

EMPATHY AND PROSOCIAL
BEHAVIORS IN INFANCY

By

JANNA M. COLAIZZI

Bachelor of Science in Psychology
Southern Nazarene University
Bethany, Oklahoma
2010

Master of Science in Psychology
Oklahoma State University
Stillwater, Oklahoma
2013

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

EMPATHY AND PROSOCIAL
BEHAVIORS IN INFANCY

Dissertation Approved:

Dr. David G. Thomas

Dissertation Adviser

Dr. Jennifer Byrd-Craven

Dr. Melissa Burkley

Dr. Amanda Morris

ACKNOWLEDGEMENTS

Many sincere thanks are due to a multitude of people without whom this project would not have been possible. First, to my advisor, Dr. David Thomas, for your invaluable support and mentorship—I have appreciated our cycling meetings and the investments you have made in both my education and personal well-being. I have truly learned a great deal from you. Second, to Dr. Stephanie Grant for your guidance in pursuing this academic path—I would not be where I am now if not for you. I would also like to thank Drs. Jennifer Byrd-Craven and Jessica Calvi for your advice and valuable time teaching me the intricacies of psychoneuroendocrinology assessments, Drs. Amanda Morris and Melissa Burkley for your instruction and guidance on study design, and the numerous graduate and undergraduate students who have assisted in this project including Evan Jordan, Elisa Duell, Courtney Hartman, Kyle Christopher, Stacey Hamilton, Jon Lehenbauer, Landon Coulter, and Sammantha Roshay for all your endless hard work and determination. I also owe thanks to the Women’s Faculty Council, the Psychology Department, Dr. David Thomas, and my family for financial support. Many thanks to Southern Nazarene University (especially Stacie Veitch), Blue Springs Nazarene Church, and Redemption Church for the willingness to share valuable space and for the flexibility in scheduling my participants. Furthermore, I want to thank all of the parents who participated in this study for your time, interest, and enthusiasm in this project. Finally, I owe many thanks to my family for your constant cheerleading, encouragement, prayers, and interest in my research and well-being. Specifically, to my mom for your support and dedication to be the ideal research assistant, to my dad for your perfect assistance in the project from beginning (building the apparatus together) to end (edits and pep talks), to Joey for empathizing with me, spending your valuable time talking through ideas, and letting me borrow your daughter for science, to Wren for being a wonderful helper, to Grandma for your unwavering support and powerful prayers, to Jade for rescuing me, and lastly, to (the honorary Dr.) Jaysen for being my rock and providing endless support, patience, and delicious meals through the craziest times—I don’t know what I would do without you all. I could not, and would not, have persevered through this entire endeavor without every single one of you.

Name: JANNA COLAIZZI

Date of Degree: JULY, 2016

Title of Study: EMPATHY PROSOCIAL BEHAVIORS IN INFANCY

Major Field: PSYCHOLOGY

Abstract: Empathic and prosocial behaviors foster cooperation between individuals, making such behaviors essential to successful social functioning. Infants are generally thought to have the foundation for, but be developmentally incapable of, prosocial behaviors because of their physical and cognitive limitations. To address this, the current study had three aims: 1) to replicate the findings of Hamlin and colleagues (2007) in which infants make social evaluations and prefer a helpful character to a harmful one, 2) to utilize new methodology to assess infants' propensity for prosocial behaviors toward third parties, and 3) to evaluate potential predictive factors of these infants' prosocial behaviors. Forty-two infants between 9 and 11 months old were first shown a replication of the puppet show used in Hamlin and colleagues (2007) and then were taught through operant conditioning techniques to manipulate the characters in the puppet show in order to either help or hinder the puppet in need. Infant motor development and salivary cortisol, parental social support, and mother-infant behavioral and physiological synchrony were measured. Infants did not reliably choose either the helper or hinderer characters, thus not successfully replicating previous research. However, the infants who initially preferred the helper also subsequently responded more quickly and frequently when helping the character in need than their peers who initially preferred the hinderer or those who were in the control group. The possibility of perceptual preferences affecting these behaviors is discussed as well as the influences on these prosocial behaviors of infant motor skills and salivary cortisol and mother-infant behavioral and physiological synchrony. These results provide preliminary, albeit limited, support for the early emergence of prosocial behaviors in infancy through the use of developmentally appropriate procedures.

TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION.....	1
II. REVIEW OF LITERATURE.....	3
Development of Empathy.....	3
Affective Empathy.....	3
Cognitive Empathy.....	5
Prosocial Behaviors.....	7
Summary.....	14
Present Research.....	14
III. METHODOLOGY.....	18
Participants.....	18
Measures.....	19
Demographic Questionnaire.....	19
PICCOLO.....	19
CSI.....	20
MDQ.....	21
Materials.....	21
Hill Display.....	21
Operant Conditioning Microswitch.....	21
Procedure.....	22
General Procedure.....	22
Experimental Groups.....	23
Replication Phase.....	24
Conditioning Phase.....	26
Testing Phase.....	27
Salivary Cortisol.....	28

Chapter	Page
IV. FINDINGS.....	29
Descriptives.....	29
Missing Data.....	29
<i>Post Hoc</i> Exclusion Criteria.....	29
Transformations.....	30
Sex Differences.....	31
Hypothesis 1: Social Evaluations (Hamlin, Wynn, & Bloom, 2007 Replication).....	31
Hypothesis 2: Prosocial Behaviors.....	32
Group Behavioral Differences.....	33
Infant Character Choice.....	34
Infant Character Choice between Conditions.....	37
Hypothesis 3: Ancillary Variables.....	38
MDQ.....	38
CSI.....	39
PICCOLO.....	39
Salivary Cortisol.....	41
V. CONCLUSION.....	46
Hypothesis 1: Social Evaluations (Hamlin, Wynn, & Bloom, 2007 Replication).....	47
Hypothesis 2: Prosocial Behaviors.....	51
Group Behavioral Differences.....	51
Infant Character Choice.....	52
Hypothesis 3: Ancillary Variables.....	55
MDQ.....	55
CSI.....	55
PICCOLO.....	56
Salivary Cortisol.....	57
General Discussion.....	60
REFERENCES.....	62
APPENDICES.....	75

LIST OF TABLES

Table	Page
Table 1: Procedures and Hypotheses for Experimental Groups	80
Table 2: Correlations between Operant Conditioning Measures.....	81

LIST OF FIGURES

Figure	Page
Figure 1	83
Figure 2	84
Figure 3	85
Figure 4	86
Figure 5	87
Figure 6	88
Figure 7	89
Figure 8	90
Figure 9	91
Figure 10	92
Figure 11	93
Figure 12	94
Figure 13	95
Figure 14	96
Figure 15	97
Figure 16	98
Figure 17	99
Figure 18	100

CHAPTER I

INTRODUCTION

The study of empathy has been a prominent topic in philosophy and psychology for centuries. Researchers and philosophers alike have been interested in why we cooperate, what drives us to perform altruistic behaviors, and how we become emotionally connected to others (Smith, 1759). Over two centuries ago, Adam Smith (1759) observed “though our brother is upon the rack...by the imagination we place ourselves in his situation, we conceive ourselves enduring all the same torments, we enter as it were into his body, and become in some measure the same person with him, and thence form some idea of his sensations, and even feel something which, though weaker in degree, is not altogether unlike them” (p. 9). It has not been until relatively recently, however, that the study of the early development of empathy has become a particular area of interest to psychological researchers, perhaps due to its implications for prosocial behaviors (Eisenberg & Miller, 1987). Empathic and prosocial behaviors are key to successful social functioning because they promote altruism and allow individuals to understand and relate to others emotionally: components that are crucial for a society to function by guiding social encounters and cooperation toward shared goals (de Waal, 2008). Empathy has even been labeled the “pinnacle of our social cognitive achievements—the peak of the social brain” (Lieberman, 2013, p. 160).

As humans, we are an exceptionally social species from very early in life (de Waal, 2008; Hoffman & Levine, 1976; Lieberman, 2013; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). We are not social isolates, but instead, from birth, are fundamentally linked to others because we see each other as similar beings, or “like me” (Meltzoff, 2011, p. 69). Typically, we begin to practice these emotional and social connections with others and even begin to develop moral judgments of others at a very early age (e.g., Hamlin, Wynn, & Bloom, 2007). The early onset of these social behaviors provides strong evidence for a predisposition to emotional connectedness and empathy.

Empathy is a complex construct that is best understood in multiple dimensions involving social, emotional, cognitive, behavioral, neurological, and biological components that are dependent on both the environment and the individual (Feshbach, 1978). Though the definitions vary, empathy is often described as connecting with another’s experience, both emotionally and cognitively, and is most often measured through prosocial behaviors. Many definitions stress only the behavioral or cognitive components, taking a top-down approach and perhaps missing some of the early developmental foundations of empathy. On the other hand, those taking a bottom-up approach incorporate the emotional foundation of empathy, but may also underestimate the cognitive and behavioral capabilities of young infants.

The significance of empathy calls for an understanding of its origin. However, because much of the research on empathy and prosocial behaviors focuses on children and adults, little is known about the early development of these constructs. Empathic and prosocial behaviors require a lack of egocentrism, an awareness of others (“theory of mind”), and the physical capacity to help another, and it is widely believed that none of these is developed until toddlerhood (Zahn-Waxler et al., 1992). Thus, in general, very young infants are thought to have the foundation for, but be developmentally incapable of, helping behaviors due to their physical and cognitive limitations. Although many studies suggest the presence of rudimentary empathy (i.e., emotional contagion) in infancy, the evidence that infants are incapable of prosocial behaviors is lacking. More research is needed to determine how early an infant can begin to demonstrate empathy and prosocial behaviors.

CHAPTER II

REVIEW OF LITERATURE

Development of Empathy

The theory that empathy develops in stages, beginning as an emotional reflex before any cognitive or behavioral capacities, is widely accepted in the field of empathy research and is demonstrated by the disproportionately limited number of studies focusing on cognitive and behavioral empathy in infancy (e.g., Roth-Hanania et al., 2011, discussed below). Consequently, much of the research in infancy evaluates behaviors that are thought to be precursors to empathy, namely emotional contagion (Martin & Clark, 1982; Sagi & Hoffman, 1976) and imitation (Meltzoff, 2011). The following review will integrate the three main facets of empathy— affective, cognitive, and behavioral—and provide an argument for the study of prosocial behaviors in infants younger than one year based on the developmental trajectories of affect and cognition in young infants, including imitation, self-other differentiation, and social cognition.

Affective Empathy

Affective empathy incorporates imitation, emotional contagion, and concern for others (Brown, 2011) and arguably provides the foundation for all empathy-related responses (Meltzoff, 2011). Physical imitation and emotional contagion are present almost immediately after birth and

are emphasized as a mechanism for social learning (e.g., Bandura, 1977; Hoffman, 1979; but see also Oostenbroek et al., 2016; Sagi & Hoffman, 1976; Simner, 1971). These abilities are imperative for empathy to be effective as they aid in both affect sharing and perspective-taking (Lieberman, 2013).

Imitation is essential for understanding other minds and it demonstrates the connection between the self and the other, emotionally (copying emotional expressions through emotional contagion; Simner, 1971) or physically (copying facial and other body movements; Meltzoff, 2011). Many theorists would argue that infants are born with an abstract model of the adult mind that develops through discovery of and adaptation to the infant's environment through imitation (Bloom, 2013; Meltzoff, 2011). This theory does not suggest that infants are born with an innate theory of mind *per se*, but that the foundation is present at birth, allowing the infant to match his/her actions and experiences with those of others. An infant's capacity for social cognition provides the groundwork for more complex social thought and interpersonal understanding, such as perspective-taking skills, theory of mind, and empathy, through bidirectional learning. An essential element of this foundation is imitation.

The "Like-Me" theory is a comprehensive theory of the early development of imitation, empathy, and theory of mind and includes three developmental phases: the starting state, first-person experience, and attribution to others (Meltzoff, 2011). In the starting state, infants begin to mentally represent the actions of others. The link between perceiving and producing the actions of others is demonstrated through the newborn's ability to imitate, which is functional at birth. During this stage, the infant can create a mental representation of the other's actions and recognize that those actions *look* the way this movement *feels*, and thus, the infant perceives others as "like-me".

In the second phase, first-person experience, infants begin to realize that certain actions have corresponding mental states. They experience first-hand the regular relationship between their own mental states and the corresponding actions, and learn the bidirectionality of this

relationship. In the third and final stage, attribution to others, infants begin to understand other minds and use the “like-me” perspective to mentally map their own internal states and corresponding actions to others. In this stage, the infant begins to understand that a particular action looks the way this corresponding mental state feels. Consequently, they can begin to understand the internal mental state of another through observation. This bidirectional learning is essential; the infant not only learns to understand others’ behaviors and emotions by performing them, but also the infant learns about himself by watching the actions and consequences of others, thus developing theory of mind. These stages are mutually exclusive and build over time and without imitation and mimicry, the vicarious physical and emotional experience with another would not be possible. The early emergence of these behaviors in both ontogeny and phylogeny suggests their importance in social functioning, however, affective empathy is necessary but not sufficient for a full empathic response.

Cognitive Empathy

Affective empathy is extended further when combined with the appraisal of another’s situation. Cognitive empathy incorporates attempts to understand another’s emotional state or the cause of another’s emotions (de Waal, 2008) and includes contextual appraisal (de Waal, 1996). Although he termed it sympathy, Adam Smith (1759) first described this as “conceiving what we ourselves should feel in the like situation” (p. 4). Additionally, Titchener (1909) suggested that a man “must think, by empathy, as [others] think, [and] understand as they understand” (p. 91). As expressed by these early theorists of empathy, cognitive empathy encompasses what we now call theory of mind (the ability to distinguish between the self and others and understand that others have different minds, emotions, and knowledge; Decety & Jackson, 2004), self-other differentiation, and perspective-taking (the ability to view a situation from another’s point of view; Feshbach, 1978).

Theory of mind has been related to many types of positive social behaviors and specifically to social and cognitive abilities related to empathy (e.g., Lonigro, Laghi, Biocco, &

Bumgartner, 2013). For example, emotional perspective-taking predicts prosocial behaviors (e.g., Farrant, Devine, Maybery, & Fletcher, 2012; Harwood & Farrar, 2006) and theory of mind predicts cooperative social behaviors (Jenkins & Astington, 2000) in toddlers and children aged 3 to 7 years. On the other hand, deficits in both theory of mind and empathy are seen in individuals with schizophrenia (Benedetti et al., 2009) and autism spectrum disorders (Baron-Cohen, 2002), suggesting that the cognitive (and neurological; Vollm et al., 2006) systems used for theory of mind and empathy are overlapping.

Self-other differentiation and perspective taking provide a basis for theory of mind and increase the potential for an empathic response by expanding the understanding of others' mental, physical, and emotional states. Much of the research in this area agrees that in order to produce an empathic response an individual must have developed these key cognitive abilities as well as self-regulation and decentering (diminished egocentrism; Decety & Jackson, 2004). Most of these cognitive abilities are generally thought to develop after infancy, namely around 3 years (Piaget, 1951; Ungerer et al., 1990), thus engendering the assumption that infants younger than 3 years are incapable of a full empathic response. However, this assumption may need to be revisited, as more recently, some researchers argue that self-other differentiation and perspective taking are present from the beginning of life (Davidov, Zahn-Waxler, Roth-Hanania, & Knafo, 2013; Meltzoff, 2011) and that an early sense of self contributes to the infant's ability to distinguish between self-generated behaviors and emotions, and seeing or hearing the actions or emotions of others (Davidov et al., 2013).

An infant's sense of self is based on both sensory and motor experiences (Davidov et al., 2013). Self-other differentiation develops rather early as we are born with the capacity to be socially connected to others (Meltzoff, 2011). Therefore, when an infant hears another's cry or witnesses another's distress, the infant may be displaying a rudimentary form of theory of mind. This self-other distinction can be seen through the contagious crying research in which infants can differentiate another's distress cries from the infant's own (e.g., Martin & Clark, 1982;

Simner, 1971). Specifically, newborns demonstrate self-other differentiation by not responding to (and in some cases even falling asleep to) a recording of their own cries, whereas they demonstrate distress in response to another infant's cries (Dondi, Simion, & Caltran, 1999; Martin & Clark, 1982). While this research may not directly support neonatal empathy as widely suggested (Geangu, Benga, Stahl, & Striano, 2010, 2011; Hoffman, 2000; Sagi & Hoffman, 1976; Simner, 1971)—as a more parsimonious, evolutionary-based explanation can be provided involving the competition of resources (Campos et al., 2008)—it may support the idea that infants can distinguish between the self and other, perhaps demonstrating a rudimentary form of theory of mind, even if it is reflexive and automatic.

In summary, the motivation to help another comes from the combination of imitation, theory of mind, and self-other differentiation; prosocial behaviors would not be probable without each of these. As discussed here, there is evidence for these components in infants younger than one year, which raises the question of whether or not infants are also capable of prosocial behaviors.

Prosocial Behaviors

The emotional and cognitive components of empathy provide a foundation for the motivation for prosocial behaviors (Batson, 1991; Eisenberg & Miller, 1987; Feshbach, 1978). Without both of these pillars, prosocial behaviors would be unlikely (de Waal, 2008; Preston & de Waal, 2002). Prosocial behaviors often include helping, cooperation, and sharing (Eisenberg, Fabes, & Spinrad, 2006) and are typically defined as voluntary, not driven by avoiding punishment, and intended to benefit another. These behaviors have been positively linked to empathy (for meta-analyses see Eisenberg & Miller, 1987; Feshbach, 1978) and are highly beneficial to social functioning (e.g., Archer, Diaz-Loving, Gollwitzer, Davis, & Foushee, 1981; Burleson, 1983).

Development of prosocial behaviors. Because empathy is so crucial for social functioning and provides a foundation for prosocial behaviors, understanding the early

development of prosocial behaviors is essential to fully understanding their impact. The large majority of current research on prosocial behaviors assesses child, adolescent, and adult populations, leaving these behaviors unexamined in early infancy. Many researchers suggest that prosocial behaviors do not develop until the second year of life, when children begin to reliably provide consolation and emotional support for others (Zahn-Waxler et al., 1992). At this age, these behaviors are typically examined using a simulated distress paradigm in which an adult feigns an injury and the child's physical and emotional helping responses are recorded.

Prosocial behaviors have rarely been tested in infants and when they are, the same methods are used as in studies with older children. Most notably, Roth-Hanania and colleagues (2011) conducted a study in which empathic concern, cognitive empathy, and prosocial behaviors were measured from 8 to 16 months in an accelerated longitudinal design. This team of researchers demonstrated that emotional and cognitive empathy began to emerge at 8 months and prosocial behaviors began to emerge at 10 months. Three distress situations were presented: one as a video of a distressed peer, and two separate situations of the mother feigning an injury by hitting her finger with a hammer or bumping her knee on a table. Emotional distress responses were measured through affective concern for the victim including facial, vocal, or gestural expressions of concern. Cognitive empathy was measured when the infants demonstrated hypothesis testing (attempting to explore and understand the other's situation) such as asking if their mothers were hurt. Finally, behavioral empathy, or prosocial behavior, was measured through attempts to help or comfort the victim during the feigned injury paradigms.

All three subtypes of empathy (emotional, cognitive, and behavioral) were demonstrated, each emerging on a different developmental trajectory, thus, emphasizing the need to differentiate between them. Not surprisingly, at 8 and 10 months, emotional empathy (concerned affect) was the most common and the most stable across time. Cognitive empathy (hypothesis testing) was present at a similar rate at 8 months and slightly increased in frequency over time. Prosocial behaviors were not present at 8 months and displayed by very few of the infants at 10 months (at

which time the behaviors were defined as “slight assistance” and “ambiguous”), but consistently increased from 10 to 16 months. While this study provides evidence for the continuity between the three aspects of empathy, it fails to adequately measure prosocial behaviors in infants younger than one year because it uses the same procedures used with older children requiring more developed motor skills (i.e., walking). Further investigation using age-appropriate methods is needed to investigate whether this lack of prosocial behaviors in young infants is due to the underdevelopment of empathy-related abilities that contribute to prosocial behaviors or more simply due to methodology and undeveloped infant motor skills.

Empathic behaviors were also examined in younger infants by Hay, Nash, and Pedersen (1981) who assessed 6-month-old infants’ other-oriented responses to distress through the use of a contagious cry paradigm with live interactions between same-aged peers (as opposed to recorded distress cries as seen in Simner, 1971). In this study, self-distress, or contagious crying, responses were very rare when another infant displayed distress. Instead, infants would visually attend to the distressed peers and the peers’ mothers and, in approximately half of the trials, the infants directed their behaviors toward the distressed peer through leaning, gesturing, or touching. This research and that of Roth-Hanania and colleagues (2011) demonstrate the possibility of rudimentary prosocial behaviors before one year of age. If provided with age-appropriate methods, the concern toward others that is demonstrated within the first year of life could also support the early emergence of prosocial behaviors (Davidov et al., 2013). The research is scarce, however, and the conclusions are somewhat ambiguous, which calls for further investigation of prosocial behaviors early in development using new methodologies.

Intentionality and morality. Although there is very little research on infants’ prosocial *behaviors*, there is a recent body of research that supports the idea that young infants engage in social cognition and use many of the mental abilities that support prosocial behaviors, namely the interpretation of intentionality and morality in others. As stated above, prosocial behaviors are highly influenced by both emotional and cognitive empathy, and especially the understanding of

another's perspective, goals, and intentions. In order to help another achieve a goal, an individual must recognize that person's goal and understand that his/her goal might differ from one's own (Warneken & Tomasello, 2009). Infants appear to be capable of these complex social and cognitive evaluations at a surprisingly early age (Hamlin, Wynn, & Bloom, 2007; Henderson & Woodward, 2011; Kuhlmeier, Wynn, & Bloom, 2003; Premack & Premack, 1997). In fact, for infants as young as 3 months, social evaluation is selective and infants are able to appraise the rationality and morality of a situation (Gergely, Bekkering, & Király, 2002; Hamlin, Wynn, & Bloom, 2010).

To emphasize this, Matthew Lieberman (2013) stated “we possess a capacity or, more accurately, the inescapable inclination to see and understand others in terms of their intentional mental processes” (p. 106) and Meltzoff (2011) stated, “perhaps earlier [than 18 months of age]...persons are understood within a framework involving goals and intentions” (p. 68). In fact, in addition to neonatal imitation (e.g., Meltzoff & Moore, 1977), young infants demonstrate imitation and understanding of others' goals (Hamlin et al., 2008). Specifically, seven-month-old infants reliably reach for a toy after they view an experimenter reaching for the toy, but not when the experimenter's movements toward the toy are ambiguous (Hamlin et al., 2008). Similarly, Hamlin, Newman, and Wynn (2009) assessed 8-month-old infants' ability to infer goals. In this paradigm, infants were shown an adult holding a ring and unsuccessfully attempting to place it on top of a cone. Infants were able to infer an actor's unfulfilled goals even if some of the actions were irrelevant to the goal. These results suggest that 7- and 8-month-old infants understand another's intention and accurately analyze the goal-directed behaviors of others. Together, these studies demonstrate that infants within the first year of life not only imitate but also understand and infer the goals and intentions of others.

These attributions extend beyond understanding physical actions to inferring emotional states and moral intentions. As early as 3 months old, infants can attribute goals and intentions to inanimate objects such as puppets and geometric moving shapes with faces (Hamlin et al., 2008;

Hamlin et al., 2007, 2010). Similarly, both infants and older children often discriminate between the recipients of their helping behaviors based on characteristics of the other. For example, children are more prone to help others based on the intentions and moral character of the other (Vaish, Carpenter, & Tomasello, 2010), the others' history of helpfulness (Dunfield & Kuhlmeier, 2010), and if the child empathizes with the other (Eisenberg & Miller, 1987; Vaish, Carpenter, & Tomasello, 2009).

This social evaluation is important to understanding others' intentions, and therefore, whether or not the other would be an adequate social partner. Distinguishing between those who will help and those who will harm is important to understanding and surviving the social world. As a result, individuals tend to prefer those who help and avoid those who hinder. Previous research has established that infants positively evaluate those who help at 3, 6, and 10 months of age (Hamlin et al., 2007, 2010) and toddlers engage in prosocial behaviors toward adults and peers, especially if the other has been helpful in the past or a victim of an 'antisocial' behavior (Howes & Farver, 1987; Vaish et al., 2009; Warneken & Tomasello, 2006). Additionally, infants and toddlers are less inclined to evaluate positively and act prosocially toward an individual who has behaved negatively toward another in the past (Dunfield & Kuhlmeier, 2010; Hamlin, 2014; Hamlin & Baron, 2014; Hamlin et al., 2010; Vaish et al., 2009).

The research on social evaluation and early moral development in infancy and toddlerhood has recently greatly expanded, building on the evidence that early infants can attribute mental states, goals, and intentions to objects (Kuhlmeier et al., 2003; Premack & Premack, 1997). In 2007, Hamlin, Wynn, and Bloom assessed how 6- and 10-month-olds evaluate others' social behaviors and which individual characteristics are important for deciding who is a desirable social partner. In this study, infants were shown a scenario (based on Kuhlmeier et al., 2003) with three characters: circle, square, and triangle wooden blocks with eyes glued to them. After a habituation phase, the infants saw a character (the 'climber', or 'protagonist') move up a hill. The climber was then either pushed up the hill by the 'helper', or

pushed down the hill by the ‘hinderer’. Infants were encouraged to choose (i.e. reach for) a character after each trial and reliably chose the helper over the hinderer, the helper over a neutral character, and a neutral character over the hinderer. Hamlin and colleagues (2010) replicated these experiments with even younger infants, in which the looking behavior of 3-month-olds was used to measure a preference for the hinderer, helper, or neutral character. Again, infants reliably looked longer at the helper or neutral character over the hinderer. These effects were not present when the eyes were removed from the wooden blocks, thus, eliminating the social aspect from the characters.

Infant social evaluations were assessed in similar studies using puppets as agents instead of wooden blocks (Hamlin & Wynn, 2011; Hamlin, Wynn, Bloom, & Mahajan, 2011). In these studies, 3-, 5-, 8-, 19-, and 23-month-old infants watched scenes involving neutral (the protagonist), helping, and hindering puppets. In one experiment, the protagonist attempted to retrieve a toy from a box and either the hinderer would slam the box shut or the helper would open the box. Another similar experiment involved the neutral character throwing a ball and either the hinderer stealing the ball or the helper rolling the ball back. After watching these scenes, infants were again given a choice of puppet (through looking behaviors for the younger infants and reaching behaviors for older infants) and reliably preferred the helper (opening the box or rolling the ball back) to the hinderer (closing the box or stealing the ball). The infants did not, however, show a character preference when the protagonist was replaced by an inanimate, mechanical pincer, suggesting that the social aspect of these studies is essential to infants’ understanding and interpretation of the morality and goals of the actors (Hamlin & Wynn, 2011).

