

THE BEHAVIORAL, EMOTIONAL, AND ATTENTIONAL EFFECTS OF HUMAN
BABY SCHEMA

by

Karin Machluf

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The Charles E. Schmidt College of Science
In Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy

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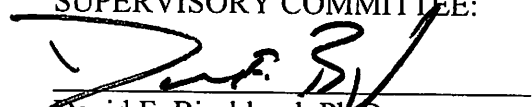
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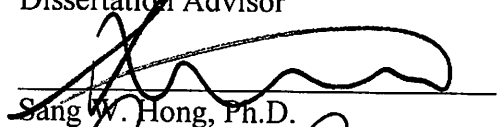
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This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. David F. Bjorklund, Department of Psychology, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the Charles E. Schmidt College of Science and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

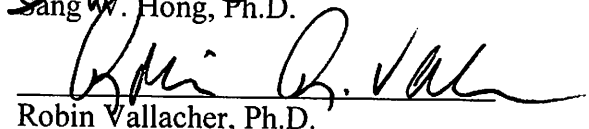
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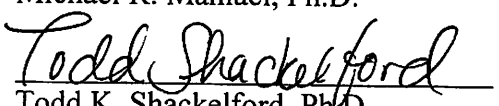
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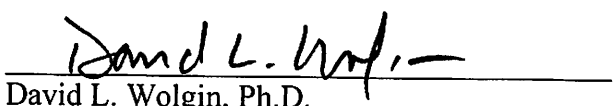
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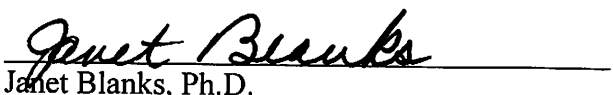
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ABSTRACT

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Children exhibit neotenous, or physically immature, features, such as a large rounded head relative to body size, adult-sized eyes, round cheeks, a small chin, and a short narrow nose. Bowlby (1969) and others (Eibl-Eibesfeldt, 1989; Hrdy, 2005) propose that, in species whose young depend on care from an adult, these features could enhance offspring survival. Lorenz (1943) argued that adult humans are particularly attracted to these features, and that these characteristics, which he termed *Kindchenschema* or “baby schema,” trigger a cognitive system that processes and reacts specifically to infantile features for the purpose of enhancing motivation to engage in caretaking behaviors. The goal of the studies proposed here is to examine the behavioral, attentional, and emotional effects of baby schema.

In Experiment 1, 207 participants were randomly assigned to view images of human infant faces, animal infant faces, human adult faces, or neutral stimuli.

Participants then answered an 8-item empathy questionnaire. Participants who viewed pictures of human infant and animal infant faces rated themselves as having significantly higher empathy than those who viewed human adult and neutral stimuli. Although females, on average, had significantly higher empathy scores than male participants, there was no significant interaction between gender and condition.

Experiment 2 examined whether neotenous stimuli influences visual perception by testing whether viewing human infant faces increases visual contrast sensitivity, a dimension of early vision. In a between subjects design, nine participants were presented with stimuli of infant, adult, and scrambled faces, and then performed a two-alternative forced-choice (2AFC) orientation discrimination task for the target Gabor. Results revealed that when participants were presented with a human infant face before the target stimuli appeared, there was a slight increase in contrast sensitivity at threshold. Although participants were more accurate in detecting the tilt of the Gabor patch after viewing infant faces than after viewing adult faces across some of the contrast levels, this difference was not significant.

Lastly, Experiment 3 investigated whether neotenous stimuli influences behaviors associated with caretaking, namely fine-motor abilities and behavioral carefulness. Eighty-six participants completed one trial of the mirror-tracing task before and after viewing images of human infant faces, animal infant faces, human adult faces, or neutral stimuli. Difference scores between pre-test and post-test on both error and time were calculated. Non-parametric analyses found no significant differences between conditions on difference in error or difference in time.

DEDICATION

I would like to dedicate this dissertation to Dr. Patrick Douglas Sellers II. Doug, you are the love of my life, my partner in crime, best friend, and safe haven. I could not imagine my life without you in it, sharing our mutual love and appreciation for food, yoga, science, books, art, and exploration. You enrich my life every day, and I am so grateful to have found you. Thank you for sticking by me through the good times, but, most importantly, through the times when I lost faith in myself and needed you most. I love you.

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I. INTRODUCTION

Parental care is crucial for the survival of the offspring of many species, especially mammals. Neonates in many animals require the care of at least one parent to survive to reproductive age. In fact, care for offspring is a fundamental evolutionary dimension of the bio-behavioral repertoire of many species (Clutton-Brock, 1991). Parental investment is particularly high in humans, given the extended period of immaturity. Although other mammals enter the juvenile life stage after weaning, human children are required to mature at least 7 or 8 years before they begin to acquire the physical and mental abilities necessary for independence (see Bogin, 2003). Children must survive this often-hazardous period of infancy and childhood before reaching adulthood, when reproduction (and subsequent rearing) of children occurs. This extended childhood is, therefore, the “crucible of evolution” (Bjorklund & Sellers, 2011), such that any adaptations that increase the likelihood of reaching adulthood should be favored by natural selection. Although natural selection operates at all stages of the lifespan, it operates at some stages more than others, especially early in development.

Ontogenetic adaptations: An evolutionary developmental perspective

Evolutionary developmental psychology applies the principles of evolution to explain contemporary human development: “It involves the study of the genetic and environmental mechanisms that underlie the universal development of social and cognitive competencies and the evolved epigenetic (gene-environment interactions)

processes that adapt these competencies to local conditions; it assumes that not only are behaviors and cognitions that characterize adults the product of selection pressures operating over the course of evolution, but so also are characteristics of children's behaviors and minds" (Bjorklund & Pellegrini, 2002, p. 4). It posits that natural selection operates throughout ontogeny (i.e., the lifetime of the individual), in addition to operating during the organism's reproductive years (e.g., Bjorklund, Ellis, & Rosenberg, 2007; Bjorklund & Pellegrini, 2000, 2002; Bjorklund & Hernández Blasi, 2005; Burgess & MacDonald, 2005; Ellis & Bjorklund, 2005; Geary & Bjorklund, 2000).

One tenet of evolutionary developmental psychology is that mastering the complexities of human social communities requires an extended childhood. In evolutionary biology, when there are great costs associated with a characteristic (here, an extended juvenile period), there should also be great benefits. These benefits, for ancient and contemporary humans, include the development of a brain capable of procuring the skills to navigate the intricacies of the social world (Bjorklund, Cormier, & Rosenberg, 2005; Dunbar, 1995, 2010). The complexities of human societies vary cross-culturally, and it takes time for children to acquire the abilities to cooperate and compete with their fellow *Homo sapiens*. Humans' extended period of immaturity, coupled with a big brain that permits a social learning ability unsurpassed in the animal world, allowed our species to become as socially sophisticated as we are. Furthermore, evolutionary developmental psychology posits that if natural selection operates at all life stages, and an extended childhood is so costly, then we might profitably consider adaptations associated with infancy and childhood, specifically *ontogenetic adaptations*. Ontogenetic adaptations are evolved characteristics specifically selected to serve an adaptive function at a specific

time in development. These adaptations emerge at different times in development and adapt the child for challenges specific to that life stage. These adaptations may disappear when they are no longer functional (Bjorklund, 1997). One example of an ontogenetic adaptation, and the topic of this paper, is children's physical immaturity. Children exhibit neotenuous, or physically immature, features, such as a large rounded head relative to body size, adult-sized eyes, round cheeks, a small chin, and a short narrow nose.

Bowlby (1969) and others (Eibl-Eibesfeldt, 1989; Hrdy, 2005) propose that, in species whose young depend on care from an adult, a preference for an infant's features could enhance offspring survival. Bowlby suggested that infants activate "innate releasing mechanisms" to attract the parent (specifically, in his theory, the mother or primary attachment figure). These mechanisms can be positive, such as smiling and babbling, or negative, such as crying (see Cassidy, 2008). In turn, adult sensitive responsiveness fosters infants' motivation to interact and has positive effects on infant development (Landry et al., 1997; Sroufe, 2000; Trevarthen & Aitken, 2001; Tronick, 2005; van IJzendoorn et al., 1995).

Physical immaturity may have also evolved to provide indirect benefits for infants from adults. As infants evolved neotenuous characteristics, others have proposed that adults have evolved to attend to these features. Adults are extraordinarily attuned to the facial characteristics that typify their young. Lorenz (1943) argued that adult humans are particularly attracted to these features, and that these characteristics, which he termed *Kindchenschema* or "baby schema," trigger a cognitive system that processes and reacts specifically to infantile features for the purpose of enhancing motivation to engage in caretaking behaviors.

Cuteness and Kindchenschema

These neotenous features are typically considered as cute. Much of the research regarding baby schema finds that infant faces are rated as more cute than adult faces. Sternglanz, Gray, and Murakami (1977) parametrically varied eye height, eye width, iris size, and vertical feature position and had participants rate the attractiveness of infant faces. They found that a large forehead associated with a small chin and large eyes make a baby face look “cute.” Another study (Alley, 1981) found that a more rounded infantile head shape increased cuteness ratings when head size was held constant.

Extending the research on perception of cuteness, Glocker and colleagues (2009) varied the width and the length of the face and the size of the forehead, eyes, nose, and mouth of infant faces, and found that features present in human infants (a round face, a high forehead, big eyes, a small nose, and a small mouth) were defined as “high” Kindchenschema features. They found that cuteness ratings were positively related to the degree of the Kindchenschema, and that the high baby-schema infants elicited stronger motivation for caretaking than the unmanipulated and the low baby-schema infants. Indications of immaturity, therefore, promote parental nurturing and caretaking at a specific time in development, reflective of an ontogenetic adaptation (Bjorklund, 1997; Oppenheim, 1981).

Further evidence that neotenous infant faces are related to triggering caretaking behavior from adults, the preference for neotenous infant faces emerges around puberty and seems to have a hormonal link. Fullard and Reiling (1975) found that preferences for neotenous facial features did not appear until adolescence. Before puberty, children did not differ in their preferences when asked to select whether they would prefer to view an

adult face or an infant face. Fullard and Reiling (1975) also found that girls, on average, began exhibiting preferences for neotenous facial features two years earlier than boys, suggesting that biases towards signals of immaturity might be related to the emergence of puberty (and possible parenthood). Sprengelmeyer and colleagues (2009) investigated both men and women during early adulthood (19 – 26 years), middle adulthood (45 – 51 years), and later adulthood (53 and older) on their perceptions of pictures of infants that were manipulated to reflect varying levels of cuteness. Women were more sensitive to varying levels of cuteness during early to middle adulthood compared to women in later adulthood and men of any age. This work provides support that biases toward infantile features seem to be specific to times during development when women are more likely to find themselves in a caregiving role, possibly mediated by hormones.

