a dark curtain. A light in the corner of the recording frame was in place to signal to the coder that the stimulus had started. Caregivers were instructed not

to interact with their infants while the stimulus was playing and to attend to the stimulus with neutral expression on their faces. Should the child turn to look at the caregiver, caregivers were instructed not to look back at their infant throughout the duration of the stimulus. A computer in the adjacent observation room was connected to both the camera and the video monitor to play the stimulus.

Stimulus. The stimulus consisted of three separate conditions, each of which was 120 seconds in length. Sound settings were the same for both of the conditions containing audio. However, the visual display changed with each condition. The first condition consisted of audio-only, in which the screen appeared blank. The audio for this condition was made up of laughter clips of eight different infants of various ages within the first year of life with the majority being Caucasian, which matched the mode ethnicity for sample. These eight audio clips ranged in duration from 4.23 seconds to 21.36 seconds. The second condition consisted of a compilation of both audio and video laughter. The audio from these videos was the same audio from the first condition, but was accompanied by their corresponding video. The duration of each of these clips was the same as the first condition, but the order was changed. The final condition, the control condition, acted as a baseline and was comprised of eight clips of high contrast animated geometric patterns specifically designed for infant visual stimulation. These videos were provided by "Hey Bear Productions – Baby View". The use of these animations provided a visual stimulus for infants to attend to. To maintain consistency across conditions these clips also ranged in duration from 4 to 21 seconds. This condition was chosen to reduce the occurrence of inattention towards the stimulus during the condition, while not including any social aspects that might have elicited emotional responses.

Directly following the termination of each of the conditions, a "stop sign" appeared on the screen for approximately 10 seconds, which signaled to the coder to turn off the coder signal light in the corner of the screen. Finally a clock appeared on the screen counting down the 2-minute break that occurred between each of the conditions. During this break, the primary caregivers were allowed to interact with their infants and sooth them if necessary. If the infant showed signs of distress after the two minutes has passed, additional time was allotted to ensure that the infant has returned to a baseline mood before continuing with the next condition. Finally, conditions were counterbalanced, creating a total of six different orders in which the stimulus was presented.

The majority of studies observing contagious crying in infancy used only audio for their crying stimuli (Simner, 1971; Sagi & Hoffman, 1976; Martin & Clark, 1982), however, the present study used both auditory and visual stimuli. The reasoning behind this alteration from previous studies is twofold. First, when trying to evoke laughter it is important to remember that it is a social process and generally requires the presence of another person (Provine, 2004). Second, by 5 months of age, infants are able to distinguish differences in vocal emotional expressions, but tis occurs primarily when they are accompanied by a corresponding facial expression (Kahana-Kalman & Walker-Andrews, 2001). A study on intermodal perception demonstrated the importance of synchronous pairings of auditory and visual stimuli (Walker-Andrews, 1986; Walker-Andrews & Lennon, 1991). The results of this study indicated that 7-month-old infants displayed increased attentiveness towards synchronous stimuli as opposed to stimuli

where the auditory expressions did not match the visual expressions being displayed, suggesting that infants are able to detect incongruence within the stimuli.

Procedure

Infants and primary caregivers visited the Developmental and Psychophysiology Laboratory in the Psychology Department at Oklahoma State University when the infant was 5 months of age and they returned approximately five months later when the infant was 10 months of age. At this time infants were placed in the seat and allowed to engage in free play for a minimum of ten minutes or until the infant appeared to have acclimated to the laboratory environment. Acclimation to the environment was marked by a baseline behavioral state of a 2 or 3 as outlined by the AFFEX behavioral scaling system (Goldsmith, & Rothbart, 1999), indicating that the infant was alert/calm or alert/active, respectively. During the free play session, caregivers were instructed to engage in activities (i.e. peek-a-boo, blowing raspberries, funny faces, etc.) that had previously elicited a positive emotional response in their infants. This was to ensure that the infant had the ability to display positive emotions prior to trying to elicit an emotional contagion response. Directly following the free play session, the 10-minute stimulus recording began. During each of the 2-minute break sessions, the light signaling to the coder that the stimulus was on was switched off. Caregivers were informed that they could cease participation at any time, or interact with their infants should they become distressed while the stimulus was playing. After the stimulus played through, caregivers were administered the demographic questionnaire (5-month only) and the MAI (10-month only). Completion of these measures marked the end of the study.

Due to the fact that the present study was part of a larger study that measured the physiological emotional responses of infants during observations of both ages, both heart rate and basal cortisol levels were assessed to determine whether or not physiological changes occurred even if behavioral changes in affect were not present. Cortisol samples were taken after the 10-minute free play session, following the 6-minute stimulus recording, and after a 10-minute cool down session at the end of the study. Heart rate was recorded throughout the duration of the study using an electrocardiograph (EKG). Additional measures, including the Infant Behavioral Questionnaire (IBQ-R) and the Attachment During Stress (ADS) scale were collected for further analysis of the emotional responsiveness of the infant, but were not included in the results of this report.

CHAPTER IV

FINDINGS

Observation oriented modeling (OOM; Grice, 2011; Grice et al., 2012) was used to analyze the data. OOM compares the actual observations for each infant in each condition and at each age of assessment with expected patterns of outcomes and summarized the results with accuracy indices. Depending on the statistical test, traditional null hypothesis statistical testing (NHST) relies on a variety of assumptions, such as homogeneity and normality of population distributions, whereas OOM utilizes randomization tests that are free of such assumptions. The data for this study violated the normality and homogeneity of treatment difference variances assumptions as many variables were skewed and the infants often did not respond emotionally to the condition stimuli, thus obtaining scores of zero. Because OOM is similar to non-parametric methods, we were able to avoid the strict assumptions of NHST while also focusing more of our attention on the emotional responding of individual infants in our study. Nonetheless, traditional descriptive statistics are reported in Tables 8 and 9 as summaries of the variables.

Hypothesis 1

The first purpose of the present study was to determine if infants would mimic the facial expressions and vocalizations that are displayed in the laughing stimuli and

subsequently "catch" the emotion associated with those expressions, therefore converging emotionally with the infant models. More specifically, it was predicted that the audio-only condition would be sufficient in prompting a positive affective response similar in duration and intensity to the responses in the contagious crying studies. However, due to the fact that laughter and smiling (the most common positive emotional responses) are social in nature, it was expected that the audio-video condition would evoke responses of greater intensity and duration compared to the audio-only and control conditions. Therefore, it was predicted that the audio-video stimulus would elicit positive affect in a greater number of infants when compared to audio-only condition and the control condition, and the audio-only condition would evoke positive affect in a greater number of infants when compared to the control condition. An Ordinal Pattern Analysis (Grice et al., 2015) in OOM was used to test these predictions.

With regard to the *duration* of positive emotional responding to the conditions, the expected ordinal pattern for each infant was as follows: audio-video > audio-only > control. Results indicated that only 6 of the 42 infants matched this pattern completely with respect to their duration scores. This frequency can be converted to a percentage (14.29%) which is referred to as the Percent Correct Classification (PCC) in an Ordinal Pattern Analysis. A simple randomization test can also be used to assign a probability statistic, referred to as a chance-value (or *c*-value), to the PCC. Based on 1000 random trials for duration, the *c*-value was .36, indicating that a PCC of at least 14.29% was likely to occur by chance 36% of the time for the current data and expected ordinal pattern. More specific comparisons showed, consistent with expectation, more infants demonstrating equal or longer durations for the audio-only (PCC = 57.14, *c*-value = .03)

and audio-video (PCC = 61.90, *c*-value = .01) conditions when compared to the control condition. Opposite of expectation, however, slightly more infants showed longer durations of positive responding for the audio-only condition compared to the audio-visual condition (PCC = 52.38, *c*-value = .15).

The PCC values above indicate percentages based on the full sample size. However, five infants did not respond emotionally at all to the control and audio-only conditions, five infants did not respond emotionally to the control and audio-video conditions, and four infants did not respond to the audio-only and audio-video conditions (i.e. they obtained a score of zero for each condition being compared). Of the emotionally responsive infants, 24 infants demonstrated an increase in duration between the control and audio-only conditions (n = 37, PCC = 64.86, *c*-value = .04), 24 infants between the control and audio-video conditions (n = 37, PCC = 70.27, *c*-value < .01), and 15 showed an increase from audio-only to the audio-video condition (n = 38, PCC = 39.47, *c*-value = .92).

Additional analyses comparing the control condition with combinations of the two experimental conditions were also conducted. Results indicated that 21 infants (PCC = 50.00, *c*-value = .57) showed longer durations in *both* the audio-only and the audio-video conditions compared to the control; while 29 infants showed longer durations for *either* the audio-only or audio-video (PCC = 69.05, *c*-value = .02) conditions compared to the control.

With regard to the *intensity* of positive emotional responding across the three conditions, the overall ordinal pattern (viz., audio-video > audio-only > control) was again first examined. Results indicated that only 5 of the 42 infants (PCC = 11.90, *c*-

value = .47) matched this expected pattern completely. Specific ordinal comparisons showed a greater number of infants with equal or higher emotional responding for the audio-only (PCC = 61.90, *c*-value = .01) and audio-video (PCC = 61.90, *c*-value < .01) conditions compared to the control condition. Once again, inconsistent with the hypothesis, the audio-video condition did not yield greater emotional intensity compared to the audio-only (PCC = 35.71, *c*-value = .80).