Taken together, these studies suggest that infants as young as 3 months old understand and evaluate the goal-directed actions of social but not non-social actors. Hamlin and colleagues conclude that “this capacity may serve as the foundation for moral thought and action, and its early developmental emergence supports the view that social evaluation is a biological adaptation” (Hamlin, Wynn, & Bloom, 2007; p. 557). The early emergence of these preferences

implies the importance of social evaluation of others and the evolution of our cooperative tendencies and moral development (Trivers, 1971).

Given the success of these social evaluation studies, recent replication attempts have been made. Although some report significant (Scola, Holovet, Arciszewski, & Picard, 2015) and mixed results (Cowell & Decety, 2015), many others have failed to reproduce these findings. For example, Salvadori and colleagues (2015) replicated Hamlin and Wynn (2011) involving the box opening/closing goal paradigm. This research team was not able to replicate the precocious infant behavior reported previously and instead reported that only 15 of 24 infants chose the helper over the hinderer (and 12 of 24 chose the helper in a subsequent modified paradigm). Similarly, Scarf and colleagues (2012) reported a replication attempt of the Hamlin, Wynn, and Bloom (2007) hill paradigm. In contrast to social evaluations, they suggested that infants were responding to simple associations, or perceptual preferences, in the paradigm. Specifically, the initial Hamlin and colleagues (2007) methodology involves the ‘climber’ character bouncing (presumably out of excitement) after being helped up the hill. Scarf and colleagues (2012) demonstrated that infants preferred *any* character that bounced regardless of helping or hindering. Specifically, after the climber was pushed up the hill and bounced at the top, infants preferred the helper. Conversely, after the climber was pushed down the hill and bounced at the bottom, the infants preferred the hinderer. And when the climber bounced in both trials (helping and hindering), the infants chose randomly and preferred both characters equally (but see also a reply to Scarf et al., 2012 in Hamlin, Wynn, & Bloom, 2012). These studies provide mixed justifications for the contradictory findings including methodological and theoretical attributions that suggest these infant behaviors are driven by something other than precocious abilities to evaluate social behaviors.

In summary, although some methodological issues remain questionable (i.e., the impact of perceptual preferences on these infants’ choices), the bulk of this research suggests that infants and toddlers have an understanding of another’s moral character—positive and negative—and

demonstrate a preference for positive, prosocial actors. This points to the potential that the cognitive foundation for prosocial behaviors may indeed be present in young infants. However, the current methodology is limited to older children and adults, as it requires physical capabilities, such as walking, that are not yet developed in infancy. Therefore, if, in fact, these infants are cognitively capable, new methodologies are needed to accommodate young infants' physical capacities in order to accurately assess their ability to act prosocially.

Summary

This overview of the early development of empathy in infancy integrates the affective (imitation and emotional contagion), cognitive (theory of mind and perspective taking), and behavioral (prosocial behaviors and moral development) aspects of empathy. Cognitive empathy is highly integrated with affective empathy, as both are necessary but not sufficient to produce prosocial behaviors. Previous research suggests that affective and rudimentary cognitive empathy are developed very early in the first year of life, thus laying a developmental foundation for empathy (Hoffman, 2000; Davidov et al., 2013), and that prosocial behaviors and more complex cognitions are developed after the first year of life (Roth-Hanania et al., 2011). However, the methodologies used in such studies do not account for the physical limitations of infants younger than one year. Perhaps new methods accommodating the limited motor skills of young infants could be used to explore the assumption held by many researchers (e.g., Piaget, 1951; Zahn-Waxler et al., 1992) that infants younger than one year are not capable of prosocial behaviors. The research discussed here suggests that affective empathy may provide a foundation for the other facets of empathy, but the early emergence of cognitive and behavioral empathy should not be ruled out.

Present Research

The general purpose of this study was to assess the possibility of prosocial behaviors in early infancy despite the physical limitations of that age group. Many researchers and theorists currently posit that prosocial behaviors do not emerge until well after the first year of life,

however, there is evidence that precursors to these behaviors and the corresponding cognitions are present before one year (Davidov et al., 2013). By using age-appropriate methods, this study aimed to address the very early development of prosocial behaviors through the use of an experimental design with random assignment.

The first purpose of the present study was to replicate the findings of Hamlin, Wynn, and Bloom (2007). An exact replication was used based on the methods from the 2007 article and personal communication with Kiley Hamlin (November, 21, 2014). Notable deviances from the original methods are the exclusion of bouncing when the ‘climber’ reached the top of the hill and the exclusion of rolling down the hill when the ‘climber’ was pushed down (Scarf et al., 2012). It was hypothesized that similar findings would emerge as seen in Hamlin and colleagues’ work on social evaluation. Specifically, it was hypothesized that when shown the puppet show with a character—the protagonist—trying and failing to move up a hill, a second character helping the protagonist up, and a third character pushing the protagonist down, infants would reliably choose (i.e., reach for) the helping character over the hindering character.

The second purpose of the present study was to incorporate a dimension of agency into this paradigm. Specifically, infants were not only given the opportunity to evaluate the social behavior of the characters (in the Hamlin et al., 2007 replication), but they were also given the opportunity to interact with the character in need. It was hypothesized that 9- to 11-month-old infants would act prosocially towards another in need. Specifically, it was hypothesized that after viewing the puppet show with the protagonist in need of help and after learning how to physically manipulate the other characters in the puppet show infants would act more quickly and more frequently to help the protagonist character than to hinder the protagonist. Additionally, it was hypothesized that infants who chose the helper in the initial Hamlin and colleagues (2007) replication, would also help the character when given the chance and the infants who chose the hinderer would not.

The third and final purpose of the present study was to address ancillary variables that may influence the prosocial behaviors of the infants. It was hypothesized that prosocial behaviors may be influenced by the infant's sex and self-produced locomotion, the parents' social support, and the mother-infant behavioral engagement and physiological synchrony.

To elaborate, self-produced locomotion can highly affect an infant's perspective on the world and social interactions (Campos et al., 2000). Therefore, differing levels of locomotion in infants can change how they behave and react to social situations such as the one presented in this study. It was hypothesized that infants who are more adept with self-produced locomotion would also be more willing to manipulate the characters in the puppet show.

Furthermore, social support from one's significant other can highly influence parenting behaviors and parents with stronger support from their partners also tend to exhibit more positive and sensitive parenting practices (Funk & Rogge, 2007). It was hypothesized that infants would be more apt to act prosocially toward the character in need if their parents are strongly supported by their significant others.

Additionally, both biological processes (e.g., cortisol activity) and environmental factors (e.g., parenting) influence the development of empathy (Shirtcliff et al., 2009). Sensitive and responsive parenting can influence an infant's physiological activity and social behaviors by fostering empathy (Farrant et al., 2012; Gunnar & Quevedo, 2007). Cortisol, in particular, is connected to the social brain (i.e., the limbic system) and responsive to social stress (Taylor et al., 2000). Maternal physical contact, shared environments (Morelius, Ortenstrand, Theodorsson, & Frostell, 2015), warm and sensitive parenting (Loman & Gunnar, 2010), maternal engagement, and secure attachments (Gunnar & Quevedo, 2007) can buffer infant cortisol levels and responses to stress in general (Gunnar & Donzella, 2002; Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003). Conversely, children show elevated cortisol levels when their mothers are more intrusive and controlling and in response to maltreatment and insecure attachments (Gunnar & Quevedo, 2007; Miller, Chen, & Zhou, 2007; Taylor et al., 2012).

Cortisol tends to be synchronized between closely related pairs (e.g., parent-infant or romantic partners; Middlemiss, Granger, Goldberg, & Nathans, 2012) and salivary cortisol can be used as a measure of physiological attunement and sensitivity between a parent and infant (Davis & Granger, 2009; Granger et al., 2007; Sethre-Hofstad, Stansbury, & Rice, 2002; Stenius et al., 2008; van Bakel & Riksen-Walraven, 2008). Physiological responses between mothers and children are more congruent (Sethre-Hofstad et al., 2002) and children show more prosocial behaviors (Farrant et al., 2012) when the mother-infant relationship is secure, sensitive, and responsive. Therefore, it was hypothesized that more sensitive parents would be more synchronized both behaviorally and physiologically with their infants and that those infants would respond more prosocially than those in less synchronous dyads.

On the other hand, infant cortisol can also influence empathic behaviors (Shirtcliff et al., 2009). Specifically, individuals with low cortisol reactivity show dampened behavioral responses to the distress of others and therefore are less likely to demonstrate empathic behaviors (Shirtcliff et al., 2009), whereas higher acute cortisol reactivity tends to promote prosocial behaviors (Shirtcliff et al., 2009) and is associated with children who have higher social competence, better social skills (Booth, Granger, & Shirtcliff, 2008; Shirtcliff et al., 2009), and higher empathic traits (Nakayama, Takahashi, Wakabayashi, Oono, & Radford, 2007). It was, therefore, hypothesized that infants with higher salivary cortisol levels would also show more prosocial behaviors. Together, using both behavioral and physiological measures (as opposed to a self-report measures), positive parenting behaviors and infant emotional responding can be more accurately evaluated as potential influences on the infants' prosocial behaviors (Roggman, Cook, Innocenti, Jump Norman, & Christiansen, 2013; Shirtcliff et al., 2009).

CHAPTER III

METHODOLOGY

Participants

Participants were 42 healthy, typically developing infants with an average age of 10.5 months ($SD = 21.3$ days). Sixty-nine percent of infants were female ($N = 29$). Maternal age ranged from 22 to 45 years ($M = 30.9$, $SD = 4.9$) and most mothers were married (81%). Average household income ranged between \$70,000-90,000 a year and 19% of parents were on federal assistance of some kind. The majority of mothers (83%) and fathers (73%) had a college degree or higher and were employed full-time (56% of mothers and 90% of fathers). Thirty-five mothers (83%) and 36 fathers (88%) were Caucasian, 2 mothers and 3 fathers were African American, 1 mother was Asian, 2 fathers were Native American, and 4 mothers were multi-ethnic including Caucasian, Native American, Asian, and African American.

Caregiver-infant dyads were recruited from daycare centers, churches, social media groups, and community centers in Stillwater, Oklahoma, the greater Oklahoma City, Oklahoma area and the greater Kansas City area in Kansas and Missouri. Infants were tested in the Developmental and Psychophysiological Laboratory at Oklahoma State University in Stillwater, at Southern Nazarene University in Oklahoma City, and at Redemption Church and Blue Springs

Nazarene Church in the Kansas City area. Participants received \$15 to help defer the cost of travel. This project was approved by the Institutional Review Board at Oklahoma State and Southern Nazarene universities. An *a priori* power analysis was conducted using G*Power statistical software (Faul, Erdfelder, Lang, & Buchner, 2007) and indicated that a total sample of 36 participants (12 in each of the three experimental groups) would be sufficient to detect 95% power for a large effect size with an alpha of .05.

Measures

Demographic Questionnaire

A demographic questionnaire was used to acquire general information about the mothers, infants, fathers, and pregnancies. Information included infant age, sex, and due date, maternal age, household income, and parental race/ethnicity, employment, education, and marital status (see Appendix A).

Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO)

Parental sensitivity and positive parenting interactions were measured behaviorally using the Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO; Roggman et al., 2013). The PICCOLO consists of a 10-minute free-play video-recorded session between the infant and the parent. All dyads included the mother and the infant, although some fathers were present during the testing as well. During the free-play time, the experimenter left the room and did not interact with the dyad. The mother was instructed to play as she typically would with the infant. Age-appropriate toys were provided for the dyad to use during this time. The videos were later coded on a scale of 0 to 2 for positive parenting interactions including affection (warmth, physical closeness, positive expressions toward the child), responsiveness (responding to the child's cues, emotions, words, interests, and behaviors), encouragement (active support of the child's exploration, effort, skills, initiative, curiosity, creativity, and play), and teaching (shared conversation and play, cognitive stimulation,

explanations, and questions). Research assistants followed the instructions for video coding provided by Roggman and colleagues (2013). One research assistant coded all PICCOLO videos and a second research assistant coded a random subset of the full sample ($n = 9$) for interrater reliability. Interrater reliability was initially low ($r = .740$); therefore, the research assistants recoded each common file and reconciled any discrepancies. The reliability of the main coder to the final, reconciled scores was strong ($r = .975$). The PICCOLO yields 4 total scores, each ranging from 0 to 14 (and 0 to 16 for teaching). These parenting behaviors have been shown to predict positive childhood outcomes for cognitive development, vocabulary, and behavior and are related to fewer antisocial behaviors, more secure attachments, better social development, and better emotion regulation and empathy (Roggman et al., 2013). The PICCOLO total score and each domain have good internal consistency (total score Cronbach's $\alpha = .91$, affection domain $\alpha = .78$, responsiveness domain $\alpha = .75$, encouragement domain $\alpha = .77$, and teaching domain $\alpha = .80$) and predictive validity ($\alpha = .67$). Construct validity was established for the subscales of the PICCOLO through correlations with multiple parenting measures and child cognitive standardized tests (Roggman et al., 2013).

Couples Satisfaction Index (CSI)

The Couples Satisfaction Index (CSI; Funk & Rogge, 2007) was used as a measure of significant other's support. The CSI is a 32-item relationship satisfaction questionnaire developed by item response theory and factor analysis based on 180 potential items. The scale has good reliability (Cronbach's $\alpha = .98$) and convergent and construct validity when compared to 8 other well-validated relationship satisfaction self-report measures (Funk & Rogge, 2007). Items include statements such as "Please indicate the degree of happiness, all things considered, of your relationship" and participants are asked to answer from "Extremely unhappy" to "Perfect". Other items include "I have a warm and comfortable relationship with my partner", "I cannot imagine another person making me as happy as my partner does", "How good is your relationship compared to most?", and "How rewarding is your relationship with your partner?" Each item on

the scale ranges from 0 to 5 (with one exception from 0 to 6). The items are summed for a total score that ranges from 0 to 161. The cut-point at which a relationship is considered in distress is a score of 104.5 or lower (Funk & Rogge, 2007).

Motor Development Questionnaire (MDQ)

The Motor Development Questionnaire (MDQ; Frankel, Campos, & Anderson, 2005) is a parent-report infant self-produced locomotion scale and was used to determine the level of motor skills acquired by the infant at the time of the appointment. The questionnaire includes explanations of multiple levels of motor development (crawling, standing, walking, etc.) and asks the parent to indicate if and when the child has acquired each skill and how often the skill is used.

Materials

Hill Display

All dimensions and designs for the hill display and characters were replicated from Hamlin, Wynn, and Bloom (2007; see Figure 1). All events occurred on a custom wooden display (48 inches wide, 24 inches high) containing a white background and a green 'hill' extended 4 inches in front. The hill had two inclines that plateau (one shallow, 5-inch elevation from the bottom; one steep, 16-inch elevation from the bottom) rising from the bottom right to the top left corners of the display. Characters were wooden shapes (3.5 x 3.5 inches) with eyes (1-inch diameter) including a red circle, blue square, and yellow triangle. The red circle was used as the climber in all trials. Since gaze direction is an important indication of one's desires (Baron-Cohen, 1995; Hamlin, 2014), and infants do not show preferences for characters with ambiguous gaze-direction (Scarf et al., 2012), the climber's eyes were glued in a position looking upward toward the top of the hill. The characters had rods on the back in order to be moved along a track (that follows the outline of the hill) by the experimenter from behind the display. The display was covered with a black movable curtain.

Operant Conditioning Microswitch

A microswitch in a wooden housing (7 x 5 x 5 inches with a large lever on top that

activates the microswitch) was placed on a portable table in front of the mother and infant during the conditioning and testing phases within reach of the infant (see Figure 2b). The microswitch was also connected to a Propeller DNA board (as described in Varnon & Abramson, 2013) that connected to and activated a red LED light behind the display board (in clear view of the experimenter), and speakers that emitted a chime sound every time the microswitch was activated, acting as positive reinforcement for the infants for pressing the lever (see Figure 2a). Each of the reinforcements were 2-seconds long, therefore, the sound was only produced as quickly as every 2 seconds, regardless of how many times the infant pressed the lever within those 2 seconds. The propeller DNA board recorded every response made by the infant (button presses) and reinforcements given (chime sound) in a digital spreadsheet on a micro SD card that could be later coded separately for all phases of testing for latency to first response, number of total responses, interval between each response, and total duration of each phase.

Procedure

General Procedure

The parent was given the informed consent form upon arrival at the appointment. The 10-minute free-play time for the PICCOLO task immediately followed during which the parent and infant were alone in the room with toys that were provided. This segment was video recorded and later coded following the PICCOLO protocol (Roggman et al., 2013). The three phases of the puppet show (see below) were presented next. In order to provide an optimal window of time for salivary cortisol to peak, the parents were given 10-15 minutes to fill out the three questionnaires before the saliva samples were collected (Davis & Granger, 2009). During this time, the experimenters reintroduced the toys and played with the infant. The average total duration of each session was 45-60 minutes.

The prosocial behavior procedure consisted of three phases described below. For all phases, the parent was instructed to hold the infant on his/her lap facing forward toward the hill display and sit upright with the parent's arms supporting the infant's torso. If the infant became

distressed or fidgety, the parent was instructed to attempt to keep her/him attending toward the display. The display was placed on a table approximately 60 inches in front of the infant.

Experimental Groups

Participants were randomly assigned to one of three experimental groups, each consisting of all three phases of testing. The first phase was the replication phase in which an exact replication of Hamlin and colleagues (2007) was used. The second phase was the conditioning phase in which infants were taught through operant conditioning techniques how to manipulate the helper and hinderer characters (Skinner, 1963). The third and final phase was the testing phase in which the infant was given the opportunity to use the skills learned in the conditioning phase to help the climber up the hill or push the climber down the hill (as seen in Phase 1). The phases will be described in detail below. The shapes used for the helper and hinderer characters were randomly counterbalanced across subjects between the yellow triangle and the blue square. Also randomly counterbalanced were the order of trials (helping and hindering) in all three phases and the positions (left or right) of characters in choice trials.

The infants in the first experimental group ($n = 16$) were shown the climber trying and failing to move up the hill, the helper pushing him up the hill, and the hinderer pushing him down the hill for Phase 1 (see below for descriptions and Figure 1a). Infants were then conditioned to move the same helper up the hill and hinderer down the hill in Phase 2 and then given the opportunity use these same characters to push the climber up or down the hill in Phase 3.

The second ($n = 13$) and third ($n = 13$) experimental groups served to control for perceptual preferences by the infants. The infants in the second experimental group were shown only the climber moving up and down the hill without a helper or hinderer for Phase 1. The climber followed the same physical trajectory as if being pushed by the helper or hinderer but without interacting with the helper or hinderer, thus making these movements less social in nature than the events presented to Group 1 (see Figure 1b). In Phase 2, infants were conditioned to move the helper and hinderer characters (which were novel to these infants) up and down the hill,

respectively. In Phase 3, infants were able to use the helper or hinderer characters to move the climber up or down the hill.

Finally, the infants in the third experimental group saw the helper and hinderer move up and down the hill while the climber sat motionless at the bottom of the hill (see Figure 1c). These two characters' physical movements were identical to those of the helper and hinderer presented to Group 1, however their actions were less social in nature because they did not interact with the climber. Phases 2 and 3 were identical to the first and second experimental groups. See Table 1 for the layout of phases and experimental groups.

Replication Phase

The first phase served to replicate the findings of Hamlin, Wynn, and Bloom (2007). The following description depicts the methods used for participants in Group 1 (for a summary of the procedures for each experimental group, see Table 1). During this phase, the table with the microswitch and lever was placed outside the reach of the infant. The replication phase began with the climber (red circle) resting at the bottom of the hill. The climber then moved easily up the first shallow incline then made two unsuccessful attempts to move up the steep incline, decelerating with each upward movement and accelerating with each downward movement to indicate a struggle to get to the top. On the first attempt, the climber moved 1/3 of the way up the hill then fell back down. On the second attempt, the climber moved 2/3 of the way up and fell back down. Finally, on the third attempt, either the helper or hinderer entered the display. In the helping condition, the helper entered at the bottom of the hill (lower right) and moved up the hill toward the climber. The helper then pushed the climber twice up to the top of the steep incline. Once the climber made it to the top, the helper moved back down the hill and out of the display. In the hindering condition, the hinderer entered at the top of the hill (top left) and moved down the hill, pushing the climber twice down to the bottom of the steep incline. Once at the bottom, the climber fell down to the end of the display and the hinderer moved back up the hill and out of the display. Infants received four habituation trials (alternating between helping and hindering) to

the movement of these characters.

In previous studies, confounds regarding the perceptual preferences of the infants have been ruled out. More specifically, Hamlin (2014) suggests that infants choose the helper over the hinderer based on social and not perceptual characteristics. To test this, Hamlin's research team replicated the paradigm but replaced the climber with a red circle with no eyes, thus making it inanimate. Infants in this study did not prefer the helper/upward movement to the hinderer/downward movement thus supporting the evidence that infants were making social inferences with the characters (Hamlin, 2014; Hamlin et al., 2007). Additionally, Hamlin (2014) repeated this procedure using a climber with an undirected gaze (i.e., the eyes were not fixed in a position looking up the hill but instead, free to move) and infants in the undirected gaze conditions were equally likely to prefer the helper or the hinderer. Therefore, the eyes of all three characters in the present study were fixed (the protagonist was looking diagonally up the hill and the helper and hinderer were looking straight downward).

Other studies have found perceptual differences in this paradigm when the protagonist bounces (indicating excitement) when he reaches the top of the hill with the help of the helper (per the original methodology in Hamlin, Wynn, & Bloom, 2007). Most notably, Scarf and colleagues (2012), as discussed above, reported effects that were highly dependent on the bouncing of the characters, as opposed to the social valence. Therefore, the present study did not include bouncing, rolling (also used in the hindering trials of the original Hamlin, Wynn, & Bloom, 2007 methodology), or any other purposeful perceptual differences besides the upward and downward movements of the characters. Additionally, it should be noted here that due to a potential blue color bias, based on personal communication with Kiley Hamlin (November, 15, 2015), the blue color was changed from a royal blue (shown in Figure 2) to a dusty blue (shown in Figure 1) after participant number 10.

Choice procedure. After the helping and hindering conditions in the replication phase, the infants were presented with a choice between the helping and hindering characters (also

replicated from Hamlin, Wynn, & Bloom, 2007). An experimenter who was blind to the character identities administered the choice procedure. Experimenters presented the infants with a foam board (18 x 24 inches) with the blue and yellow characters attached at the bottom of the board with Velcro 12 inches apart. Experimenters were instructed to look directly at the infant or at the center of the board and prompt the infants to make a choice by saying “Hi, who do you like?” or “Can you choose one?” Infants were prompted until they physically reached for one of the characters for up to 2 minutes (after which it was counted as no choice). Choices were determined by the first character that an infant physically reached toward when it was preceded by a look. All infants made a choice. Mothers were asked to close their eyes during the choice procedure, but many of them did not. This differed from the procedure presented in Hamlin, Wynn, and Bloom (2007), however, none of the mothers made physical or verbal suggestions to influence their infant’s choice. Some mothers helped to prompt their infant with similar phrases as the experimenter (e.g., “Can you choose one?” “Which one do you like?”). All three experimental groups were given a choice between the helper and hinderer characters.

Conditioning Phase

The second phase served as a conditioning phase for the infants using operant conditioning techniques similar to those used by Carolyn Rovee-Collier (e.g., Barr, Vieira, & Rovee-Collier, 2001; Harshorn & Rovee-Collier, 1997). During this phase, infants were taught that pressing the lever simultaneously produced a sound and the movement of a character either up or down the hill, depending on where the character was positioned at the beginning of the trial (the top or bottom of the hill). Specifically, each lever press activated the microswitch and produced a chime sound and activated a light to cue the experimenter to move the character 6 inches. Seven responses from the infant were necessary to move the character completely up or down the hill. After 7 responses were met, the trial concluded and the curtain was raised.

Before this phase began, an experimenter moved the table with the microswitch and lever within reach of the infant. An LED light strip was turned on inside the display within the infant’s

sight to indicate that the lever was activated. An experimenter demonstrated how the lever functioned by getting the attention of the infant by saying, “See this box? Watch what happens when I push this”, and the experimenter pressed the lever at least twice. When the lever was pressed, a chime sounded and a second experimenter bounced both the helper and the hinderer within the hill display. The experimenter then prompted the infant to try. When the infant had successfully pushed the lever at least three times, the experimenter said “Good job!” and moved behind the curtain.

The completion of characters’ movements to either the top or the bottom of the hill was used as the learning criterion. In other words, each time the infant made a response, the character was moved 6 inches up or down the hill. Criterion was reached when the character arrived at either the top or bottom of the hill (after seven responses from the infant) a total of four times (alternating completions both up and down the hill). Both character movements up and down the hill were taught to criterion using the same behavior from the infant (pressing the lever).

Testing Phase

The third phase served as a testing phase for the infants. During this phase, the infant was still within reach of the lever and the climber was reintroduced into the display following the same movements as in the replication phase (failed attempts to move up the hill). In this phase, however, the climber continuously tried and failed to move up the hill until contact was made with the helper or hinderer (as determined by infant responses). This phase was divided into 2 counterbalanced conditions: helping and hindering. In the helping condition, the same helping character used in the replication phase was presented at the bottom of the hill. Responses from the infant moved the helper up the hill 6 inches per reinforcement. In the hindering condition, the same hindering character used in the replication phase was presented at the top of the hill. Responses from the infant moved the character down the hill 6 inches per reinforcement. For all groups, one trial of each (helping and hindering) was given. Between 2 and 3 infant responses were needed (depending on the current movement of the climber) in order for the helper or

hinderer to reach the climber. The trial ended either when the infant was reinforced 7 times (and the character moved completely through the display) or when 60 seconds had passed, whichever came first. The amount of time it took the infant to achieve 7 responses for each trial, the total number of responses, and the average interval between responses were measured as the dependent variables in each trial. Latency to first response was also measured for each trial.