Unique Brain Activation for Baby Schema

There also seems to be a neural basis for baby schema. Recently, the neural responses to infant faces compared to that of adult faces was also examined. Positing that processing of infant faces may be different because of its importance in eliciting parental responsibility and care, Swain, Lorberbaum, Kose, and Strathearn (2007) used fMRI to examine parental responses to faces of their own infants in comparison to those of other infants. They found slower activity to own infants in striate and extrastriate visual areas, as well as in reward-related areas such as the amygdala, anterior cingulate, and nucleus accumbens (see also Ranote et al., 2004 for similar findings). A more recent study tested whether there is brain activation exclusive to infant faces when compared to viewing adult faces, explicitly testing whether there is dedicated neural activity for processing infant faces. Using magnetoencephalography (MEG), Kringelbach et al. (2008) found

specific brain activity in medial orbitofrontal cortex (mOFC), an area implicated in reward behavior, when viewing infant faces, but not when viewing adult faces. Furthermore, they found increased power of activity in the right fusiform face gyrus (FFA) shortly after the activation in the mOFC. These findings suggest that the right FFA is receiving feedback from the mOFC exclusively when viewing infant faces, providing the foundation for a brain basis of the “innate releasing mechanisms” posited by Lorenz (1943).

Extending this research, Glocker et al. (2009) sought to dissociate the brain responses to baby schema from the brain responses to infants, in general. Using fMRI, they measured brain activity of adults viewing images of infants that varied on baby schema. They found unique activity in the mesocorticolimbic system, specifically the nucleus accumbens, when viewing the highly neotenous faces, but not when viewing faces rated as less neotenous, furthering the findings of unique activity in the reward systems of the brain.

Present Studies

Taken together, the findings highlighted above support Lorenz’s (1943) and Bowlby’s (1969) hypotheses regarding infant faces. The goal of the studies proposed here is to examine the behavioral, attentional, and emotional effects of baby schema.

Experiment 1 tested whether viewing infant faces triggers feelings of empathy, also arguably important when taking care of an infant (Preston, 2013). Experiment 2 examined whether neotenous stimuli influences visual perception by testing whether viewing human infant faces increases visual contrast sensitivity, a dimension of early vision. Lastly, Experiment 3 investigated whether neotenous stimuli influences behaviors

associated with caretaking, namely fine-motor abilities and behavioral carefulness. I expect to find that viewing infant faces will trigger baby schema, which will produce differences in infant-care related behaviors, attention, and emotional responsiveness

II. EXPERIMENT 1 - BABY SCHEMA AND EMPATHY

Empathy is of particular interest here given its role in fostering prosocial behavior, such as caretaking and parenting (Eisenberg & Fabes, 1998; Hoffman, 2000; Staub, 1979). Although a number of definitions of *empathy* exist, there is a wide consensus that empathy comprises two dimensions: cognitive empathy and affective, or emotional, empathy (Baron-Cohen & Wheelwright, 2004; Cox et al., 2012; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). Cognitive empathy is the ability to understand what another person might feel or think. Affective, or emotional, empathy is the ability to experience and share the emotions of others (Eisenberg & Fabes, 1998, p. 702).

Theories and research from different fields show that cognitive and affective empathy are dissociable phenomena. They are based on different neurocognitive mechanisms, and deficits in cognitive and affective empathy have differential effects. For example, low affective empathy, but not low cognitive empathy, is related to bullying (Jolliffe & Farrington, 2006b) and narcissistic personality disorder (Ritter et al., 2011). In turn, low cognitive empathy, but not low affective empathy, is related to offending (Jolliffe & Farrington, 2004), schizophrenia (Ritter et al., 2011), and borderline personality disorder (Harari, Shamay-Tsoory, Ravid, & Levkovitz, 2010). Furthermore, altruistic motivation for in-group members is associated with cognitive but not affective empathy (Mathur, Harada, Lipke, & Chiao, 2010). According to the most comprehensive theory on empathy, Baron-Cohen's empathizing-systemizing theory (Baron-Cohen,

2003), empathy is one of the two evolutionarily primary cognitive systems is found in degrees in the general population. Whereas systemizing works well for understanding inanimate, physical phenomena, empathizing is a powerful way of understanding the social world.

There has been some research examining the emotional effects of baby schema. For example, children high in Kindchenschema are rated highly on positive attributes such as warmth and honesty (Berry, Zebrowitz, & McArthur, 1985). Furthermore, Kindchenschema has a positive emotional influence on mother-child interaction. Mothers of cute babies exhibit more affectionate interactions compared to mothers with relatively less-neotenous babies (Langlois, Ritter, Casey, & Sawin, 1995). Recent studies by Sherman and colleagues (2009; 2013) found across two experiments that adults report more positive emotions, scoring higher in self-report measures of positive affect, tenderness, and calmness after viewing neotenous faces of puppies and kittens.

These studies, however, did not examine empathy. Studies examining the effects of baby schema on empathy are oddly scarce, and are typically found in early literature examining the prevention of child abuse. For example, Milner, Halsey, and Fultz (1996) found that low-risk mothers reported an increase in empathy after viewing images of crying infants, while mothers who were categorized as high-risk for child abuse reported no increase in empathy and instead reported an increase in feelings of hostility. Others have replicated these findings (Caselles and Milner, 2000; Perez-Albeniz & de Paul, 2003; Wiehe, 2003) and extended the findings with fathers (Perez-Albeniz & de Paul, 2004), supporting theories that suggest that a lack of empathy and the presence of negative affect precede abusive behavior.

These results suggest that the tendency to respond emotionally, or empathically, to infantile physical features may promote care to infants. The experiment examined whether viewing infant faces triggers feelings of empathy. Specifically, I hypothesized that adults will have higher self-reported ratings of emotional empathy after viewing neotenous stimuli (both human infant and animal infant stimuli) than adults viewing non-neotenous stimuli (human adult and neutral stimuli).

III. EXPERIMENT 1 - METHOD

Participants

Two hundred and seven participants completed this study. Participants were recruited in two ways. The first method utilized the psychology subject pool at Florida Atlantic University ($N = 31$, 23 female, 8 male; Mean age = 20.41 years, range = 18–44). Participants were granted one research credit for their participation. The second method was online through Amazon’s Mechanical Turk (MTurk; $N = 176$; 65 female, 111 male; mean age = 32.75 years, range = 20–64). Participants recruited through MTurk were compensated 15¢ to complete a survey that was advertised as follows: “Short Survey (5–10 minutes to complete). In this survey we ask you to answer a short questionnaire.” Participants were assigned randomly to one of four between-subjects conditions: human infant faces, animal infant faces, human adult faces, and neutral stimuli.

Materials

Stimuli. Sixteen pictures of each stimulus type were used for each condition. Human adult stimuli were obtained from the FACES database compiled by Ebner et al. (2010). Human infant face stimuli were obtained through royalty-free images online and matched for size. The pictures included nine images of infant girls and nine images of infant boys. Pictures of puppies and kittens were also obtained through royalty-free images online, and included size matched pictures of eight kittens and eight puppies on a

plain white background. Lastly, pictures of furniture were also gathered from royalty-free websites and matched for size (see Figure 1 for a sample of the stimuli).

Empathy measure. The eight-item form of the Empathy Quotient (EQ-8) constructed by Loewen, Lyle, and Nachshen (2009) was used. The eight-item version of the Empathy Quotient was derived from Wakabayashi et al.'s (2006) analysis of the full 60-item EQ. They presented a principal components factor analysis of a 60-item scale (Wakabayashi et al., 2006, Table 2). Using Wakabayashi's data, the four affirmative EQ questions with the highest principal component factor loadings and the four reversal items with the highest factor loading were chosen for the eight-item version (the questions are found in Appendix A). Participants rated each item on a 4-point Likert-type scale with 1 being "Strongly Agree" and 4 being "Strongly Disagree". An empathy score was then created by aggregating each participant's rating on all 8 items, with a lower score denoting higher levels of empathy.

Procedure

Participants logged onto the survey using a link provided. After participants provided informed consent, demographic questions were presented. They were then provided with the stimuli for their condition (either infant faces, adults faces, etc.). Participants then answered the short EQ-8 questionnaire. After completing the questionnaire, participants were thanked for their time.

IV. EXPERIMENT 1 – RESULTS

Mean empathy scores for each condition are displayed in Table 1. Empathy scores were examined using a one-way ANOVA with planned orthogonal contrasts. Planned orthogonal contrasts were used to test the hypothesis that viewing neotenous stimuli triggers feelings of empathy. This method was chosen for this analysis because the hypothesis predicted one particular pattern of effects: that participants who viewed the neotenous stimuli (both human infant and animal infant) would show higher levels of empathy compared to participants who viewed non-neotenous stimuli (either human adult or neutral stimuli). One-tailed probability statistics were used given the one-tailed, directional hypothesis. When including all four conditions in the model, there was a significant effect for condition on levels of empathy, $F(3, 202) = 2.74, p < .05, \eta_p^2 = .18$. Planned contrasts revealed that viewing neotenous stimuli (either human infant, $M = 20.46, SD = 3.89$, or animal, $M = 21.22, SD = 4.11$) significantly increased empathy compared to viewing non-neotenous stimuli (human adult, $M = 22.23, SD = 2.89$, or neutral stimuli, $M = 21.48, SD = 3.80$), $t(167) \leq -1.94, p < .05$ (1-tailed), $r = .15$. There was no significant difference between viewing only the neutral stimuli compared to all other stimuli conditions, $t(64) = -.29, p < .05$ (1-tailed), suggesting that it is not an effect of viewing faces. Furthermore, there was no significant difference between human infant faces stimuli and animal infant face stimuli, $t(90) = -.98, p > .01$ (1-tailed), further suggesting that the difference is between neotenous stimuli and non-neotenous stimuli.