Five infants did not respond emotionally at all to the control and audio-only conditions, or to the control and audio-video conditions, and four infants did not respond to the audio-only and audio-video conditions. After removing the emotionally unresponsive infants, 26 infants demonstrated an increase in emotional intensity between the control and audio-only conditions (n = 37, PCC = 70.27, *c*-value = .01), 26 infants between the control and audio-video conditions (n = 37, PCC = 70.27, *c*-value = .01), and 15 showed an increase from audio-only to audio-video conditions (n = 38, PCC = 38.47, *c*-value = .80). Moreover, a minority of the infants (PCC = 47.61, *c*-value = .68) were found to demonstrate an increase in intensity to *both* the audio-only and the audio-video conditions compared to the control condition, while a majority of the infants (PCC = 76.19, *c*-value < .01) were found to demonstrate an increase in intensity to *either* the audio-only or audio-video conditions compared to the control condition.

An identical set of Ordinal Pattern Analyses were conducted on the infants' 10-month assessment data. Results indicated that only 5 of the 38 infants (PCC = 13.16, *c*-value = .28) matched this pattern completely with respect to their duration scores. Once again, specific comparisons were consistent with the original hypothesis in that a majority of infants demonstrated equal or longer durations for the audio-video (PCC =

52.63, *c*-value = .09) and the audio-only (PCC = 52.63, *c*-value = .08) when compared to the control condition. However, inconsistent with the original hypothesis, fewer than half of the infants in the audio-video condition yielded longer durations compared to the audio-only condition (PCC = 41.03, *c*-value = .66) Six infants did not respond emotionally at all to the control and audio-only conditions, seven infants did not respond emotionally to the control and audio-video conditions, and two infants did not respond to the audio-only and audio-video conditions. Of the emotionally responsive infants, 20 demonstrated an increase between the control and audio-only conditions (n = 32, PCC = 62.50, *c*-value = .06), 20 between the control and audio-video conditions (n = 33, PCC = 60.61, *c*-value = .08), and 16 showed an increase from audio-only to audio-video conditions (n = 37, PCC = 43.24, *c*-value = .65).

When comparing the control condition with combinations of the two emotionally charged experimental conditions, results indicated that a minority of the infants (PCC = 34.21, *c*-value = .98) were found to demonstrate longer durations to *both* the audio-only and the audio-video conditions compared to the control condition, while a majority of the infants (PCC = 71.05, *c*-value < .01) were found to demonstrate longer durations to *either* the audio-only or audio-video conditions compared to the control condition.

With regard to *intensity* of positive emotional responding at 10 months of age, results indicated that only 6 of the 38 infants (PCC = 15.79, *c*-value = .12) matched this pattern completely with respect to their intensity scores. Specific comparisons were not consistent with the original hypothesis in that a *minority* of infants demonstrated equal or increased intensity for the audio-only (PCC = 39.47, *c*-value = .47) and the audio-video (PCC = 47.37, *c*-value = .30) when compared to the control condition and for the audio-

only condition compared to the audio-video condition (PCC = 46.15, *c*-value = .25). Seven infants did not respond emotionally at all to the control and audio-only conditions, five infants did not respond emotionally to the control and audio-video conditions, and three infants did not respond to the audio-only and audio-video conditions. Of the emotionally responsive infants, 15 demonstrated an increase between the control and audio-only conditions (n = 31, PCC = 48.39, *c*-value = .52), 18 infants increased in intensity between the control and audio-video conditions (n = 33, PCC = 54.55, *c*-value = .30), and 18 showed an increase from audio-only to the audio-video condition (n = 36, PCC = 50.00, *c*-value = .25).

When comparing the control condition with combinations of the two experimental conditions, results indicated that a *minority* of the infants (PCC = 23.68, *c*-value = 1.00) were found to demonstrate greater intensity levels to *both* the audio-only and the audio-video conditions compared to the control condition, while a *majority* of the infants (PCC = 63.16, *c*-value = .08) were found to demonstrate greater intensity to *either* the audio-only or audio-video conditions compared to the control condition.

Data for both the 5- and 10-month assessment did not follow the originally predicted pattern (audio-video > audio-only > control). However, more specific comparisons indicated that positive emotional responding is elicited more often in infants by the two emotionally charged conditions compared to the control condition. Additionally, it was found that the audio-video condition elicited emotional responses in a greater number of infants compared to the audio-only condition. Overall, a majority of infants responded with positive emotions to either the audio-only or the audio-video

condition. Indicating that infants are catching the emotions of their peers as was originally hypothesized.

Hypothesis 2

In addition to differences between each condition, it was hypothesized that age would influence the emotional responses elicited by the stimulus. More specifically, it was predicted that infants would show more positive affect (measured by intensity and duration) in both the audio-video and audio-only conditions, respectively, when observed at 10 months compared to 5 months of age. In order to test this hypothesis an Ordinal Pattern Analysis was conducted to determine the effect of age on the duration of positive emotional responses between the ages of 5 and 10 months of age. With regard to increases in *duration* of positive emotional responding across ages, the results indicated that the pattern was correctly matched by 17 infants (PCC = 44.74, *c*-value = .23) in the control condition, 19 infants (PCC = 48.72, *c*-value = .36) in the audio-only condition, and 22 infants (PCC = 56.41, *c*-value = .14) in the audio-video condition.

Additionally, an Ordinal Pattern Analysis was conducted to determine the effects of development on the *intensity* of positive emotional responding in the 42 infants. Results did not support our original hypothesis, in that only a *minority* of infants demonstrated an increase in positive emotional responding between the two ages of assessment. Specifically, the pattern was matched correctly by 18 infants (PCC = 47.37, *c*-value = .29) in the control condition and the audio-video condition (PCC = 47.37, *c*-value = .55), and only 13 infants in the audio-only condition (PCC = 33.33, *c*-value = .95).

Taken together, these results indicate that the audio-video condition was most effective in increasing the number of infants that responded with positive emotions toward the stimulus, but overall, positive emotional responding was not found to increase between the two ages of assessment in these infants.

Hypothesis 3

The third purpose of the study was to determine if there is a relationship between the level of infant-caregiver attachment and the propensity for the infant to converge emotionally with their peers as identified by positive emotional responding toward the audio-only and audio-video conditions. Specifically, it was hypothesized that infant-mother dyads who display a more secure attachment pattern would be more likely to display a positive emotional response and that as the level of attachment between the infant and mother increased, the intensity and duration of the infants' positive emotional displays would also increase. To test this hypothesis, Spearman correlation analyses were run to examine the relationship between levels of attachment and the intensity and duration of emotional responding at both 5 and 10 months of age.

No significant correlations between attachment pattern and positive emotional responding in the audio-only and audio-video conditions were found (see Tables 3 and 4). All 39 of the maternal reported attachment scores indicated secure attachment between the mother and infant. Attachment scores ranged from 85 to 104, with the original scale allowing for a score range between 26 and 104. These results indicate that there is not a significant relationship between attachment and emotional responding to positive stimuli at 5 or 10 months of age.

Additional Findings

Negative Emotional Responding Hypothesis 1. In addition to the coding of positive emotional responses to each condition, negative emotional responding was also recorded to determine if the positive emotional stimuli could reduce the occurrence of negative emotional responding in infants. In order to determine if the stimulus condition had an effect on the intensity and duration of negative emotional responding, identical sets of Ordinal Pattern Analyses were conducted. The expected ordinal pattern for the duration and intensity of negative emotional responding was as follows: control > audio-only > audio-video.

Similar to the findings for positive emotional responding, only 5 of the 42 infants (PCC = 11.90, *c*-value = .14) matched this pattern completely with respect to their negative responding duration scores at 5 months of age. More specific comparisons showed that, inconsistent with expectations, a *minority* of infants demonstrated equal or shorter durations of negative emotional responding toward the audio-only (PCC = 45.24, *c*-value = .02) and audio-video (PCC = 45.24, *c*-value = .01) conditions compared to the control condition, and only a *minority* of infants had shorter durations of negative emotional responding toward the audio-video condition compared to the audio-only condition (PCC = 23.81, *c*-value = .73). Fourteen infants did not respond with negative affect at all to the control and audio-only conditions, 14 infants did not respond negatively to the control and audio-video conditions, and 19 infants did not respond negatively to the audio-only and audio-video conditions. Of the emotionally responsive infants, 19 demonstrated a decrease between the control and audio-only conditions (n = 28, PCC = 67.86, *c*-value = .03), 19 between the control and audio-video conditions (n =

28, PCC = 67.86, *c*-value = .01), and 10 showed a decrease from audio-only to audio-video conditions (n = 23, PCC = 43.48, *c*-value = .73).

Additional analyses comparing the control condition with combinations of the two experimental conditions were also conducted. Results indicated that only 17 infants (PCC = 40.00, *c*-value = .91) showed longer durations in *both* the audio-only and the audio-video conditions compared to the control; while 21 infants showed longer durations for *either* the audio-only or audio-video conditions (PCC = 50.00, *c*-value = .54).