Salivary Cortisol

The end of the testing phase concluded the prosocial behavior testing procedure. Following that, parents were given approximately 15 minutes to complete the three questionnaires (demographics, CSI, and MDQ) and infants were provided with toys with which to play. Salivary cortisol was collected from both the infant and the mother at the end of the 15 minutes (post-task) to account for the delay in cortisol peak (Davis & Granger, 2009). Saliva was obtained from the parent by chewing on an absorbent swab and from the infant by the parent or experimenter holding an absorbent swab in the infants' mouth until sufficiently saturated with saliva or until the infant began to become distressed. Saliva-saturated swabs were then sealed in a vial and stored at -20°C until assayed for cortisol at Oklahoma State University. Samples were assayed in duplicate utilizing a highly sensitive enzyme immunoassay technique with established standard and control ranges. All reagents used are commercially available (Salimetrics, State College, PA, USA) and assays were run without modification to the manufacturer's recommended protocols. These procedures are routinely used as a measure of adrenal function (Davis & Granger, 2009). On the day of assay, saliva samples were thawed, vortexed, and centrifuged at 3000 RPM for 15 minutes to extract saliva from the swab and remove mucins that may interfere with cortisol levels. The enzyme-linked immunosorbent assay (ELISA) test uses 25 µL of saliva, designed to capture the full range of salivary cortisol (0.003 to 3.00 µg/dL). The enzymatic reaction was measured by optical density on a standard plate reader at 450 nm. Salivary cortisol levels are reported in micrograms per deciliter (µg/dL).

CHAPTER IV

FINDINGS

Descriptives

Missing Data

Three participants were removed from behavioral analyses: one of these infants did not meet the learning criteria in the operant conditioning phase and did not produce any responses during the testing phase (female in experimental Group 3), one infant was pulled away from the apparatus by her mother during both testing phase conditions and therefore did not produce any responses (female in experimental Group 2), and the third participant was removed due to equipment malfunction in the hindering condition. One mother did not fill out the Couples Satisfaction Index and one infant was removed from the salivary cortisol data because it was an outlier greater than three standard deviations above the mean. All analyses were conducted with pairwise deletions to minimize the missing data; therefore *Ns* vary and are reported for each test.

***Post Hoc* Exclusion Criteria**

All other infants met the learning criteria of 28 presses in the operant conditioning phase. However, further behaviors suggest that some infants may not have learned the procedure. When examining the data, three infants stood out as potential outliers (all three

infants were in Group 2). All analyses involving the testing phase were run both with and without these three infants and are reported below. At the lower extreme, two of these infants (both female) were marked as potential outliers because their operant conditioning phase was greater than 500 seconds *and* in both the helping and hindering conditions in the testing phase, they had a ratio of presses to duration of less than .01 (which is equal to 0 or 1 press in both testing conditions *and* reaching the maximum amount of time—60 seconds—in both testing conditions). Meeting both of these criteria may indicate that these infants did not initially learn the association between pressing the button and moving the character. At the upper extreme, one infant (male) was marked as a potential outlier because the operant conditioning phase was less than 90 seconds *and* the ratio of presses to duration was greater than one in both testing conditions (which is equal to more than one press per second in both conditions). Meeting both of these criteria may suggest that the infant was not fully engaged in the paradigm but instead pressed the button quickly and frequently regardless of the phase. Outliers are not significantly different from the remaining subjects on age or any of the behavioral, salivary cortisol, or questionnaire data. Marginal differences indicate that the missing infants are slightly less synchronous (salivary cortisol synchrony, $t[40] = 1.83, p = .08$) and have mothers who are slightly less inclined to teach (PICCOLO, $t[39] = -1.90, p = .06$).

Transformations

For the behavioral data from the testing phase, the average interval between presses was slightly skewed (skewness between 2.1 and 3.0 and kurtosis between 4.2 and 9.5 for helping and hindering conditions) both with and without outliers. Therefore, a natural log (LN) transformation was conducted, which normalized the distributions (skewness between .06 and .14 and kurtosis between -.61 and .02 for helping and hindering conditions). Infant salivary cortisol was also slightly skewed (skewness = 1.85, kurtosis = 3.05). To normalize the distribution, a natural log transformation was also used for both infant and maternal salivary cortisol levels and

the synchrony variable was calculated based on these transformations (skewness between -.29 and .85, kurtosis between -.75 and .27 for all three variables post-transformation).

Sex Differences

Sex differences were examined using one-way analyses of variance (ANOVAs) with sex as the between-subjects factor and each behavioral, physiological, and parenting measure as the dependent variables. For all subjects, significant sex differences were found for motor development. Specifically, males were significantly older than females when they started sitting on their own (males $M = 6.04$ months, $SD = 1.54$; females $M = 5.08$ months, $SD = 1.12$; $F[1, 37] = 4.78, p = .04$) but also spent a significantly higher percentage of time crawling than females (males $M = 62.7\%$, $SD = 42.26$; females $M = 34.81\%$, $SD = 40.85$; $F[1, 38] = 3.95, p = .05$). Additionally, significant sex differences were found in the hindering condition for average interval between presses (males $M = -.13$, $SD = .84$; females $M = .62$, $SD = .89$; $F[1, 33] = 5.75, p = .02$). Without the three outliers, sex differences remained significant for the interval of presses in the hindering condition (males $M = -.04$, $SD = .81$; females $M = .62$, $SD = .89$; $F[1, 32] = 4.20, p = .05$; see Figure 3). This remained significant after also statistically controlling for motor skills. No additional differences were found. Overall, sex differences showed that males were slower to develop sitting behaviors but were more active when crawling. Males also pressed the button faster than females in the hindering condition only.

Hypothesis 1: Social Evaluations (Hamlin, Wynn, & Bloom, 2007 Replication)

First, to assess the validity of the replication, the character preference of the infants was measured via the choice procedure. It was expected that, similar to the findings of Hamlin and colleagues (2007), the majority of infants in experimental Group 1 would prefer the helper to the hinderer in the choice procedure and that infants in experimental Groups 2 and 3 would not show a clear preference based on character valence.

Descriptives and two-tailed binomial tests were run for all subjects in each experimental group. No significant differences were found. Infants in Group 1 ($n = 16$) chose the helper 44%

of the time and the hinderer 56% of the time ($p = .80$). Infants in Group 2 ($n = 13$), who saw only the non-social movements of the protagonist, chose the blue character 62% of the time and the yellow character 38% of the time ($p = .58$). Finally, infants in Group 3 ($n = 13$), who saw only the non-social upward and downward movements of the blue and yellow characters chose the helper/upward movement 31% of the time, the hinderer/downward movement 69% of the time ($p = .27$) and the blue character 54% of the time ($p = 1.0$). All participants together ($n = 42$), 55% of infants chose the blue character ($n = 23$) and 45% chose yellow ($n = 19$, $p = .64$). A Pearson chi-square test was used to examine the differences between groups on both color and character preferences. No significant differences were found for either color or character choice ($p > .6$ for all tests; see Figure 4a and 4b).

It should be noted that, at the beginning of the study, the infants seemed to show a blue color preference (8 of the first 10 participants chose blue). Therefore, the blue color was changed from a royal blue to a dusty blue (K. Hamlin, personal communication, November 5, 2015) after participant number 10. After removing the first 10 infants from the choice measure, for all subjects ($n = 32$), 47% chose blue and 53% chose yellow ($p = .86$). When divided by groups, the differences remained non-significant, however deleting these 10 participants considerably lowers the total n in each group and therefore lowers the statistical power. In Group 1 ($n = 11$), 55% chose the helper, 45% chose the hinderer ($p = 1.0$), and 27% chose blue ($p = .23$). For Group 2 ($n = 10$), 70% chose the blue character, indicating a potential continued—though still non-significant—color preference after changing the blue color ($p = .34$). Finally, in Group 3 ($n = 11$), 36% chose the helper/upward movement ($p = .55$) and 45% chose blue ($p = 1.0$; see Figure 4c and 4d).

Hypothesis 2: Prosocial Behaviors

Four main behavioral measures were recorded during the testing phase. Each of these was recorded separately for the helping condition and the hindering condition. The variables include: latency (in seconds) to the first button press, average interval (in seconds) between

button presses, the total number of button presses, and the total condition duration (in seconds). The natural log (LN) of interval is used in all analyses to correct for skewness (see Transformations section above). Additionally, infants' 'active time' was calculated as the difference between the total condition duration and the latency to first response, indicating the total time (in seconds) during each condition in which infants were actively pressing the button. Each of these operant response dependent variables was dependent on and correlated with each other and across conditions (see Table 2). While these variables provide overlapping information, each offers a unique perspective on the behaviors of the infants.

Group Behavioral Differences

To assess within-subject differences, repeated measures ANOVAs were used to analyze the differences between infant behaviors in the helping and hindering conditions during the testing phase. It was hypothesized that infants in experimental Group 1 would respond more quickly and frequently during the helping condition than during the hindering condition and that there would be no significant differences in responding between the helping and hindering conditions for experimental Groups 2 and 3.

Duration (total condition duration). Repeated measures ANOVAs were run to examine the differences between experimental groups (between-subjects factor) for helping and hindering behaviors (repeated factors) for each dependent measures. Many of the behavioral measures were in the direction of more helping behaviors than hindering (e.g., shorter latency and more presses in the helping condition for Group 1), however, only one marginally significant difference was found for duration of condition (main effect for repeated measures, $F[1, 36] = 3.45, p = .07, \text{partial } \eta^2 = .09$) indicating that, as expected, the helping condition was marginally shorter than the hindering condition. However, pairwise comparisons showed no difference in behaviors between groups. Additionally, infants within each group showed no significant differences between helping and hindering behaviors, however, Group 1 was trending in that

direction with the helping condition having a slightly shorter duration than hindering (mean difference = 5.06, $p = .17$; see Figure 5a).

After removing the outliers, this relationship remained marginal (repeated measures main effect ($F[1, 33] = 3.54, p = .07$, partial $\eta^2 = .10$; pairwise comparison for Group 1, $p = .19$; see Figure 5b). After also removing the first 10 subjects, and after controlling for motor skills (see Hypothesis 3 MDQ analyses below), this relationship was non-significant.

Infant Character Choice

In order to test the effects of infant character choice from the initial choice procedure on their subsequent helping or hindering behaviors, a series of 2 x 2 factorial ANOVAs were run with experimental group and character choice as independent factors and helping or hindering behaviors as the predicted factors. The combination of information provided by a) Group 2 serving as a control for color choice by not being exposed to the helper (upward movement) or hinderer (downward movement) initially, b) the non-significant color preferences for Group 2 (and all other groups), and c) the counterbalancing of color in Groups 1 and 3, points to the conclusion that color preference was not a significant factor in the infants' choices or behaviors. Therefore, Group 2 is not used in subsequent analyses involving choice. These analyses were run with all subjects both with and without the first 10 infants who saw the royal blue color (all three outliers were all in Group 2, so removing them for these analyses was not necessary).

All 2 x 2 factorial ANOVAs were run using each of the measures of both the helping and hindering conditions (latency, interval, presses, duration, and active time). No analyses were statistically significant in the hindering condition.

Helping condition duration (total condition duration). There was no significant main effect, however, there was a significant interaction between group and choice ($F[1, 24] = 5.83, p = .02$ partial $\eta^2 = .20$). Pairwise comparisons showed that infants in Group 1 who chose the helper ($n = 7, M = 30.57, SD = 12.54$) had a shorter helping duration compared to the infants in

Group 3 who chose the helper/upward character ($n = 4$, $M = 51.25$, $SD = 12.26$, mean difference = 20.68, $p = .02$; see Figure 6a).

When the first 10 infants were removed, these relationships remained significant (interaction, $F[1, 18] = 6.15$, $p = .02$, partial $\eta^2 = .26$; pairwise comparison between Group 1 helper choice, $n = 6$, $M = 29.00$, $SD = 12.96$, and Group 3 helper choice, $n = 4$, $M = 51.25$, $SD = 12.26$, mean difference = 22.25, $p = .02$; see Figure 6b).

Helping condition active time (difference between the total condition duration and the latency to respond). There was no significant main effect, however, there was a significant interaction between group and choice ($F[1, 24] = 6.04$, $p = .02$, partial $\eta^2 = .20$). Pairwise comparisons showed that infants in Group 1 who chose the helper ($n = 7$, $M = 18.34$, $SD = 14.35$) had a shorter helping active time compared to the infants in Group 1 who chose the hinderer ($n = 9$, $M = 32.50$, $SD = 13.58$, mean difference = 14.16, $p = .04$). Infants in Group 1 who chose the helper also had a shorter active time compared to infants in Group 3 who chose the helper/upward character ($n = 4$, $M = 35.83$, $SD = 16.23$, mean difference = 17.49, $p = .04$; see Figure 7a).

When the first 10 infants were removed, these relationships remained significant (interaction, $F[1, 18] = 7.70$, $p = .01$, partial $\eta^2 = .30$; pairwise comparison between Group 1 helper choice, $n = 6$, $M = 15.74$, $SD = 13.79$, and Group 1 hinderer choice, $n = 5$, $M = 34.81$, $SD = 10.04$, mean difference = 19.07, $p = .02$; pairwise comparison between Group 1 helper choice and Group 3 helper choice, $n = 4$, $M = 35.83$, $SD = 16.23$, mean difference = 20.09, $p = .02$; see Figure 7b).

Helping condition interval (average interval between button presses). There was a significant main effect for group, ($F[1, 24] = 6.79$, $p = .02$, partial $\eta^2 = .22$) indicating that infants in Group 3 had a larger (i.e., slower) average interval in the helping condition than infants in Group 1. This main effect was qualified by a significant interaction between group and choice ($F[1, 24] = 7.87$, $p = .01$, partial $\eta^2 = .25$). Pairwise comparisons showed that infants in Group 1 who chose the helper ($n = 7$, $M = -.28$, $SD = .78$) had a shorter interval between presses in the

helping condition compared to the infants in Group 1 who chose the hinderer ($n = 9$, $M = .56$, $SD = .65$, mean difference = $.84$, $p = .03$). Finally, infants in Group 1 who chose the helper had a shorter interval between presses than infants in Group 3 who chose the helper/upward character ($M = 1.29$, $SD = 1.08$, mean difference = 1.57 , $p = .002$; see Figure 8a).

When the first 10 infants were removed, these relationships remained significant (main effect for group, $F[1, 18] = 4.95$, $p = .04$, partial $\eta^2 = .22$; interaction, $F[1, 18] = 6.11$, $p = .02$, partial $\eta^2 = .25$; pairwise comparison between Group 1 helper choice, $n = 6$, $M = -.33$, $SD = .84$, and Group 3 helper choice, $n = 4$, $M = 1.29$, $SD = 1.08$, mean difference = 1.62 , $p = .005$; pairwise comparison between Group 1 helper choice and Group 1 hinderer choice became marginal, $p = .07$; see Figure 8b).

Helping condition presses (number of button presses). There was a significant main effect for group ($F[1, 24] = 5.03$, $p = .03$, partial $\eta^2 = .17$) indicating that infants in Group 1 had more button presses in the helping condition than infants in Group 3. This main effect was qualified by a significant interaction between group and choice ($F[1, 24] = 16.43$, $p < .001$, partial $\eta^2 = .41$). Pairwise comparisons showed that infants in Group 1 who chose the helper ($n = 7$, $M = 17.86$, $SD = 3.63$) had more presses in the helping condition compared to the infants in Group 1 who chose the hinderer ($n = 9$, $M = 10.11$, $SD = 4.26$, mean difference = 7.75 , $p = .001$) and than infants in Group 3 who chose the helper/upward character ($n = 4$, $M = 8.25$, $SD = 4.65$, mean difference = 9.61 , $p = .001$; see Figure 9a).

When the first 10 infants were removed, the main effect for group became marginal, ($F[1, 18] = 3.64$, $p = .07$, partial $\eta^2 = .17$) and the interaction remained significant ($F[1, 18] = 20.85$, $p < .001$, partial $\eta^2 = .54$). Significant pairwise comparisons were found between Group 1 helper choice ($n = 6$, $M = 18.83$, $SD = 2.79$) and Group 3 helper/upward choice ($n = 4$, $M = 8.24$, $SD = 4.65$, mean difference = 10.58 , $p < .001$) and between Group 1 helper choice and Group 1 hinderer choice ($n = 5$, $M = 8.80$, $SD = 4.66$, mean difference = 10.03 , $p < .001$; see Figure 9b).

In summary, as predicted, infants in Group 1 who chose the helper also had a shorter duration, shorter active time, faster interval between presses, and a higher number of presses in the helping condition than infants in Group 3 who chose the helper/upward character. These same infants (Group 1, helper choice) also had a shorter active time, faster interval between presses, and more presses in the helping condition than infants in Group 1 who chose the hinderer. There were no differences in the hindering condition.

Infant Character Choice between Conditions

Repeated measures 2 x 2 x 2 ANOVAs with infant behavioral variables as the repeated factors and both group membership and infant initial character choice as the between-subjects factors were run separately for all behavioral measures (latency, interval, presses, duration, and active time).

Duration (total condition duration). With all subjects, a non-significant but trending interaction was found ($F[1, 24] = 2.95, p = 1.0, \text{partial } \eta^2 = .11$). Pairwise comparisons showed that only within Group 3, for the infants who chose the hinderer/downward character, there was a marginal difference between helping ($n = 8, M = 37.63, SD = 10.78$) and hindering conditions ($M = 47.63, SD = 9.07, \text{mean difference} = 10.0, p = .07$; see Figure 10a).

When the first 10 participants were removed, this interaction became significant ($F[1, 18] = 8.47, p = .01, \text{partial } \eta^2 = .32$). Pairwise comparisons showed that only within Group 3, for the infants who chose the hinderer/downward character, there was a significant difference between helping ($n = 7, M = 38.00, SD = 11.59$) and hindering conditions ($M = 48.57, SD = 9.36, \text{mean difference} = 10.57, p = .04$; see Figure 10b).

In summary, contrary to expectations, only infants in Group 3 who chose the hinderer/downward character had a shorter duration in the helping condition than in the hindering condition. Infants in Group 1 showed no differences for duration between conditions based on their initial character choice. For all subjects, these results were marginally significant, however they became much stronger after removing the first 10 infants.

Hypothesis 3: Ancillary Variables

To predict infant helping and hindering behaviors from the CSI, MDQ, PICCOLO, and salivary cortisol scores, Pearson correlations were run between these measures and the prosocial behavior measures with all subjects and after removing the three outliers. To determine if group membership (experimental group versus both control groups) moderated these relationships, a series of simple moderations using regression analyses were performed on each of these variables and are reported below. CSI, PICCOLO, and salivary cortisol scores were used as predictors of the infant helping and hindering behaviors based on group membership and MDQ scores were used as statistical controls. Moderation analyses were used in addition to bivariate correlations because the moderations allow examination of the correlations to be split between the experimental groups. Thus, a comparison can be made between the slope for Group 1 only and the slope for the control groups only. For example, it is predicted that parenting will have an effect on helping behaviors, but only for Group 1 and not the control groups; therefore, using a moderation analysis, the difference in correlation coefficients based on group membership can be examined. For these moderation analyses, all independent variables were mean centered and groups were dummy coded (0 = control, 1 = experimental) to make the analyses more interpretable. Moderations were run using a simple slopes analysis moderation approach with the PROCESS statistical software (Model 1, 1,000 Bootstrap samples, and 95% bias corrected CI's; Hayes, 2013).

MDQ

Ages and percent of time spent practicing motor skills for each motor development milestone were recorded to examine if more advanced motor development influenced button presses or helping behaviors. The average age for crawling was 7 months, 8 months for pulling up, 9 months for using furniture to assist walking (cruising) and adult help to support walking, and 10 months for standing and walking more than two consecutive steps (however, only 9 infants in this sample had started walking). These average ages are slightly below the average

ages (i.e., more precocious) of the general population (e.g., Santrock, 2016). Sex differences in motor development are described above.

Total presses (total number of button presses across both conditions). For all subjects, no items on the MDQ correlated with total button presses indicating that the infants' motor development did not affect the number of button presses. However, when outliers were removed the percentage of time infants spent crawling correlated negatively with total presses ($r = -.36, p = .04, n = 33$). This relationship remained significant when controlling for sex ($r = -.46, p = .01, n = 30$). No moderation analyses were significant for the MDQ. In summary, only when outliers are removed, infants with more practiced motor skills also pressed the button *less* in both conditions. Therefore, subsequent analyses involving the control groups without the outliers were also run using infant motor skills (i.e., percentage of time spent crawling) as a statistical control.

CSI

No significant relationships were found for the CSI. The scores on the CSI ranged from 59 to 160 with an average score of 141.25 ($SD = 18.62$). There was a restricted range of responding on this questionnaire and mothers' responses were abnormally high. Specifically, the current sample's average (141.25) was significantly higher than a previously reported average response of 121 ($SD = 32$; Funk & Rogge, 2007; $t[39] = 6.88, p < .001$). Additionally, the cut point at which a relationship is considered in distress is a score of 104.5 or lower (Funk & Rogge, 2007) and only two (5%) of the mothers in the current sample met this criterion.

PICCOLO

The PICCOLO yields 4 total scores ranging from 0-14 for affection, responsiveness, and encouragement, and 0-16 for teaching. The average score for affection was 9.3 ($SD = 2.5$), 11.2 ($SD = 2.3$) for responsiveness, 9.9 ($SD = 2.5$) for encouragement, and 7.3 ($SD = 2.6$) for teaching. The total scores (possible range = 0 to 58) ranged from 21 to 52 ($M = 37.7, SD = 8.2$). Previously reported averages (Roggman et al., 2013) are reported for infants as young as 14 months and are focused on an Early Head Start sample. In this previous study, the total PICCOLO score for 14

month old infants ranged from 7.5 to 58.0 ($M = 38.5$, $SD = 7.7$; Roggman et al., 2013). The averages for each individual score were 10.9 for affection, 10.6 for responsiveness, 9.7 for encouragement, and 7.4 for teaching (Roggman et al., 2013). The current study's average for affection was significantly below the average reported by Roggman and colleagues (2013; $t[41] = -4.12$, $p < .001$) and the total range of responses in the current sample was more restricted.

Affection.

Helping condition active time (difference between the total condition duration and the latency to respond). For all subjects, there was a significant correlation between maternal affection and the infants' active time in the helping condition ($r = .34$, $p = .03$, $n = 40$), indicating that mothers showing higher levels of affection had infants with longer durations in the helping condition. Moderation analyses showed that there was a significant overall model ($F[3, 36] = 3.99$, $p = .02$, $R^2 = .22$) and interaction ($M = 3.79$, $t = 2.09$, $p = .04$, 95% CI = .12 to 7.47) and the simple slope for Group 1 was significant ($M = 4.31$, $t = 3.44$, $p = .02$, 95% CI = 1.77 to 6.85; see Figure 11a). The overall model remained significant when the outliers were removed ($F[3, 33] = 4.0$, $p = .02$, $R^2 = .23$; non-significant, trending interaction, $M = 3.64$, $t = 1.76$, $p = .09$, 95% CI = -.56 to 7.84; Group 1 simple slope, $M = 4.31$, $t = 3.44$, $p = .002$, 95% CI = 1.76 to 6.86; see Figure 11b). This relationship was weakened when controlling for motor skills ($F[4, 29] = 3.72$, $p = .02$, $R^2 = .29$; interaction non-significant).

Hindering condition interval (average interval between button presses). For all subjects, there was a significant correlation between maternal affection and the infants' interval between presses in the hindering condition ($r = .37$, $p = .03$, $n = 34$), indicating that mothers showing higher levels of affection had infants who had slower rates of button pressing. A moderation analysis showed that there was a significant overall model for affection and interval in the hindering condition ($F[3, 30] = 10.77$, $p < .001$, $R^2 = .28$). The interaction was significant ($M = .28$, $t = 2.38$, $p = .02$, 95% CI = .04 to .52) and the simple slope for Group 1 was significant ($M = .34$, $t = 5.65$, $p < .001$, 95% CI = .21 to .46; see Figure 12a). These relationships remained

significant and slightly improved when the outliers were removed ($F[3, 29] = 10.80, p < .001, R^2 = .30$; interaction, $M = .33, t = 3.02, p = .005, 95\% \text{ CI} = .11 \text{ to } .56$; Group 1 simple slope, $M = .34, t = 5.65, p < .001, 95\% \text{ CI} = .21 \text{ to } .46$; see Figure 12b). This relationship was still significant after controlling for motor skills ($F[4, 25] = 8.32, p < .001, R^2 = .31$; interaction, $M = .37, t = 2.90, p = .008, 95\% \text{ CI} = .11 \text{ to } .62$).

In summary, contrary to expectations, infants in Group 1 only with more affectionate mothers also had a longer active time in the helping condition and a longer interval (slower response rate) in the hindering condition than infants in the control groups.

Salivary Cortisol

Infant salivary cortisol. Infant salivary cortisol was transformed with a natural log and ranged from -3.15 to -.82 ($M = -2.31, SD = .615$; maternal salivary cortisol was also transformed using a natural log and ranged from -3.96 to -1.43, $M = -2.65, SD = -.64$; see Transformations section for details). Due to changes in the diurnal pattern of cortisol (Davis & Granger, 2009), all analyses involving salivary cortisol were run while statistically controlling for the time of day during which the sample was taken. Infant and maternal salivary cortisol correlated with each other ($r = .43, p = .006$) and infant salivary cortisol correlated marginally with the PICCOLO encouragement scale (all subjects, $r = .29, p = .07$; without outliers, $r = .33, p = .06$).

Total. The infant scores from both conditions were summed to create a total score for each dependent variable. Infant salivary cortisol correlated positively with total duration ($r = .49, p = .002$) and total average interval ($r = .42, p = .02$). After removing outliers and controlling for motor skills, duration became marginal ($r = .34, p = .06$) and interval remained significant ($r = .42, p = .03$). When divided by groups, moderation analyses were significant for both of these variables.

Duration (total condition duration). When moderated by groups, there was a significant overall model for total duration ($F[4, 33] = 5.30, p = .002, R^2 = .34$) and a marginal interaction ($M = 30.09, t = 1.91, p = .07, 95\% \text{ CI} = -2.04 \text{ to } 62.22$). The simple slope for Group 1 was

significant indicating that infants in Group 1 with higher cortisol also had longer durations across both conditions ($M = 23.69, t = 3.50, p = .001, 95\% \text{ CI} = 9.92 \text{ to } 37.46$; see Figure 13a). These remained significant when the outliers were removed ($F[4, 30] = 3.90, p = .01, R^2 = .32$; interaction, $M = 39.06, t = 2.43, p = .02, 95\% \text{ CI} = 6.19 \text{ to } 71.94$; Group 1 simple slope, $M = 45.88, t = 3.52, p = .001, 95\% \text{ CI} = 19.29 \text{ to } 72.48$; see Figure 13b) and after controlling for motor skills ($F[5, 26] = 2.86, p = .04, R^2 = .32$; interaction, $M = 39.25, t = 2.31, p = .03, 95\% \text{ CI} = 4.27 \text{ to } 74.23$).

