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The Effect of Friendly Touch on Compliance in Preschool-Age Children

by

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Abstract

The majority of past research on touch has focused on adults or infants and not on preschool-age children. This study aimed to replicate the robust adult finding that touch increases compliance using a delay-of-gratification task in a sample of 30 preschool-age children (M = 58.9 months). Children were randomly assigned to the intervention or control condition. Children in the intervention condition received a friendly touch on the back before they were instructed on the laboratory task to wait until they received permission from the experimenter to look for or eat a candy. Results showed that touch increased compliance by increasing the amount of time (in seconds) children waited to eat the candy. Children in the touch condition waited 144.53 seconds longer to eat the candy than children in the no touch condition. This finding has implications for how touch could be used to promote positive behavior and increase self-control in young children.

Introduction

Recent headlines about clergy members and teachers sexually harassing children have ignited concern over the way Americans touch one another. These days, something as commonplace as a friendly pat on the back, or a hug, can be looked at with suspicion. In 2006, a four-year-old boy in Texas was suspended from school for hugging his teacher (Associated Press, 2010). While the teacher thought the child displayed inappropriate physical behavior, the boy's father argued that the young boy did not understand that what he was doing was considered wrong. Many schools are now implementing 'No Touch' policies that forbid not only teachers from touching their students, but also students from touching one another. It is no longer acceptable in schools for children to receive a pat on the back for encouragement, or a hug when they are crying (Glod, 2007; Belkin, 2009). In short, touch has become taboo in the United States.

The United State's fear of physical contact is evident in all aspects of life. This can be demonstrated through comparisons with other cultures. For example, a study by Field (1999) showed that American adolescents touch each other significantly less than French adolescents. Yet this lack of touch may have some unintended negative consequences. Scientific research has shown that interpersonal touch has many positive effects, including lowering stress hormones (Holt-Lunstad, Brimingham, & Light, 2008), increasing emotional attachment (Weiss, Wilson, Hertenstein, & Campos, 2000; Hofer & Shair, 1980), increasing compliance (Kleinke, 1977; Crusco & Wetzel, 1984; Hornik & Ellis, 1988; Willis & Hamm, 1980) and in the case of premature infants, increasing growth (Dieter, Field, Hernandez-Reif, Emory, & Redzepi, 2007; Beachy, 2003, Vickers, Ohlsson, Lacy, & Horsley, 2004). In a society where anxiety and depression are increasingly prevalent (Twenge, 2000; Klerman & Weissman, 1989) touch may be an inexpensive and effective intervention.

Most of the research conducted on the effects of touch has focused mainly on premature infants and adults, while the impacts of touch on children has remained largely unexplored due to the sensitive nature of issues concerning touch and children in our culture. However, without looking at how children understand and respond to touch, we may be ignoring the possible positive benefits of decreased stress, increased interpersonal connection and increased compliance. Furthermore, a greater understanding of how touch affects children will lead to a more informed analysis and explanation of adult findings. Exploring touch in children is an essential step to filling in the large gap in developmental literature in this field.

While touch could have potential impacts on multiple domains of behavior, a particular outcome of interest is children's ability to self-regulate. A plethora of adult studies have shown that touch increases compliance (e.g. Kleinke, 1977; Crusco & Wetzel, 1984; Hornik & Ellis, 1988; Willis & Hamm, 1980). If the touch and compliance outcomes demonstrated in adults could be replicated with children, then teachers and parents could use touch to foster compliance and possibly increase self-control in children. The current study aims to explore the effect of touch on compliance in preschool-age children and is one of the first studies to look at touch and children in a lab setting.