To examine gender differences or interactions between condition and gender, empathy scores were examined by a 2 (Gender: Male, Female) x 4 (Condition: Human Infant, Human Adult, Animal Infant, Neutral) between-subjects ANOVA. Participants who viewed infant faces had the lowest scores on the empathy measure ($M = 20.46$, $SD = 3.89$), followed by those who viewed Animal Faces ($M = 21.22$, $SD = 4.11$), Neutral Stimuli ($M = 21.49$, $SD = 3.8$), and Adult Faces ($M = 22.23$, $SD = 2.8$). The main effect for Condition, however, only approached significance, $F(3,205) = 2.15$, $p = .095$. This is in line with the analysis above, suggesting a linear trend with those viewing human infant faces having the lowest empathy scores (which denote higher empathy levels) followed by animal infant stimuli, neutral stimuli, and human adult stimuli.

The analysis also produced a significant main effect for Gender, with females having significantly lower scores on the empathy measure ($M = 20.56$, $SD = 3.61$) than males ($M = 21.78$, $SD = 3.74$), $F(1,205) = 5.45$, $p = .021$, suggesting that females had greater empathy level than males. This is in line with the empathy literature, supporting the consistent findings that females have higher empathy levels than males (Wakabayashi et al., 2006). Finally, there was no significant interaction, with no significant difference between empathy scores of males who saw infant faces ($M = 21.15$, $SD = 3.99$), adult faces ($M = 22.48$, $SD = 2.74$), animal infant faces ($M = 21.35$, $SD = 4.24$), or neutral stimuli ($M = 22.52$, $SD = 3.58$) when compared to females who saw infant faces ($M = 19.8$, $SD = 3.72$), adult faces ($M = 21.91$, $SD = 2.91$), animal infant faces ($M = 20.82$, $SD = 3.84$), or neutral stimuli ($M = 20.3$, $SD = 3.79$), $F(3,205) = 0.496$, $p > .05$. Mean empathy scores for each condition by gender are also displayed in Table 1.

V. EXPERIMENT 1 - DISCUSSION

In this study, the effect of viewing neotenous stimuli on a self-report measure of empathy was examined. Participants were exposed to either neotenous stimuli in the form of human infants or animal infants (puppies and kittens) or non-neotenous stimuli in the form of human adult or neutral stimuli (pictures of furniture). The pattern of results observed in this investigation revealed that viewing neotenous stimuli significantly increased participants' rating of their empathy when compared to participants who viewed non-neotenous stimuli.

These findings suggest that empathy is one mechanism triggered by baby schema. Empathy may be important for understanding child abuse and how empathy relates to child-directed behavior, as indicated by studies showing that mothers who are at low-risk for child abuse respond empathetically to photos of infants, while those who are categorized as high-risk for child abuse do not show an empathic response. These results suggest that the tendency to respond emotionally, or empathically, to infantile physical features may promote care to infants.

With regard to gender, although women rated themselves as more empathic overall, there was no significant interaction between condition and gender. This suggests that women and men do not differ in their empathic responses to neotenous stimuli. From an evolutionary perspective, it is typically hypothesized that it is adaptive for infants to attract more attention from women than men since women have typically served as the primary caretakers throughout evolutionary history (Hrdy, 2009). However, given that it

is equally important for both males and females to maximize the chances of successful reproduction *and* survival of their offspring, it is therefore less obvious to expect gender differences.

A couple of limitations exist in this study. First, the empathy measure used in this study measures trait empathy rather than state empathy (sometimes also termed dispositional or affective empathy). Trait empathy refers to how globally empathic a person is, while state empathy refers to how empathic they feel at any given moment. Examining changes in state empathy may be a more valid way of examining whether baby schema triggers changes empathy. Empathy as a construct has been difficult to study and test due to variations in definitions and measurements (see de Vignemont & Singer, 2006; Preston & de Waal, 2002; Taylor & Signal, 2005), and these difficulties poses a continuing problem for researchers and theorists (Chlopan et al., 1985; Eisenberg & Strayer, 1987; Preston & de Waal, 2002). Future research could alleviate these issues by using multiple empathy measurement tools to assess the measurement most sensitive to emotional responding. Furthermore, potentially examining non-survey measures of empathy, such as possible hormonal links or behavioral empathy measures, in conjunction to empathy measures may be explanatory of the relationship between baby schema and its influence on empathy.

Additionally, this study did not control for the parental status of participants. Others found differences between parents and non-parents in their response to infantile stimuli. As expected, parental status turned out to be a consistent significant predictor of baby schema, suggesting that parents may more sensitive to the BSE (Lehmann, Huis in't

Veld, & Vingerhoets, 2013). Future research should examine parental status as a covariate to examine whether the baby schema effect is indiscriminate to parental status.

VI. EXPERIMENT 2 - BABY SCHEMA AND EARLY VISUAL PROCESSES

Attention allows people to select a subset of information and grant it priority for processing. Attending to information in the environment could play an even more substantial role when that information is evolutionarily relevant. Indeed, there is evidence that an evolutionarily relevant stimulus facilitates both the speed with which information is processed and the likelihood that it will be processed (Jiang et al. 2006; Hoffmann et al., 2012; Anderson & Phelps, 2001; Vuilleumier & Schwartz, 2001). For example, research examining the influence of emotional stimuli (Jiang et al. 2006) and threatening stimuli (Hoffmann et al., 2012) on subconscious attention has found that processing of these stimuli can occur independently of conscious awareness. Salient cues in a visual scene can attract visual attention and enhance information processing at the attended location.

For a cue to attract visual spatial attention, the cue needs to be perceived. However, it makes ecological and evolutionary sense for important events to influence observers' spatial attention even before the observer becomes aware of the event. For example, Jiang et al. (2006) examined whether invisible erotic images of males and females influence spatial attention. They used a Posner cuing paradigm, a common task often used to assess an individual's ability to shift attention, and interocular suppression, where an image presented to one eye is suppressed by a flash of another image presented

to the other eye, to suppress erotic images from being consciously perceived. After each image presentation, participants had to indicate the orientation of a briefly presented Gabor patch, a sine wave grating seen through a constrained visual window (see Figure 2 for example of a Gabor patch), that was presented to either the left or right side of the fixation point. Looking at the results for men and women independently, Jiang et al. (2006) found that male participants were more accurate when the Gabor patch followed the invisible image of a nude female and less accurate when followed by an invisible image of a nude male. Female participants, comparably, showed more accuracy when the Gabor patch was followed by an invisible image of a nude male, but did not, however, have the “repelled” reaction when presented with invisible images of nude females. These findings suggest that the invisible images affected participants’ spatial attention ability.

Jiang et al. (2006) suggest that their findings make evolutionary and ecological sense; highly aversive, appealing, or threatening stimuli trigger emotional brain systems, specifically in the amygdala, while redirecting spatial attention abilities. Brosch, Sander, and Scherer (2007), in line with the reasoning of Jiang et al. (2006), also hypothesized that throughout evolution the human brain became specialized to preferentially perceive stimuli that have high biological significance. With neonates as a prototypical example of a highly biologically relevant stimulus, they tested whether pictures of infants displaying Kindchenschema have a facilitating effect on the attentional system when compared with pictures of adults. They also tested whether pictures of cats and dogs, which were artificially selected to possess Kindchenschema-like features, would also modulate attention. They used a dot-probe test, where participants were momentarily presented

with a dot on either the left or right side of the screen after being presented with a cue (in this case either an image of an adult or an infant) in that location, and asked to state which side of the screen the dot appeared. Brosch et al. (2007) predicted that increased allocation of attention to highly relevant stimuli would lead to enhanced processing and perceptual analysis of the event and trigger synchronized changes in the autonomic, motor, and motivational system to prepare the organism for adaptive responses to the stimulus event. The results indicated that photos of human infants captured attention more than photos of adult faces. Additionally, this effect was specific for human stimuli; puppies and kittens did not capture attention more than adult cats and dogs. Finally, they found no sex differences, suggesting that infant faces are biologically significant for men and women and are therefore prioritized by the attention system.

These finding suggests enhanced attentional processing of evolutionarily relevant stimuli. The goal of the present study is to extend this research by examining whether infant faces influence early visual processes, irrespective of attention. Attention can be allocated to a relevant location either by overtly moving the eyes or by covertly deploying attention to that location (Posner, 1980). Covert attention, the method used here, allows the observer to monitor the environment and informs subsequent eye movements. Research has established that covert attention enhances perception performance on a variety of perceptual tasks, such as visual search (Carrasco & McElree, 2001), letter identification (Talgar, Pelli, & Carrasco, 2004), and texture segmentation (Yeshurun & Carrasco, 1998, 2000). Furthermore, covert attention also enhances processes carried out by the primary visual cortex, such as spatial resolution (Carrasco, Williams, & Yeshurun, 2002; Yeshurun & Carrasco, 1998, 2000) and contrast sensitivity

(Cameron, Tai, & Carrasco, 2002; Carrasco, Ling, & Read, 2004; Carrasco, Penpeci-Talgar, & Eckstein, 2000; Phelps, Ling, & Carrasco, 2006).

Given the attentional benefits of evolutionary relevant stimuli and the research showing that covert attention affects early visual processes (particularly contrast sensitivity), the goal of the present study is to determine whether baby schema interacts with attention to enhance the processing of early visual perception. Unlike Borsch et al. (2007) who tested whether baby schema facilitated attentional shifting, this study tested whether baby schema results in an increase in early visual processing. This experiment was modeled using the paradigm from Phelps et al. (2006) who examined whether emotion, particularly fear, influences early visual processing. Participants were presented with stimuli of fearful faces and neutral faces before being presented with a target stimulus and asked to judge the orientation of that target as the contrast varied. They found that fearful faces enhanced visual perception, as evidenced by greater contrast sensitivity.

Contrast sensitivity is used here to understand the relationship among baby schema, attention, and early vision since enhanced contrast sensitivity brought about by an arousing cue would allow observers to better detect the presence of potentially evolutionarily-relevant stimuli (infants) and to respond to them more effectively. Contrast sensitivity refers to the ability of the visual system to distinguish between an object and its background. For example, a black cat on a white snowy background is an example of high contrast, while a white cat on a white snowy background is an example of low contrast. As in Phelps et al. (2006), the paradigm randomly presented faces of human infants, human adults, and scrambled faces (control condition), and measured the effect

of the face on contrast thresholds (e.g., the minimum contrast level of the Gabor patch) for a subsequent orientation discrimination task. An orientation discrimination task was used because performance on this task improves with contrast (e.g., Cameron et al., 2002; Carrasco et al., 2000; Foley & Legge, 1981). I predicted that if baby schema enhances perception, irrespective of attention, the presence of an infant face would result in lower contrast thresholds (i.e., detecting the tilt of the gabor patch at lower contrast levels) than the presence of an adult or scrambled face. In other words, the level of contrast needed to accurately perform the orientation discrimination task will be lower when the stimuli are preceded by an infant face than when the stimuli are preceded by an adult or scrambled face.