Interval (average interval between button presses). When moderated by groups, there was a significant overall model for interval ($F[4, 29] = 3.70, p = .02, R^2 = .30$) and a significant interaction ($M = 2.46, t = 2.16, p = .04, 95\% \text{ CI} = .13 \text{ to } 4.80$). The simple slope for Group 1 was significant indicating that infants in Group 1 with higher cortisol also had longer (i.e., slower) intervals between presses across both conditions ($M = 3.11, t = 3.05, p = .005, 95\% \text{ CI} = 1.02 \text{ to } 5.09$; see Figure 14a). These relationships remained significant when the outliers were removed ($F[4, 28] = 3.76, p = .01, R^2 = .33$; interaction, $M = 2.66, t = 2.36, p = .03, 95\% \text{ CI} = .35 \text{ to } 4.97$; Group 1 simple slope, $M = 3.08, t = 3.05, p = .005, 95\% \text{ CI} = 1.01 \text{ to } 5.15$; see Figure 14b), however, the overall model became non-significant after statistically controlling for motor skills ($F[5, 24] = 1.85, p = .14, R^2 = .32$).

Helping condition. Infant salivary cortisol correlated positively with duration ($r = .49, p = .002$), interval between presses ($r = .47, p = .004$), and latency to first response ($r = .33, p = .04$) and marginally with active time ($r = .30, p = .07$) in the helping condition. Infant salivary cortisol also correlated negatively with the number of presses in the helping condition ($r = -.49, p = .002$). When outliers were removed, infant salivary cortisol correlated with duration ($r = .40, p = .02$), interval ($r = .45, p = .006$), and number of presses ($r = -.35, p = .04$) in the helping condition. When also controlling for motor skills, only the relationship between interval and cortisol was significant ($r = .43, p = .02$). When divided by experimental groups, no moderation analyses were significant.

Hindering condition. Infant salivary cortisol correlated positively with the duration of the hindering condition ($r = .34, p = .04$) and negatively with the number of presses in the hindering condition ($r = -.38, p = .02$). When outliers were removed and motor skills were statistically controlled for, however, both of these relationships became non-significant. When divided by experimental groups, moderation analyses were significant for both of these variables and for the average interval between presses.

Duration (total condition duration). When moderated by groups, there was a significant overall model for duration in the hindering condition ($F[4, 33] = 3.82, p = .01, R^2 = .24$) and an interaction ($M = 19.53, t = 2.17, p = .04, 95\% \text{ CI} = 1.18 \text{ to } 37.53$). The simple slope for Group 1 was significant indicating that infants in Group 1 with higher cortisol also had longer durations in the hindering condition ($M = 23.69, t = 3.50, p = .001, 95\% \text{ CI} = 9.92 \text{ to } 37.46$; see Figure 15a). These relationships remained significant when the outliers were removed ($F[4, 30] = 3.55, p = .02, R^2 = .26$; interaction, $M = 24.91, t = 2.62, p = .01, 95\% \text{ CI} = 5.52 \text{ to } 44.30$; Group 1 simple slope, $M = 23.65, t = 3.50, p = .001, 95\% \text{ CI} = 9.86 \text{ to } 37.44$; see Figure 15b). This relationship was still significant after controlling for motor skills ($F[5, 26] = 3.75, p = .01, R^2 = .33$; interaction, $M = 23.15, t = 2.21, p = .04, 95\% \text{ CI} = 1.62 \text{ to } 44.69$).

Interval (average interval between button presses). When moderated by groups, there was a significant overall model for interval in the hindering condition ($F[4, 29] = 6.73, p = .001, R^2 = .32$) and an interaction ($M = 1.91, t = 3.48, p = .002, 95\% \text{ CI} = .79 \text{ to } 3.04$). The simple slope for Group 1 was significant indicating that infants in Group 1 with higher cortisol also had longer (i.e., slower) intervals between presses in the hindering condition ($M = 1.96, t = 4.44, p < .001, 95\% \text{ CI} = 1.06 \text{ to } 2.86$; see Figure 16a). These relationships remained significant when the outliers were removed ($F[4, 28] = 7.35, p < .001, R^2 = .37$; interaction, $M = 2.03, t = 3.76, p = .001, 95\% \text{ CI} = .92 \text{ to } 3.14$; Group 1 simple slope, $M = 1.94, t = 4.45, p < .001, 95\% \text{ CI} = 1.05 \text{ to } 2.84$; see Figure 16b). This relationship was still significant after statistically controlling for

motor skills ($F[5, 24] = 3.94, p = .01, R^2 = .36$; interaction, $M = 2.03, t = 3.17, p = .004, 95\% \text{ CI} = .71 \text{ to } 3.35$).

Presses (total number of button presses). When moderated by groups, there was a significant overall model for the number of presses in the hindering condition ($F[4, 33] = 2.73, p = .05, R^2 = .29$) and an interaction ($M = -9.56, t = -2.15, p = .04, 95\% \text{ CI} = -18.58 \text{ to } -.53$). The simple slope for Group 1 was significant indicating that infants in Group 1 with higher cortisol also had fewer presses in the hindering condition ($M = -12.00, t = -3.19, p = .003, 95\% \text{ CI} = -19.66 \text{ to } -4.34$; see Figure 17a). These relationships remained significant when the outliers were removed ($F[4, 30] = 2.67, p = .05, R^2 = .31$; interaction, $M = -12.59, t = -3.01, p = .005, 95\% \text{ CI} = -21.12 \text{ to } -4.05$; Group 1 simple slope, $M = -12.03, t = -3.76, p = .003, 95\% \text{ CI} = -19.70 \text{ to } -4.36$; see Figure 17b). This relationship became marginal after statistically controlling for motor skills ($F[5, 26] = 2.42, p = .06, R^2 = .34$; interaction, $M = -10.87, t = -2.45, p = .02, 95\% \text{ CI} = -19.98 \text{ to } -1.76$).

Maternal salivary cortisol. Maternal salivary cortisol did not correlate with any of the infant behavioral measures or parenting measures. When divided by experimental groups, a moderation analysis was significant for hindering duration.

Hindering condition duration (total condition duration). When moderated by groups, there was a significant overall model for duration in the hindering condition ($F[4, 34] = 3.07, p = .03, R^2 = .20$) and an interaction ($M = 20.15, t = 3.02, p = .005, 95\% \text{ CI} = 6.60 \text{ to } 33.71$). The simple slope for Group 1 was significant indicating that infants in Group 1 with mothers with higher cortisol levels also had a longer duration in the hindering condition ($M = 14.52, t = 2.95, p = .006, 95\% \text{ CI} = 4.51 \text{ to } 24.53$; see Figure 18a). These relationships remained significant when the outliers were removed ($F[4, 31] = 2.93, p = .04, R^2 = .22$; interaction, $M = 18.92, t = 2.76, p = .01, 95\% \text{ CI} = 4.96 \text{ to } 32.89$; Group 1 simple slope, $M = 14.87, t = 3.00, p = .005, 95\% \text{ CI} = 4.76 \text{ to } 25.00$; see Figure 18b). This relationship became marginal after statistically controlling for

motor skills ($F[5, 27] = 2.50, p = .06, R^2 = .29$; interaction, $M = 16.30, t = 1.86, p = .07, 95\% \text{ CI} = -1.68 \text{ to } -34.27$).

Mother-infant salivary cortisol synchrony. Salivary cortisol synchrony between the mother and infant was calculated as the absolute value of the difference between the natural-log-transformed maternal and infant salivary cortisol scores, where scores closer to zero indicate more synchronous dyads. Synchrony scores ranged from .03 to 1.71 ($M = .59, SD = .42$).

No group differences were found for salivary cortisol synchrony and infant helping behaviors, however, as a whole, salivary cortisol synchrony correlated positively with the duration in the helping condition ($r = .35, p = .03, n = 36$), marginally positively with the active time in the helping condition ($r = .29, p = .08, n = 36$), and negatively with the number of presses in the helping condition ($r = -.34, p = .04, n = 36$) indicating that infants in more synchronous dyads demonstrated faster and more frequent helping responses. However, after removing the outliers, these relationships became non-significant.

In summary, overall—and especially for Group 1—infants with higher cortisol also had longer total durations and longer average intervals across both conditions. Contrary to predictions, after outliers were removed, infants with higher salivary cortisol levels also had fewer presses, longer durations, longer intervals between presses in the helping condition only, and marginally less encouraging mothers. Consistent with predictions, when divided by experimental groups, Group 1 infants with higher salivary cortisol levels also had a longer duration, longer interval, and fewer presses in the hindering condition only. Maternal cortisol did not correlate with any infant measures. However, when divided by groups, mothers with higher cortisol had infants in Group 1 who also had longer durations in the hindering condition. Finally, although no group differences were found, for all subjects, mother-infant dyads with more synchronous salivary cortisol levels (lower numbers) also had infants who demonstrated more helping behaviors. However, after removing the outliers, none of these correlations remained significant.

CHAPTER V

CONCLUSION

The purpose of the current study was to address the possibility of prosocial behaviors emerging before the first year of life if infants are provided with age-appropriate methods to do so. To summarize, it was hypothesized that 1) when replicating Hamlin and colleagues (2007), infants would reliably choose the helper character over the hinderer character only after being shown the social puppet show (Group 1), 2) when provided with developmentally appropriate methods to do so, infants would help the character in need, especially if they initially saw the social puppet show, and 3) parenting factors and infant motor development contribute to the extent of infants' helping or hindering behaviors. The current study showed that infants did not have significant character preferences in the Hamlin and colleagues (2007) replication and only marginal differences between groups in duration of helping versus hindering. However, infants did show more helping behaviors if they also chose the helper in the initial choice procedure. These results allow us to conclude that, to an extent, infants are able to extend social evaluations to prosocial actions. Additionally, sex differences were found indicating that males develop slower regarding motor skills (sitting, in particular), are more active (specifically regarding amount of time spent crawling), and have faster button presses than females in the hindering condition only, suggesting

that males exhibited more hindering behaviors. If indeed this paradigm is shedding light on infant prosocial behaviors, this sex difference is expected as it is synonymous with the current literature's reports of males demonstrating a trend toward fewer empathic and prosocial behaviors than females in childhood (e.g., Baron-Cohen, 1995). However, these differences could also be explained by the differences in motor development, specifically the finding that males in this sample are generally more active. This more parsimonious explanation emphasizes that these initial sex differences in social behaviors may not be the result of socialization of gender roles at this young age but instead of general motor development differences between the sexes (Geary, Byrd-Craven, Hoard, Vigil, & Numtee, 2003).

Hypothesis 1: Social evaluations (Hamlin, Wynn, & Bloom, 2007 Replication)

It cannot be concluded from this study that infants prefer a helping to a hindering character after watching a social puppet show. When infant choices between characters were directly examined, there were no significant differences in preference for valence, movement, or color in each of the three groups or as a whole (only 44% of infants chose the helper). Although this study followed the methods and personal suggestions of Kiley Hamlin as closely as possible, there were a few methodological limitations that could have contributed to these findings. First, the sample size was small and therefore the effect sizes may be smaller than originally assumed. Although an initial power analysis was conducted based on the effects found in the original study and the current sample size met these requirements, similar effects were not found here. This could be due to the inherent assumptions of a power analysis that the effects from one sample are generalizable to the entire population. This is rarely the case, and therefore the effect in the population could be smaller than that reported in the original study, thus explaining the null results here. However, before removing the first 10 infants, the choice procedure effects were not only small, but also in the opposite direction (56% chose the *hinderer*) and likely cannot be explained solely by a statistical power issue. After removing the first 10 infants, effect size

becomes a likely explanation not only because the sample size was greatly decreased but also because slightly more than half (55%) of the infants chose the helper.

Second, changing the blue color after 10 participants is a noteworthy limitation. The initial blue color was chosen based on that used in the Hamlin and colleagues (2007) study. After a seemingly clear blue preference was discovered, Kiley Hamlin (personal communication, November 5, 2015) suggested a color change in accordance to what has been used in subsequent similar studies in their lab. While this may have resolved the potential issue, logistical difficulties in recruiting make removing these first 10 infants altogether too costly. Therefore, the results with all subjects should be interpreted in light of this color change, but the results without these 10 infants should be interpreted with caution as well, as there could be issues related to statistical power. Although it is outside the scope of this current project, it is worth mentioning that data collection will continue further using the revised blue color in order to eventually replace these 10 infants.

Without these 10 infants, there were still no significant differences in character preference; however, the sample size considerably decreased to 11 infants in Group 1. With this smaller sample size, these findings (55% of infants chose the helper) still do not come close to supporting those of the original study in which 88% of 10-month-old infants chose the helper. It is therefore, of course, a possibility that infants generally do not understand the social and moral complexities of this paradigm and are simply responding to perceptual preferences (e.g., Salvadori et al., 2015; Scarf et al., 2012) as has long been a criticism of these types of studies (Martin & Clark, 1982; Premack & Premack, 1997). This is also a possibility regarding the infants in the current study. In fact, infants in Group 2 seemed to show a slight, non-significant blue preference and infants in Group 3 seemed to show a slight, non-significant hinderer/downward movement preference (even after removing the first 10 infants). These differences may be illuminating potential trends that could be exaggerated with a larger sample size. However, in the current study, these trends were all non-significant and the consistent

statistical trends based on choice and infant behavior suggest that more than perceptual preferences may be influencing these infants' behaviors (see Hypothesis 2).

Another methodological limitation is that mothers were asked to close their eyes during the choice procedure (based on the methods used in Hamlin's studies). However, many of them did not. This could have influenced the infants' choices, although, after reviewing and coding the videos of the choice procedure, it is unlikely that this made a difference. Even though they did not close their eyes, none of the mothers said anything or made any gestures toward their infant or the puppets to influence their infant's choice. If the mother did say anything, it was mimicking the experimenter's prompting to make a choice but never leaning toward one character or the other.

Furthermore, infants were shown only two habituation events for each character (based on personal communication, Kiley Hamlin, March 20, 2014). It is a possibility that this was not sufficient for infants to fully habituate to the social paradigm. If this is the case, infants may not have understood the social characteristics of the paradigm and chose randomly in the choice procedure, even if they are developmentally capable of prosocial behaviors.

Lastly, due to difficulties in recruiting, these data were collected across four cities in three different states. While this improved the speed of data collection, the locations and research assistants varied often (6 locations and 6 research assistants in total). The project was initially designed to be portable, however, the multiple locations created varied testing environments for the infants. There is no way to fully know how or if this affected the data collected, but it should be noted. Also due to recruiting difficulties, the demographics of the current sample are generally above average and, therefore, skewed (e.g., average sample income is \$70,000-90,000 and 83% of mothers and 73% of fathers had a college and/or graduate degree). These divergences from the population could potentially influence the results of the current study. Previous research has reported that socioeconomic status (SES) can have an influence infant development (Ursache & Noble, 2016). Specifically, lower SES is typically associated with infant and child deficits in

cognitive flexibility (Clearfield & Niman, 2012), attention (Clearfield & Jedd, 2013), language, memory, executive functioning, self-control, emotion regulation, and socio-emotional processing (often mediated by negative or more detached parenting and high stress; see Ursache, 2016 for review). With a more representative sample that includes more low SES families, one would expect to see increased diversity and variability in prosocial responding and social understanding exhibited by the infants.

In summary, from the choice procedure alone, this study was not able to replicate Hamlin and colleagues (2007). This does not necessarily rule out the possibility that this procedure was in fact addressing infant social evaluations, but it does draw into question other possible explanations for these infants' behaviors as well as the validity and reliability of the procedure with 10-month-old infants (not to mention any younger infants; Hamlin et al., 2010). Having seen no preferences within the experimental groups in this study makes it difficult to confidently rule out perceptual preferences of color or movement. On one hand, the preferences in Group 2 toward the blue color and also in Group 3 toward the downward movement bring this point into considerable question. On the other hand, these differences are all non-significant and therefore statistically irrelevant, even if theoretically relevant. More research would be necessary (and many labs are currently working in that direction; e.g., Cowell & Decety, 2015; Salvadori et al., 2015; Scarf et al., 2012; Scola et al., 2015) to completely rule out these other explanations. It is possible that these null results and those of other similar replications could be explained by the unintentional omission of crucial methodological details not reported in the original studies. This could indicate a "lab effect" in which a specific team of researchers consistently finds stronger results with a specific paradigm, given that the large majority of published studies reporting the evidence of infant social evaluations comes from one research team (e.g., Bloom, 2013; Dunfield & Kuhlmeier, 2010; Hamlin, 2014; Hamlin & Baron, 2014; Hamlin et al., 2008; Hamlin & Wynn, 2011; Hamlin et al., 2007, 2010; Hamlin et al., 2011; Kuhlmeier et al., 2003). However, if

the effects are that highly dependent on undetectable methodological changes, it calls into question the inherent strength of the initial reported effects.

Hypothesis 2: Prosocial behaviors

Group Behavioral Differences

When divided by groups, only marginal differences were found between helping and hindering total condition duration and these differences were non-significant after removing the first 10 infants or statistically controlling for infant motor skills. The three groups did not differ from each other, nor did the duration between helping and hindering differ within each group. Group 1 was the closest to statistical significance but not even marginal ($p = .17$ and $p = .19$ without outliers), but perhaps with a larger sample size, these trends would be augmented. The general lack of group differences could be due to a small sample size or, as is always a possibility, perhaps this particular paradigm is not assessing prosocial behaviors as expected. Additionally, the fact that this relationship became non-significant when controlling for motor skills suggests that the variance in motor development at this age may greatly contribute to the infants' ability and willingness to press the button, consequently confounding any potential differences in prosocial behaviors.

Furthermore, although some small group differences were found, as a whole, the infants' behaviors were highly correlated between the helping and hindering conditions. This indicates that infants who had a high rate of button pressing in one condition often had a high rate across the entire experiment and comparably for each of the other dependent measures. For example, only 28 presses were necessary to complete the conditioning phase and the average number of presses was 51. Similarly, only 14 presses were necessary for the helping and hindering conditions together, and the average number of presses for those together was 24. These measures were initially chosen based on research that demonstrates the ability of young infants to not only learn operant responses, but also apply them to other situations (e.g., Barr et al., 2001). While the reinforcement was meant to be appealing to the infants, perhaps the sound and the

movement of the characters were too reinforcing for the infants and they enjoyed pressing the button regardless of whether they understood the implications. Future research should examine the possibility of helping behaviors using a different, less reinforcing stimulus.

Although many of the statistical relationships were in the same direction (e.g., shorter duration, more presses, and shorter latency in the helping condition), most were non-significant. That, combined with the seemingly random choices in the Hamlin replication, provides minimal direct evidence of social evaluations or helping behaviors within this particular paradigm. Based on this minimal evidence, it is a possibility that 1) many of the infants did not understand the social aspect of this paradigm due to experimenter error (failure to move the puppets in such a way that clearly demonstrates intention and social interaction), 2) infants at this age are simply not yet capable of making these complex social or moral evaluations, 3) if they are able to socially/morally evaluate, infants cannot yet make the cognitive leap from social evaluations to prosocial action, 4) the current methods are not adequately assessing the prosocial capabilities of these infants, or 5) the stimulus was too reinforcing, thus washing out any potential effects. If any of the first four explanations are entirely accurate, no clear trends should have emerged in any of the subsequent analyses. However, infants showed behavioral trends based on their initial character choices, especially in Group 1, suggesting that infants may have understood the social actions demonstrated in the puppet show and can act in congruence with this. The fifth explanation is a strong possibility as suggested by the high number of responses across the entire session, as mentioned above. Regardless of this minimal evidence, it is not sufficient to say that the paradigm was not informative in any sense as the behavioral trends are consistent with the hypotheses when examining the groups based on their initial character choices.

Infant Character Choice

Generally, infants who both saw the examples of helping and hindering in the social puppet show *and* chose the helper, also helped more than their peers who chose the hinderer or were in the control group. Specifically, these infants had a shorter condition duration, shorter

active time, faster interval between button presses, and higher number of button presses in the helping condition than their peers. All of these behavioral measures were highly related, and each explains a unique part of the story (analogous to height and weight measures). The fact that they are all in the same direction denotes a clear trend. There could be many possible explanations for these behavioral trends, but first, the possibility of perceptual preferences driving these effects must be ruled out.

If these trends were due to perceptual preferences of color, one would expect color preferences in their choices, especially for Group 2, who saw only uphill and downhill movements by the protagonist. While there was a slight blue preference for Group 2 infants, it was not statistically significant and therefore can be ruled out, for now. Similarly, if this effect were due to perceptual preferences of directional movement, one would expect directional preferences in infant choices, especially for Group 3, who saw uphill and downhill movements by the ‘helper’ and ‘hinderer’ but without the protagonist. Similar to Group 2 color preferences, two-thirds of infants in Group 3 chose the downward moving character in the choice procedure, suggesting they may have a downward perceptual bias, but the lack of statistical significance of this trend implies that it, too, can be ruled out for now. These trends are not entirely theoretically insignificant, however, and should be examined more closely in future studies.

Furthermore, if infants were acting on perceptual biases alone, it would be expected that they would prefer the same character in the choice procedure and in the testing phase. While this was true for the infants in Group 1, it did not hold true for Group 3, where this difference would be expected to be stronger. In Group 1, infants tended to prefer the same character in both conditions. In other words, if they chose the helper, they also helped more than their peers, and if they chose the hinderer, they did not hinder, but they also did not help as much as their peers. If these effects were solely driven by perceptual preferences, infants in both groups who chose the hinderer should also hinder more (which was not the case) and infants in both groups who chose the helper should help more (which was only true for Group 1, not Group 3). In fact, Group 3

infants who chose the helper actually helped *less* than their Group 1, helper-choice peers. Moreover, if they chose the hinderer, Group 3 infants completed the helping condition marginally *faster* than the hindering condition, especially after removing the first 10 infants. In other words, if these infants preferred the downward movement, they still helped more than hindered and if they preferred the upward movement, they did not subsequently help. Outside of these differences, Group 3 infants did not show any other behavioral differences, which indicates that they served as an adequate control and suggests that these differences are not solely based on a preference for movement.

A post hoc analysis on character choice shows that Group 1 infants did not differ on age or any other ancillary variables except for two motor development measures. Specifically, infants who chose the helper started to pull up on furniture (helper $M = 7.6$ months, $SD = 1.44$, hinderer $M = 9.0$, $SD = 1.09$, $t[14] = -2.16$, $p = .05$) and walk with adult support (helper $M = 7.8$ months, $SD = 1.69$, hinderer $M = 9.63$, $SD = .79$, $t[12] = -2.66$, $p = .02$) on average 1.5 months before the infants who chose the hinderer. Group 3 infants did not differ on any ancillary variables based on choice. This motor development difference for Group 1 infants could also reflect a cognitive developmental difference in these infants that could be driving the varied character choices. In other words, it is possible that the infants who chose the helper were more cognitively advanced and therefore understood the social implications of the puppet show, whereas the other infants did not understand the social implications and chose based on perceptual preferences (Cowell & Decety, 2015; Scarf et al., 2012). The present study did not directly address cognitive development, therefore this is entirely speculative and this effect would need to be examined further in future studies to draw any explicit conclusions.

To summarize, infants in Group 1 who chose the helper, also helped more than their peers who chose the hinderer or were in the control group. Perceptual preferences should be considered, as there were slight trends toward blue color and downward movement. However, in the present study, these differences were non-significant and therefore can be ruled out.

Furthermore, the consistent trends based on infant choices and subsequent behaviors (especially for Group 1) suggest that infants who saw the social puppet show and had more precocious motor skills *and* chose the helper, subsequently performed helping behaviors. This provides some evidence that these behavioral trends are complex and cannot be fully explained by perceptual preferences.

Hypothesis 3: Ancillary Variables

Multiple ancillary variables were measured as potential predictors of infant prosocial behaviors. Specifically, infant motor development, positive parenting behaviors, infant salivary cortisol, and mother-infant salivary cortisol synchrony all uniquely contributed to the behaviors of these infants.

MDQ

In summary, for all groups and only when outliers were removed, infants with more practiced motor skills (percentage of time spent crawling) also had *fewer* total button presses, suggesting perhaps more controlled motor skills. This finding should be taken into consideration when interpreting the other results reported after removing outliers as this suggests that the infants' motor skills were contributing negatively to their overall performance on these tasks. Specifically, the differences in duration of condition, which was already marginal, became non-significant when controlling for motor skills. This suggests that the shorter duration in the helping condition may be partially driven by the amount of time infants spend practicing their motor skills.

CSI

No significant relationships were found for the CSI and any other maternal or infant variables. This finding could be due to the restricted range of responding provided by this sample. Specifically, only two of the mothers reported numbers below the standard level considered to indicate a distressed relationship (Funk & Rogge, 2007). This restricted range could be influenced by the poor representation of the general population in this sample's

demographics (above average household income and maternal education in particular) or simply due to demand characteristics in which the mothers potentially did not respond truthfully to all items on the questionnaire.

PICCOLO

Infants in Group 1 with more affectionate mothers also had a slower interval in the hindering condition and a longer active time in the helping condition than infants in the control groups. As shown through these two different measures, infants with highly affectionate mothers were slower to respond in both conditions. The literature on maternal affection in infancy generally highlights positive outcomes for children (Roggman et al., 2013) including higher levels of prosocial behaviors in childhood (Caspi et al., 2004; Knafo & Plomin, 2006) and better cognitive skills (Petrill & Deater-Deckard, 2004). Since the relationships between maternal affection and infant behaviors in the present study were in the same direction in both the helping and the hindering conditions (i.e., in both conditions, infants with more affectionate mothers responded more slowly), they are not necessarily addressing infant prosocial behaviors and instead perhaps addressing general infant behaviors such as motor or cognitive performance. When statistically controlled for, motor development accounted for part of the relationship between active time in the helping condition and maternal affection, whereas interval in the hindering condition and maternal affection remained relatively unaffected by infant motor skills. This suggests that motor development could have been partially driving these effects, but cannot fully explain them. Furthermore, the present study had a restricted response range on the PICCOLO, and the affection scores in particular were significantly lower than previously reported averages. This restricted range could be explained by the current sample composition, specifically the abnormally high income and education levels of these families. This restriction, along with the lower affection scores, could be influencing the effects reported here.