Positive Effects of Touch on Cognition

Past research has shown that a friendly touch can affect one's cognition in profound, multi-faceted ways, supporting the hypothesis that touch may in fact help children in many areas of their life. Touch has been found to increase attachment (Weiss et al., 2000; Hofer & Shair, 1980), lower both perceived and psychological stress (Holt-Lunstad et al., 2008; Coen, Schaefer, & Davidson, 2006), activate emotion and executive control areas of the brain (Rolls et al. 2003a; Olausson et al., 2002) and communicate discrete emotions (Hertenstein & Keltner, 2006; Hertenstein, Holmes, McCullogh, & Keltner, 2009). Touch clearly has strong, positive affects on human's emotional and cognitive processes.

Development and Attachment. One of the main ways that touch positively impacts cognition is through its effect on attachment in development. In a classic study conducted by Harlow and Zimmerman (1958), a monkey had a choice between two surrogate mothers: one made out of terrycloth and one made out of wire mesh. For some of the monkeys, the wire mesh mother provided milk and the terrycloth mother did not, while for other monkeys, these conditions were reversed. Harlow found that the monkeys preferred the terry cloth mother even when she did not provide milk, suggesting that contact was just as necessary, if not more so, than nourishment. This study opened the doors to research concerning the necessity of touch in normal human development.

Touch has been found to be particularly important during the beginning stages of life. Specifically, touch in the form of massage has been shown to have profound medical benefits for premature infants. These positive effects include: improved weight gain, improved sleep/wake states, decreased stress, early discharge from the NICU, improved skin integrity, increased development of the sympathetic nervous system, and enhanced parent-infant bonding (Dieter et al., 2007; Beachy, 2003; Vickers et al., 2004; Hernandez-Reif, Diego, & Field, 2007, 2005; Kuhn et al., 1991; Field, 2003).

In addition to the physiological benefits of touch in the care of preterm infants, touch has also been shown to be an emotional necessity in development. One example of this is the strong bond touch creates between parent and child in development (Field, 2003). Weiss et al. (2000) observed this relationship between touch and parent/infant bonding in more detail. In their study, Weiss et al. observed mothers feeding their low birth weight infants and coded for maternal touch, maternal sensitivity, and infant responsiveness. At the end of the infant's first year, the researchers found a positive correlation between the amount of nurturing touch the mother displayed and the secure attachment between the mother and low birth weight infant.

Animal studies conducted by Hofer and Shair (1980), similarly showed that touch strongly affects attachment. In a series of studies on rats, they examined which components of mother-pup interactions could most effectively down-regulate pups' natural separation responses, such as ultrasonic cries. Using artificial surrogate mothers, the researchers found that only texture and thermal warmth, when presented alone, could effectively down-regulate separation behaviors. Thus, Hofer and Shair suggested that touch alone, specifically in the form of texture and warmth, could facilitate attachment behaviors.

Touch and Stress. Another area where touch has been found to be beneficial is as a means to reduce both physiological and perceived stress. Touch can decrease the release of the stress hormone cortisol and increase the release of the social bonding hormone oxytocin in both adults and infants (Holt-Lunstad et al., 2008; Feldmen, Singer, & Zagoory, 2010). Further, animal studies have shown that early touch affects the genetic makeup of rats' hypothalamic-pituitary-adrenal axis (a pathway that controls responses to stress), causing them to be more resilient to stress later in life (Meaney et al. 1991; Liu et al. 1997). Coen, Schaffer, and Davidson's fMRI study (2006) showed that brain regions that are activated by the anticipation of a stressful event could be attenuated by the touch of a loved one. Already massage has started to be implemented in certain work places to lower the stress of employees and increase productivity, with positive results (Field, 2003). If touch has similar effects in school-age children, then touch-based interventions could support reduced stress and associated positive outcomes, such as increased self-regulation.