Additionally, identical pattern analyses were conducted for *intensity* of negative emotional responding and results indicated that, once again, only 5 of the 42 infants (PCC = 11.90, *c*-value = .06) matched the pattern completely. Specific comparisons indicated that inconsistent with expectations, a *minority* of infants demonstrated equal or reduced levels of intensity of negative emotional responses toward the audio-only (PCC = 42.86, *c*-value = .04) and audio-video (PCC = 42.86, *c*-value = .02) conditions compared to the control condition, and only a *minority* of infants demonstrated reduced intensity to the audio-video condition compared to the audio-only condition (PCC = 23.81, *c*-value = .58). Fourteen infants did not respond emotionally at all to the control and audio-only conditions, 14 infants did not respond emotionally to the control and audio-video conditions, and 19 infants did not respond to the audio-only and audio-video conditions. Of the emotionally responsive infants, 18 demonstrated a decrease between the control and audio-only conditions (n = 28, PCC = 64.29, *c*-value = .05), 18 between the control and audio-video conditions (n = 28, PCC = 64.29, *c*-value = .02), and 10 showed a decrease from audio-only to audio-video conditions (n = 23, PCC = 43.48, *c*-value = .58).

Additional analyses comparing the control condition with combinations of the two experimental conditions were also conducted. Results indicated that only 15 infants (PCC = 35.71, *c*-value = .97) showed greater intensity in *both* the audio-only and the audio-video conditions compared to the control, while 21 infants showed greater intensity for *either* the audio-only or audio-video (PCC = 50.00, *c*-value = .59) conditions.

An identical set of Ordinal Pattern Analyses were conducted on the infants' 10-month assessment data. Results indicated that only 6 of the 38 infants (PCC = 15.79, *c*-value = .18) matched this pattern completely with respect to their duration scores. Once again, specific comparisons were inconsistent with the original hypothesis in that a *minority* of infants were found to have equal or shorter durations of negative emotional responding for the audio-only (PCC = 36.84, *c*-value = .72) and the audio-video (PCC = 47.37, *c*-value = .06) when compared to the control condition. Additionally, a *majority* of infants showed shorter durations of negative emotional responding in the audio-video condition compared to the audio-only condition (PCC = 51.28, *c*-value = .04). Eight infants did not respond emotionally at all to the control and audio-only conditions, 11 infants did not respond emotionally to the control and audio-video conditions, and 10 infants did not respond to the audio-only and audio-video conditions. Of the emotionally responsive infants, 14 demonstrated a decrease between the control and audio-only conditions (n = 30, PCC = 46.67, *c*-value = .70), 18 infant between the control and audio-video conditions (n = 27, PCC = 66.67), and 20 showed a decrease from audio-only to audio-video conditions (n = 29, PCC = 68.97, *c*-value = .02).

When comparing the control condition with combinations of the two emotionally charged experimental conditions, results indicated that 17 infants (PCC = 44.74, *c*-value

= .93) demonstrated negative emotional responding for longer durations in *both* the audio-only and the audio-video conditions compared to the control condition; while 21 infants demonstrated longer durations for either the audio-only or audio-video conditions (PCC = 50.00, *c*-value = .56).

With regard to intensity of negative emotional responding at the 10-month assessment, results indicated that once again only 6 of the 38 infants (PCC = 15.79, *c*-value = .13) matched the pattern completely. More specific comparisons indicated that only 42.11% of infants demonstrated equal or reduced levels of intensity toward the audio-only (PCC = 42.11, *c*-value = .42) compared to the control condition and 44.74% of infants demonstrated equal or reduced levels of intensity toward the audio-video stimulus (PCC = 44.74, *c*-value = .09) compared to the control condition. Furthermore, only a *minority* of infants (PCC = 48.72, *c*-value = .04) showed equal or reduced levels of intensity between the audio-only and audio-video conditions. Eight infants did not respond emotionally at all to the control and audio-only conditions, 11 infants did not respond emotionally to the control and audio-video conditions, and 10 infants did not respond to the audio-only and audio-video conditions Of the emotionally responsive infants, 16 demonstrated a decrease between the control and audio-only conditions (n = 30, PCC = 53.33, *c*-value = .46), 17 infants between the control and audio-video conditions (n = 27, PCC = 62.96, *c*-value = .07), and 19 showed a decrease from audio-only to audio-video conditions (n = 29, PCC = 65.52, *c*-value = .06).

Moreover, a *minority* of the infants (PCC = 36.84, *c*-value = .97) were found to demonstrate a decrease in intensity to *both* the audio-only and the audio-video conditions compared to the control condition, while a exactly half of the infants (PCC = 50.00, *c*-

value = .57) were found to demonstrate a decrease in intensity to *either* the audio-only or audio-video conditions compared to the control condition.

Taken together, these results indicate that infants did not follow the originally predicted pattern of decreasing negative emotions across conditions for either the 5- or 10-month assessments (audio-video < audio-only < control) when the entire sample was considered. In fact, the most frequent pattern in both the 5- and 10-month data indicated an increase in negative emotional responding in the emotionally charged conditions compared to the control condition. However, when emotionally non-responsive infants were excluded from the analyses, the originally expected effect emerged in that negative emotional responding was reduced in the two experimental conditions.

Negative emotional responding in hypothesis 2. Once again, to better understand general changes in emotional responding between the ages of 5 and 10 months, identical ordinal pattern analyses were conducted to determine the effects of age on negative emotional responses between 5 and 10 months. With regard to changes in *duration* of negative emotional responding across ages, the results indicated that the pattern was correctly matched by only 14 of 39 infants (PCC = 36.84, *c*-value = .70) in the control condition, 8 infants (PCC = 20.51, *c*-value <.01) in the audio-only condition, and 8 infants (PCC = 20.51, *c*-value = .94) in the audio-video condition.

Additionally, an ordinal pattern analysis was conducted to determine the effects of development on the *intensity* of negative emotional responding in the 38 infant sample size. Results did not support our original hypothesis, in that only a *minority* of infants demonstrated a decrease in negative emotional responding between the two ages of assessment. Specifically, the pattern was matched correctly by 12 infants (PCC = 31.58,

c-value = .89) in the control condition, 8 infants (PCC = 20.51, *c*-value = 1.00) in the audio-only condition, and 8 infants in the audio-video condition (PCC = 20.51, *c*-value = .89) Taken together, these results indicate that negative emotional responding does not decrease, but rather increases between the two ages of assessment in these infants.

Maternal Attachment. Additionally, a Spearman's correlation was run to determine the effects of infant-mother attachment on negative emotional responding. However, no significant correlations were found between attachment scores and negative emotional responding at either age or in any of the three conditions (see Tables 6 and 7).

Infant Referencing. Infants will reference their primary caregivers in order to examine the emotional expressions of their caregivers and use that information to make inferences about how to respond emotionally in novel situations (Hutman & Dapretto, 2009). To better understand general changes in emotional responding between the ages of 5 and 10 months, identical ordinal pattern analyses were conducted to determine the effects of age on infant referencing between 5 and 10 months. Results indicated that a *majority* of infants demonstrated an increase in referencing between the two ages of assessment for all three conditions: the control condition (PCC = 65.79, *c*-value = .01), the audio-only condition (PCC = 66.67, *c*-value = .01) and the audio-video condition (PCC = 66.67, *c*-value = .01).Taken together, these results indicate that the number of infants that referenced their mothers was found to increase in all three conditions between the two ages of assessment.

Condition Order. As previously mentioned, the condition orders in this study were counterbalanced to control for order effects. There were a total of six conditions to which the infants were randomly assigned. To assess the effectiveness of this randomization,

the primary results from the various analyses above were examined for each infant. For the total duration variable, for instance, six Ordinal Pattern Analyses (audio-video > audio-only > control; audio-video > control; audio-only > control, etc.) were conducted above to test the first hypothesis. The number of instances in which each infant matched these ordinal patterns was tallied, resulting in values ranging from 0 (the infant's responses never matched expectation) to 6 (the infant's responses matched every expected ordinal pattern). Examination of these tallies failed to reveal any consistent differences across the six conditions for the duration or intensity effects regarding the first hypothesis. In other words, the results did not differ consistently across conditions. For example, the median tally for duration at 5-months for the ACV condition was .50, indicating that the four infants from this condition rarely matched the expected ordinal patterns. The medians for the other five conditions were all 3.50 or higher. This difference in medians, however, was not observed for the 10-month durations. Such inconsistent differences across conditions is perhaps not surprising given the small sample sizes, which ranged from four (the ACV condition) to nine (the VAC condition).

CHAPTER V

DISCUSSION

Empathy is characterized by the ability to share and understand the emotions of others. While empathy encompasses both negative and positive emotions, the positive emotions are often overlooked in the study of empathy and emotional contagion. This is partially due to the fact that past theories of emotions have been suitable for negative affect, but not for the study of positive affect. Additionally, this uneven balance of the study of emotions stems from the fact that the field of psychology focuses mainly on understanding and improving psychological problems and negative emotions are often a causal factor or contributor to many psychological disorders. The study and understanding of positive emotions is not only important, but also necessary due to the role these emotions play in engaging people with their environments and facilitating group activities, both of which are adaptive for individuals. The main objective of the present study was to establish that the phenomenon of positive emotional contagion occurs in infants, that it can be generated in the same way as its negative counterpart, and that this occurrence will strengthen across development.