The current study did not directly assess cognitive performance, and therefore, only speculative associations can be provided here. In particular, a possible explanation for these

findings is that infants in the present study with more affectionate mothers were also exhibiting deeper, more time-consuming cognitive processing. Previous research has reported that positive parenting behaviors can impact infant cognitive and social processing such that parental involvement and the provision of a stimulating environment promote cognitive development in children (Leyendeckera, Jakel, Kademoglu, & Yagmurlu, 2011). More specifically, higher maternal affection is associated with better cognitive ability, memory, school-readiness, and less antisocial behavior (see Roggman et al., 2013 for review). It is, therefore, a possibility that the infants in Group 1 with more affectionate mothers also were slower to respond in general to the present stimuli because they were more secure with their mothers and able to take the extra time to process the social aspects of the puppet show, leading to slower responses overall. Another explanation could involve the development of executive functions, particularly inhibitory control (Diamond, 2002). Specifically, infants begin to develop the foundations of executive functions early in infancy (Diamond, 2002; Paterson, Heim, Friedman, Choudhury, & Benasich, 2006) and this development is highly dependent on positive parenting behaviors (Clark & Woodward, 2015; Holochwost et al., 2016). In the present study, it is possible that the infants with more affectionate mothers were also demonstrating a more developed groundwork for executive functioning, in particular, inhibitory control. This may also contribute to deeper cognitive processing and slower behavioral responses. These elucidations also explain the differentiation between experimental groups, suggesting that the relationship between maternal affection and slower infant responses (or deeper social cognitive processing) was dependent on whether or not infants saw the *social* puppet show versus the controls.

Salivary Cortisol

Salivary cortisol was collected from both the mother and the infant as a measure of physiological synchrony. Only one saliva sample was collected from each dyad (possibly capturing the diurnal pattern of cortisol at the time of the appointment; Davis & Granger, 2009) but the samples were collected 15 minutes following the task (possibly capturing the stress

response to the stimuli and the testing environment; Davis & Granger, 2009). This is a potential limitation in the study design because 1) samples were not collected at the same time of day for every appointment and thus are snapshots of different segments of the diurnal pattern, and 2) only one sample does not provide adequate information for cortisol reactivity because there is no baseline with which to compare. While these may cloud the interpretation, important information can still be drawn from these data, especially after statistically controlling for time of day.

Parenting behaviors can strongly influence infant cortisol responses such that sensitive and responsive parenting is associated with lower infant cortisol levels (see Gunnar & Quevedo, 2007 for review; Liu et al., 1997; Morelius et al., 2015) and insecurely attached dyads are associated with higher infant cortisol (Gunnar & Quevedo, 2007; Taylor et al., 2012). The infants in the present study with higher salivary cortisol also have mothers with lower levels of encouragement. This implies that lower levels of maternal engagement could be amplifying these infants' high stress responses, however this relationship was marginal.

On the other hand, infants with higher salivary cortisol also demonstrated a longer duration and slower button presses across both conditions. In the helping condition only, infants also showed fewer button presses if they had higher cortisol levels. These findings could be explained by examining previous reports indicating that higher reactive and atypically high diurnal patterns of salivary cortisol in children predict slower reaction times (Gaysina, Garder, Richards, & Ben-Shlomo, 2014) and poorer cognitive functioning (MacKinnon McQuarrie, Siegel, Perry, & Weinberg, 2014; Quesada, Tristao, Pratesi, & Wolf, 2014). However, a comparable explanation can be provided here as that regarding affectionate parenting and slower infant responses. The current study reports that infants with 1) more affectionate mothers and 2) higher cortisol levels also demonstrated slower responses overall. Previous research has suggested that positive parenting can influence children's social and cognitive development such that supportive parenting increases children's emotion regulation and cognitive abilities (Diamond, 2013; Miller & Cohen, 2001; Roskam, Stievenart, Meunier, & Noel, 2014). Additionally, individuals with

moderate to high cortisol reactivity (with typical recovery) tend to demonstrate better executive functioning, more self-regulation (Blair, Granger, & Razza, 2005; Davis, Bruce, & Gunnar, 2002; Obradovic, Bush, Stamperdahl, Adler, & Boyce, 2010), extraversion, and social competence (Gunnar, Tout, de Haan, Pierce, & Stansbury, 1997; Obradovic et al., 2010). The infants in the present study generally had a lower overall range of cortisol than previous reports (current study range .04 to 1.69 $\mu\text{g/dL}$; standard range for 6-month-olds 0 to 2.73 $\mu\text{g/dL}$; Salimetrics Salivary Cortisol Enzyme Immunoassay Kit, 2014) suggesting that these infants do not have atypically high patterns of cortisol that would be indicative of poorer cognitive outcomes. It is therefore possible that these infants could have the foundation for more precocious executive functions and social skills and could be using the extra time to exercise inhibition, process the social aspects of the puppet show more deeply, and respond thoughtfully and therefore slowly to the social behaviors presented in the puppet show. Furthermore, when divided by experimental groups, only the infants in Group 1 had longer durations and slower intervals overall, and fewer presses in the hindering condition if they or their mothers also had higher salivary cortisol. In other words, for infants who saw the social puppet show, those with higher salivary cortisol showed slower responses overall and particularly fewer hindering behaviors. Additionally, Group 1 infants showed slower hindering responses (i.e., longer duration) if their mothers had higher salivary cortisol levels. Although cortisol synchrony did not show any significant relationships, this may suggest that infants were responding both physiologically and behaviorally to their mother's elevated cortisol levels (Middlemiss et al., 2012). These results also suggest that these infants may have been responding physiologically to the social qualities of the paradigm with elevated cortisol responses and were particularly sensitive to the negative, hindering behaviors presented by the characters. In general, low cortisol levels, and especially cortisol reactivity, are associated with fewer empathic responses (Shirtcliff et al., 2009), whereas high cortisol levels, and reactivity, promote empathic and prosocial behaviors (Booth et al., 2008; Nakayama et al., 2007; Shirtcliff et al., 2009). Therefore, the current findings suggest that a higher salivary cortisol

response to the social paradigm cultivates fewer hindering behaviors for the infants who experienced the social puppet show.

No group differences were found for salivary cortisol synchrony. However, for all subjects, mother-infant dyads with more synchronous salivary cortisol levels also had infants with more presses, a shorter duration, and shorter active time in the helping condition. This supports the current hypothesis and is congruent with recent literature that physiological responses between mothers and children are more synchronized when the mother-infant relationship is secure, sensitive, and responsive (Sethre-Hofstad et al., 2002). Additionally, encouraging, sensitive, and responsive parenting facilitates prosocial behaviors in children (Farrant et al., 2012) and the findings from the current study show that infants of more synchronous dyads exhibited more helping behaviors. However, after removing the outliers, these correlations were significantly weakened, suggesting that other infant characteristics may be driving these relationships.

General Discussion

If arguments regarding the early development of imitation and infant moral judgments are correct, infants should be able to not only understand, reason, and evaluate others' behaviors but also act on these basic moral principles, given that they are capable of physically performing the helping behaviors. These mental capacities and evaluations of others' behaviors should translate to behaviors as they do in toddlerhood (e.g., Warneken & Tomasello, 2009). There is an increasing amount of literature suggesting that preverbal infants are able to understand cooperation and prosocial behaviors. This body of work argues that infants under one year can understand complex social constructs in third parties including unmet goals (Henderson & Woodward, 2011) and the positive and negative evaluation of goal-meeting and goal-hindering behaviors (Premack & Premack, 1997). After the first year, these mental abilities become more complex and helping behaviors begin to emerge (e.g., Dunfield & Kuhlmeier, 2010; Warneken & Tomasello, 2007). However, these studies in infancy have not assessed anything beyond infant mental states and social evaluations by extending to infant *behaviors*. While the current study did

not show clear infant preferences as Hamlin's team has done or broad differences in group helping behaviors as seen in toddlers (Warneken & Tomasello, 2007), it did show a significant interaction between these two infant behaviors. Specifically, the infants for whom the social behaviors were modeled in the puppet show *and* who chose the helpful character also behaved much differently than their peers. These results allow us to conclude that perhaps some infants are not only judging moral character but also acting on their moral judgments by exhibiting helping behaviors. For this study, perceptual preferences may be involved but are non-significant and therefore these results suggest that infants can act prosocially in this context.

In conclusion, the research presented here offers an innovative approach to the study of empathy and prosocial behaviors in infants. It incorporates the emotional, cognitive, and behavioral aspects of empathy and attempts to determine the early developmental trajectory of empathy-related behaviors and mental processes. While the results reported here might not be independently outstanding, they do contribute important information to the current body of literature by addressing the possibility of the early emergence of these behaviors. Since this is the first study of its kind to examine the likelihood of agency behind infant social evaluations, more research is necessary to further explore these behavioral trends and definitively rule out the influence of perceptual preferences on these behaviors. Specifically, future research should focus on using alternative methods of measuring prosocial behaviors in infants this young (particularly, a less reinforcing stimulus or a different paradigm), emphasize the addition of more experimental controls in order to further rule out perceptual preferences, examine the development of prosocial behaviors through age comparisons with longitudinal or cross-sectional experimental designs extending into toddlerhood, and include measurements of additional biomarkers such as heart rate to further understand the early development of these behaviors. The current study, through the use of age-appropriate methods, has unlocked the possibility of studying early emerging prosocial actions and contributes important information to understanding the early development of empathy and prosocial behaviors in infancy.

REFERENCES

- Archer, R. L., Diaz-Loving, R., Gollwitzer, P. M., Davis, M. H., & Foushee, H. C. (1981). The role of dispositional empathy and social evaluation in the empathic mediation of helping. *Journal of Personality and Social Psychology, 40*, 786-796.
- Bandura, A. (1977). *Social Learning Theory*. New Jersey: Prentice Hall, Inc.
- Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Cambridge: MIT Press.
- Baron-Cohen, S. (2002). The extreme male brain theory of autism. *Trends in Cognitive Sciences, 6*(6), 248-254.
- Barr, R., Vieira, A., & Rovee-Collier, C. (2001). Mediated imitation in 6-month-olds: Remembering by association. *Journal of Experimental Child Psychology, 79*, 229-252.
doi: 10.1006/jecp.2000.2607
- Batson, C. D. (1991). *The altruism question: Toward a social-psychological answer*. Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.
- Benedetti, F., Bernasconi, A., Bosia, M., Cavallaro, R., Dallaspezia, S., Falini, A., . . . Smeraldi, E. (2009). Functional and structural brain correlates of theory of mind and empathy deficits in schizophrenia. *Schizophrenia Research, 114*, 154-160.

- Blair, C., Granger, D. A., & Razza, R. P. (2005). Cortisol reactivity is positively related to executive function in preschool children attending head start. *Child Development, 76*, 554-567.
- Bloom, P. (2013). *Just Babies: The Origins of Good and Evil*. New York: Crown Publishers.
- Booth, A., Granger, D. A., & Shirtcliff, E. A. (2008). Gender- and age-related differences in the association between social relationship quality and trait levels of salivary cortisol. *Journal of Research on Adolescence, 18*(2), 239-260.
- Brown, M. (2011). Learning from service: The effect of helping on helpers' social dominance orientation. *Journal of Applied Social Psychology, 41*(4), 850-871.
- Burleson, B. R. (1983). Social cognition, empathic motivation and adults' comforting strategies. *Human Communication Research, 10*, 295-304.
- Campos, J. J., Anderson, D. I., Barbu-Roth, M. A., Hubbard, E. M., Hertenstein, M. J., & Witherington, D. (2000). Travel broadens the mind. *Infancy, 1*(2), 149-219.
- Campos, J. J., Witherington, D., Anderson, D. I., Frankel, C. I., Uchiyama, I., & Barbu-Roth, M. (2008). Rediscovering development in infancy. *Child Development, 79*(6), 1625-1632.
- Caspi, A., Moffitt, T. E., Morgan, J. M., Rutter, M., Taylor, A., Arseneault, L., . . . Polo-Tomas, M. (2004). Maternal expressed emotion predicts children's antisocial behavior problems: Using monozygotic-twin differences to identify environmental effects on behavioral development. *Developmental Psychology, 40*(2), 149-161. doi: 10.1037/0012-1649.40.2.149
- Clark, C. A. C., & Woodward, L. J. (2015). Relation of perinatal risk and early parenting to executive control at the transition to school. *Developmental Science, 18*(4), 525-542. doi: 10.1111/desc.12232
- Clearfield, M. W., & Jedd, K. E. (2013). The effects of socio-economic status on infant attention. *Infant & Child Development, 22*, 52-67. doi: 10.1002/icd.1770

- Clearfield, M. W., & Niman, L. C. (2012). SES affects infant cognitive flexibility. *Infant Behavior & Development, 35*, 29-35. doi: 10.1016/j.infbeh.2011.09.007
- Cowell, J. M., & Decety, J. (2015). Precursors to morality in development as a complex interplay between neural, socioenvironmental, and behavioral facets. *Proceedings of the National Academy of Science, USA, 112*(41), 12657-12662. doi: 10.1073/pnas.1508832112
- Davidov, M., Zahn-Waxler, C., Roth-Hanania, R., & Knafo, A. (2013). Concern for others in the first year of life: Theory, evidence, and avenues for research. *Child Development Perspectives, 7*(2), 126-131. doi: 10.1111/cdep.12028
- Davis, E. P., Bruce, J., & Gunnar, M. (2002). The anterior attention network: Associations with temperament neuroendocrine activity in 6-year-old children. *Developmental Psychobiology, 40*, 43-56.
- Davis, E. P., & Granger, D. A. (2009). Developmental differences in infant salivary alpha-amylase and cortisol responses to stress. *Psychoneuroendocrinology, 34*(795-804). doi: 10.1016/j.psyneuen.2009.02.001
- de Waal, F. B. M. (1996). *Good Natured: The Origins of Right and Wrong in Humans and Other Animals*. Cambridge, MA: Harvard University Press.
- de Waal, F. B. M. (2008). Putting the altruism back into altruism: The evolution of empathy. *Annual Review of Psychology, 59*, 279-300. doi: 10.1146/annurev.psych.59.103006.093625
- Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and Cognitive Neuroscience Reviews, 3*(2), 71-100. doi: 10.1177/1534582304267187
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168.
- Diamond, A. (Ed.). (2002). *Normal development of prefrontal cortex from birth to young adulthood: Cognitive functions, anatomy, and biochemistry*. London, UK: Oxford University Press.

- Dondi, M., Simion, F., & Caltran, G. (1999). Can newborns discriminate their own cry and the cry of another newborn infant? *Developmental Psychology*, *35*(2), 418-426.
- Dunfield, K. A., & Kuhlmeier, V. A. (2010). Intention-mediated selective helping in infancy. *Psychological Science*, *21*, 523-527. doi: 10.1177/0956797610364119
- Eisenberg, N., Fabes, R. A., & Spinrad, T. L. (2006). Prosocial development. In N. Eisenberg, W. Damon & R. M. Lerner (Eds.), *Handbook of Child Psychology* (Sixth ed., pp. 646-718): John Wiley & Sons, Inc.
- Eisenberg, N., & Miller, P. A. (1987). The relation of empathy to prosocial and related behaviors. *Psychological Bulletin*, *101*(1), 91-119.
- Farrant, B. M., Devine, T. J., Maybery, M. T., & Fletcher, J. (2012). Empathy, perspective taking and prosocial behaviour: The importance of parenting practices. *Infant & Child Development*, *21*(2), 175-188. doi: 10.1002/icd.740
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.
- Feshbach, N. (1978). Studies of empathic behavior in children. *Progress In Experimental Personality Research*, *8*(1), 1-47.
- Frankel, C. B., Campos, J. J., & Anderson, D. I. (2005). Measuring the acquisition and consequences of crawling, walking, and related motor milestones. *Unpublished manuscript*.
- Funk, J. L., & Rogge, R. D. (2007). Testing the ruler with item response theory: Increasing precision of measurement for relationship satisfaction with the Couples Satisfaction Index. *Journal of Family Psychology*, *21*, 572-583.
- Gaysina, D., Garder, M., Richards, M., & Ben-Shlomo, Y. (2014). Cortisol and cognitive function in midlife: The role of childhood cognition and educational attainment. *Psychoneuroendocrinology*, *47*, 189-198. doi: 10.1016/j.psyneuen.2014.05.018

- Geangu, E., Benga, O., Stahl, D., & Striano, T. (2010). Contagious crying beyond the first days of life. *Infant Behavior & Development*, *33*, 279-288. doi: 10.1016/j.infbeh.2010.03.004
- Geangu, E., Benga, O., Stahl, D., & Striano, T. (2011). Individual differences in infants' emotional resonance to a peer in distress: Self-other awareness and emotion regulation. *Social Development*, *20*(3), 450-470. doi: 10.1111/j.1467-9507.2010.00596.x
- Geary, D. C., Byrd-Craven, J., Hoard, M. K., Vigil, J., & Numtee, C. (2003). Evolution and development of boys' social behavior. *Developmental Review*, *23*, 444-470. doi: 10.1016/j.dr.2003.08.001
- Gergely, G., Bekkering, H., & Király, I. (2002). Rational imitation in preverbal infants. *Nature*, *415*, 755.
- Granger, D. A., Blair, C., Willoughby, M., Kivlighan, K. T., Hibel, L. C., Fortunato, C. K., . . . Investigators, F. L. P. (2007). Individual differences in salivary cortisol and alpha-amylase in mothers and their infants: Relation to tobacco smoke exposure. *Developmental Psychobiology*, *49*, 692-701.
- Gunnar, M., & Donzella, B. (2002). Social regulation of the cortisol levels in early human development. *Psychoneuroendocrinology*, *27*, 199-220.
- Gunnar, M., & Quevedo, K. (2007). The neurobiology of stress and development. *Annual Review of Psychology*, *58*, 145-173. doi: 10.1146/annurev.psych.58.110405.085605
- Gunnar, M., Tout, K., de Haan, M., Pierce, S., & Stansbury, K. (1997). Temperament, social competence, and adrenocortical activity in preschoolers. *Developmental Psychobiology*, *31*, 65-85.
- Hamlin, J. K. (2014). The case for social evaluation in preverbal infants: Gazing toward one's goal drives infants' preferences for Helpers over Hinderers in the hill paradigm. *Frontiers in Psychology*, *5*(1563). doi: 10.3389/fpsyg.2014.01563
- Hamlin, J. K., & Baron, A. S. (2014). Agency attribution in infancy: Evidence for a negativity bias. *PloS One*, *9*(5), 1-8.

- Hamlin, J. K., Hallinan, E. V., & Woodward, A. L. (2008). Do as I do: 7-month-old infants selectively reproduce others' goals. *Developmental Science, 11*(4), 487-494. doi: 10.1111/j.1467-7687.2008.00694.x
- Hamlin, J. K., Newman, G. E., & Wynn, K. (2009). Eight-month-old infants infer unfulfilled goals, despite ambiguous physical evidence. *Infancy, 14*(5), 579-590. doi: 10.1080/15250000903144215
- Hamlin, J. K., & Wynn, K. (2011). Young infants prefer prosocial to antisocial others. *Cognitive Development, 26*, 30-39.
- Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature, 450*, 557-560. doi: 10.1038/nature06288
- Hamlin, J. K., Wynn, K., & Bloom, P. (2010). Three-month-olds show a negativity bias in their social evaluations. *Developmental Science, 13*(6), 923-929. doi: 10.1111/j.1467-7687.2010.00951.x
- Hamlin, J. K., Wynn, K., & Bloom, P. (2012). Reply to Scarf et al.: Nuanced social evaluation: Association doesn't compute. *Proceedings of the National Academy of Science, USA, 109*(22). doi: 10.1073/pnas.1204712109
- Hamlin, J. K., Wynn, K., Bloom, P., & Mahajan, N. (2011). How infants and toddlers react to antisocial others. *Proceedings of the National Academy of Science, USA, 108*, 19931-19936.
- Harshorn, K., & Rovee-Collier, C. (1997). Infant learning and long-term memory at 6 months: A confirming analysis. *Developmental Psychobiology, 30*, 71-85.
- Harwood, M. D., & Farrar, M. (2006). Conflicting emotions: The connection between affective perspective taking and theory of mind. *British Journal of Developmental Psychology, 24*(2), 401-418.
- Hay, D. F., Nash, A., & Pedersen, J. (1981). Responses of six-month-olds to the distress of their peers. *Child Development, 52*, 1071-1075.

- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis*. New York: The Guilford Press.
- Heinrichs, M., Baumgartner, T., Kirschbaum, C., & Ehlert, U. (2003). Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biological Psychiatry, 54*(1389–1398).
- Henderson, A. M. E., & Woodward, A. L. (2011). "Let's work together": What do infants understand about collaborative goals? *Cognition, 121*, 12-21. doi: 10.1016/j.cognition.2011.05.008
- Hoffman, M. L. (1979). *Development of empathy and altruism*. Paper presented at the Annual Meeting of the American Psychological Association, New York, NY.
- Hoffman, M. L. (2000). *Empathy and moral development: Implications for caring and justice*. Cambridge, MA: Cambridge University Press.
- Hoffman, M. L., & Levine, L. E. (1976). Early sex differences in empathy. *Developmental Psychology, 12*(6), 557-558.
- Holochwost, S. J., Garipey, J. L., Propper, C. B., Gardner-Neblett, N., Volpe, V., Neblett, E., & Mills-Koonce, W. R. (2016). Sociodemographic risk, parenting, and executive functions in early childhood: The role of ethnicity. *Early Childhood Research Quarterly, 36*, 537-549. doi: 10.1016/j.ecresq.2016.02.001
- Howes, C., & Farver, J. (1987). Toddlers' responses to the distress of their peers. *Journal of Applied Developmental Psychology, 8*, 441-452.
- Jenkins, J. M., & Astington, J. W. (2000). Theory of mind and social behavior: Causal models tested in a longitudinal study. *Merrill-Palmer Quarterly, 46*(2), 203-220.
- Knafo, A., & Plomin, R. (2006). Parental discipline and affection and children's prosocial behavior: Genetic and environmental links. *Personality Processes and Individual Differences, 90*(1), 147-164. doi: 10.1037/0022-3514.90.1.147

- Kuhlmeier, V., Wynn, K., & Bloom, P. (2003). Attribution of dispositional states by 12-month-olds. *Psychological Science, 14*(5), 402-408.
- Leyendeckera, B., Jakel, J., Kademoglu, S. O., & Yagmurlu, B. (2011). Parenting practices and pre-schoolers' cognitive skills in Turkish immigrant and German families. *Early Child Development and Care, 181*(8), 1095-1110. doi: 10.1080/03004430.2010.517836
- Lieberman, M. D. (2013). *Social: Why our brains are wired to connect*. New York, NY: Random House, Inc.
- Liu, D., Diorio, J., Tannenbaum, B., Caldji, C., Francis, D., Freedman, A., & al., et. (1997). Maternal care, hippocampal glucocorticoid receptors, and hypothalamic-pituitary-adrenal responses to stress. *Science, 277*, 1659-1662.
- Loman, M. M., & Gunnar, M. (2010). Early experience and the development of stress reactivity and regulation in children. *Neuroscience and Biobehavioral Reviews, 34*, 867-876. doi: 10.1016/j.neubiorev.2009.05.007
- Lonigro, A., Laghi, F., Biocco, R., & Bumgartner, E. (2013). Mind reading skills and empathy: Evidence for nice and nasty ToM behaviors in school-aged children. *Journal of Child and Family Studies, 23*, 581-590.
- MacKinnon McQuarrie, M. A., Siegel, L. S., Perry, N. E., & Weinberg, J. (2014). Reactivity to stress and the cognitive components of math disability in grade 1 children. *Journal of Learning Disabilities, 47*(4), 349-365. doi: 10.1177/0022219412463436
- Martin, G. B., & Clark, R. D. (1982). Distress crying in neonates: Species and peer specificity. *Developmental Psychology, 18*(1), 3-9.
- Meltzoff, A. N. (2011). Social cognition and the origins of imitation, empathy and theory of mind. In Usha Goswami (Ed.), *The Wiley-Blackwell Handbook of Childhood Cognitive Development* (2nd ed.): Wiley-Blackwell.
- Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science, 198*(4312), 75-78.