Touch and Neural Systems. In recent years, researchers have started to explore the neural systems for encoding touch. Specifically, researchers have looked at the different modes of processing pleasant touch. In a study conducted by Francis et al. (1999), pleasant touch, in the form of velvet, and neutral touch, in the form of a wooden dowel, were applied to a participant's hand while an fMRI was taken. The researchers found that the orbitofrontal cortex was activated by pleasant touch while the primary somatosensory cortex was activated more by the neutral touch. Rolls et al. (2003a) expanded on this study, including a direct comparison with brain areas activated by painful touch. The same methods were applied with the addition of painful touch in the form of sand paper. Regions of the orbitofrontal cortex were activated more by both pleasant and painful touch than by neutral touch. Within the orbitofrontal cortex, painful and pleasant touch activated different areas. Painful touch activated the posterior dorsal part of the anterior cingulate cortex and pleasant touch activated the rostral part of the anterior cingulated cortex. Since the somatosensory cortex was less activated by painful and pleasant touch than by neutral touch, the orbitofrontal cortex activation was most likely related to affective aspects of touch (Rolls et al., 2003a). The orbitofrontal cortex has also been associated with reward functions in the brain, specifically rapid reinforcement association learning (Rolls, 2003b).

Overall, the orbitofrontal cortex is a main area of the brain activated by pleasant touch. But the orbitofrontal cortex is not activated by touch to just any part of the body. In a study done by McCabe, Edmund, Bilderbeck, and McGlone (2008), moisturizing cream was applied to the forearm and hand. The hand is made of glabrous skin that does not contain conductive tactile (CT) fiber afferents, while the forearm does contain CT fiber afferents. The touch applied to the forearm, which contained CT fiber afferents, activated the orbitofrontal cortex more than touch applied to glabrous skin on the hand. Thus, CT fiber afferents may specially activate the orbitofrontal cortex.

CT fiber afferents are a class of conductive-fibers which are unmeylinated, slow-conducting fibers that are part of the anterolateral system and have been specifically correlated with pleasant touch. In a study by Loken, Wessberg, Morrison, McGlone, and Olausson (2009), microneurography technique was used to record afferent activity in a single CT fiber afferent and a single myelinated afferent in a human receiving tactile stimulation. The tactile stimulation consisted of a soft brush moving with constant speed over a certain skin receptive field area. In a separate session, subjects rated the positive hedonic quality of the brush stroking. The researchers found a linear correlation between mean firing rates and mean ratings of pleasantness of CT-fiber units, but not for myelinated units. The mean pleasantness ratings were significantly lower in the palm where there are no CT fiber afferents, than in the forearm, where there are CT fiber afferents. Therefore, touch that activates CT fiber afferents can be thought of as pleasant touch.

One reason that CT-fiber-afferent-activating touch could be processed as positive is because it activates the limbic area in the brain, which is related to emotion. Olausson et al. (2002) studied CT fiber afferents in a unique patient lacking large myelinated afferents. This patient found that activation of CT fiber afferents produced a faint sensation of pleasant touch, despite their lack of normal sensory receptors. Further, fMRI analysis during CT fiber afferent stimulation showed activation of the insular region (part of the limbic system), but not the primary (S1) or secondary somatosensory (S2) areas. In normal subjects, CT fiber afferent stimulation activated S1, S2, and the insular cortex. These results indicate that the CT system specifically activates the limbic area and this activation may underlie emotional, hormonal or affiliated responses to touch.

In summary, pleasant touch activates CT fiber afferents, found in non-glabrous skin, which activate the orbitofrontal cortex and the limbic area of the brain. Since friendly touch activates the reward pathway and emotional areas of the brain, it may be that touch-based intervention could prove to be beneficial in children for promoting on-task, reward related behavior and better emotional understanding.