VII. EXPERIMENT 2 - METHOD

Participants

Nine undergraduate students (5 females; $M_{age} = 22$) from the Florida Atlantic University subject pool participated in this study. They were all naïve to the purpose of the study and had normal or corrected-to-normal vision. None of the participants were parents.

Materials

Consistent with Phelps et al. (2006), stimuli were generated using MATLAB and presented on a standard computer monitor. Each trial began with fixation on a central cross ($0.8^\circ \times 0.8^\circ$) presented to each eye. The target display consisted of four Gabor patches (sinusoidal gratings enveloped by a Gaussian; 2 cycles/deg, $7.9^\circ \times 7.9^\circ$), which were centered at 11 degrees eccentricity on the intercardinal meridians. One Gabor patch was tilted (8 degrees) either clockwise or counterclockwise (target stimulus), and the other three were oriented vertically (distractor stimuli). Both the location and the tilt of the target Gabor were random from trial to trial. This study used the method of constant stimuli to obtain psychometric functions. In each trial, the contrast of the Gabors was randomly sampled from a set of Michelson contrasts in nine log increments from 4% contrast to 20% contrast (see Figure 3 for example of four contrast levels). The four Gabor stimuli were preceded by either an adult face, an infant face, or a scrambled face at the center of the screen ($5^\circ \times 6.6^\circ$ of visual angle). The stimuli set included 10 unique exemplars of each category (5 female faces and 5 male faces), for a total of 20 facial

stimuli and 10 scrambled images.

Procedure

Participant viewed the display binocularly at a distance of 83 cm from the monitor, with their heads stabilized by a chin rest that was adjusted for their height and comfort. They were asked to fixate on the central fixation point throughout the experiment. On each trial, a fixation point appeared for 500 ms and was followed by the brief flash of either an adult face, infant face, or scrambled face in the center of the screen (75 ms). Following a blank interstimulus interval of 50 ms, the four Gabor stimuli (one tilted target and three distractors) were presented for 40 ms. The 165-ms interval between cue onset and stimulus offset was chosen to impede eye movements, therefore ensuring that the participants performed the task under conditions of covert attention (Mayfrank, Kimmig, & Fischer, 1987).

Participants then performed a two-alternative forced-choice (2AFC) orientation discrimination task for the target Gabor. If the target was tilted to the left, they indicated its orientation by pressing “1.” If it was tilted to the right, they pressed “2.” No feedback was given; both correct and incorrect responses were followed by a tone (please see Figure 4). Each participant completed six experimental blocks of 108 trials each; a third of the trials contained adult faces, a third contained infant faces, and a third contained scrambled faces. The experiment lasted approximately 1 hour.

VIII. EXPERIMENT 2 - RESULTS

Percent accuracy scores for each condition across the nine contrast levels are summarized in Table 2. The data were fit to a Weibull function, with threshold (contrast level at which participants cannot discriminate between conditions with above-chance accuracy) taken at 75%. As seen in the psychometric function in Figure 5, when participants were presented with a human infant face before the target stimuli appeared, there was a slight increase in contrast sensitivity at threshold (17.9% contrast for infant faces vs. 21.8% contrast for adults faces and 23.3% for scrambled faces, see Figure 6). In other words, the level of contrast needed to perform the orientation discrimination task was lower when the stimuli were preceded by an infant face than when they were preceded by an adult or scrambled face. Although participants were more accurate in detecting the tilt of the Gabor patch after viewing infant faces than after viewing adult faces across some of the contrast levels, dependent samples t-test show that this difference was not significant, $t(8) = -.965, p > .36$. Similarly, the differences between both infant faces and the scrambled images, $t(8) = -.886, p > .40$, and adult face and scrambled faces, $t(8) = -.333, p > .75$, were also not significant.

IX. EXPERIMENT 2 - DISCUSSION

The goal of this study was to examine the effect of baby schema on early visual processing, namely contrast sensitivity. Findings indicate that contrast sensitivity was only marginally better after viewing neotenous stimuli than after viewing adult or scrambled faces.

Although this is the first study to examine the influence of baby schema on early visual processing, other studies examining the cognitive benefits on attention have consistently found that baby schema influences attentional processing (Brosch et al. 2007, Nittono et al., 2012). While it is possible that baby schemas do not influence early visual processing, a few alternative explanations exist as to why these results may have emerged. First, the protocol lasted about an hour, possibly too long for participants to sustain adequate focus, visual acuity, and attention. Many of the participants noted that their eyes were tired, head hurt from the flashing, or had difficulty focusing on the center of the screen (where the cues were presented). Additionally, and possibly consequently, error scores were particularly high in this sample (see Figure 6), possibly masking a significant difference. It is possible that collecting data from more participants, and splitting up the testing sessions could yield a significant difference.

X. EXPERIMENT 3 - THE BEHAVIORAL INFLUENCE OF BABY SCHEMA

The research discussed above highlights how adults may prefer and attend to infants' neotenous features, but Lorenz's (1943) baby schema is posited to influence caretaking *behavior*. Research on the influence of neoteny on behavior is rather sparse. One study by Sherman, Haidt, and Coan (2009) presented images of puppies and kittens (neotenous stimuli) or adult cats and dogs (non-neotenous stimuli), and asked participants to complete a fine-motor dexterity task. This fine-motor task measured behavioral carefulness, and taking care of a small infant requires fine-motor skill and slow, deliberate movements (Sherman et al., 2009). Participants who viewed images of puppies and kittens performed better on the measure than those who viewed images of adult cats and dogs. Although this study was the first to examine behavioral carefulness, arguably an important attribute when taking care of a small infant, it has limitations. First, the measure used to assess behavioral carefulness was the game "Operation" (Hasbro, Pawtucket, RI). They used this game because it was a comparable task to the O'Connor tweezer dexterity task (Lafayette Instruments, Lafayette, IN), a standardized fine-motor skill test, which could be measured without time constraints (the score a participant receives in the O'Connor tweezer dexterity task incorporates speed). Although the use of "Operation" could be a valid task to measure behavioral carefulness, other, more valid and reliable, dexterity tasks could be more useful for identifying differences in fine-motor skill upon triggering baby schema. Furthermore, Sherman and colleagues only used images of animals (specifically canines and felines), with no comparison to human infant

faces. This is not the first study to use nonhuman stimuli; much of the literature testing adult preferences and attention to neoteny uses images of cute nonhumans (Lehmann, Huid in't Veld, & Vingerhoets, 2013, Nittono et al., 2012). These studies typically find that this baby-schema effect extends to both humans and nonhumans, arguably due to artificial selection through breeding practices. A study, using the same animal stimuli and methodology discussed above, recently replicated the findings of Sherman et al. (2009), finding that adults viewing baby animals perform better and faster when playing Operation than adults who viewed images of adult animals (Nittono et al., 2012). They further extended this finding on two non-motor visual search tasks, with accuracy increasing after viewing baby animals.

This study attempted to replicate the findings of Sherman, Haidt, and Coan (2009) while using human infant faces along with the animal stimuli used in their study. Additionally, this study tested whether this effect exists when a mirror-tracing task, a fine-motor dexterity task where both time and error can be objectively measured. It is hypothesized that the increased behavioral carefulness effect will translate to stimuli from human infants, resulting in lower error scores (increase fine motor skill) and longer time to complete (behavioral carefulness) in the mirror-tracing task.

XI. EXPERIMENT 3 - METHOD

Participants

Eighty-six undergraduate students from the Florida Atlantic University subject pool participated in this study (46 females; $MAge = 20.39$, $SD = 3.48$). Participants were randomly assigned to one of four between-subjects conditions for the picture-viewing task: human infant faces, animal infant faces (puppies and kittens), human adult faces, or neutral stimuli (furniture).

Materials

Stimuli. Stimuli for this experiment were the same as for Experiment 1.

Fine motor task. The Mirror Tracing task (Lafayette Instrument, Lafayette, IN) was used for this experiment as it is a valid and reliable measure to examine multiple psychological phenomena such as memory and fine motor skill (Allen, 1948; Tsao, 1950), and is not constrained by a time limit, allowing for completion time to be measured.

The participant's task was to trace a pattern, a six-pointed star made up of two parallel lines approximately $\frac{1}{4}$ " apart, from visual cues that are reversed and inverted by a mirror. The pattern was attached to the board and is blocked from view by a metal shield that prevents the participant from looking directly at his or her hand or the pattern (see Figure 7 for illustration of the mirror tracing task). Errors were tallied by counting the

number of times the subject touched or crossed over one of the sides of the star. Time to complete the task in seconds was also recorded.

Procedure

In this between-subjects design, participants were randomly assigned to one of the four stimulus conditions (i.e., infant faces, adult faces). Participants completed a practice trial with the mirror-tracing task to get familiar with the task. They then completed the pre-test trial of the mirror-tracing task. Time to complete the task and error was recorded. They were then shown a slideshow of the stimuli (of one of the four conditions). The slideshow was displayed on a computer screen on a table adjacent to where they completed the fine-motor task. During the slideshow participants were asked to rate each image on a 5-point Likert-type scale on how pleasing the image was. This question was a way to ensure that participants looked at the images; during preliminary pilot testing, looking times suggested that participants were simply flipping through the slideshow so that the experiment would end faster and not actually looking at the stimuli. Finally, participants completed the mirror-tracing task again. A pre-test – post-test design was chosen to control from within-person variability in fine-motor abilities. Furthermore, this method was used in other studies examining the affect of baby schema on behavior (Sherman et al., 2009; 2013).

XII. EXPERIMENT 3 - RESULTS

Mean differences (posttest-minus-pretest) in both error and time are presented by gender and condition in Table 3. To examine whether participants significantly differed in number of errors and completion time for the mirror-tracing task between pre-test and post-test, a 4 (Condition) x 2 (Gender) independent ANOVA was conducted for each dependent measure.

Difference in Time between Pre-test and Post-test

All groups, on average, took less time to complete the mirror drawing task on the posttest relative to the pretest, reflective of a practice effect. Although participants who viewed infant faces took, on average, less time to complete the mirror tracing task compared to their pre-test completion time ($M = -55.28$, $SD = 58.49$) than Adult human faces ($M = -23.82$, $SD = 55.08$), Baby animal faces ($M = -36.48$, $SD = 45.65$), and Neutral stimuli ($M = -41.82$, $SD = 48.26$), the main effect for condition was not statistically significant, $F(3,86) = 1.29$, $p > .05$. Furthermore, when examining gender, there were no significant differences between males ($M = -37.15$, $SD = 52.65$), and females ($M = -40.84$, $SD = 52.18$), $F(1,86) = .741$, $p > .05$. Finally, there was no significant interaction between Gender and Condition, $F(3,86) = .305$, $p > .05$ (see Figure 8).