- Middlemiss, W., Granger, D. A., Goldberg, W. A., & Nathans, L. (2012). Asynchrony of mother-infant hypothalamic-pituitary-adrenal axis activity following extinction of infant crying responses induced during the transition to sleep. *Early Human Development, 88*, 227-232.
- Miller, Chen, E., & Zhou, E. S. (2007). If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychological Bulletin, 133*(1), 25-45. doi: 10.1037/0033-2909.133.1.25
- Miller, & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24*, 167-202.
- Morelius, E., Ortenstrand, A., Theodorsson, E., & Frostell, A. (2015). A randomised trial of continuous skin-to-skin contact after preterm birth and the effects on salivary cortisol, parental stress, depression, and breastfeeding. *Early Human Development, 91*, 63-70. doi: 10.1016/j.earlhumdev.2014.12.005
- Nakayama, Y., Takahashi, T., Wakabayashi, A., Oono, H., & Radford, M. H. B. (2007). Sex differences in the relationship between cortisol levels and the Empathy and Systemizing Quotients in humans. *Neuroendocrinology Letters, 28*(4), 445-448.
- Obradovic, J., Bush, N. R., Stamperdahl, J., Adler, N. E., & Boyce, W. T. (2010). Biological sensitivity to context: The interactive effects of stress reactivity and family adversity on socioemotional behavior and school readiness. *Child Development, 81*(1), 270-289.
- Oostenbroek, J., Suddendorf, T., Nielsen, M., Redshaw, J., Kennedy-Costantini, S., Davids, J., . . . Slaughter, V. (2016). Comprehensive longitudinal study challenges the existence of neonatal imitation in humans. *Current Biology, 26*, 1334-1338. doi: 10.1016/j.cub.2016.03.047
- Paterson, S. J., Heim, S., Friedman, J. T., Choudhury, N., & Benasich, A. A. (2006). Development of structure and function in the infant brain: Implications for cognition,

- language and social behavior. *Neuroscience and Biobehavioral Reviews*, 30, 1087-1105.
doi: 10.1016/j.neubiorev.2006.05.001
- Petrill, S. A., & Deater-Deckard, K. (2004). Task orientation, parental warmth and SES account for a significant proportion of the shared environmental variance in general cognitive ability in early childhood: Evidence from a twin study. *Developmental Science*, 7(1), 25-32.
- Piaget, J. (1951). *The child's conception of the world*. London: Routledge and Kegan Paul.
- Premack, D., & Premack, A. J. (1997). Infants attribute value to the goal-directed actions of self-propelled objects. *Journal of Cognitive Neuroscience*, 9(6), 818-856.
- Preston, S. D., & de Waal, F. B. M. (2002). Empathy: Its ultimate and proximate bases. *Behavioral and Brain Sciences*, 25, 1-72.
- Quesada, A. A., Tristao, R. M., Pratesi, R., & Wolf, O. T. (2014). Hyper-responsiveness to acute stress, emotional problems and poorer memory in preterm children. *Stress*, 17(5), 389-399. doi: 10.3109/10253890.2014.949667
- Roggman, L. A., Cook, G. A., Innocenti, M. S., Jump Norman, V., & Christiansen, K. (2013). Parenting Interactions with Children: Checklist of Observation Linked to Outcomes (PICCOLO) in diverse ethnic groups. *Infant Mental Health Journal*, 34(4), 290-306.
- Roskam, I., Stievenart, M., Meunier, J. C., & Noel, M. P. (2014). The development of children's inhibition: Does parenting matter? *Journal of Experimental Child Psychology*, 122, 166-182. doi: 10.1016/j.jecp.2014.01.003
- Roth-Hanania, R., Davidov, M., & Zahn-Waxler, C. (2011). Empathy development from 8 to 16 months: Early signs of concern for others. *Infant Behavior & Development*, 34, 447-458.
- Sagi, A., & Hoffman, M. L. (1976). Empathic distress in the newborn. *Developmental Psychology*, 12(2), 175-176.
- Salvadori, E., Blazsekova, T., Volein, A., Karap, Z., Tatone, D., Mascaro, O., & Csibra, G. (2015). Probing the strength of infants' preference for helpers over hinderers: Two

- replication attempts of Hamlin and Wynn (2011). *PLoS ONE*, 1-10. doi:
10.1371/journal.pone.0140570
- Santrock, J. (2016). *Essentials of Life-Span Development* (Fourth ed.). New York, NY: McGraw-Hill Education.
- Scarf, D., Imuta, K., Colombo, M., & Hayne, H. (2012). Social evaluation or simple association? Simple associations may explain moral reasoning in infants. *PLOS ONE*, 7(8). doi:
10.1371/journal.pone.0042698.g001
- Scola, C., Holovet, C., Arciszewski, T., & Picard, D. (2015). Further evidence for infants' preference for prosocial over antisocial behaviors. *Infancy*, 20(6), 684-692. doi:
10.1111/inf.12095
- Sethre-Hofstad, L., Stansbury, K., & Rice, M. A. (2002). Attunement of maternal and child adrenocortical response to child challenge. *Psychoneuroendocrinology*, 27, 731-747.
- Shirtcliff, E. A., Vitacco, M. J., Graf, A. R., Gostisha, A. J., Merz, J. L., & Zahn-Waxler, C. (2009). Neurobiology of empathy and callousness: Implications for the development of antisocial behavior. *Behavioral Sciences and the Law*, 27, 137-171. doi: 10.1002/bsl.862
- Simner, M. L. (1971). Newborn's response to the cry of another infant. *Developmental Psychology*, 5(1), 136-150.
- Skinner, B. F. (1963). Operant behavior. *American Psychologist*, 18(8), 503-515. doi:
10.1037/h0045185
- Smith, A. (1759). *Theory of moral sentiments*. London: Millar.
- Stenius, F., Theorell, T., Lilja, G., Scheynius, A., Alm, J., & Lindblad, F. (2008). Comparisons between salivary cortisol levels in six-months-old and their parents. *Psychoneuroendocrinology*, 33, 352-359.
- Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A. R., & Updegraff, J. A. (2000). Biobehavioral responses to stress in females: Tend-and-befriend, not fight-or-flight. *Psychological Review*, 107(3), 411-429. doi: 10.1037//0033-295X.107.3.411

- Taylor, Z. E., Spinrad, T. L., VanSchyndel, S. K., Eisenberg, N., Huynh, J., Sulik, M. J., & Granger, D. A. (2012). Sociodemographic risk, parenting, and effortful control: Relations to salivary alpha-amylase and cortisol in early childhood. *Developmental Psychobiology*. doi: 10.1002/dev.21079
- Titchener, E. B. (1909). *Lectures on the experimental psychology of the thought-processes*. New York: The Macmillian Company.
- Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, 46, 35-57.
- Ungerer, J. A., Dolby, R., Waters, B., Barnett, B., Kelk, N., & Lewin, V. (1990). The early development of empathy: Self-regulation and individual differences in the first year. *Motivation and Emotion*, 14, 93-106.
- Ursache, A., & Noble, K. G. (2016). Neurocognitive development in socioeconomic context: Multiple mechanisms and implications for measuring socioeconomic status. *Psychophysiology*, 53, 71-82. doi: 10.1111/psyp.12547
- Vaish, A., Carpenter, M., & Tomasello, M. (2009). Sympathy through affective perspective taking and its relation to prosocial behavior in toddlers. *Developmental Psychology*, 45(2), 534-543. doi: 10.1037/a0014322
- Vaish, A., Carpenter, M., & Tomasello, M. (2010). Young children selectively avoid helping people with harmful intentions. *Child Development*, 81, 1661-1669. doi: 10.1111/j.1467-8624.2010.01500.x
- van Bakel, H. J. A., & Riksen-Walraven, J. M. (2008). Adrenocortical and behavioral attunement in parents with 1-year-old infants. *Developmental Psychobiology*. doi: 10.1002/dev.20281
- Varnon, C., & Abramson, C. (2013). The propeller experiment controller: Low-cost automation for classroom experiments in learning and behavior. *Innovative Teaching*, 2(2).

- Vollm, B. A., Taylor, A. N. W., Richardson, P., Corcoran, R., Stirling, J., McKie, S., . . . Elliot, R. (2006). Neuronal correlates of theory of mind and empathy: A functional magnetic resonance imaging study in a nonverbal task. *Neuroimage*, *29*(90-98).
- Warneken, F., & Tomasello, M. (2006). Altruistic helping in human infants and young chimpanzees. *Science*, *311*(5765), 1301-1303.
- Warneken, F., & Tomasello, M. (2007). Helping and cooperation at 14 months of age. *Infancy*, *11*(3), 271-294.
- Warneken, F., & Tomasello, M. (2009). The roots of human altruism. *British Journal of Psychology*, *100*, 455-471.
- Zahn-Waxler, C., Radke-Yarrow, M., Wagner, E., & Chapman, M. (1992). Development of concern for others. *Developmental Psychology*, *28*(1), 126-136.

APPENDICES

APPENDIX A

Demographic Information Questionnaire

Child Information

What is your relationship to your infant? (e.g., mother, father, stepmother)

Gender of infant _____ Male _____ Female

Birth date of infant _____
Month Day Year

Birth weight of infant _____ lbs _____ oz

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

Was your infant born by c-section? (circle one) YES NO

Was your infant adopted? (circle one) YES NO

If yes, at what age? _____

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
- Cohabiting, not married

Your own ethnic group (check all that apply) _____ Native American Nation: _____

- African American
- Hispanic
- Asian
- White
- Multiethnic Describe _____
- Other

Highest grade you completed in school (check one)

- | | |
|-------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> 6 th grade | <input type="checkbox"/> 12 th grade |
| <input type="checkbox"/> 7 th grade | <input type="checkbox"/> some vo-tech |
| <input type="checkbox"/> 8 th grade | <input type="checkbox"/> some college courses |
| <input type="checkbox"/> 9 th grade | <input type="checkbox"/> vo-tech graduate |
| <input type="checkbox"/> 10 th grade | <input type="checkbox"/> college graduate |
| <input type="checkbox"/> 11 th grade | <input type="checkbox"/> post-graduate work |

Highest grade your spouse/partner completed in school (check one)

- | | |
|-------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> 6 th grade | <input type="checkbox"/> 12 th grade |
| <input type="checkbox"/> 7 th grade | <input type="checkbox"/> some vo-tech |
| <input type="checkbox"/> 8 th grade | <input type="checkbox"/> some college courses |
| <input type="checkbox"/> 9 th grade | <input type="checkbox"/> vo-tech graduate |
| <input type="checkbox"/> 10 th grade | <input type="checkbox"/> college graduate |
| <input type="checkbox"/> 11 th grade | <input type="checkbox"/> post-graduate work |

Your current household income per year before taxes (check one)

- | | |
|----------------------------------------------|------------------------------------------------|
| <input type="checkbox"/> Unknown | <input type="checkbox"/> \$71,000 - \$80,000 |
| <input type="checkbox"/> Under \$10,000 | <input type="checkbox"/> \$81,000 - \$90,000 |
| <input type="checkbox"/> \$11,000 - \$20,000 | <input type="checkbox"/> \$91,000 - \$100,000 |
| <input type="checkbox"/> \$21,000 - \$30,000 | <input type="checkbox"/> \$101,000 - \$110,000 |
| <input type="checkbox"/> \$31,000 - \$40,000 | <input type="checkbox"/> \$111,000 - \$120,000 |
| <input type="checkbox"/> \$41,000 - \$50,000 | <input type="checkbox"/> \$121,000 - \$130,000 |
| <input type="checkbox"/> \$51,000 - \$60,000 | <input type="checkbox"/> \$131,000 - \$140,000 |
| <input type="checkbox"/> \$61,000 - \$70,000 | <input type="checkbox"/> Over \$140,000 |

Your Employment (check one)

- | | |
|---------------------------------------------|-----------------------------------------------------------|
| <input type="checkbox"/> Unemployed | <input type="checkbox"/> Unemployed because of disability |
| <input type="checkbox"/> Employed part-time | <input type="checkbox"/> Retired |
| <input type="checkbox"/> Employed full-time | |

Father's Employment (if living with you)

- | | |
|--------------------------------------------------|-----------------------------------------------------------|
| <input type="checkbox"/> Not living in household | <input type="checkbox"/> Employed full-time |
| <input type="checkbox"/> Unemployed | <input type="checkbox"/> Unemployed because of disability |
| <input type="checkbox"/> Employed part-time | <input type="checkbox"/> Retired |

Is your current spouse/partner the father of your infant (check one) YES NO

Ethnic group of the biological father of the baby. (check all that apply)

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

Do you currently receive state or federal financial assistance? (check all that apply)

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

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 B

Tables

Table 1

Procedures and Hypotheses for Experimental Groups

Phase	Group 1	Group 2	Group 3
Replication	Climber moves up and down hill with helper and hinderer	Climber moves up and down hill without helper or hinderer	Climber sits at the bottom of hill. Helper and hinderer use same movements without climber
Choice Procedure	Infant can choose between the helper and hinderer	Infant can choose between the blue and yellow characters	Infant can choose between the helper/upward and hinderer/downward characters
Conditioning	Helper up; hinderer down. 7 responses each	Helper up; hinderer down. 7 responses each	Helper up; hinderer down. 7 responses each
Testing	Infant can use helper to help and hinderer to hinder	Infant can use helper to help and hinderer to hinder	Infant can use helper to help and hinderer to hinder
Hypotheses	Infants will choose the helper over the hinderer. Infants will respond more frequently and rapidly in the helping condition	Infants will show no choice preference between the blue and the yellow characters. Infants will show no difference in frequency of responses between conditions	Infants will show no choice preference between the helper/upward and the hinderer/downward characters. Infants will show no difference in frequency of responses between conditions

Table 2

Correlations between Operant Conditioning Measures

Helping					
Measure	Hindering	Latency	Presses	Duration	LN Interval
Latency	.047 39				
Presses	.649*** 39	-.225 40			
Duration	.537*** 39	.420** 40	-.605*** 40		
LN Interval	.585*** 34	.035 38	-.667*** 38	.623*** 38	
Active Time	.304 39	-.229 40	-.496** 40	.787*** 40	.622*** 38
Hindering					
	Helping	Latency	Presses	Duration	LN Interval
Latency	.047 39				
Presses	.649*** 39	-.453** 39			
Duration	.537*** 39	.429** 39	-.730*** 39		
LN Interval	.585*** 34	-.123 34	-.648*** 34	.500** 34	
Active Time	.304 39	-.595*** 39	-.207 39	.471** 39	.565*** 34

Note. Pearson r correlations between operant conditioning measures for helping and hindering conditions. Ns listed below each r value. * $p < .05$, ** $p < .01$, *** $p < .001$

APPENDIX C

Figures

Figure 1

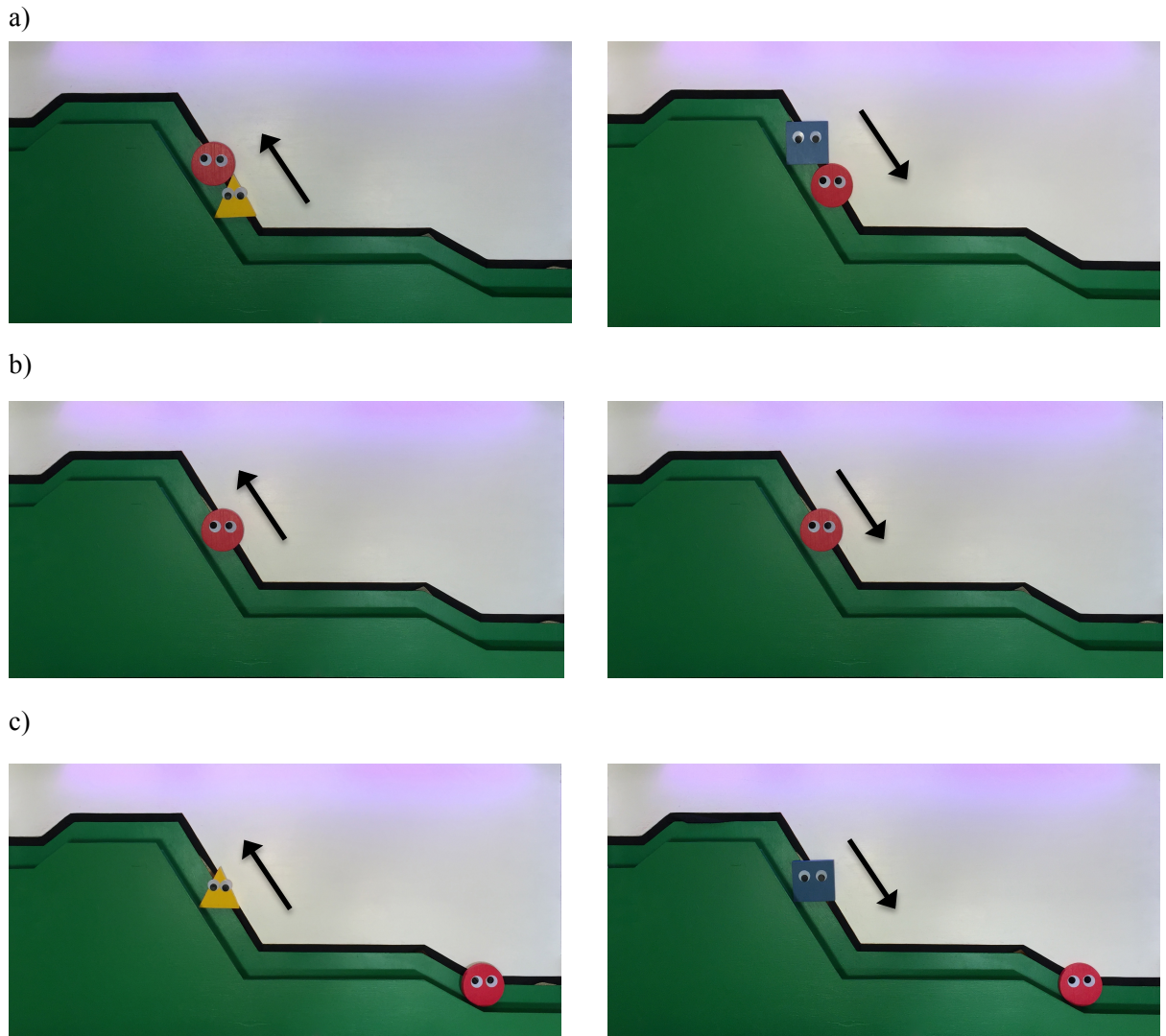
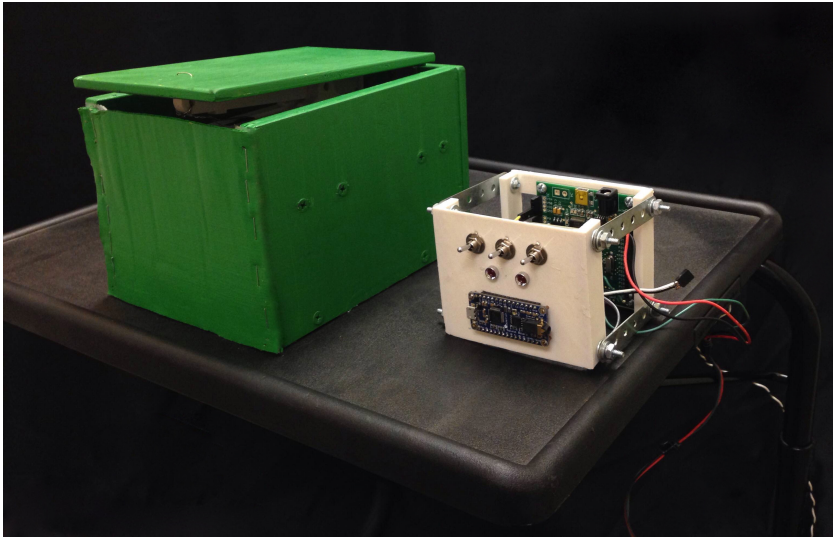


Figure 1. All events shown to infants. a) Helping and hindering habituation events shown to Group 1 infants. In the helping condition (left picture), the yellow triangle pushes the climber (red circle) up the hill after two unsuccessful climbing attempts by the climber. In the hindering condition (right picture), the blue square pushes the climber (red circle) down the hill after two unsuccessful climbing attempts by the climber. b) Events shown to control Group 2. The climber making the same movements as if being pushed up or down by the helper (left picture) and hinderer (right picture). c) Events shown to control Group 3. The yellow triangle (left picture) and blue square (right picture) making the same upward and downward movements as Group 1 events, but without the climber. The revised blue color is shown here.

Figure 2

a)



b)



Figure 2. The microswitch box. a) The box shown to infants with a lever and microswitch inside and the propeller DNA board (used by the experimenter only) with toggles to indicate phase. b) An infant interacting with the microswitch box. Each button press makes a sound and moves the yellow and blue characters in the puppet show. The original blue color of the square puppet is shown here.

Figure 3

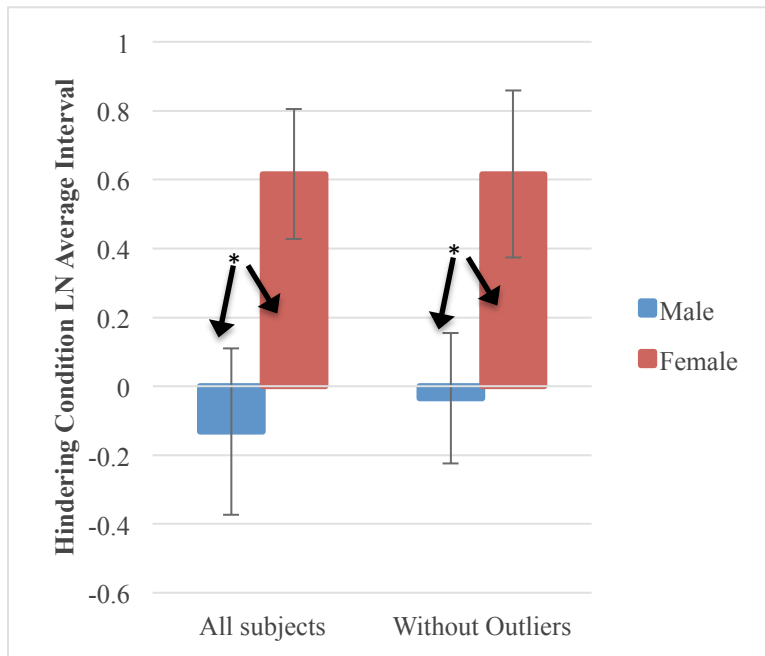
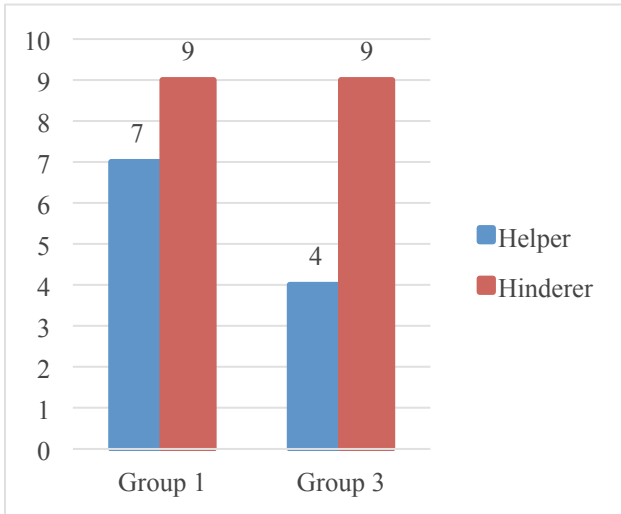


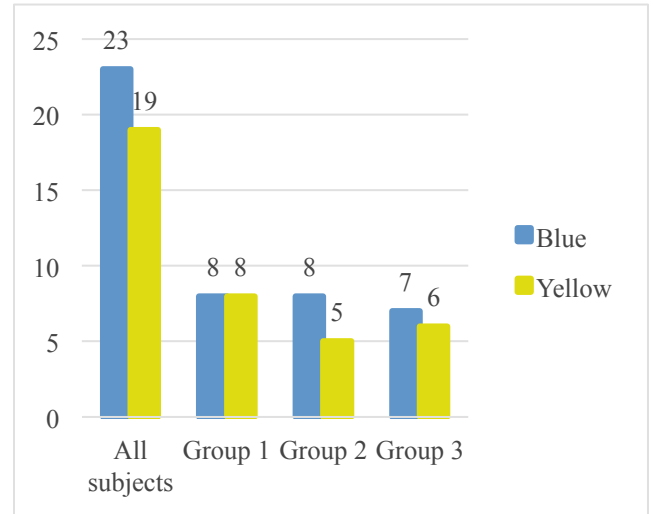
Figure 3. Male and female infants' average interval between presses in the hindering condition both with and without outliers. With all subjects, male versus female, $t[32] = 2.40, p = .022$. Without outliers, male versus female, $t[31] = 2.05, p = .049$. Asterisk, $p < .05$.

Figure 4

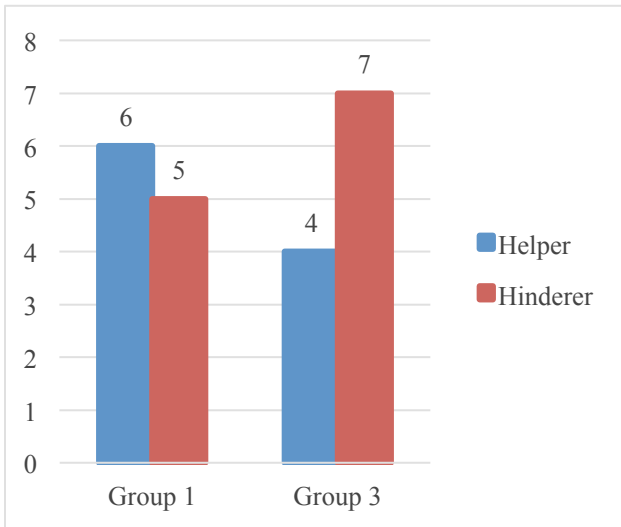
a)



b)



c)



d)

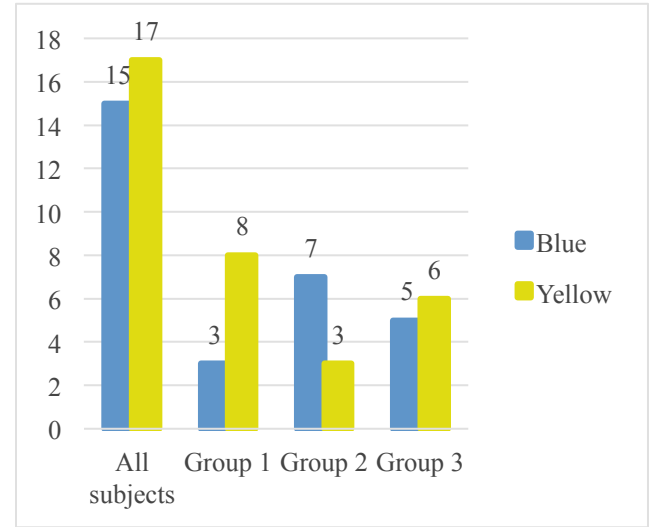
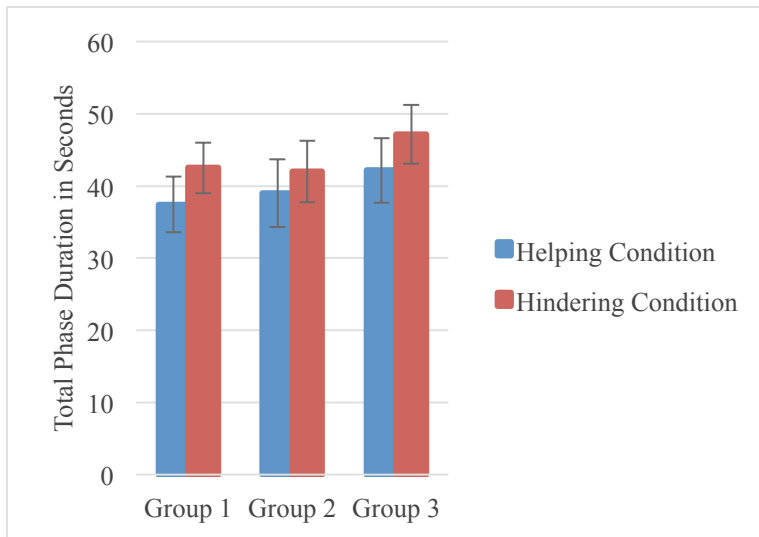


Figure 4. Number of infants who chose each character in different experimental groups. a) Character choices for Group 1 and control Group 3 for all subjects. b) Color choices for all subjects, Group 1, and control Groups 2 and 3 for all subjects. c) Character choices for Group 1 and control Group 3 after removing the first 10 infants. d) Color choices for all subjects, Group 1, and control Groups 2 and 3 after removing the first 10 infants. All differences are non-significant.