Hypothesis 1

The main purpose of hypothesis one was to provide evidence that positive emotional contagion does occur in infants and that it can be produced using similar

methods to those implemented in the contagious crying studies (Geangu et al., 2010; Martin & Clark, 1982; Simner, 1971). While the previous studies on emotional contagion and contagious crying implemented only auditory stimuli to produce an emotional response in infants, both audio-only and audio-video stimuli were implemented in this study. In addition to the use of two forms of emotionally charged stimuli, a control condition was also included to allow for a baseline comparison. At 5 months of age, more infants were found to display positive emotional responses of greater intensity and longer duration in the audio-only and audio-video conditions compared to the control condition; the audio-only condition also evoked positive affect of greater intensity and longer duration in a greater number of infants than the control condition, but these differences were only marginal as just over half of the infants fit this specific comparison pattern with regard to duration, but these differences were more robust for measures of intensity. Nevertheless, this was not in keeping with the second portion of the original hypothesis, which suggested that more infants would show positive emotional responses of the greatest intensity and longest duration in the audio-video condition due to the inclusion of a more social entity (visual images of infant peers). Further analysis indicated that when emotionally unresponsive infants were excluded from the analyses, these results became more robust providing more evidence for the occurrence of this phenomenon.. By 10 months of age, the effect of the emotionally charged stimuli on positive emotional responding was still present, but had diminished to just above half of the infants for measures of duration and just below half of the infants for measures of intensity. However, when the emotionally unresponsive infants were removed from the analyses, these findings once again became more robust. While only a small minority of

infants responded with greater intensity and longer duration to *both* emotionally charged stimuli, a vast majority of infants had greater positive emotional responding to at least one of the two experimental conditions.

With regard to the effects found in the 5-month assessment, it is plausible that infants were capable of converging emotionally with their peers when provided with an emotionally charged stimulus. However, the audio-video condition may have been too stimulating to actually produce a greater amount of positive emotion in more infants than the audio-only condition, but maintained the infants' overall attention. Television programs aimed at infants and toddlers generally implement rapid changes in both images and sound that are interesting to the infant/toddler viewer, but can ultimately overstimulate their senses (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004). The use of several combined video clips created a similar rapidity of images and sound changes that may have also contributed to the over-stimulation of the infants and the reduced effects in the audio-video condition compared to the audio-only condition. Additionally, it has been found that when trying to elicit laugher and social smiling in infants, the effective elicitors proceed from intrusive tactile and auditory information (tickling, loud and abrupt vocalizations by primary caregivers) to visual social events across the first year of life with 12-month-old infants responding more frequently to visual social events (Sroufe & Waters, 1976). This does not necessarily explain the diminished effect at 10 months, but could provide supporting evidence as to why the 5-month-old infants responded with greater intensity and longer duration to the audio-only condition (auditory information) compared to the audio-video condition (visual social events). Furthermore, there was an increase in the number of unresponsive infants at 10

months (even compared to the 5-month assessment) that strengthened this trend. . This reduction in positive emotional responding could be due (at least in part) to referencing behaviors by the infant, for which support will be provided below.

Overall, the findings from both ages of assessment support the theory that emotional contagion does occur in infancy and that it can be elicited by an auditory stimulus with positive emotional vocalizations. It should be noted that while positive emotional responding did occur during these assessments, overt laughter was only observed on some occasions (<1% of possible intensity coding occasions). This is not consistent with the findings of the contagious crying studies that provided a basis for the current exploratory study (Martin & Clark, 1982; Geangu et al., 2010; Simner, 1971). Therefore, it can be inferred that emotional contagion may be a building block of more mature forms of empathy, but positive emotional contagion is not as easily produced by positive emotional displays by peers as is negative emotional contagion by the distressed cries of peers.

Hypothesis 2

The purpose of hypothesis two was to determine if the ability for infants to "catch" the emotions of their peers would increase in both intensity and duration between the two ages. As negative emotional contagion has been theorized to be a building block of more mature forms of empathy (Hatfield, Cacioppo, & Rapson, 1993) it can be subsequently theorized that if emotional contagion is a more primitive form of the empathy that develops later in life, it should strengthen across the course of development. Such is the case for positive emotionality in general, which is found to increase in both frequency and intensity throughout the development of the infant (Rothbart, 1989;

Sallquist, et al., 2010). Additionally, by 10 months, infants are locomotor, which has been found to trigger perceptual and emotional changes and increase the need for emotional communication (Anderson, et al., 2013; Campos 2000). Regardless, there was not an effect of age on the intensity or duration of positive emotional responding to the positively charged conditions in the stimulus. One possible explanation is that by 10 months of age infants have been laughing for an average of 6 months (Sroufe & Waters, 1976) and the minimal social interaction provided by both audio-only and audio-video recordings may not be enough of a social event to produce an emotional response or convergence with the stimuli.

Another possible explanation to the modest effect in the audio-video condition could be due to habituation to television by 10 months of age. A study my Zimmerman, Christakis, and Meltzoff (2007) observing the television viewing patterns of infants between 2 and 24 months found that nearly 40% of infants began watching television by the time they were 3 months of age and that the amount of time they spent watching increased with age. As infants are exposed to a stimulus repeatedly, their attunement to the stimulus decreases (Turk-Browne, Scholl, & Chun, 2008). While the infant participants in this study would not have habituated to this specific set of visual stimuli, it is possible that increased television watching has habituated the infants to the novelty of rapidly changing auditory and visual stimuli.

Finally, as infants gain locomotor capabilities they begin to explore their world and increase the distance between themselves and their primary caregivers while doing so. As infants are exploring novel situations, they will engage in social referencing with their caregivers and use the emotional responses from the caregivers to make inferences

about their actions and their own emotional responses. However, it was previously mentioned that a lack of an emotional response by a caregiver when her infant is referencing her will affect the willingness of the infant to explore novel situations, reduce the distance that an infant is willing to stray from its caregiver, and reduce overall activity level compared to a caregiver who attended to the situation and provided emotional feedback for her infant (Sorce & Emde, 1981). In the current study, mothers were instructed to try to maintain a neutral expression and to try to avoid looking at their infants when the infants attempted to reference them. It is possible that by the 10-month assessment the infants' tendency to respond positively to the stimulus was affected by the unresponsiveness of the caregivers. Further support for this explanation can be found in a recent study by Mireault et al. (2014) that reported the social referencing behaviors of 6- and 12-month-old infants toward a humorous stimulus. It was found that by 12 months of age infants would only smile toward the stimulus after referencing their caregivers when the caregivers were displaying a positive emotional expression and they were much less likely to smile toward the stimulus when caregivers displayed neutral expressions. This indicates that the affect displayed by the caregiver had an impact on the likelihood that the infant would interpret the event as humorous. Thus, the positive affect evoked by the stimuli in the 10-month-olds in the present study may have been dampened by the failure of their caregivers to also show positive emotional expressions. Indeed, in the present study, when infant referencing between the two ages was examined, it was found that a majority of infants increased time spent referencing their caregivers between the two ages. These results support the contention of Feinman and Lewis (1983) that infant referencing may begin at an earlier age of development, but is not fully developed until

approximately 10 months of age. This finding has important implications for the previously provided explanations as to findings of both positive and negative emotional responding in infants across this 5-month developmental period. Increased referencing from the 5 to 10-month assessment provides support for the reduced number of infants that responded with positive emotions at the 10-month assessment.

Overall, the findings from this study did not support the original hypothesis that positive emotional responding would increase between the two ages of assessment. Failure to find an effect could be due to the methodologies implemented, environmental exposure to television and a habituation to novel images on a screen, and/or the effects of maternal referencing.

Hypothesis 3

The aim of hypothesis three was to determine if the level of attachment between the infant and primary caregiver was related to an infant's tendency to engage in a positive emotional response to the stimulus. Bowlby (1989) suggested that the attachment relationship provides a platform for an infant's emotional understanding. Secure attachment between the infant and primary caregiver has been linked to an increase in empathic responding (Kestenbaum, Farber, Sroufe, 1989) and insecure attachment has been linked to an increase in negative emotional responding (Weinfield, Sroufe, Egeland, & Carlson, 1999; Cassidy & Saver, 1999). The current hypothesis and previous research linking empathy responding and attachment was not supported in that there was not a significant relationship found between the two. This could be due to the fact that the majority of our sample consisted of mothers of high socioeconomic status which is found

to be associated with secure attachment (Fish, 2004). Indeed, the scores on the attachment measure all fell in the top 25% of the range of scores that were possible.

Additional Findings

Negative Emotional Responding. Negative emotional responding was also coded in this study to provide a more comprehensive view of the patterns of emotional responding of infants across conditions and ages. Inconsistent with expectations, it was found that at both ages of assessment, duration and intensity of negative affect were not reduced in the majority of infants by either the audio-only or the audio-video condition. However, the effect was found when the emotionally unresponsive infants were removed from analysis, which provides support that the negative emotions of emotionally responsive infants can be placated by the positive emotional stimuli.

Cohen (2002) found that during situations that cause infant distress, behavioral distress is reduced by providing a distracting stimulus for the infant. In the present study, some infants appeared to become distressed by the confinement of the infant chair they were seated in during the stimulus presentation. The level of positive emotional intensity in the stimuli may not have provided enough distraction to reduce the intensity and duration of distress elicited by the confinement of the infant chair.

Negative emotional responding in hypothesis 2. A secondary aim of hypothesis two was to determine how negative emotional responding differed across ages groups. Findings in this area supported the previous explanations of overstimulation by the stimulus and distress due to the infant seat used in the study. The number of infants that fit the specified pattern indicated that the control was most effective (but still significantly fewer than half of the infants) in reducing negative emotional responding

between the two ages. The explanation of visual stimulation can account for this difference compared to the experimental conditions. The control condition had brightly colored, rapidly changing visual stimuli that may have acted as a distractor from the infants' distress.