Difference in Error between Pre-test and Post-test

Similar to the results above, analysis did not reveal a significant difference in error between pre-test and post-test between those who viewed human infant faces ($M = -$

5.0, $SD = 5.66$), human adult faces ($M = -3.91$, $SD = 4.51$), animal infant faces ($M = -4.44$, $SD = 7.16$), and neutral stimuli ($M = -8.69$, $SD = 52.18$). Furthermore, there was no main effect for gender, with men ($M = -5.76$, $SD = 8.23$) and women ($M = -5.32$, $SD = 7.49$) scoring comparable number of errors. Lastly, there was no significant interaction between Gender and Condition, $F(3,86) = 2.01$, $p > .05$ (see Figure 9).

Non-parametric analyses on both Difference in Time and Difference in Error

Upon further examination of the data, analysis of the distribution shows that both the Difference in Time data and Difference in Error data were negatively skewed (skewness = -0.919, Kurtosis = 0.493 and skewness = -1.636, Kurtosis = 1.922, respectively). To statistically test for non-normality in the distributions, a Kolmogorov-Smirnov Test was conducted. The Difference in Time, $D(86) = .179$, $p < .0001$, and the Difference in Error scores, $D(86) = .236$, $p < .0001$, were both significantly non-normal. This violates one of the assumptions needed to properly interpret an ANOVA; therefore, a non-parametric test is required.

To examine whether participants significantly differed in number of errors and completion time for the mirror-tracing task between pre-test and post-test across all four conditions, a one-way independent Kruskal-Wallis test was conducted for each dependent measure. The Kruskal-Wallis test provides a rank for each score, regardless of condition (the lowest score receives a 1, the second lowest score received a 2, etc.). Once each score is ranked, it groups the scores back by condition and analyzes it using a chi-square test. Results revealed that difference in time was not significantly affected by the different conditions, $H(3) = 3.32$, $p > .05$. Additionally, there were also no significant

differences between conditions on difference in error, $H(3) = 1.98, p > .05$ (see Table 4 for summary of ranked data). No follow-up post-hoc tests were conducted.

XIII. EXPERIMENT 3 - DISCUSSION

This study tested the effects of baby schema on fine motor skill. Results revealed no significant difference between conditions on both difference in time or difference in error. In fact, even though not statistically significant, when examining difference in time to complete the mirror tracing task, those who viewed infant faces took *less* time than those who viewed adult, baby animal, and neutral faces. These findings are contrary to previous research. Prior studies consistently and reliably found that baby schema triggers behavioral carefulness and greater fine motor skill (Sherman et al., 2009; 2013, Nittono et al., 2011).

Although these results are surprising, some alternate explanations exist as to why they may have arose. First, the faces of the human infants may have been too standardized. In an attempt to standardize the images, all stimuli included infant faces with neutral facial expressions, direct eye contact with the camera, and with a white background. It is possibly quite rare in a natural environment to encounter a baby with a neutral face staring directly at someone. Typically, babies exhibit a multitude of facial expressions and emotions (Tronick, 1989), and elicit smiling (Goldberg, 1977), pointing (Tomasello, Carpenter, & Liszkowski, 2007), or infant-directed speech (Pegg, Werker, & McLeod, 1992) from an attending adult. Also, by standardizing the pictures, all external markers of overall size were removed. Overall body size and size of head relative to body size is one key baby schema feature, and was absent from these images. It is possible that using stimuli of babies in more naturalistic settings and with the whole body in the image might result in the triggering of baby schema.

Additionally, perhaps the mirror-tracing task was not a measure sensitive enough to gauge differences in fine motor skill. Previous literature used the game Operation (Hasbro Co.), and found significant results, suggesting that a measure that primes adults for “babyiness” (Nittono et al., 2012) might be more valid. Future research can focus on identifying multiple methods of measuring various motor skills to elucidate whether baby schema does

XIV. GENERAL DISCUSSION

The goal of the experiments reported here was to assess the behavioral, perceptual, and emotional effects of human baby schema. Experiment 1 tested whether viewing infant faces triggers feelings of empathy. Participants viewed pictures of human infant faces, animal infant faces, human adult faces, or neutral stimuli, and were then asked to fill out a short 8-item empathy questionnaire. Results revealed a significant difference between conditions, with participants who viewed images of neotenous stimuli (human infant and animal infant stimuli) rated themselves as having higher empathy than participants who viewed non-neotenous stimuli (either human adult or neutral stimuli). This suggesting that viewing stimuli with baby schema results in participants rating themselves as having higher empathy, suggesting an emotional influence of neotenous stimuli.

The second experiment examined whether neotenous stimuli influences visual perception by testing whether viewing human infant faces increases visual contrast sensitivity, a dimension of early vision. Although the means were in the predicted direction, with better overall contrast sensitivity after viewing infant faces than after viewing adult or scrambled faces, these differences were not statistically significant. Previous research has demonstrated that baby schema is an evolutionary relevant stimuli that significantly influences attention. For example, Brosch et al. (2007) found that photos of human infants captured attention more than photos of adult faces, resulting in increased accuracy in a dot-probe task.

Lastly, Experiment 3 investigated whether neotenous stimuli influence behaviors associated with caretaking, namely fine-motor abilities and behavioral carefulness. In a pretest-posttest paradigm, participants completed the mirror-tracing task before and after viewing a slideshow with either human infant faces, human adult faces, animal infant faces, or neutral stimuli. This examination also produced null results. These results do not, however, indicate that baby schema does not influence behavior, as Sherman et al., (2009; 2013) and others (i.e., Nittono et al., 2009) found that viewing neotenous stimuli increases behavioral carefulness on a fine motor task. These findings presented here suggest that there are issues present in the stimuli, the measurements, and/or the protocols.

Table 1. Mean Empathy Scores on the EQ-8 by Gender and Condition

Condition	Gender	Mean	SD	N
Human Infant	Male	21.1471	3.98583	34
	Female	19.8000	3.72432	35
	Total	20.4638	3.88655	69
Human Adult	Male	22.4815	2.73679	27
	Female	21.9091	2.9099	22
	Total	22.2245	2.89978	49
Animal Infant	Male	21.3529	4.23465	34
	Female	20.8182	3.84235	11
	Total	21.2222	4.10592	45
Neutral	Male	22.5217	3.57859	23
	Female	20.3000	3.78501	20
	Total	21.4884	3.80083	43
Total		21.2621	3.72457	206

Table 2. Mean Accuracy Percentages by Contrast and Condition

Contrast	Condition	Mean	SD	N
0.0400	Infant Faces	0.6065	0.14748	9
	Adult Faces	0.6296	0.09648	9
	Scrambled Faces	0.6620	0.13084	9
	Total	0.6327	0.12395	27
0.0489	Infant Faces	0.6759	0.08784	9
	Adult Faces	0.6296	0.14943	9
	Scrambled Faces	0.7037	0.15652	9
	Total	0.6698	0.13324	27
0.0598	Infant Faces	0.7269	0.15466	9
	Adult Faces	0.7083	0.13502	9
	Scrambled Faces	0.6991	0.13626	9
	Total	0.7114	0.13719	27
0.0731	Infant Faces	0.7593	0.17895	9
	Adult Faces	0.7269	0.11620	9
	Scrambled Faces	0.7176	0.14991	9
	Total	0.7346	0.14579	27
0.0894	Infant Faces	0.7593	0.11024	9
	Adult Faces	0.7269	0.11558	9
	Scrambled Faces	0.7176	0.09420	9
	Total	0.7762	0.1041	27
0.1094	Infant Faces	0.7593	0.15278	9
	Adult Faces	0.7269	0.10781	9
	Scrambled Faces	0.7176	0.14649	9
	Total	0.7901	0.13201	27
0.1337	Infant Faces	0.8009	0.10646	9
	Adult Faces	0.7824	0.16667	9
	Scrambled Faces	0.7870	0.16242	9
	Total	0.7840	0.14389	27
0.1636	Infant Faces	0.8148	0.11927	9
	Adult Faces	0.7777	0.14434	9
	Scrambled Faces	0.7593	0.14096	9
	Total	0.8133	0.13195	27
0.20	Infant Faces	0.8241	0.15652	9
	Adult Faces	0.8333	0.09108	9
	Scrambled Faces	0.7824	0.17278	9
	Total	0.8148	0.13932	27

Table 3. Mean Difference in Time and Error Between Pre-Test and Post-Test by Gender and Condition

Dependent Measure	Gender	Condition	Mean	SD	N
Difference in Time	Female	Human Infant Faces	-48.1276	56.4003	10
		Human Adult Faces	-31.2978	50.35425	11
		Animal Infant Faces	-40.5385	55.76082	13
		Neutral Stimuli	-43.8333	51.87894	12
		Total	-40.8381	52.18402	46
	Male	Human Infant Faces	-62.4276	62.68666	10
		Human Adult Faces	-15.6	61.49833	10
		Animal Infant Faces	-31.2	29.89527	10
		Neutral Stimuli	-39.4	46.19091	10
		Total	-37.1569	52.6452	40
	Total	Human Infant Faces	-55.2776	58.49784	20
		Human Adult Faces	-23.8227	55.08388	21
		Animal Infant Faces	-36.4783	45.65072	23
		Neutral Stimuli	-41.8182	48.26281	22
		Total	-39.1259	52.12224	86
Difference in Error	Female	Human Infant Faces	-3.8	5.82714	10
		Human Adult Faces	-3.0909	2.91392	11
		Animal Infant Faces	-7.0769	8.56798	13
		Neutral Stimuli	-6.7432	10.04693	12
		Total	-5.3243	7.48922	46
	Male	Human Infant Faces	-6.2	5.53373	10
		Human Adult Faces	-4.8	5.82714	10
		Animal Infant Faces	-1	2.0548	10
		Neutral Stimuli	-11.0377	12.93437	10
		Total	-5.7594	8.22933	40
	Total	Human Infant Faces	-5	5.66615	20
		Human Adult Faces	-3.9048	4.5045	21
		Animal Infant Faces	-4.4348	7.15939	23
		Neutral Stimuli	-8.6952	11.3738	22
		Total	-5.5267	7.79832	86