Figure 5

a)



b)

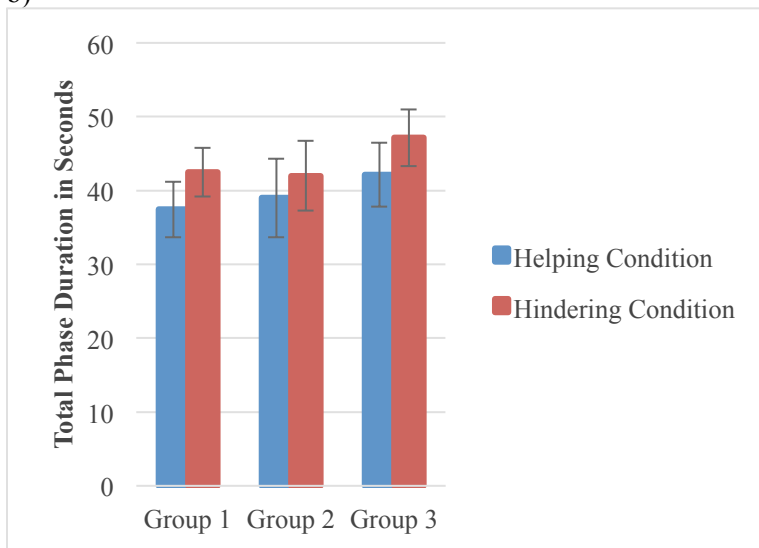
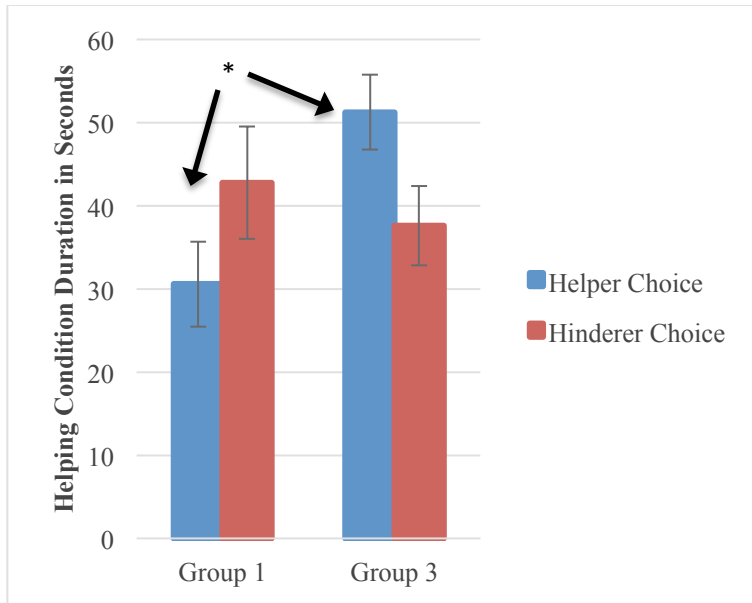


Figure 5. Results of a repeated measures ANOVA: Total condition duration in the helping and hindering conditions for all experimental groups. a) Differences in duration of conditions for all subjects within groups, $F[1, 36] = 3.45, p = .071$, partial $\eta^2 = .087$. b) Differences in duration of conditions within groups after removing outliers, $F[1, 33] = 3.54, p = .069$, partial $\eta^2 = .097$. All pairwise comparisons are non-significant.

Figure 6

a)



b)

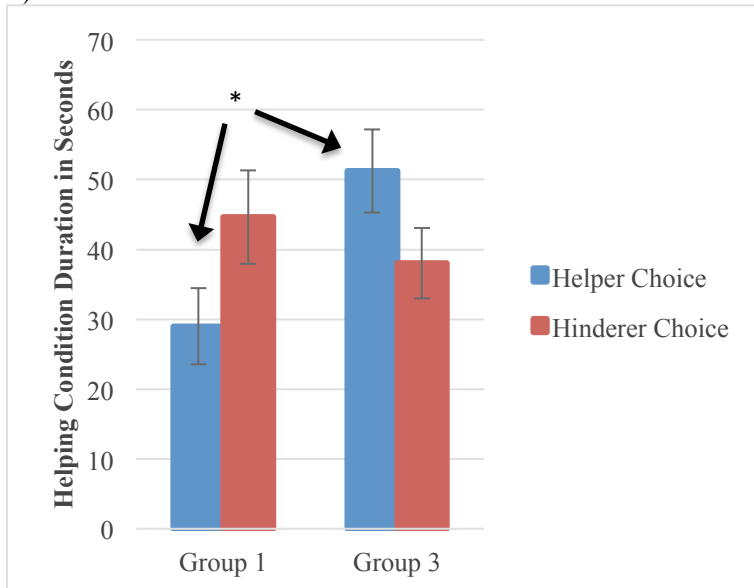


Figure 6. Results of a 2 x 2 factorial ANOVA: Condition duration in the helping condition divided by infant character choice for Group 1 and Group 3. a) All subjects, interaction: $F[1, 24] = 5.83, p = .024, \text{partial } \eta^2 = .195$. b) Without the first 10 subjects due to blue color change, interaction: $F[1, 18] = 6.15, p = .023, \text{partial } \eta^2 = .255$. Asterisk, pairwise comparisons, $p < .05$.

Figure 7

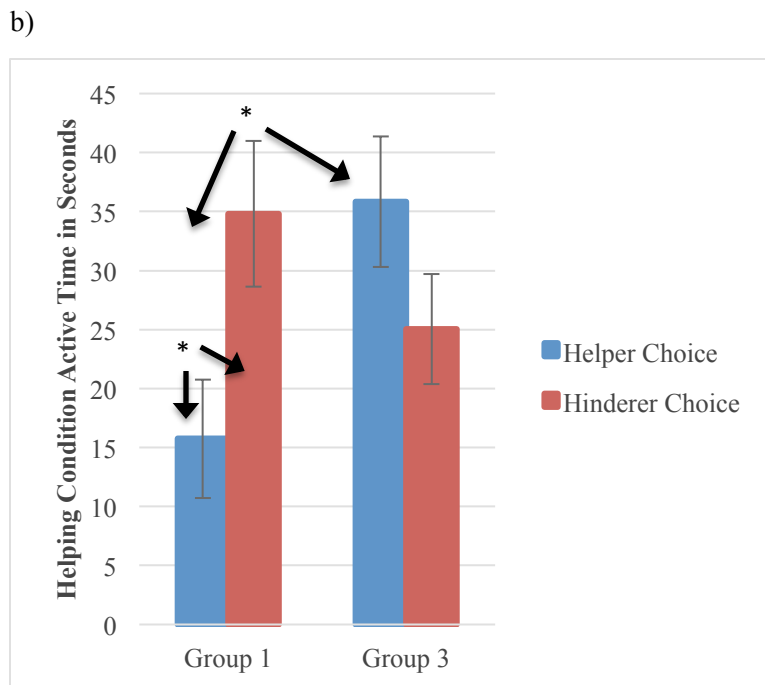
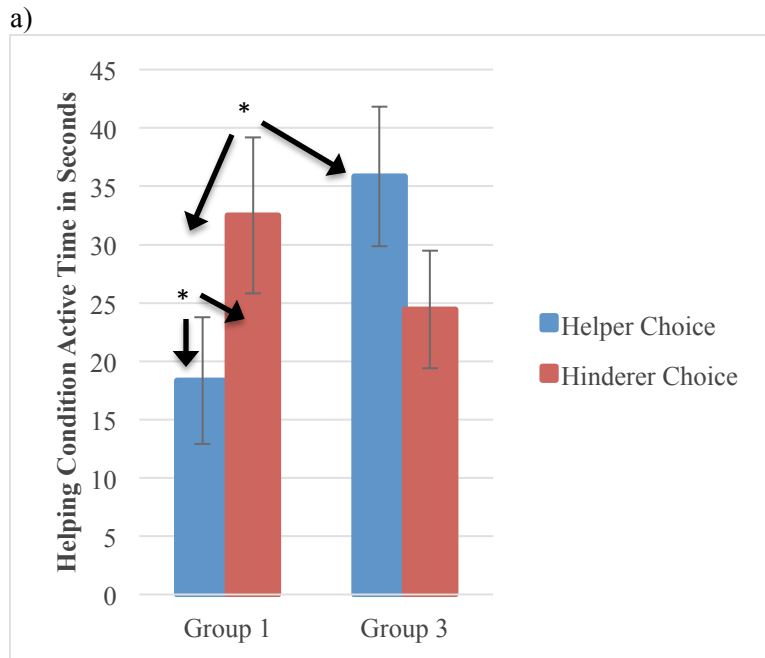
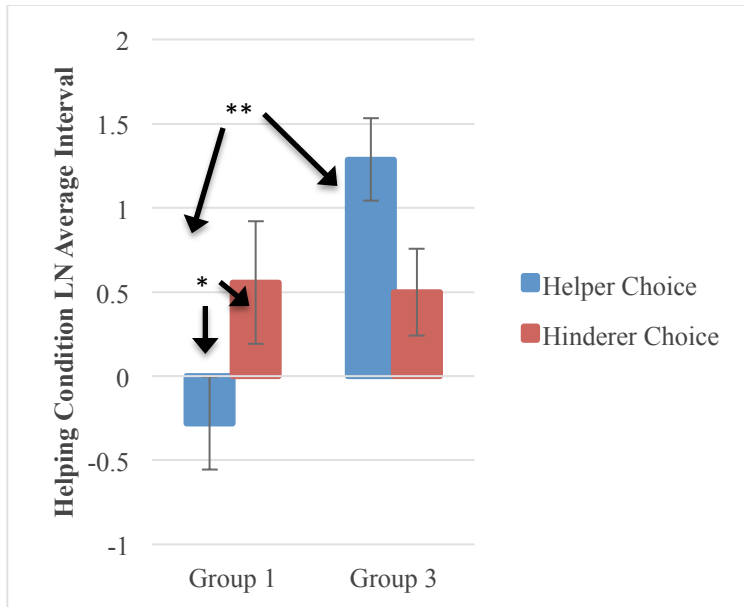


Figure 7. Results of a 2 x 2 factorial ANOVA: Duration of active time (total condition duration minus latency to first response) in the helping condition divided by infant character choice for Group 1 and Group 3. a) All subjects. Interaction: $F[1, 24] = 6.04, p = .022, \text{partial } \eta^2 = .201$. b) Without the first 10 subjects due to blue color change. Interaction: $F[1, 18] = 7.70, p = .012, \text{partial } \eta^2 = .300$. Asterisk, pairwise comparisons, $p < .05$.

Figure 8

a)



b)

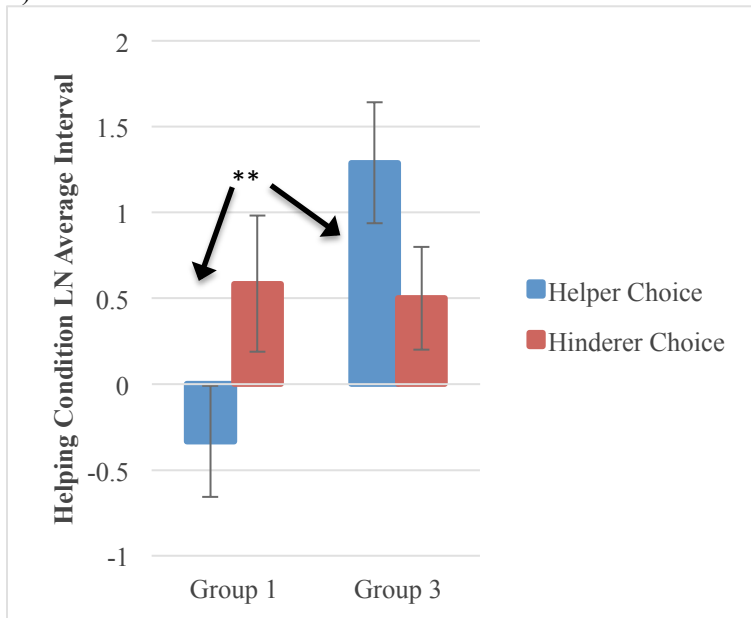
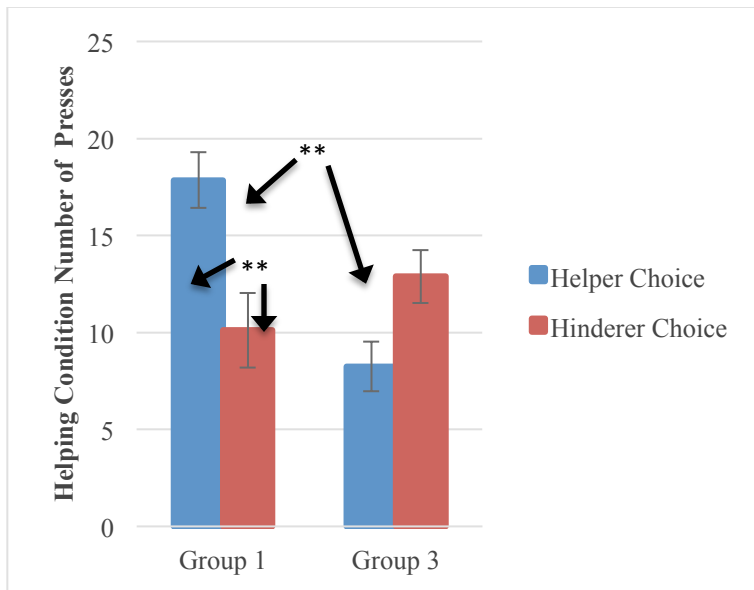


Figure 8. Results of a 2 x 2 factorial ANOVA: Natural log (LN) of the average interval between button presses in the helping condition divided by infant character choice for Group 1 and Group 3. a) All subjects. Group main effect, $F[1, 24] = 6.79, p = .015$, partial $\eta^2 = .221$; interaction, $F[1, 24] = 7.87, p = .010$, partial $\eta^2 = .247$. b) Without the first 10 subjects due to blue color change. Group main effect, $F[1, 18] = 4.95, p = .039$, partial $\eta^2 = .216$; interaction, $F[1, 18] = 6.11, p = .024$, partial $\eta^2 = .253$. Asterisk, pairwise comparisons, $p < .05$. Double asterisk, pairwise comparisons, $p < .01$.

Figure 9

a)



b)

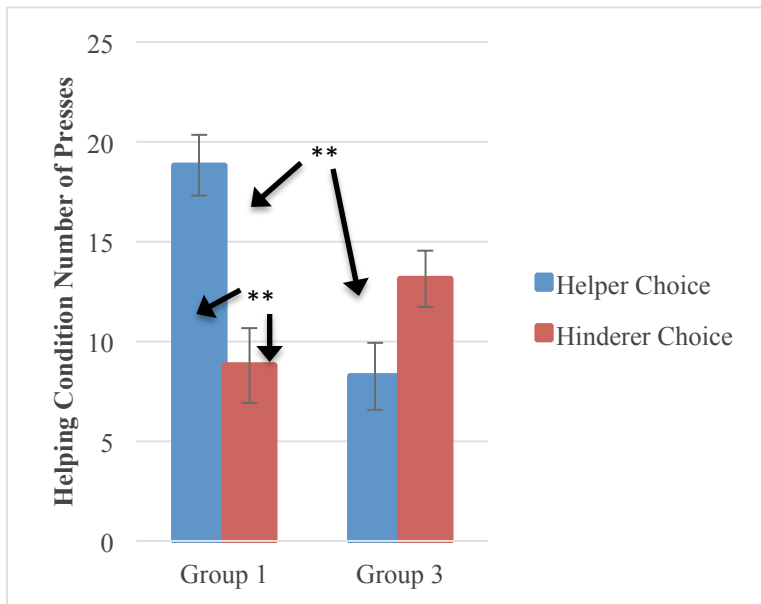
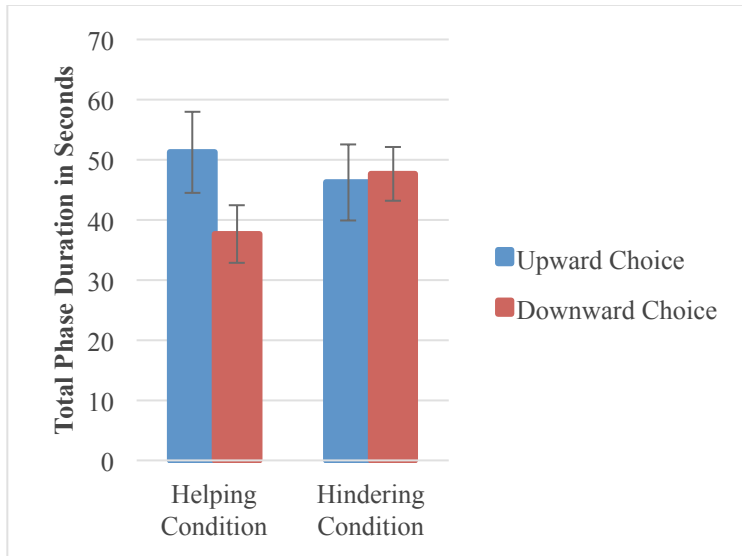


Figure 9. Results of a 2 x 2 factorial ANOVA: Number of button presses in the helping condition divided by infant character choice for Group 1 and Group 3. a) All subjects. Group main effect, $F[1, 24] = 5.03, p = .034, \text{partial } \eta^2 = .173$; interaction, $F[1, 24] = 16.43, p < .001, \text{partial } \eta^2 = .406$. b) Without the first 10 subjects due to blue color change. Group main effect, $F[1, 18] = 3.64, p = .072, \text{partial } \eta^2 = .168$; interaction, $F[1, 18] = 20.85, p < .001, \text{partial } \eta^2 = .537$. Asterisk, pairwise comparisons, $p < .05$. Double asterisk, pairwise comparisons, $p < .01$.

Figure 10

a)



b)

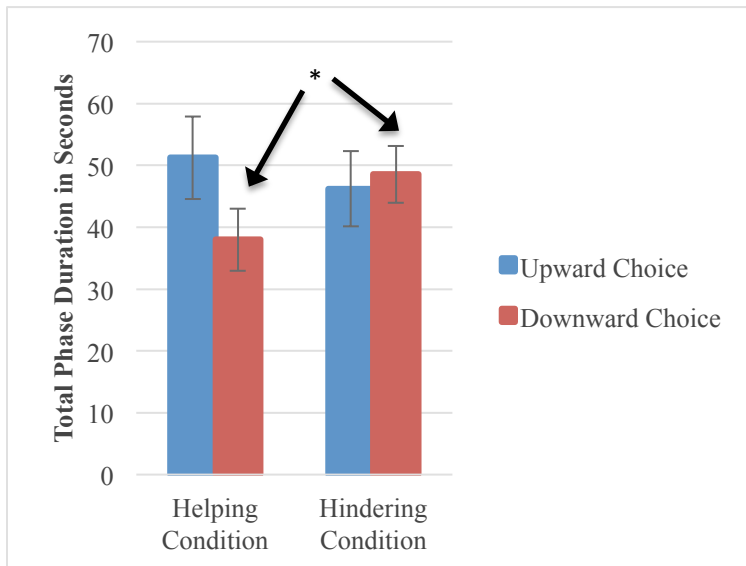
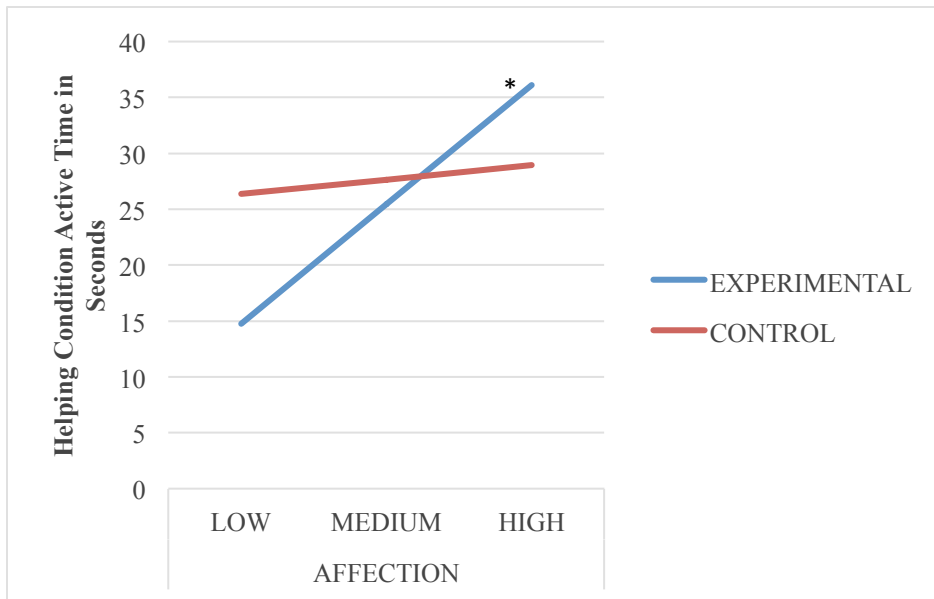


Figure 10. Results of a repeated measures ANOVA: Condition duration between the helping and hindering conditions divided by infant character choice for Group 3 only. a) All subjects. Interaction, $F[1, 24] = 2.95, p = .099$, partial $\eta^2 = .109$. b) Without the first 10 subjects due to blue color change. Interaction, $F[1, 18] = 8.47, p = .009$, partial $\eta^2 = .320$. Asterisk, pairwise comparisons, $p < .05$.

Figure 11

a)



b)

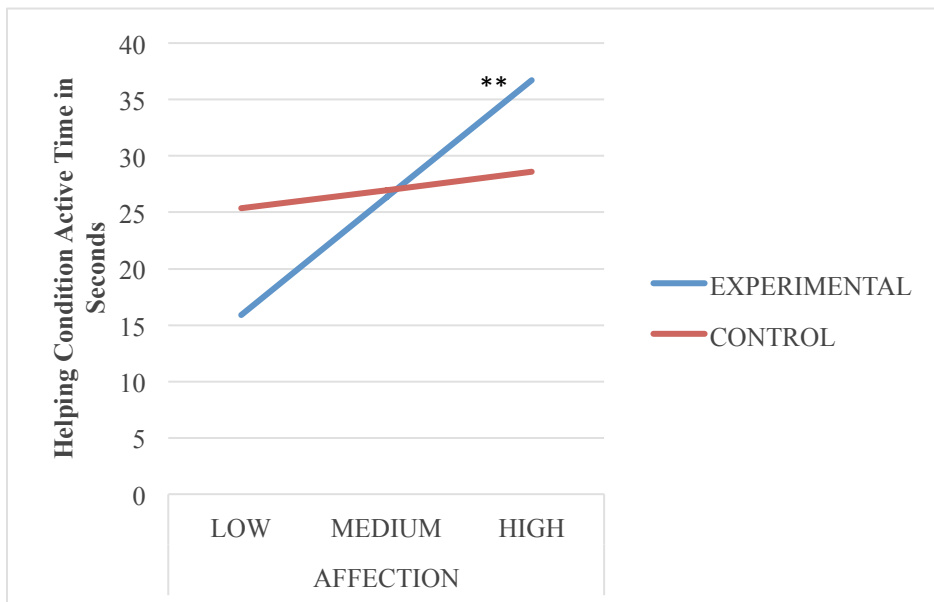
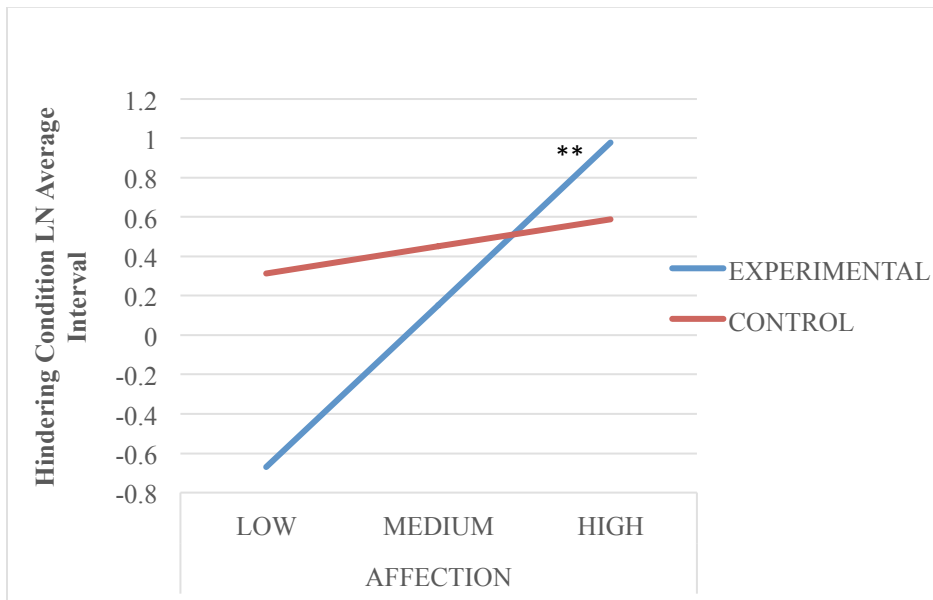


Figure 11. Results of a moderation regression analysis: Affection PICCOLO scores and duration of active time (total duration minus latency to first response) in the helping condition divided by experimental groups. a) All subjects. Overall model, $F[3, 36] = 3.99, p = .015, R^2 = .22$; interaction, $M = 3.79, t = 2.09, p = .043$ 95% CI = .12 to 7.47. b) Without outliers. Overall model, $F[3, 33] = 4.0, p = .015, R^2 = .23$; interaction, $M = 3.64, t = 1.76, p = .087$, 95% CI = -.56 to 7.84. Asterisk, simple slopes, $p < .05$; double asterisk, simple slopes, $p < .01$.