Touch and Emotions. Touch is also a significant factor in our understanding of interpersonal emotions. Most people agree that a hug feels good, while a punch hurts. However obvious it may seem that touch elicits and communicates emotion, this area of research remains largely unexplored. Hertenstein and Campos conducted one of the first studies exploring this relationship in 2001. They had mothers either tense their fingers around their infant's abdomen, relax their grip around their infant's abdomen, or remain neutral while their infant was presented with novel objects. The results revealed that the infants waited longer to touch the object and touched the object less when the mother's fingers were tense than in the neutral condition. No difference was found between the condition in which mother's fingers were relaxed and the control condition. Thus, infants' emotions can be affected by their mothers' touch. Hertenstein and Keltner expanded on this topic with adults in 2006 and 2009. They studied whether or not people could identify emotions from the experience of being touched on the arm by a stranger they could not see. The results showed that people could actually identify many distinct emotions from touch (Hertenstein & Keltner, 2006). Specifically, people could decode anger, fear, disgust, love, gratitude, sympathy, happy, and sad based on the feel of different touches (Hertenstein et al., 2009). These same results were replicated in Spain (considered a more physical culture than the U.S.), so certain emotions may be universally conveyed by touch, although this area of research needs to be further explored. Findings from these studies support that people are in fact able to differentiate between 'good' and 'bad' touch. This should somewhat alleviate people's fear that children will misunderstand the emotional intentions of supportive touch (e.g. confusing supportive touch with sexual touch).

In conclusion, past studies have shown that touch affects cognitive processes in various positive ways. Touch increases feelings of attachment, lowers stress hormones, activates the limbic area and orbitofrontal cortex, and communicates discrete feelings. Given all these positive effects and their beneficial implications, it seems only natural that one would continue to explore how touch impacts cognition during development.

Touch and Compliance

Early Studies. In addition to the positive effects of touch on stress, attachment, and emotional understanding, many studies show that touch robustly increases compliance in adults. Some of the earliest studies on touch explored the relationship between touch and compliance to a request in adults. Kleinke (1977) conducted the landmark study in this area, introducing the idea that touch could increase compliance. In this study, experimenters posed as lay people and approached subjects that walked out of a phone booth in which a dime had strategically been placed. The experimenters asked the subjects if they had found a dime left in the phone booth. Interestingly, subjects who were touched by the experimenter were more likely to return the dime. A follow-up study by Kleinke showed that people were more likely to lend an experimenter a dime in a shopping mall when the experimenter touched their arm (Kleinke, 1977). In both cases, touch seemed to increase the participant's compliance to a request.

In another study, Crusco and Wetzel (1984) found that if waitresses touched their patrons briefly on the forearm or palm, they would receive a larger tip than if they did not touch their client. This phenomenon has been labeled the 'Midas Touch,' in reference to King Midas, a character from Greek mythology famous for turning everything he touched into gold. Stephen and Zweigenhaft (1986) replicated Crusco and Wetzel's study, but had only waitresses touch male and female dyads dining together to look at the effect of gender on touch. Though Crusco and Wetzel found no gender effects, Stephan and Zweigenhaft found that females touched by female waitresses tipped more than males touched by female waitresses. Similarly Hornik (1992) found that touching could not only lead to a higher tip, but also increased the customer's evaluation and reaction towards the waiter.

This touch and compliance phenomenon was also studied in relation to marketing. Smith, Gier, and Willis (1982) conducted a study in which shoppers in a supermarket were approached by an incognito experimenter with a request to sample a new food product. The patrons who were touched by the experimenter were more likely to both try the food and buy the food than patrons who were not touched. Surprisingly, the touch and no touch groups did not differ in their taste rating of the product. Furthermore, the patron's gender did not affect his or her response. Hornik and Ellis (1988) found that subjects approached in a mall who were touched by an experimenter posing as a store assistant were more likely to fill out a mall survey then subjects who were not touched. In addition, the subject's perceived burden of filling out the survey was decreased when he or she was touched. In this same situation, touch has also been found to improve the interpersonal feelings between the subjects and solicitors (Hornik, 1987). Lastly, Hornik (1992) looked at the interplay between touch and time spent shopping. He found that shoppers who were touched by experimenters posing as store clerks shopped longer and purchased more.