Table 4. Mean rank scores for Kruskal-Wallis Test For Difference in Time and Error

Dependent Measure	Condition	Mean Rank	N
Difference in Time	Infant Faces	37.48	20
	Adult Faces	51.36	21
	Baby Animal Faces	42.8	23
	Neutral Stimuli	42.4	22
	Total		86
Difference in Error	Infant Faces	41.63	20
	Adult Faces	44.57	21
	Baby Animal Faces	48.7	23
	Neutral Stimuli	38.75	22
	Total		86

Figure 1. Example of (a) Adult Face, (b) Infant Face, (c) Baby Animal Stimuli, and (d) Neutral Stimuli

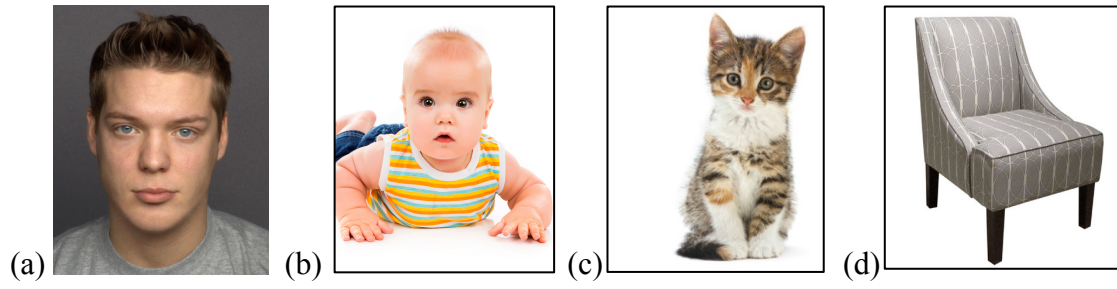


Figure 2. Example of a Gabor Patch. This Gabor Patch is Tilted to the Right



Figure 3. Example of Four Contrast Levels From Low Contrast (a) to High Contrast (d)

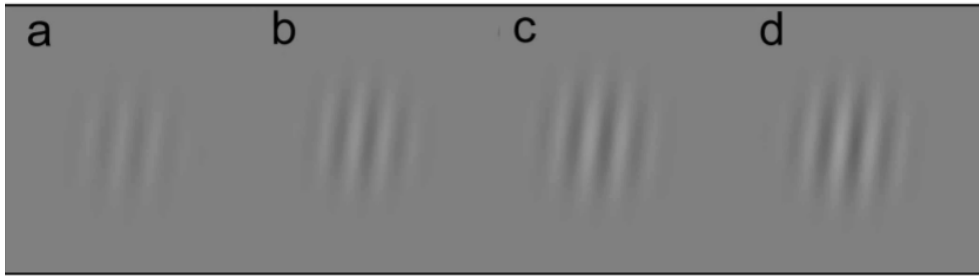


Figure 4. Trial Sequence for Experiment 2

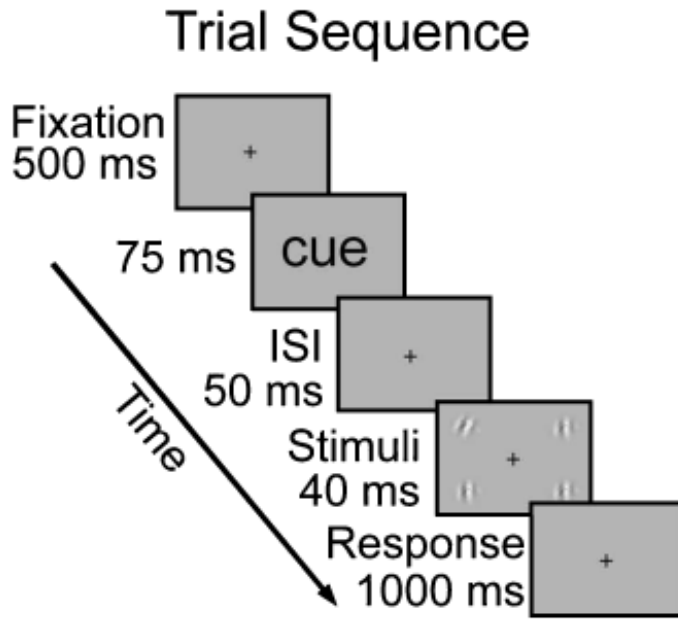


Figure 5. Contrast Psychometric Function Showing Participants' Average Accuracy as a Function of the Stimulus Contrast Level for Each Condition

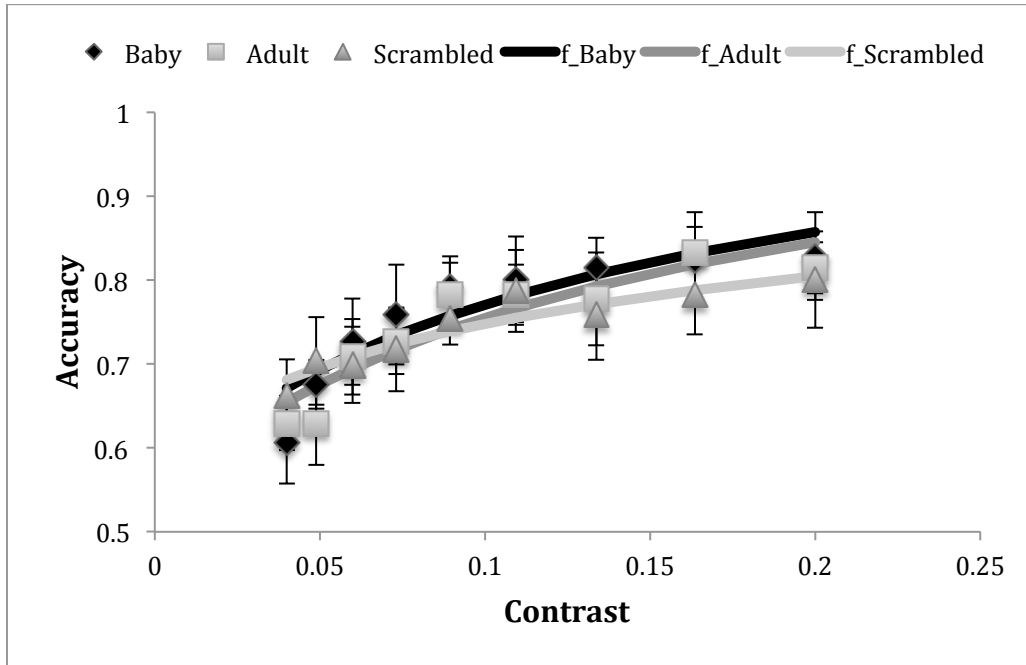


Figure 6. Average Accuracy at Threshold by Condition

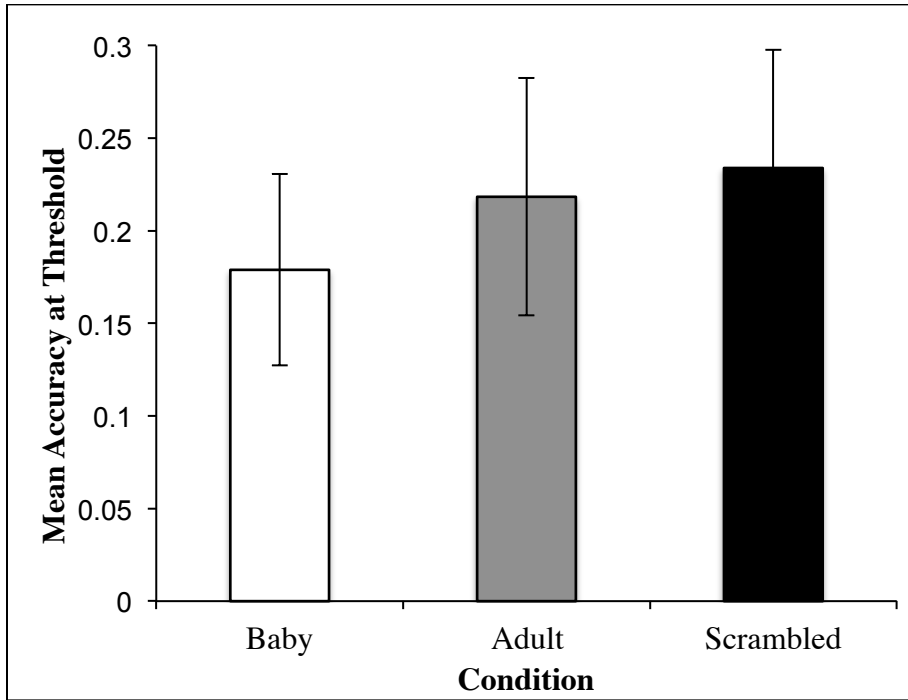


Figure 7. Mirror Tracing Task



Figure 8. Mean Difference in Time Between Pre-Test and Post-Test in Mirror Tracing Task