Figure 12

a)



b)

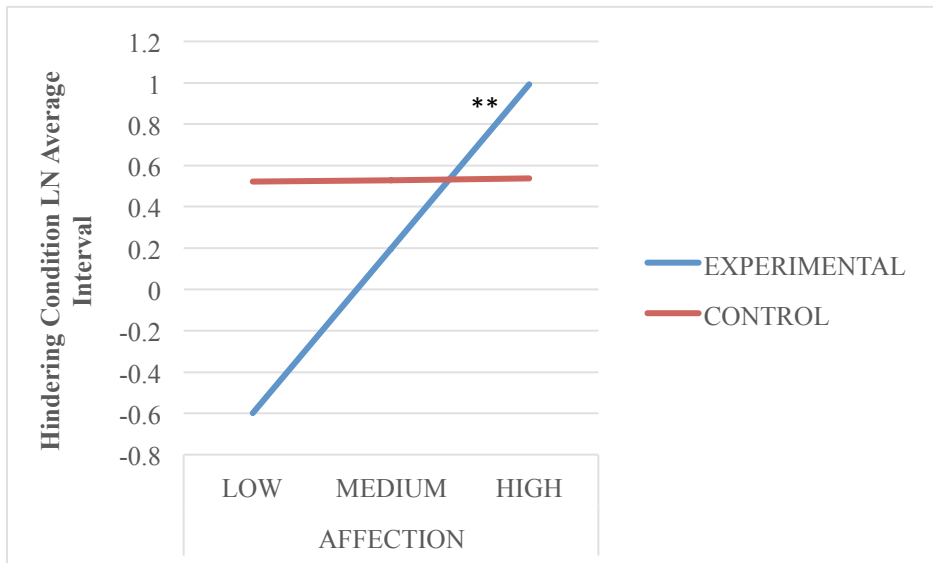
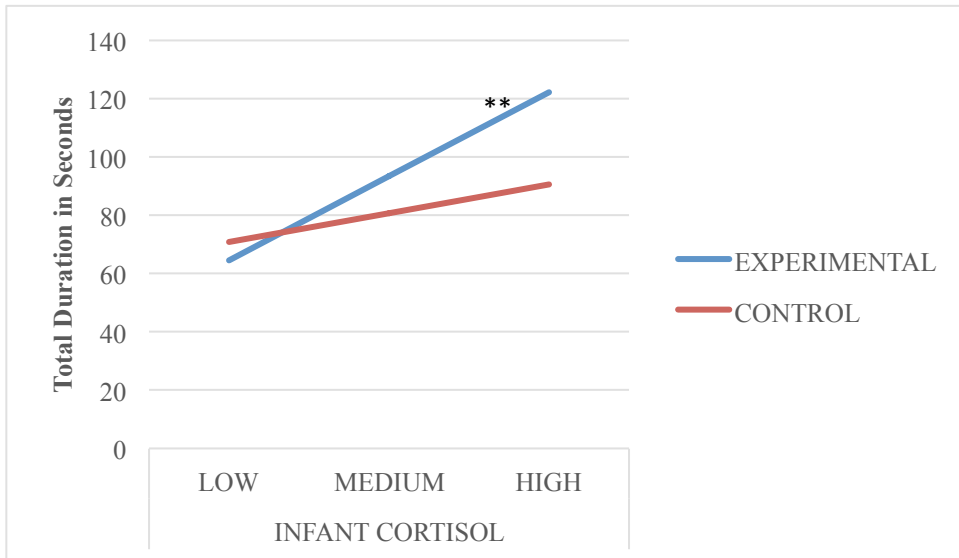


Figure 12. Results of a moderation regression analysis: Affection PICCOLO scores and natural log (LN) of the average interval between button presses in the hindering condition divided by experimental groups. a) All subjects. Overall model, $F[3, 30] = 10.77, p < .001, R^2 = .28$; interaction, $M = .28, t = 2.38, p = .024, 95\% \text{ CI} = .04 \text{ to } .52$. b) Without outliers. Overall model, $F[3, 29] = 10.80, p < .001, R^2 = .30$; interaction, $M = .33, t = 3.02, p = .005, 95\% \text{ CI} = .11 \text{ to } .56$. Double asterisk, simple slopes, $p < .01$.

Figure 13

a)



b)

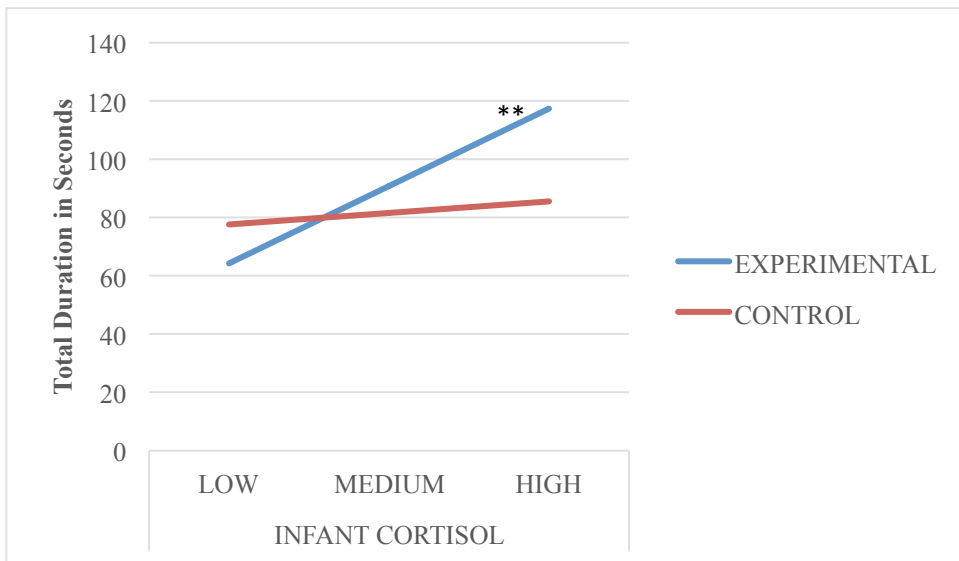
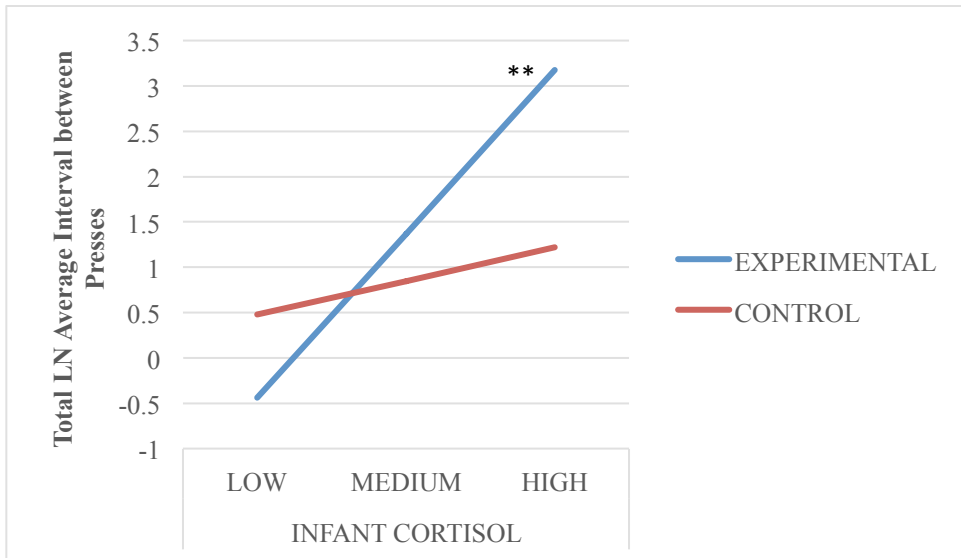


Figure 13. Results of a moderation regression analysis: Infant salivary cortisol levels and total duration across both conditions divided by experimental groups. a) All subjects. Overall model, $F[4, 33] = 5.30, p = .002, R^2 = .34$; interaction, $M = 30.09, t = 1.91, p = .07, 95\% \text{ CI} = -2.04 \text{ to } 62.22$. b) Without outliers. Overall model, $F[4, 30] = 3.90, p = .01, R^2 = .32$; interaction, $M = 39.06, t = 2.43, p = .02, 95\% \text{ CI} = 6.19 \text{ to } 71.94$. Double asterisk, simple slopes, $p < .01$.

Figure 14

a)



b)

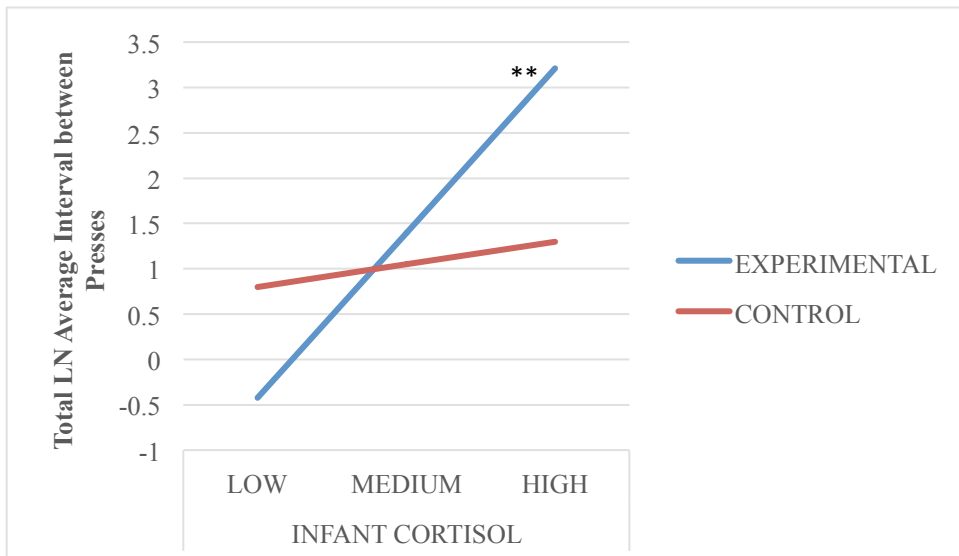
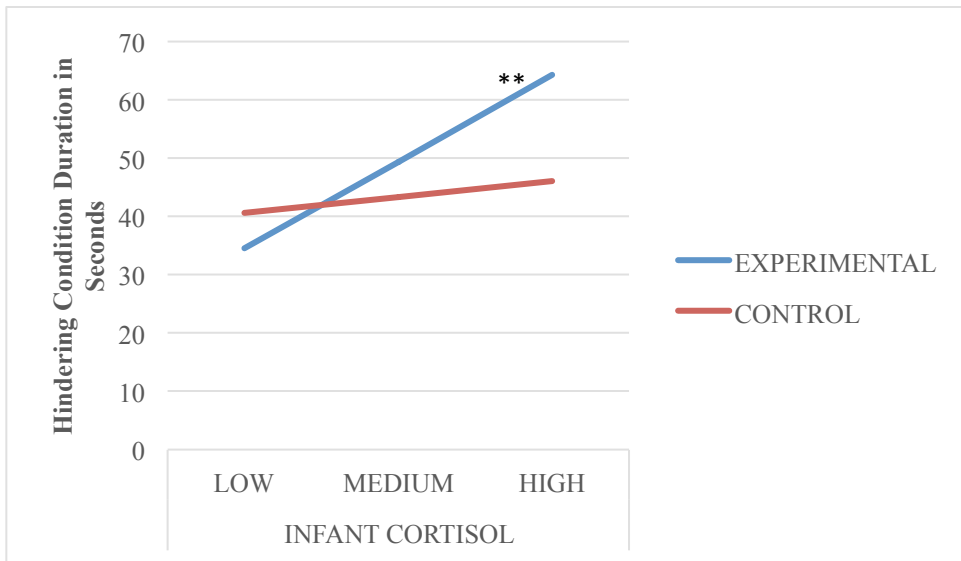


Figure 14. Results of a regression moderation analysis: Infant salivary cortisol levels and total LN average interval across both conditions divided by experimental groups. a) All subjects. Overall model, $F[4, 29] = 3.70, p = .02, R^2 = .30$; interaction, $M = 2.46, t = 2.16, p = .04, 95\% \text{ CI} = .13 \text{ to } 4.80$. b) Without outliers. Overall model, $F[4, 28] = 3.76, p = .01, R^2 = .33$; interaction, $M = 2.66, t = 2.36, p = .03, 95\% \text{ CI} = .35 \text{ to } 4.97$. Double asterisk, simple slopes, $p < .01$.

Figure 15

a)



b)

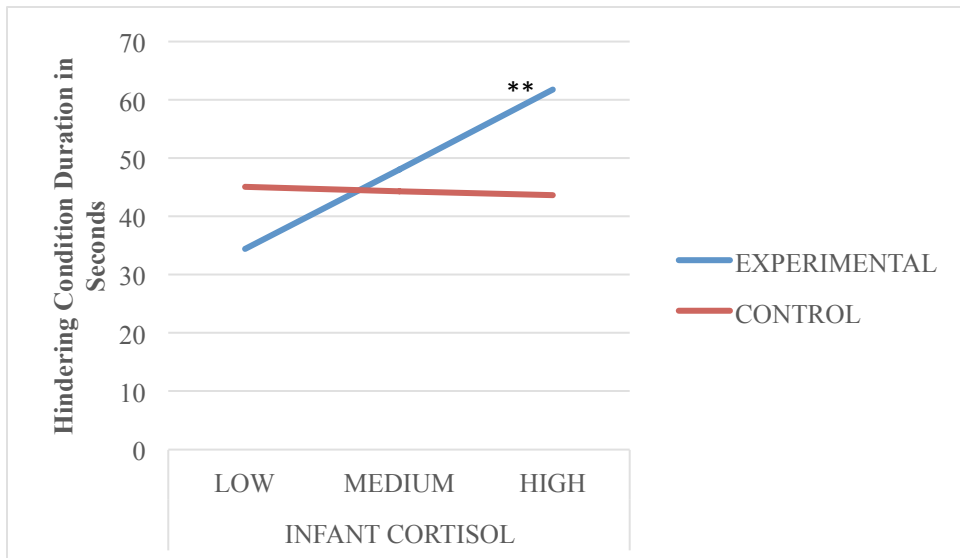
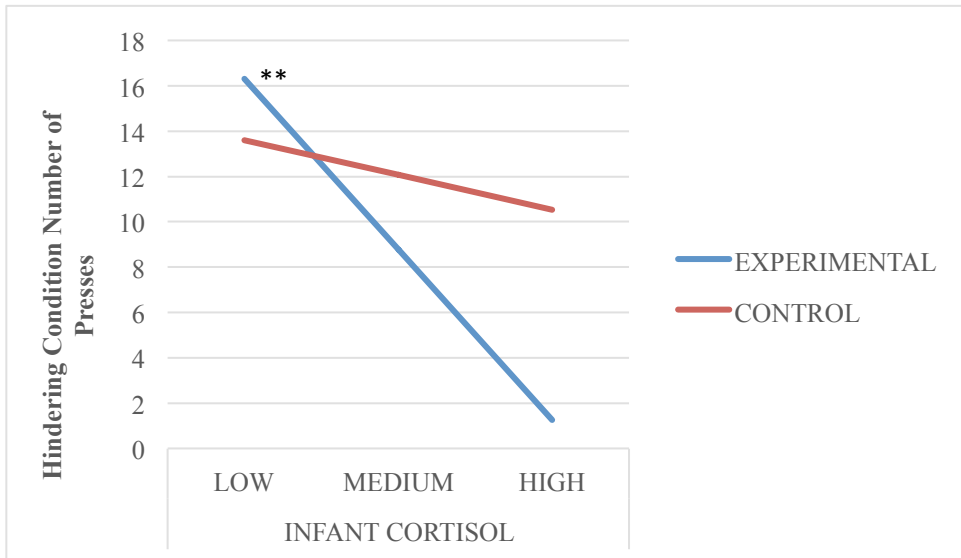


Figure 15. Results of a moderation analysis: Infant salivary cortisol levels and duration in the hindering condition divided by experimental groups. a) All subjects. Overall model, $F[4, 33] = 3.82, p = .01, R^2 = .24$; interaction, $M = 19.53, t = 2.17, p = .04, 95\% \text{ CI} = 1.18 \text{ to } 37.53$. b) Without outliers. Overall model, $F[4, 30] = 3.55, p = .02, R^2 = .26$; interaction, $M = 24.91, t = 2.62, p = .01, 95\% \text{ CI} = 5.52 \text{ to } 44.30$. Double asterisk, simple slopes, $p < .01$.

Figure 16

a)



b)

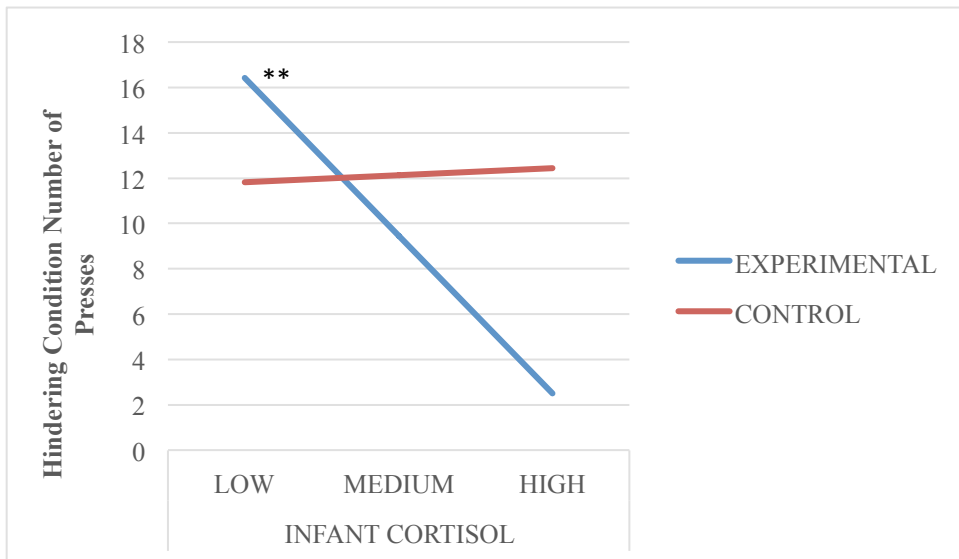
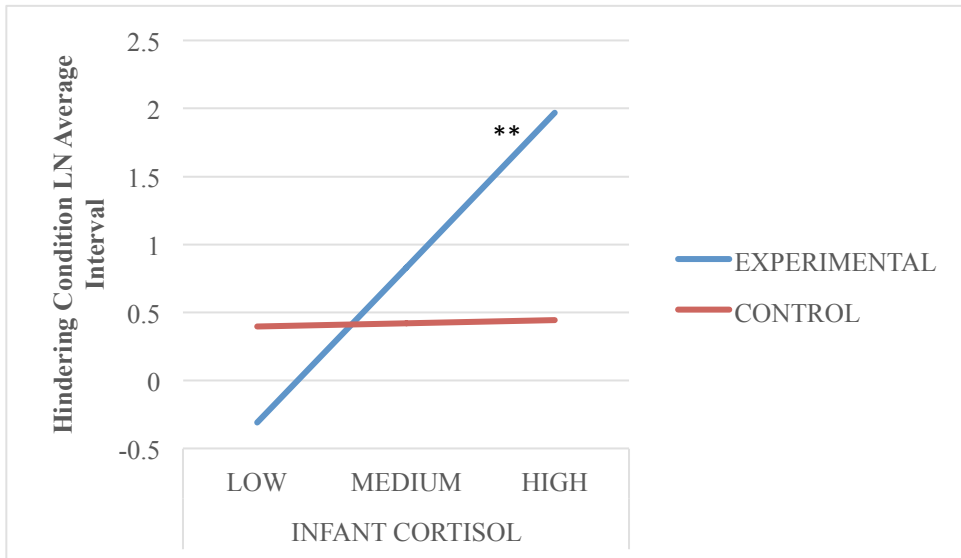


Figure 16. Results of a moderation analysis: Infant salivary cortisol levels and number of button presses in the hindering condition divided by experimental groups. a) All subjects. Overall model, $F[4, 29] = 6.73, p = .001, R^2 = .32$; interaction, $M = 1.91, t = 3.48, p = .002, 95\% \text{ CI} = .79$ to 3.04 . b) Without outliers. Overall model, $F[4, 28] = 7.35, p < .001, R^2 = .37$; interaction, $M = 2.03, t = 3.76, p = .001, 95\% \text{ CI} = .92$ to 3.14 . Double asterisk, simple slopes, $p < .01$.

Figure 17

a)



b)

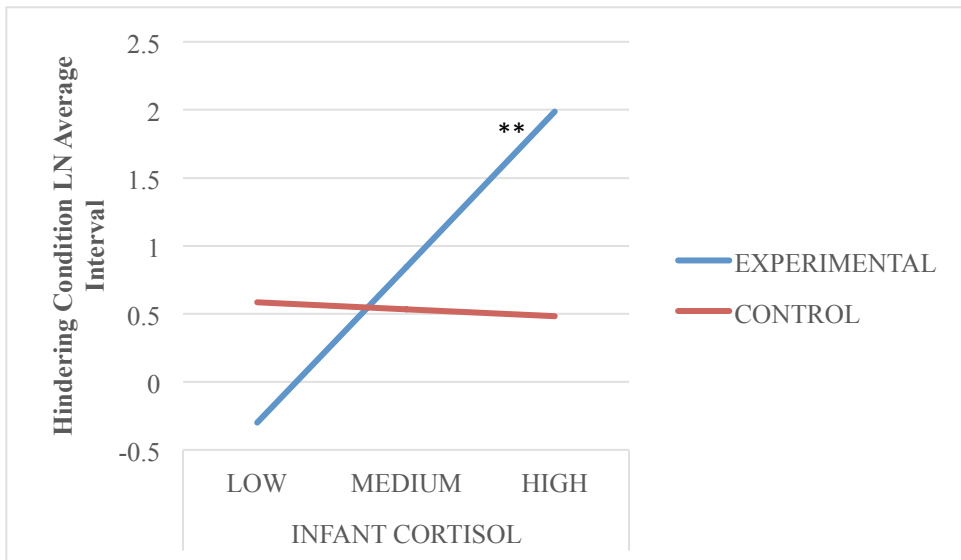
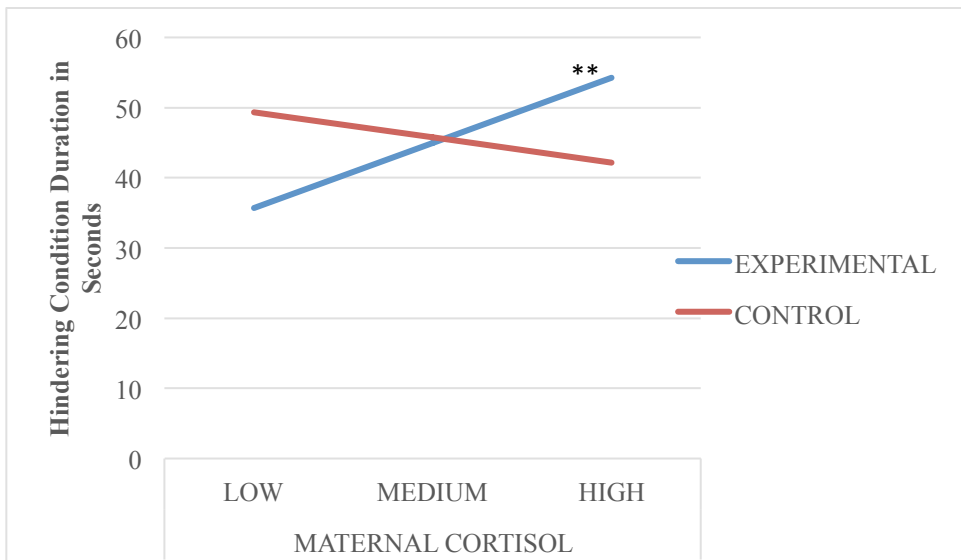


Figure 17. Results of a moderation analysis: Infant salivary cortisol levels and natural log transformation of the average interval between button presses in the hindering condition divided by experimental groups. a) All subjects. Overall model, $F[4, 33] = 2.73, p = .05, R^2 = .29$; interaction, $M = -9.56, t = -2.15, p = .04, 95\% \text{ CI} = -18.58 \text{ to } -.53$. b) Without outliers. Overall model, $F[4, 30] = 2.67, p = .05, R^2 = .31$; interaction, $M = -12.59, t = -3.01, p = .005, 95\% \text{ CI} = -21.12 \text{ to } -4.05$. Double asterisk, simple slopes, $p < .01$.

Figure 18

a)



b)

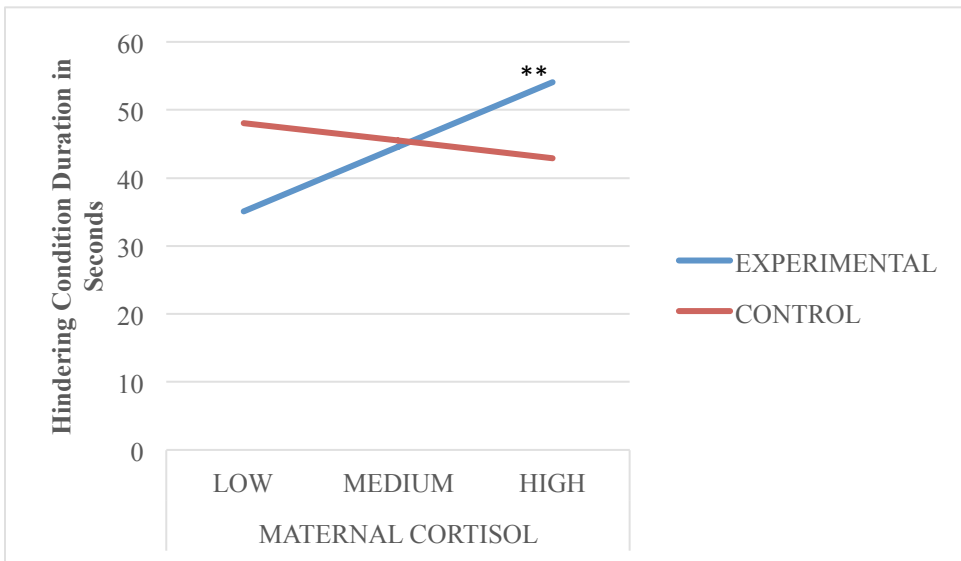


Figure 18. Results of a moderation regression analysis: Maternal salivary cortisol levels and the duration of the hindering condition divided by experimental groups. a) All subjects. Overall model, $F[4, 34] = 3.07, p = .03, R^2 = .20$; interaction, $M = 20.15, t = 3.02, p = .005, 95\% \text{ CI} = 6.60 \text{ to } 33.71$. b) Without outliers. Overall model, $F[4, 31] = 2.93, p = .04, R^2 = .22$; interaction, $M = 18.92, t = 2.76, p = .01, 95\% \text{ CI} = 4.96 \text{ to } 32.89$. Double asterisk, simple slopes, $p < .01$.

Oklahoma State University Institutional Review Board

Date: Monday, May 11, 2015
IRB Application No AS1535
Proposal Title: Empathy and prosocial behaviors in infancy

Reviewed and Processed as: Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 5/10/2016

Principal Investigator(s):

Janna Colaizzi	David Thomas
116 N Murray	116 N. Murray
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

Janna M. Colaizzi

Candidate for the Degree of

Doctor of Philosophy

Thesis: EMPATHY AND PROSOCIAL BEHAVIORS IN INFANCY

Major Field: Psychology

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in Psychology at Oklahoma State University, Stillwater, Oklahoma in July, 2016.

Completed the requirements for the Master of Science in Psychology at Oklahoma State University, Stillwater, Oklahoma in 2013.

Completed the requirements for the Bachelor of Science in Psychology at Southern Nazarene University, Bethany, Oklahoma in 2010.

Experience: Research experience in the Developmental and Psychophysiological and Psychobiology Laboratories at Oklahoma State University, the Neuropsychology Laboratory at New York University, and the Research and Evaluation Department at Sesame Workshop. Experience with data analysis and statistical consulting at Southern Nazarene University. Developmental Psychology and Introduction to Psychology teaching experience at Oklahoma State University. Statistical academic emphasis earned at Oklahoma State University.

Professional Memberships: International Society for Infant Studies (ISIS), World Association for Infant Mental Health (WAIMH), Society for Research in Child Development (SRCD), Southwestern Psychological Association (SWPA), Psychology Graduate Student Association (PGSA)