The above studies provide a strong indication that touch increases compliance in simple tasks. Additional studies show that the same relationship may be true for more difficult, longer tasks. In a study done by Patterson, Powell, and Lenihan (1986), experimenters either touched or did not touch participants when asking them to help hand-score bogus personality inventories (a boring, hard task). In this case, touch increased compliance by increasing time spent scoring the inventories. Willis and Hamm (1980) looked at touch and compliance with two tasks of two levels of difficulty. In the first easy task, subjects were asked to sign a petition supporting a popular cause on a college campus. In the second, more difficult task, participants were asked to complete a brief rating scale that took a few minutes to fill out. In both conditions, being touched increased compliance, but touch had a greater effect on compliance when the task was more difficult. On the difficult task of looking after a large, excited dog for ten minutes, Gueguen and Fischer-Loku (2002a) also found that touch increased compliance. Nannberg and Hansen (1994) found that even when a subject was touched only after agreeing to take a long, difficult questionnaire, there was still an increase in the subject's willingness to complete the difficult task.

Touch has been found to not only increase compliance, but also altruistic behavior in an un-related task. In a study by Gueguen and Fisher-Lokou (2003), an experimenter asked people on the street to help him find a famous place in a nearby town. In half of the cases, the experimenter touched the participant. After the question was answered, the experimenter walked away and then proceeded to drop many diskettes on the ground. Touch was shown to both directly increase compliance (by helping the experimenter find the famous place) and also indirectly increase altruistic behavior in subsequent interactions. This study shows that the 'compliance effect' can spread into further situations with the 'toucher'.

Understanding the Interaction Between Touch and Compliance. Recent studies have begun to unpack the correlation between touch and compliance. In one study, Gueguen (2002b) looked at the effects of different types of touch on compliance. In this experiment, men and women were approached at random on the street and asked for money to pay for a parking meter. In the 'draw attention touch' condition, the experimenter would tap twice on the shoulder of the subject when asking for money. In the "touch for need" condition, the experimenter would hold the subject's hand for one to two seconds when asking for money. Touch overall increased compliance, but the 'touch for need' elicited more help from subjects than the 'draw attention touch'. However, it should be noted that this study was conducted in France, a country with a more physical culture than the U.S. (Field, 1999). Perhaps, the 'touch for need' touch would come off as presumptuous and uncomfortable in cultures such as the U.S. where strangers do not often hold other stranger's hands, causing the opposite effect on compliance.

Gueguen (2002c) also looked at the effects of awareness on touch and compliance. Experimenters pretended to be marketing students and approached subjects in a mall, asking them to fill out a marketing survey that they had to complete for school. At the end of the survey, participants were asked if they were aware that the experimenter touched their forearm when asking their request. Interestingly, only 27.7% of participants in the touch condition answered that they knew they were touched. Overall, people who were touched were more likely to fill out the questionnaire than people who were not touched, but consciousness of the touch had no effect.

The status of the 'toucher' also effects how people react to touch. In a study by Gueguen (2002d), experimenters dressed up either in elegant, conventional, or very neglected clothing. Hence, clothing comprised the manipulation of the perceived status of the experimenter. The experimenters then asked people in a mall to answer a questionnaire about television programs. In all three conditions, the experimenter touched only half of the participants when soliciting requests. Overall, touch increased compliance, but touch by a higher-status person increased compliance the most.

Culture also plays a large role in the perception of touch. The majority of the studies on touch have been done in France (e.g. Gueguen & Fischer-Loku, 2002a; Gueguen, 2002b; Gueguen, 2002c; Gueguen, 2002d; Gueguen & Fischer-Loku, 2003; Gueguen, 2004), Israel (e.g. Hornik, 1987; Hornik & Ellis, 1988; Hornik, 1992) and the United States (e.g. Klienke, 1977; Crusco & Wetzel, 1984). While these studies show a positive correlation between touch and compliance, other countries with different views on touch may not find this to be true. For example, Dolinski (2010) conducted a study on touch and compliance in Poland. He found that male-to-male touch in Poland, a notably homophobic culture, actually decreased the rate of compliance to a request and this was strongly correlated with the degree of homophobia of the participant.