A possible explanation as to the increase in duration and intensity of negative emotional responding between 5 and 10 months of age might be attributed to the distress that was evoked by the confinement of the chair. Anecdotally speaking, experimenters found it to be more difficult to place the infants in the 10-month chair, buckle them in, and found that they often attempted to escape the confinement of the seat. Additionally, informal maternal reports support infant dissatisfaction with a restriction of mobility due to infant car seats and highchairs. Visual stimuli may have been effective in distracting the infants from their distress due to immobility. However, as inclusion criteria for the 10- month assessment required that infants be locomotive, a significant increase in intensity and duration of negative emotional responding between the ages of 5 and 10 months could have been due to an overall increase in distress caused by immobility after they were capable of locomotion.

Maternal Attachment. As discussed in the section of maternal attachment and positive emotion, the attachment relationship provides a platform for the understanding and regulation of emotions (Bowbly, 1989) and insecure attachment has been linked to an increase in negative emotional responding (Weinfield, Sroufe, Egeland, & Carlson, 1999; Cassidy & Saver, 1999. No significant relationships were found between attachment and negative emotional responding due to the fact that the scores on the attachment measure

all fell in the top 25% of the range of scores that were possible, indicating secure attachment in all of our infant-mother dyads.

Implications

The study of emotional contagion is important for a myriad of reasons, many of which are linked to the advancement of social cognition. Understanding the underlying mechanisms of emotional contagion provides insight to this complex phenomenon that allows us to better understand our own emotions and the emotions of others. It also highlights the various means by which infants are able to gain information regarding the emotional states of others. The ability to recognize emotions in others allows us to better understand, express, and regulate our own emotions. It is theorized that this understanding also provides infants with the realization that they are similar in nature to the other person, or that others are "like them" (Goswami, 2011). An infant's recognition of being "the same" as the people they are observing gives them the ability to better interpret their social interactions with others. In so doing, they can more easily maneuver, manipulate, and influence the outcomes of their social encounters as they hone their social skills throughout development. Additionally, it is necessary for people to accurately feel the emotions that others are feeling in order to truly understand another person. The ability to "catch" the emotion that another person is experiencing is central to the ability to begin to fully grasp the situation and respond to it appropriately.

Typically developing infants are able to learn and understand others through the processes mentioned above. However, it has been documented that children with autism have deficits in social emotional relatedness and are less likely to strengthen their emotional understanding necessary to understand social interactions later in life. The

imitation of facial expressions, an important underlying mechanism of emotional contagion, is incapacitated by autism (Scambler et al., 2007). This impairment affects not only the infant's ability to realize that they are "like others", but also disrupts the attachment bonds between the mother and infant. According to Dawson et al. (1990), not only are children with autism less likely to react to positive facial expressions displayed by their mothers, but mothers of autistic children also direct fewer smiles towards their children. Due to the fact that the reciprocal smile is important to the formation of attachment patterns between a mother and her child (Hutman & Dapretto, 2009), this would suggest that children with autism would likely form non-secure attachment patterns with their mothers. The present study could provide insight into the detection of autism in infancy and create a platform for the development of treatment models based on emotional exchanges with peers.

While all of these are influential reasons to continue the study of emotional contagion, the necessity of studying it within the context of empathy cannot be overlooked. Empathy is considered to be a precursor to moral development. Empathic children have been observed showing less aggression and other increased helping and prosocial behaviors including an increase in the ability to make moral judgments (Mehrabian, Young, & Soto, 1988). The finding that positive emotional contagion can be evoked in 5-month-old infants provides supporting evidence to the theory of emotional contagion as a building block for more mature forms of empathy, which could potentially be influential in future studies of both negative and positive emotional contagion and empathy responding. The lack of effect at 10 months of age indicates that either the methodologies implemented in the study or certain environmental or developmental

effects occur between the ages of 5 and 10 months that reduce the tendency to differentially respond with positive affect to social vs. non-social stimuli. Together these findings open a new area of study in developmental and empathy-related research that can and should be built on in the future.

Limitations and Future Directions

As previously mentioned, laughter and smiling most often occur during social interactions. The use of recorded auditory and visual stimuli as opposed to a live model may have resulted in the lack of emotional convergence with the emotions displayed by the stimuli. Difficulty in obtaining multiple infants simultaneously for observation, coupled with the inability to ensure the production of positive expression from a live infant model, made the use of recorded visual and auditory stimuli necessary. Additionally, the lack of familiarity with the infants used to create the stimuli may also lead to a lack of emotional response from the infant participant. Haviland and Lelwica (1987) found that infants of 10 weeks of age would only display an emotional response when a live model was used and when the infant was familiar with the model (usually a primary caregiver). While this was necessary for younger infants, previous literature did not allude to the idea that these stipulations would be necessary to evoke an emotional response at 5 and 10 months of age. The present study aimed to use peers (same aged infants) of the participants in order to more closely model the studies observing contagious crying. However, future research could consider using primary caregivers as the models of emotional displays. Contagious crying studies found that infants responded with distress more frequently when exposed to the cries of same-aged infants

as opposed to older infants, but differences in positive emotions could remove the necessity of using peers as stimuli.

One minor change could be implemented while maintaining the vast majority of the methodology used in this study. Instructing the mother to maintain a positive expression (as opposed to a more neutral one) could increase the likelihood that infants would respond positively toward the stimulus. This would provide some indication as to how infants learn their emotional responses through social referencing and possibly increase the effect of the stimulus at 10 months. Additionally, a future study might assess the relationship between social referencing and both positive and negative emotional responding. As social referencing in this study was found to increase with age, increases in negative emotional responding may be positively correlated with social referencing toward a caregiver that is not displaying overt positive emotion.

Another limitation to this study was the use of a confining infant seat at the 10-month assessment. Due to the nature of the stimulus and in order to maintain the infants' attention, a seat with a buckle was required to keep the infant in place. The increase in negative emotional responding at the 10-month assessment may have been due to irritability with the confining seat after infants have obtained locomotor abilities. Additional methodologies might be implemented in the future to reduce immobility of the infants during the stimulus presentation. Additionally, there is a great deal of variability in infants' emotional responding and negative emotional responding can be influenced by a variety of factors including time since last being fed, time since last taking a nap, and the time of day assessed in general. While the goal for assessments was to assess each participant after napping and being fed, this was difficult to accomplish due to the

varying schedules of the infants and mothers. If possible, stricter requirements should be set in place for appointment scheduling to adjust for these effects.

Contrary to expectations, this study found no significant relationship-between maternal attachment and infant emotional responding. It was previously discussed that all of our mothers fell in the 75th percentile and above on the Maternal Attachment Inventory, creating a "ceiling effect". It was this lack of variability in our in our attachment measure that likely led to a lack of relationship with infant emotional responding. Increased variability in the demographics of the sample may result in the emergence of a relationship between attachment and the variables of emotional responding.

Finally, there were minor cases of outliers in each model but these individuals changed by both condition and age. For example, a subject may have produced outlying scores in the control condition at the 5-month assessment, but have maintained near average scores for all other conditions across both age groups. For this reason, removing the outliers from the data set would have resulted in the loss of nearly half of the subjects, resulting in a lack of power. With this in mind, future studies may need to increase their sample sizes above the number indicated by a Gpower analysis. This would allow for the removal of outlier scores, while still maintaining a large enough sample size.

Conclusion

The purpose of the present study was to examine a gap in the existing literature on emotional contagion and empathic responding in infancy. Due to the fact that this study is exploratory in nature we hoped to find a contagious response to the positive affect of other infants in the form of either social smiling or overt laughter and that this response

would increase across a developmental period. In part, the findings supported the original hypotheses in that positive emotional responding to a positively charged stimulus was found in the way of social smiling, but not overt laughter. Furthermore, positive emotional contagion was not found to increase across the developmental period. In facts positive emotional contagion was found to occur in only a minority of the 10-month-old infants. Evidence of this occurrence provides an initial platform for further exploration in the area of positive affect in infancy and early childhood.

Exploratory analyses indicated that the same positive stimulus was not effective in reducing the behavioral distress exhibited by the infants at both 5 and 10 months of age. This may indicate that negative emotions are not able to be overcome by positive emotional stimuli or that the stimuli were not stimulating or social enough to distract from the infant's distress. Although this was not part of the initial hypothesis, it provides insight as to the full spectrum of emotional responding which provides a greater understanding of how infants respond to the specific stimuli implemented in this study

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APPENDICES

APPENDIX A
Tables

Table 1

Ordinal Pattern Analysis for Measures of Positive Emotional Responding at 5 and 10 Months

	Duration			*Intensity*		
Ordinal Pattern Tested	*n*	PCC	*c*-value	*n*	PCC	*c*-value
5 Month						
audio-video > audio-only > control	6	14.29	.36	5	11.90	.47
audio-only > control	24	57.14	.03	26	61.90	.01
audio-video > control	26	61.90	.01	26	61.90	.01
audio-video > audio-only	22	52.38	.15	15	35.71	.80
audio-only & audio-video > control	21	50.00	.57	20	47.61	.68
audio-only or audio-video > control	29	69.05	.02	32	76.19	.01
10 Month						
audio-video > audio-only > control	5	13.16	.28	6	15.79	.12
audio-only > control	20	52.63	.08	15	39.47	.47
audio-video > control	20	52.63	.09	18	47.37	.30
audio-video > audio-only	16	41.03	.66	18	46.15	.25
audio-only & audio-video > control	13	34.21	.98	9	23.68	1.00
audio-only or audio-video > control	27	71.05	.01	24	63.16	.08

Note. 5- Month data were complete for 42 infants; 10-month data were complete for only 38 infants.