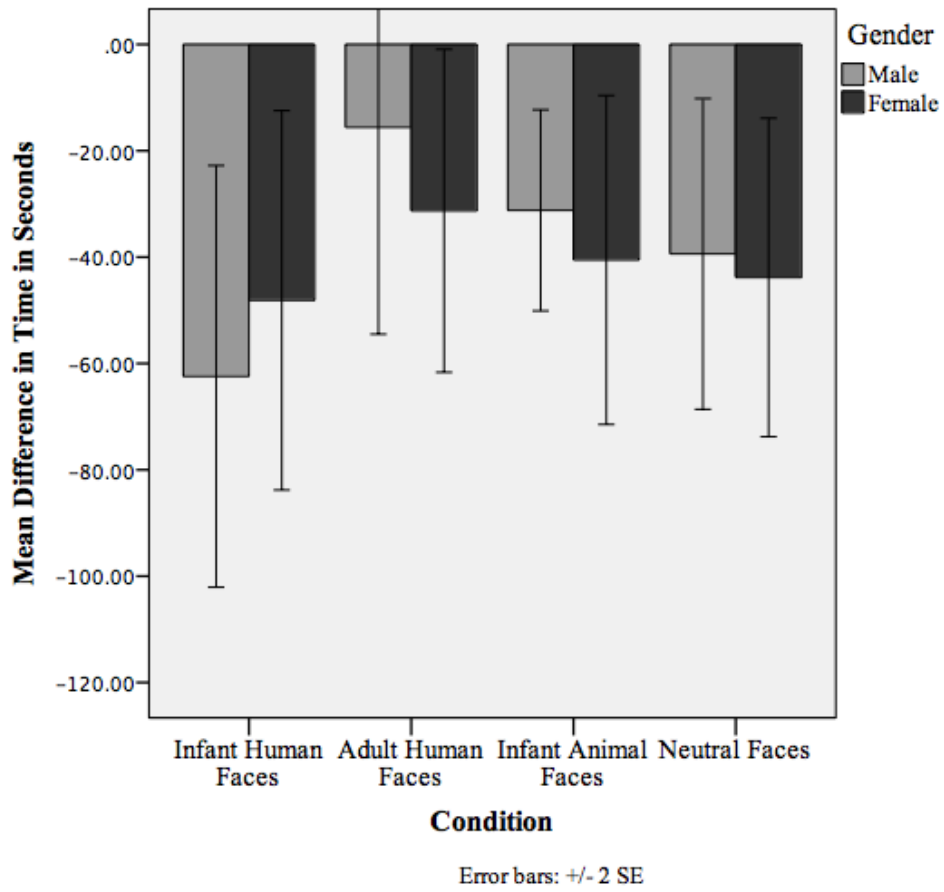
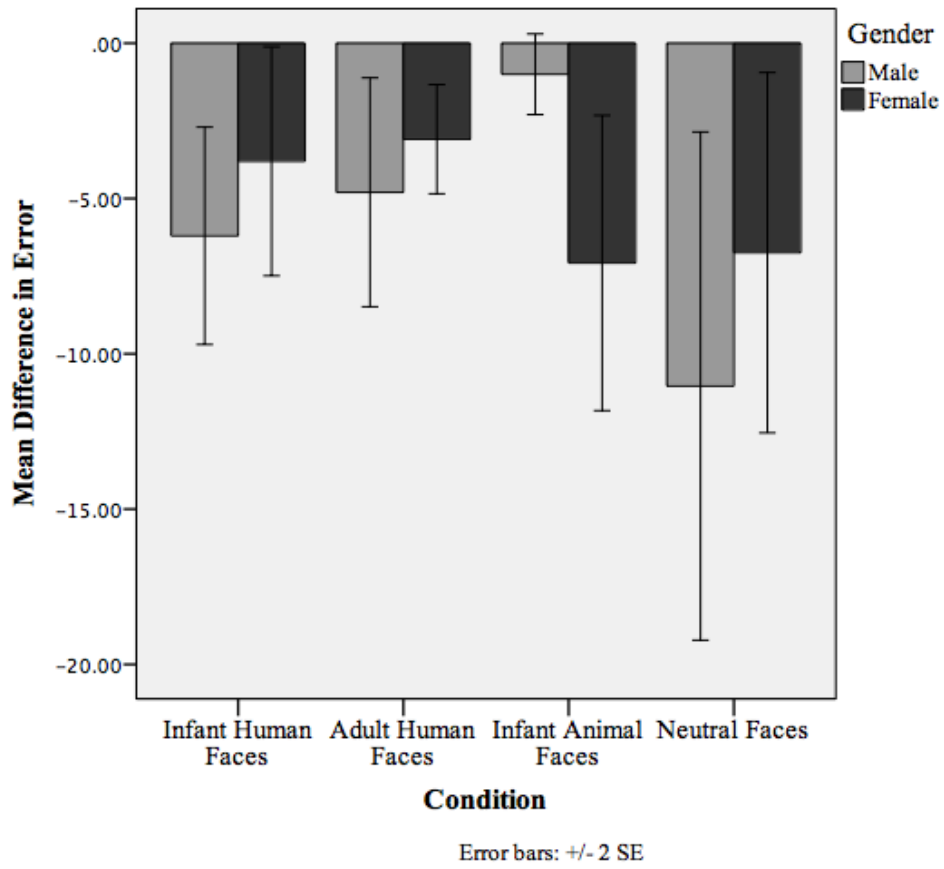


Figure 9. Mean Difference in Error Between Pre-Test and Post-Test in Mirror Tracing Task



Appendix A
EQ-8 questions

1. I find it easy to put myself in somebody else's shoes.
2. I am good at predicting how someone will feel.
3. I am quick to spot when someone in a group is feeling awkward or uncomfortable.
4. Other people tell me I am good at understanding how they are feeling and what they are thinking.
5. I find it hard to know what to do in a social situation.
6. I often find it hard to judge if something is rude or polite.
7. It is hard for me to see why some things upset people so much.
8. Other people often say that I am insensitive, though I don't always see why.

REFERENCES

- Allen, R. M. (1948). Factors in mirror drawing. *Journal of Educational Psychology, 39*, 216-226.
- Alley, T. R. (1981). Head shape and the perception of cuteness. *Developmental Psychology, 17*, 650-654.
- Anderson, A. K., & Phelps, E. A. (2001). Lesions of the human amygdala impair enhanced perception of emotionally salient events. *Nature, 411*, 305-309.
- Baron-Cohen, S. (2003). *The essential difference: Men, women, and the extreme male brain*. London: Penguin.
- Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger Syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders, 34*, 163-175.
- Berry, D. S., & McArthur, L. Z. (1985). Some components and consequences of a babyface. *Journal of Personality and Social Psychology, 48*, 312-323.
- Bjorklund, D. F. (1997). The role of immaturity in human development. *Psychological Bulletin, 122*, 153-169.
- Bjorklund, D. F., Cormier, C., & Rosenberg, J. S. (2005). The evolution of theory of mind: Big brains, social complexity, and inhibition. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory,*

- verbal ability and theory of mind* (pp. 147-174). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Bjorklund, D. F., Ellis, B. J., & Rosenberg, J. S. (2007). Evolved probabilistic cognitive mechanisms. In R. V. Kail (Ed.), *Advances in child development and behavior* (pp. 1-36). New York: Academic Press.
- Bjorklund, D. F., & Hernandez-Blasi, C. (2005). Evolutionary developmental psychology. In D. Buss (Ed.), *Evolutionary psychology handbook* (pp. 828-850). New York: Wiley.
- Bjorklund, D. F., & Pellegrini, A. D. (2000). Child development and evolutionary psychology. *Child Development, 71*, 1687-1708.
- Bjorklund, D. F., & Pellegrini, A. D. (2002). *The origins of human nature: Evolutionary developmental psychology*. Washington, DC: American Psychological Association.
- Bjorklund, D. F., & Sellers, P. D., II. (2011). The evolved child: Adapted to family life. In S. C. Roberts (Ed.), *Applied evolutionary psychology* (pp. 55-77). Oxford: Oxford University Press.
- Bogin, B. (2003). The human pattern of growth and development in paleontological perspective. In J. L. Thompson, G. E. Krovitz, & A. J. Nelson (Eds.), *Patterns of growth and development in the genus Homo* (pp. 15-44). Cambridge, England: Cambridge University Press.
- Bowlby, J. (1969). *Attachment and loss: I. Attachment*. New York, NY: Basic Books.
- Burgess, R., & MacDonald, K. (Eds.). (2005). *Evolutionary perspectives on human development*. Thousand Oaks, CA: Sage.

- Brosch, T., Sander, D., & Scherer, K. R. (2007). That baby caught my eye... attention capture by infant faces. *Emotion, 7*, 685-689.
- Cameron, E. L., Tai, J., & Carrasco, M. (2002). Covert attention affects the psychometric function of contrast sensitivity. *Vision Research, 42*, 949-967.
- Carrasco, M., Ling, S., & Read, S. (2004). Attention alters appearance. *Nature Neuroscience, 7*, 308-313.
- Carrasco, M., & McElree, B. (2001). Covert attention accelerates the rate of visual information processing. *Proceedings of the National Academy of Sciences, 98*, 5363-5367.
- Carrasco, M., Penpeci-Talgar, C., & Eckstein, M. (2000). Spatial covert attention increases contrast sensitivity across the CSF: Support for signal enhancement. *Vision Research, 40*, 1203-1215.
- Carrasco, M., Williams, P.E., & Yeshurun, Y. (2002). Covert attention increases spatial resolution with or without masks: Support for signal enhancement. *Journal of Vision, 2*, 467-479.
- Caselles, C. E., & Milner, J. S. (2000). Evaluations of child transgressions, disciplinary choices, and expected child compliance in a no-cry and a crying infant condition in physically abusive and comparison mothers. *Child Abuse & Neglect, 24*, 477-493.
- Chlopan, B. E., McCain, M. L., Carbonell, J. L., & Hagen, R. L. (1985). Empathy: Review of available measures. *Journal of Personality and Social Psychology, 48*, 635-653.
- Clutton-Brock, T. H. (1991). *The evolution of parental care*. Princeton, N.J: Princeton

- University Press.
- Cox, A., Higgins, T., Gloster, R., & Foley, B. (2012). The impact of workplace initiatives on low carbon behaviours : Case Study Report. Scottish Government. Retrieved from <http://www.scotland.gov.uk/Publications/2012/03/2237>
- Duan, C., & Hill, C. E. (1996). The current state of empathy research. *Journal of Counseling Psychology* 43, 261-274.
- Dunbar, R. I. M., & Spoor, M. (1995). Social networks, support cliques, and kinship. *Human Nature*, 6, 273-290.
- Ebner, N. C., Riediger, M., & Lindenberger, U. (2010). FACES-A database of facial expressions in young, middle-aged, and older women and men: Development and validation. *Behavior Research Methods*, 42, 351-362.
- Eibl-Eibesfeldt, I. (Ed.). (1989). *Human ethology*. New York: Aldine de Gruyter.
- Eisenberg, N., & Fabes, R. A. (1998). Prosocial development. In W. Damon, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (pp. 701-778). New York: Wiley.
- Eisenberg, N., & Strayer, J. (1987). Critical issues in the study of empathy. In: Eisenberg, N., Strayer, J. (Eds.), *Empathy and its development* (pp. 3-13). New York, NY: Cambridge University Press.
- Ellis, B. J. (2005). Determinants of pubertal timing: An evolutionary-developmental approach. In B. J. Ellis & D. F. Bjorklund (Eds.), *Origins of the social mind: Evolutionary psychology and child development*. (pp. 164-188). New York: Guilford.
- Foley, J. M., & Legge, G. E. (1981). Contrast detection and near- threshold

- discrimination in human vision. *Vision Research*, 21, 1041-1053.
- Fullard, W., & Reiling, A. M. (1976). An investigation of Lorenz's "babyness." *Child Development*, 47, 1191-1193.
- Geary, D. C., & Bjorklund, D. F. (2000). Evolutionary developmental psychology. *Child Development*, 71, 57-65.
- Glocker, M. L., Langleben, D. D., Ruparel, K., Loughhead, J. W., Gur, R. C., & Sachser, N. (2009). Baby schema in infant faces induces cuteness perception and motivation for caretaking in adults. *Ethology*, 115, 257-263.
- Goldberg, S. (1977). Social competence in infancy: A model of parent-infant interaction. *Merrill-Palmer Quarterly of Behavior and Development*, 163-177.
- Harari, H., Shamay-Tsoory, S. G., Ravid, M., & Levkovitz, Y. (2010). Double dissociation between cognitive and affective empathy in borderline personality disorder. *Psychiatry Research*, 175, 277-279.
- Hoffman, M. L. (2000). *Empathy and moral development: Implications for caring and justice*. Cambridge, UK: Cambridge University Press.
- Hoffmann, M., Lipka, J., Mothes-Lasch, M., Miltner, W. H. R., & Straube, T. (2012). Awareness modulates responses to the amygdala and the visual cortex to highly arousing visual threat. *NeuroImage*, 62, 1439-1444.
- Hrdy, S. B. (2005). Evolutionary context of human development: The cooperative breeding model. In S. C. Carter, L. Ahnert, K. Grossmann, S. B. Hrdy, M. E. Lamb, S. W. Porges, & N. Sachser (Eds.), *Attachment and bonding: A new synthesis* (pp. 9-32). Cambridge: MIT Press.
- Hrdy, S. B. (2009) *Mothers and Others*. Cambridge, MA: Harvard University Press.