Table 2

Ordinal Pattern Analysis for Measures of Positive and Negative Emotional Responding & Referencing Across Ages

Table 3

Correlations of Attachment and Intensity of Positive Emotional Responding at 5 and 10 Months

Variables	Attachment Total	Control Intensity	Audio-Only Intensity	Audio-Video Intensity	Control Intensity 10M	Audio-Only Intensity 10M	Audio-Video Intensity 10M
Attachment	--						
Control Intensity	-.223	--					
Audio – Only Intensity	-.117	.216	--				
Audio-Video Intensity	-.084	.211	.531**	--			
Control Intensity 10M	-.013	.034	-.006	-.341*	--		
Audio-Only Intensity 10M	-.039	.095	.066	-.158	.492**	--	
Audio-Video Intensity 10M	-.003	.065	.120	.249	.375*	.297	--

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

Table 4

Correlations of Attachment and Duration of Positive Emotional Responding at 5 and 10 Months

Variables	Attachment Total	Control Duration	Audio-Only Duration	Audio-Video Duration	Control Duration 10M	Audio-Only Duration 10M	Audio-Video Duration 10M
Attachment	--						
Control Duration	-.228	--					
Audio – Only Duration	-.175	.224	--				
Audio-Video Duration	-.142	.205	.599**	--			
Control Duration 10M	.005	-.030	-.081	-.266	--		
Audio-Only Duration 10M	-.039	.006	.134	-.170	.486**	--	
Audio-Video Duration 10M	.057	.149	.104	.229	.385*	.328*	--

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

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5

Ordinal Pattern Analysis for Measures of Negative Emotional Responding at 5 and 10 Months

	Duration			*Intensity*		
Ordinal Pattern Tested	*n*	PCC	*c*-value	*n*	PCC	*c*-value
5 Month						
control > audio-only > audio-video	5	11.90	.14	5	11.90	.06
control > audio-only	19	45.24	.02	18	42.86	.04
control > audio-video	19	45.24	.01	18	42.86	.02
audio-only > audio-video	10	23.81	.73	10	23.81	.58
control > audio-only & audio-video	17	40.00	.91	15	35.71	.97
control > audio-only or audio-video	21	50.00	.54	21	50.00	.59
10 Month						
control > audio-only > audio-video	6	15.79	.18	6	15.79	.13
control > audio-only	14	36.84	.72	16	42.11	.42
control > audio-video	18	47.37	.06	17	44.74	.09
audio-only > audio-video	20	51.28	.04	19	48.72	.04
control > audio-only & audio-video	17	44.74	.93	14	36.84	.97
control > audio-only or audio-video	21	50.00	.56	19	50.00	.57

Note. 5- Month data were complete for 42 infants; 10-month data were complete for only 38 infants.

Table 6

Correlations of Attachment and Duration of Negative Emotional Responding at 5 and 10 Months

Variables	Attachment Total	Control Duration	Audio-Only Duration	Audio-Video Duration	Control Duration 10M	Audio-Only Duration 10M
Attachment	--					
Control Duration	-.005	--				
Audio – Only Duration	-.182	.314*	--			
Audio-Video Duration	.047	.241	.498**	--		
Control Duration 10M	-.025	.220	.220	.212	--	
Audio-Only Duration 10M	-.077	-.044	-.087	.042	.293	--
Audio-Video Duration 10M	.195	.148	.334*	.164	.383*	.313

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

Table 7

Correlations of Attachment and Intensity of Negative Emotional Responding at 5 and 10 Months

Variables	Attachment Total	Control Intensity	Audio-Only Intensity	Audio-Video Intensity	Control Intensity 10M	Audio-Only Intensity 10M	Audio-Video Intensity 10M
Attachment	--						
Control Intensity	-.014	--					
Audio – Only Intensity	-.180	.284	--				
Audio-Video Intensity	.046	.222	.418**	--			
Control Intensity 10M	.027	.211	.177	.282	--		
Audio-Only Intensity 10M	.039	.011	-.040	.057	.258	--	
Audio-Video Intensity 10M	.225	.098	.255	.222	.344*	.279	--

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

*. Correlation is significant at the 0.05 level (2-tailed).

Table 8

Descriptive Statistics of Positive Emotional Responding

	5 Months		10 Months	
Measure	N	*M (SD)*	N	*M (SD)*
Control Duration	42	5.310 (8.42)	38	12.11 (16.78)
Audio-Only Duration	42	14.52 (21.03)	39	15.08 (16.87)
Audio-Video Duration	42	12.52 (17.66)	39	14.62 (15.58)
Control Intensity	42	2.95 (3.84)	38	4.11 (4.35)
Audio-Only Intensity	42	5.21 (5.28)	39	4.64 (4.15)
Audio-Video Intensity	42	5.00 (4.37)	39	5.23 (4.46)

Note. Duration units of measurement: seconds; Intensity units of measurement: 0-5 scale. All values represent raw, unstandardized scores.

Table 9

Descriptive Statistics of Negative Emotional Responding

	5 Months		10 Months	
Measure	N	*M (SD)*	N	*M (SD)*
Control Duration	42	14.71 (29.53)	38	19.61 (29.56)
Audio-Only Duration	42	3.69 (8.64)	39	20.21 (26.34)
Audio-Video Duration	42	6.64 (20.94)	39	13.05 (24.58)
Control Intensity	42	3.62 (5.50)	38	5.26 (6.50)
Audio-Only Intensity	42	1.64 (2.90)	39	5.44 (6.07)
Audio-Video Intensity	42	1.45 (2.50)	39	1.10 (1.65)

Note. Duration units of measurement: seconds; Intensity units of measurement: 0-5 scale. All values represent raw, unstandardized scores.

APPENDIX B
CODING POSITIVE EMOTIONAL CONTAGION VIDEOS
12-2-14

- The focus of coding will be joy, i.e., any discernible positive emotional display, most notably smiling or laughter, however, interest and distress will also be coded.
- Each individual video will be 10 minutes in length, but will be coded for 6 minutes (360 seconds), which is the combined duration of the three conditions (2 minutes each).
- The coding light towards the right of the screen will signal the START of each of the 2 minute coding periods. The disappearance of the coding light will signal the END of the 2-minute coding period.
- Divide each 2-minute condition into 30-second epochs and code each separately. However, the latency to first response will only be recorded once for each condition. Use the time code on the video for your measurements. Thus, durations will be coded to the nearest full second.
- **DO NOT** code during any time when the coding light is not turned on.
- **Variables to be coded:**
  - Baseline state: The child's state prior to the beginning of an episode:
    - 1= tired/drowsy.
    - 2= alert/calm.
    - 3= alert/active.
    - 4= fussy.
    - 5= crying.
  - Latency to first POSITIVE emotional response
  - Total duration of positive emotional response episodes (within each 30 second epoch).
    - A positive emotional episode lasts from the onset of positive facial display (smile, laughter) until no more positive emotion is seen on the infant's face.
      - If a positive emotional episode ends with 2 seconds or less before the start of the next episode, count this as a single, continuous episode.

- **If the time between 2 smiles is less than 1 second, it should be coded as one smile.**
- If the infants face is not fully visible (e.g. covering face with hands), code any visible facial expression, but **DO NOT** infer what you can't see.

- Peak intensity of **POSITIVE EMOTIONAL RESPONSE**.
  - Rank the maximum intensity for each positive emotional episode, NOT for each 30-second epoch.
  - These ratings are based on the AFFEX system, which is included below.
    - 0= No facial region shows codable joy movement.
    - 1= Only one facial region shows codable movement, identifying a low intensity joy, or expression is ambiguous, but seemingly positive (not neutral).
    - 2= Two or more facial regions show codable movement, or expression in one region is very clear.
    - 3= One or two facial region shows codable movement **AND** movement of their arms and legs.
    - 4=Two facial regions show codable movement **AND** movement of their arms and legs that lasts longer than 1 second in length.
    - 5=Two facial regions show codable movement, movement of their arms and legs, and laughter as signified by rhythmic upper body movement.
- Peak intensity of **DISTRESS RESPONSE**.
  - Rank the maximum intensity for each negative emotional episode, NOT for each 30 second epoch.
  - If the infants face is not fully visible (e.g. covering face with hands), code any visible facial expression, but **DO NOT** infer what you can't see.
  - These ratings are based on the AFFEX system, which is included below.
    - 0= No facial region shows codable fear movement.
    - 1= Only one facial region shows codable movement, identifying a low intensity distress, or expression is ambiguous, but seemingly negative (not neutral).

- 2= Only 2 facial regions show codable movement, or expression in one region is very clear.
- 3= An appearance change occurs in all 3 facial regions, or **coder otherwise has impression of strong facial distress**.
- 4=Infant is crying.
- 5=Infant is crying and flailing of the arms and/or legs or trying to escape from carseat.

- Parent behavior: Coded within each 2 min condition. Interference could be touching, holding hand, attempts to focus the infant's attention on the stimulus, or attempts to stop the infant from grabbing the blue rag or EKG leads.
  - 0= Not interfering; neutral.
  - 1= Mild interference;
  - 2= Interfering; generally disrupting.
- Missing epochs: Enter an X in the coding form if an epoch is missing.