- Jiang, Y., & He, S. (2006). Cortical responses to invisible faces: Dissociating subsystems for facial-information processing. *Current Biology*, *16*, 2023-2029.
- Jolliffe, D., & Farrington, D. P. (2004). Empathy and offending: a systematic review and meta-analysis. *Aggression and Violent Behavior*, *9*, 441-476.
- Jolliffe, D., & Farrington, D. P. (2006). Development and validation of the basic empathy scale. *Journal of Adolescence*, *29*, 589-611.
- Kringelbach, M. L., Lehtonen, A., Squire, S., Harvey, A. G., Craske, M. G., Holliday, I. E., Green, A. L., Aziz, T. Z., Hansen, P. C., Cornelissen, P. L., Stein, A., 2008. A specific and rapid neural signature for parental instinct. *PLoS ONE*, *3*, e1664.
- Landry, S. H., Smith, K. E., Miller-Loncar, C. L., Swank, P. R. (1997) Predicting cognitive-language and social growth curves from early maternal behaviors in children at varying degrees of biological risk. *Developmental Psychology*, *33*, 1040-1053.
- Langlois, J. H., Ritter, J. M., Casey, R. J., & Sawin, D. B. (1995). Infant attractiveness predicts maternal behaviors and attitudes. *Developmental Psychology*, *31*, 464-472.
- Lehmann, V., Huis in't Veld, E. M. J., & Vingerhoets, A. J. J. M. (2013). The human and animal baby schema effect: Correlates of individual differences. *Behavioral Processes*, *94*, 99-108.
- Loewen, P. J., Lyle, G., & Nachshen, J. S. (2009). An eight-item form of the Empathy Quotient (EQ) and an application to charitable giving. Retrieved from crcee.umontreal.ca/pdf/Eight%20Question%20ES_final.Pdf.
- Lorenz, K. (1943). Die angeborenen Formen möglicher Erfahrung [The innate forms of

- potential experience]. *Zeitschrift für Tierpsychologie*, 5, 235-409.
- Mathur, V. A., Harada, T., Lipke, T., & Chiao, J. Y. (2010). Neural basis of extraordinary empathy and altruistic motivation. *Neuroimage*, 51, 1468-1475.
- Mayfrank, L., Kimmig, H., & Fischer, B. (1987). The role of attention in the preparation of visually guided saccadic eye movements in man. In J. K. O'Regan & A. Levy-Schoen (Eds.), *Eye movements: From physiology to cognition* (pp. 37-45). New York: North-Holland.
- Milner, J., Halsey, L., & Fultz, J. (1995). Empathic responsiveness and affective reactivity to infant stimuli in high- and low-risk for physical child abuse mothers. *Child Abuse & Neglect*, 19, 767-780.
- Nittono, H., Fukushima, M., Yano, A., & Moriya, H. (2012). The power of Kawaii: viewing cute images promotes a careful behavior and narrows attentional focus. *PLOS ONE*, 7, e46362.
- Oppenheim, R. W. (1981). Ontogenetic adaptations and retrogressive processes in the development of the nervous system and behavior. In K. J. Connolly & H. F. R. Precht (Eds.), *Maturation and development: Biological and psychological perspectives* (pp. 73-108). Philadelphia: International Medical Publications.
- Pegg, J. E., Werker, J. F., & McLeod, P. J. (1992). Preference for infant-directed over adult-directed speech: Evidence from 7-week-old infants. *Infant Behavior and Development*, 15, 325-345.
- Perez-Albeniz, A., & De Paul, J. (2003). Dispositional empathy in high- and low-risk parents for child physical abuse. *Child Abuse Neglect*, 27, 769-780.
- Perez-Albeniz, A., De Paul, J. (2004). Gender differences in dispositional empathy for

- high and low-risk parents for child physical abuse. *Child Abuse Neglect*, 28, 289-300.
- Phelps, E. A., Ling, S., & Carrasco, M. (2006). Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science*, 17, 292-299.
- Posner, M. I. (1980). Orienting of attention. *The Quarterly Journal of Experimental Psychology*, 32, 3-25.
- Preston, S. D. (2013). The origins of altruism in offspring care. *Psychological Bulletin*, 139, 1305-1341.
- Preston, S. D., & De Waal, F. (2002). Empathy: its ultimate and proximate bases. *Behavioral Brain Science*, 25, 1-20.
- Ranote, S., Elliott, R., Abel, K. M., Mitchell, R., Deakin, J. F. W., & Appleby, L. (2004). The neural basis of maternal responsiveness to infants: An fMRI study. *NeuroReport*, 15, 1825–1829.
- Ritter, J. M., Casey, R. J., & Langlois, J. H. (1991). Adults' responses to infants varying in appearance of age and attractiveness. *Child Development*, 62, 68–82.
- Shamay-Tsoory, S. G., Aharon-Peretz, J., Perry, D. (2009). Two systems for empathy: A double dissociation between emotional and cognitive empathy in inferior frontal gyrus versus ventromedial prefrontal lesions. *Brain*, 132, 617-627.
- Sherman, G. D., Haidt, J., & Coan, J. A. (2009). Viewing cute images increases behavioral carefulness. *Emotion*, 9, 282-286.
- Sherman, G. D., Haidt, J., Iyer, R., & Coan, J. A. (2013). Individual differences in the physical embodiment of care: Prosocial women respond to cuteness by becoming

- more physically careful. *Emotion*, *13*, 151-158.
- Sprengelmeyer, R., Perrett, D. I., Fagan, E. C., Cornwell, R. E., Lobmaier, J. S., Sprengelmeyer, A., et al (2009). The cutest little baby face. Differences in adults' sensitivity to cuteness in infant faces. *Psychological Science*, *20*, 149-154.
- Sroufe, A.L., 2000. Early relationships and the development of children. *Infant Mental Health Journal*, *21*, 67-74.
- Staub, E. (1979). *Positive social behavior and morality: Socialization and development* (Vol. 2). New York: Academic Press.
- Sternglanz, S. H., Gray, J. L., & Murakami, M. (1977). Adult preferences for infantile facial features: An ethological approach. *Animal Behavior*, *25*, 108-115.
- Swain, J. E., Lorberbaum, J. P., Kose, S., & Strathearn, L. (2007). Brain basis of early parent-infant interactions: psychology, physiology, and in vivo functional neuroimaging studies. *Journal of Child Psychology and Psychiatry*, *48*, 262-287.
- Talgar, C. P., Pelli, D. G., & Carrasco, M. (2004). Covert attention enhances letter identification without affecting channel tuning. *Journal of Vision*, *4*, 22-31.
- Taylor, N. & Signal, T. D. (2005). Empathy and attitudes to animals. *Anthrozoös* *18*, 18-27.
- Tomasello, M., Carpenter, M., & Liszkowski, U. (2007). A new look at infant pointing. *Child development*, *78*, 705-722.
- Trevarthen, C. & Aitken, K. J. (2001). Infant intersubjectivity: Research, theory, and clinical applications. *Journal of Child Psychology and Psychiatry*, *42*, 3-48.
- Tronick, E. Z. (1989). Emotions and emotional communication in infants. *American psychologist*, *44*, 112.

- Tronick, E. Z. (2005). Why is connection with others so critical? The formation of dyadic states of consciousness and the expansion of individuals' states of consciousness: Coherence governed selection and the co-creation of meaning out of messy meaning making. In: J. Nadel, & D. Muir (Eds.), *Emotional development: Recent research advances* (pp. 293-315). New York, NY: Oxford University Press.
- Tsao, J. C. (1950). Shifting of distribution of practice in a mirror drawing. *Journal of Experimental Psychology*, *40*, 639-642.
- van IJzendoorn, M. H., Dijkstra, J., & Bus, A. G. (1995). Attachment, intelligence, and language: A meta-analysis. *Social Development*, *4*, 115-128.
- Vignemont, F., & Singer, T. (2006). The empathic brain: How, when, and why? *Trends in Cognitive Science*, *10*, 435-441.
- Vuilleumier, P., & Schwartz, S. (2001). Beware and be aware: Capture of spatial attention by fear-related stimuli in neglect. *NeuroReport*, *12*, 1119-1122.
- Wakabayashi, A., Baron-Cohen, S., Wheelwright, S., Goldenfeld, N., Delaney, J., Fine, D., Smith, R., & Weil, L. (2006). Development of short forms of the Empathy Quotient (EQ- Short) and the Systemizing Quotient (SQ-Short). *Personality and Individual Differences*, *41*, 929-940.
- Wiehe V.R. (2003). Empathy and narcissism in a sample of child abuse perpetrators and a comparison sample of foster parents. *Child Abuse Neglect*, *27*, 541-555.
- Yeshurun, Y., & Carrasco, M. (1998). Attention improves or impairs visual performance by enhancing spatial resolution. *Nature*, *396*, 72-75.
- Yeshurun, Y., & Carrasco, M. (2000). The locus of attentional effects in texture segmentation. *Nature Neuroscience*, *3*, 622-627.