AFFEX FACIAL EXPRESSION DEFINITIONS

Emotion	Movements In Forehead/Brows Regions	Movements In Eyes/Nose/Cheeks Regions	Movement In Mouth/Lips/Chin Regions	Notes
Anger	V Inner corners are lowered and drawn together. V Bulging or vertical furrows between the eyes may be visible due to this movement.	V Eyes may look tense or squinted. V Cheeks may be raised. V Fold under eye may deepen.	V Mouth looks tense, wide open and squarish. V Alternatively, mouth appears closed with lips pressed together.	V Don't confuse brow movements V with those in interest. See illusion of sadness note.
Fear	V Entire brow should be raised/neutral and drawn together. V Brows may also look straighter across than usual. V Faint horizontal furrows may be present in forehead.	V Upper eyelid raises making the eyes appear wider. V Eyes have tense appearance.	V Lip corners are drawn straight back. V Mouth is usually less than wide open.	V Don't confuse interest brows for V fear. See illusion of sadness note.
Sadness	V Inner corners move upward and together resulting in bulging/furrows in middle of forehead.	V Cheeks may look lower than usual or have a droopy appearance. V Alternatively, cheeks may be raised and eyes squinted.	V Lip corners should be drawn down. V Bottom lip may be pushed up and out by the chin which may be tense or wrinkled.	
Joy	V Most likely remain neutral.	V Cheeks raise V Furrow below the eyes deepens. V "Crows feet" will extend from the outer corners of the eye. V Eyes may appear squinted.	V Lip corners are raised. V Nasolabial fold deepens.	
Interest	V Entire brow is raised. V Alternatively, brows are drawn together and slightly lowered.	V Eyes look wider than usual due to raised brows. V Alternatively, eyes may be squinted and cheeks raised.	V Mouth may open.	V When coding infants, do not code "mouth opens" as interest unless it is in response to a stimulus

Note on the potential for an "illusion of sadness"

There are several occasions when an illusion of sadness may appear. Sadness should not be coded in these situations:

V The first situation is when brows are drawn tightly down and together. In this case, it is common for the inner most corners of the brows to bulge up in the middle falsely giving the appearance of sadness. This is most likely due to the large amount of fat in the infant face.

V The second situation is when the outer corners of the brows are lowered falsely giving the appearance that the inner corners have raised. In this case, be sure to observe the actual movement of the brows. In sadness, the inner corners need to be raised and drawn together. Simply observing a still frame of this expression is not sufficient to distinguish between true sadness and the illusion of sadness.

V Finally, an illusion of sadness may occur when children inhale deeply during a bout of crying. In this situation, the lip corners will be drawn down by the inhaling action giving the impression of sadness.

APPENDIX C

FAMILY CONTACT INFORMATION

Child Name:_____

Mother's/Guardian's name:_____
(circle one)
Address:_____
City/State/Zip:_____
Phone number: _____ _____
Daytime Evening
Best time of day to call:_____
Father's/Guardian's name: _____
Address:_____
(if different than above)
City/State/Zip:_____
Phone number: _____ _____
Daytime Evening
Name of 2 relatives or family friends who can help us contact you if you move:

_____
Name Relationship

_____
Address City/State/Zip Phone number

_____
Name Relationship

_____
Address City/State/Zip Phone number

APPENDIX D

Demographic Information Questionnaire

Child Information

What is your relationship to the baby? Example: mother, father, stepmother.
_____

Gender of baby _____ Male _____ Female

Birth date of baby _____
Month Day Year

Birth weight of baby ___ lbs ___oz

Date of expected birth (due date) _____
Month Day Year

Was the baby born by c-section? YES NO

Maternal Information

Birth date _____
Month Day Year

Your marital status (check one)

___ Married, first time
___ Single, separated
___ Single, widowed
___ Other, please specify: _____
___ Single, never married
___ Single, divorced
___ Remarried

Your own ethnic group (please check)

___ Native American Nation: _____
___ African American
___ Hispanic
___ Asian
___ White
___ Multiethnic Describe _____
___ _Other

Please place a check mark next to the highest grade you completed in school.

____ 6th grade
____ 7th grade
____ 8th grade
____ 9th grade
____ 10th grade
____ 11th grade
____ 12th grade
____ some vo-tech
____ some college courses
____ vo-tech graduate
____ college graduate
____ post-graduate work

Please place a check mark next to the highest grade your spouse/partner completed in school.

____ 6th grade
____ 7th grade
____ 8th grade
____ 9th grade
____ 10th grade
____ 11th grade
____ 12th grade
____ some vo-tech
____ some college courses
____ vo-tech graduate
____ college graduate
____ post-graduate work

Your current household income per month before taxes (please check one)

___ $ 0 - 100
___ $ 100 - 499
___ $ 500 - 999
___ $ 1000 - 1499
___ $ 1500 - 1999
___ $ 2000 - 2499
___ $ 2500 - 2999
___ $ 3000 - 3499
___ $ 3500 - 3999
___ $ 4000 plus

Is your current spouse/partner the father of the baby (check one)

___ yes ___ no

Ethnic group of the biological father of the baby. (please check)

___ Native American Nation: _____
___ African American
___ Hispanic
___ Asian
___ White
___ Multiethnic Describe: _____
___ Other

Do you currently receive state or federal financial assistance? (check as many as apply)

___ WIC
___ TANF
___ School lunch/breakfast
___ Food Stamps
___ Indian Health Services
___ Unemployment benefits
___ Energy assistance
___ Social Security/SSI
___ Medicaid

For how many years have you received such assistance? (check one)

___ five or more years
___ four years
___ three years
___ two years
___ one year
___ less than one year

My child seems to be less healthy than other children I know.

____ strongly agree
____ agree
____ do not agree or disagree
____ disagree
____ strongly disagree

My child has never been seriously ill.

____ agree
____ disagree

APPENDIX E

Maternal Attachment Inventory (Revised)

The following sentences describe thoughts, feelings, and situations new mothers may experience. Circle the letter under the word that applies to you.

	Almost Always	Often	Some-times	Almost Never
1. I feel love for my baby	a.	b.	c.	d.
2. I feel warm and happy with my baby	a.	b.	c.	d.
3. I want to spend special time with my baby	a.	b.	c.	d.
4. I look forward to being with my baby	a.	b.	c.	d.
5. Just seeing my baby makes me feel good	a.	b.	c.	d.
6. I know my baby needs me	a.	b.	c.	d.
7. I think my baby is cute	a.	b.	c.	d.
8. I'm glad this baby is mine	a.	b.	c.	d.
9. I feel special when my baby smiles	a.	b.	c.	d.
10. I like to look into my baby's eyes	a.	b.	c.	d.
11. I enjoy holding my baby	a.	b.	c.	d.
12. I watch my baby sleep	a.	b.	c.	d.
13. I want my baby near me	a.	b.	c.	d.
14. I tell others about my baby	a.	b.	c.	d.
15. It's fun being with my baby	a.	b.	c.	d.
16. I enjoy having my baby cuddle with me	a.	b.	c.	d.
17. I'm proud of my baby	a.	b.	c.	d.
18. I like to see my baby do new things	a.	b.	c.	d.
19. My thoughts are full of my baby	a.	b.	c.	d.
20. I know my baby's personality	a.	b.	c.	d.
21. I want my baby to trust me	a.	b.	c.	d.
22. I know I am important to my baby	a.	b.	c.	d.
23. I understand my baby's signals	a.	b.	c.	d.
24. I give my baby special attention	a.	b.	c.	d.
25. I comfort my baby when he/she is crying	a.	b.	c.	d.
26. Loving my baby is easy	a.	b.	c.	d.

Scoring: A = 4, B = 3, C = 2, D = 1. All items are summed for a single score.

APPENDIX F

CONSENT FORM & PARENT PERMISSION

Project Title: Positive Emotional Contagion in Infancy

What is the purpose of this project and why am I being asked to participate?

The purpose of the "Positive Emotional Contagion in Infancy" research study is to explore the ability of infants to converge emotionally with another infant, a phenomenon referred to as emotional contagion. More specifically, this study aims to observe an infant's tendency to mimic expressions of positive affect observed in their peers and subsequently feel the emotion associated with the mimicked expression. You are being asked to participate because you indicated (a) that you have an infant younger than 5 months old, and (b) that you are interested in learning more about the research study.

Who is responsible for it?

This project is conducted by David G. Thomas, Ph.D., in the Department of Psychology at OSU. There are also graduate and undergraduate students from the departments working on this project whom you will be meeting along the way. This project is approved by the Institutional Review Board at OSU.

What type of information is being collected and what will I be asked to do?

We will collect three types of information from you and your baby:

1. Questionnaire information about you and your family.
2. Questionnaire information about the behavior and temperament of your infant.
3. Physiological measures of infant's heart rate and salivary cortisol, testosterone, and alpha amylase.

Each type of measurement is described below:

For Mothers: Most of the procedures will take approximately 15-20 minutes.

- Demographic Information Questionnaire at 5-month visit. This questionnaire contains questions about household income, family education, etc.
- Infant Behavioral Questionnaire at 5 and 10-month visits. This questionnaire contains questions regarding the behavior of your infant in the two weeks prior to your participation in the study.

Infants: We will spend approximately 30 minutes with your infant, presenting positive emotional affect stimuli and collecting physiologic measurements. All the tests will be done at 5 months and repeated at 10 months.

- Emotional Response Stimulus (about 10 minutes). We will observe the emotional responses and expressions of your infant as they view a ten-minute stimulus containing three separate conditions. Condition one will consist of the recorded laughter of eight infants. Condition two will consist of both audio and video recordings of the same eight infants laughing. Condition three is a series of high-contrast shapes and patterns with no coinciding audio recording. We will videotape the behavioral and physiological reactions of your infant while this stimulus is playing in order to code their emotional expressions at a later time.
- Heart rate from your child to assess physiological reactivity to our stimulus

- Samples of saliva from your child to assess stress hormones

How long will each visit take?

We will ask you to bring your baby to the lab at OSU at a time when she/he has had a recent nap and will be alert. We will first collect salivary measures of cortisol, testosterone, and alpha amylase. After that is finished, we will begin playing the Emotional Response Stimulus. In addition, at the 5-month visit we will have you fill out both the demographics and the infant behavioral questionnaires. At a minimum, these procedures will take about thirty minutes, but if the baby needs rest periods, it may take up to 45 minutes.

What are the risks of participating in this project?

The risks associated with our procedures are similar to those risks associated with routine physical exams or psychological tests.

- Although the gel used to place the HR recording leads is hypoallergenic, there is a remote possibility that your baby could experience a mild allergic reaction to the gel.
- Some mothers may experience some discomfort when responding to sensitive questions about family income or aspects of prenatal care and behavior.

What about my privacy and confidentiality?

The records of this research study will be kept private. Any written results will discuss group findings and will not include information that will identify you or your child. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. It is possible that the consent process and data collection will be observed by research oversight staff responsible for safeguarding the rights and wellbeing of people who participate in research.

Computerized data will be maintained on a computer accessible only to researchers and this computer, along with all others records, will be kept in a locked room in Dr. Thomas' laboratory at OSU. In addition, your names will only appear on this consent form and on a master list which will also be kept locked in Dr. Thomas' laboratory. All other records will be identified only with a code number, and information that connects code numbers with names will be kept only on the master list. We are required to keep our records for 5 years after we publish our findings, but after that they will be destroyed.

What are the benefits of participating?

Your participation will also help us to better understand the occurrence of positive emotional responses in infancy and their role as a precursor to empathic behaviors. Additionally, it will allow us to determine whether or not infants have the ability to mimic the emotional expressions of their peers and subsequently feel the emotion they are mimicking. This converging of emotions is a process known as emotional contagion, which is hypothesized to be a primitive form of empathy.

Will I be compensated for my participation?

You will be paid for your participation to help defer the costs of traveling to OSU. You will receive $5 for the 5-month visit and $5 and a $25 cash card to Valero Short Stop when you return for the 10-month visit. You will only be paid for those visits that you actually make. If you

are taking a class at OSU that offers research credit, you will receive 1 credit for each hour of participation (½ credit for each ½ hour or less).

What are the alternatives to participating?

The alternative is to not participate. Your participation is entirely voluntary. There is no penalty for choosing to not participate and you will not lose any rights, privileges, medical care, etc. if you choose not to participate. If you are eligible for research credit in a course due to your participation, the instructor of that course will make optional comparable activities available. You may choose to not participate now, or at any time during your participation, and you are free to withdraw your consent at any time during the research study.

What if I have other questions or concerns about my participation?

If you have any questions or need to report an effect from the research procedures, you may contact Evan M. Jordan at (405) 496-8638 (evanmj@okstate.edu). If you have questions about your rights as a research volunteer, you may contact the IRB Office, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu.

SUMMARY OF TESTS AND MEASUREMENTS AND ESTIMATED TIMES

Mother's tests and measurements: Done at 5 and 10 months	
Test	Estimated time
Demographic Information Questionnaire	5-10 min
Maternal Attachment Inventory	5 min
	TOTAL TIME = approx. 15 minutes
Infant's tests and measurements: Done at 5 and 10 months	
Emotional Responsiveness Stimulus	10 min
Heart Rate Measures	2 min
Salivary Measures	6 min
	TOTAL TIME = approx. 18 minutes

MOTHERS' PROCEDURES & CONSENT

What tests and measurements will I participate in?

- Demographic Information Questionnaire at 5-month visit. This questionnaire contains questions about household income, family education, etc.
- Infant Behavioral Questionnaire at 5 and 10-month visits. This questionnaire contains questions about the behavior and temperament of your baby within the two weeks prior to your participation.

What are the risks to me of participating in this project?

The risks associated with our procedures are similar to those risks associated with routine physical exams or psychological tests.

- Some mothers may experience some discomfort when responding to sensitive questions about family income or aspects of prenatal care and behavior.

STATEMENT OF VOLUNTARY PARTICIPATION

I understand that participation is voluntary and that I will not be penalized if I choose not to participate. I also understand that I am free to withdraw my consent at any time and end my participation in this project without penalty.

SIGNATURES

I have read and fully understand the consent form. I have had a chance to ask questions about the study and my questions have been answered to my satisfaction. I sign this form freely and voluntarily. A copy of this form has been given to me.

Date: _____/_____/_____ Time: _____:_____ am/pm

_____ _____

Name (please print) Signature

"I certify that I have personally explained all elements of this form to the participant before requesting the participant to sign it."

Signed: _____

Project director or authorized representative

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INFANTS' PROCEDURES AND MOTHERS' PERMISSION

What tests and measurements will my baby participate in?

- Behavioral Measures of Emotional Responsiveness. In order to evoke an affective response in the infant, a stimulus containing three conditions will be presented on a 28-inch video monitor. Each of the conditions will be 120 seconds in length and represented by a compilation of laughter produced from infants of various ages. The first condition

will consist of an audio only condition, in which the screen will appear blank. The audio for this condition will consist of laughter clips of eight different infants of various ages within the first year of life. The second condition will consist of a compilation of both the laughter audio and a video. The audio from these videos will be the same audio from the first condition, but will be accompanied by their corresponding video. The duration of each of these clips will be the same as was stated for the first condition; however, the order of the clips will be rearranged to prevent habituation to the stimuli. Audio for each of the previous conditions will range between 66 and 70 decibels when measured from the distance the infant will be seated from the speakers. The final condition will act as a baseline and will be comprised of eight clips of high contrast animated patterns specifically designed for infant visual stimulation. The use of these animations will provide a visual for infants to attend to. There will be a two minute interval between each of the conditions during which time you can engage with, hold, or comfort your infant should you choose to do so.

- Salivary Measures. After a 10-minute initial "warm-up" period, the infants' baseline saliva sample will be taken. Infants will be given an absorbent cotton swab to be placed in their mouth either by the experimenter or the mother. The swab will be held in the infant's mouth for 2 minutes or until saturated with saliva. The swab will then be placed in a vial labeled with only an identification number and will then be placed in a freezer to be later assayed for cortisol, testosterone, and alpha amylase. Following the procedure (10-minute laughter stimulus), a second saliva sample will be taken following the same protocol. A third and final saliva sample will be taken 15 minutes after the previous sample. The timing of this will be strict in order to allow the hormones to reach their peak levels. All salivary samples will be kept in the freezer located in North Murray Hall room 310. The samples will be transported from North Murray Hall room 310 to the lab in North Murray Hall for analysis. Upon completion of the analyses, all physical samples will be destroyed following proper protocol.

What are the risks to my baby of participating in this project?

The risks associated with our procedures are similar to those risks associated with routine physical exams or psychological tests.

- Although the gel used to place the HR recording leads is hypoallergenic, there is a remote possibility that your baby could experience a mild allergic reaction to the gel.

STATEMENT OF VOLUNTARY PERMISSION

I have read and fully understand the consent form. As parent or guardian I authorize _____(print name) to participate in the described research. I also understand that I am free to withdraw my permission at any time and end my child's participation in this project without penalty.

_____
Parent/Guardian Name (printed)

_____ _____
Signature of Parent/Guardian Date

"I certify that I have personally explained all elements of this form to the participant before requesting the participant to sign it."

Signed: _____
Project director or authorized representative

APPENDIX G
Institutional Review Board Approval

Oklahoma State University Institutional Review Board

Date:	Friday, August 22, 2014
IRB Application No	AS1487
Proposal Title:	Positive Emotional Contagion in Infancy
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 8/21/2015

Principal Investigator(s):

Evan Jordan	Janna Colaizzi	David Thomas
116 N Murray	116 N Murray	116 N. Murray
Stillwater, OK 74078	Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

VITA

Evan McKenzie Jordan

Candidate for the Degree of Psychology

Master of Science

Thesis: THE OCCURRENCE OF POSITIVE AFFECT AND THE CONTAGIOUS EMPATHIC RESPONSE TO LAUGHTER IN EARLY INFANCY

Major Field: Experimental Psychology

Biographical:

Education:

Completed the requirements for the Master of Science at Oklahoma State University, Stillwater, Oklahoma in July, 2017

Completed the requirements for the Bachelor of Science in psychology at Oklahoma State University, Stillwater, Oklahoma in 2012.

Experience:

Graduate Teaching and Research Assistant, Oklahoma State University
Developmental Psychology Teaching Assistant, University of Colorado at Colorado Springs
Data Analysis Assistant in Infant and Child Development Lab, San Diego State University
Research Assistant in Life Satisfaction Lab, Oklahoma State University

Professional Memberships:

- Abstract reviewer for Southwestern Psychology Association 2013 Conference.
- Abstract reviewer for Society for Research in Child Development 2014 Conference.