Overall, the kind of touch, the touching person's status, and the cultural context can all affect compliance. Interestingly, touch does seem to increase compliance regardless of the awkward or uncomfortable nature of the touch. As Gueguen (2002d) points out, this could be because most people actually are not aware of being touched at all in these studies.

Touch in the Classroom. Touch has also been shown to be beneficial in a classroom setting. In 1973, even before Kleinke's experiment, a study done by Kazfin and Klock examined the effect of touch in the classroom on student's behavior. Thirteen moderately developmentally challenged children, ages 7-12 years old, were observed for inattentive and attentive behavior throughout the 30-day study. The first nine days consisted of baseline, in which the teacher's and children's behaviors were coded. The next nine days consisted of the teacher increasing her non-verbal encouragement (touch and smiling) following attentive student behavior. The following nine days were a reversal period in which the teacher was told to return to previous classroom practices (not increasing non-verbal behavior). The last six days of the study consisted of the teacher once again increasing non-verbal encouragement following attentive student behavior. The results of this study indicated that student attentive behavior increased during periods of increased non-verbal encouraging behavior from the teacher and decreased during the reversal phase. This study shows that nonverbal behaviors, including touch, can reinforce appropriate classroom behavior, such as attentiveness, but does not single out touch as the main predictive variable.

This positive effect of touch on attentive behavior was also demonstrated with normally developing children in a preschool and first grade setting. Wheldal, Bevan, and Shortall (1986) looked at the effect of touch from a teacher on 5-6 year old students in relation to appropriate classroom behavior. This age range was chosen because the researchers felt that teachers of younger children were more likely to use touch than teachers of older children. After a baseline phase in which the teacher's and children's behaviors and interactions were coded, an intervention phase was initiated. In the intervention phase, classroom teachers were instructed to touch children only when praising them for academic and/or social behavior (they were not instructed to increase praise from baseline). They found that a teacher's praising touch could reinforce appropriate classroom behavior. A major limitation in this study is that the researchers did not differentiate the effects of praising touch vs. praising talk. It is possible that the combination of the praising conditions is additive and stronger than each condition separately.

Gueguen (2004) also looked at the effect of touch in a classroom setting, but in college-aged students. Gueguen aimed to test the hypothesis that touch increases behavior expected by the 'toucher'. In this experiment, the subjects were students in an undergraduate statistics class. In this class, students volunteered to come up to the board to solve math problems in front of the class. The teacher in this study selectively touched some student volunteers on the forearm while they wrote their answers on the board. The students who were touched were more likely to volunteer later in class to write answers on the board. Based on these results, it seems as though touch not only increases compliance, but also fosters feelings of encouragement and comfort.

Touch has also been shown to increase performance on a task. In a study conducted by Clements and Tracy (1977), ten emotionally disturbed boys with a normal IQ, aged 9-11, were given arithmetic work sheets along with either verbal positive feedback, tactile positive feedback, or a combination of the two from a teacher. The positive tactile cue and the tactile and verbal cue together increased attention to the task and performance on the task more than the control and the verbal feedback alone conditions.

Although classrooms are instating 'No Touch' policies, many studies point to the positive effect that touch can have in a classroom setting (Kazfin & Klock , 1973; Wheldall et al., 1986; Gueguen, 2004; Clements & Tracy, 1977). These studies show that touch increases attentive, on-task behavior, feelings of comfort, and performance, pointing to the very real benefits of touch used appropriately in schools.

The Current Study

The current study aims to explore the robust finding that touch increases compliance in adults to see if this same relationship extends to preschool-age children. The motivation for this study is to reconsider our society's attitudes towards touch in children, given the remarkable potential positive effects of touch. Specifically, we may be overlooking the beneficial outcomes that touch may have in a preschool classroom. Preschool-age children are at a key age for early intervention for conduct disorders (Webster-Stratton, Reid, & Hammond, 2001, 2004). In a time where a growing number of children are developing externalizing disorders there is major concern over how to teach children impulse control (Lavigne et al., 1996; Briggs-Gowan, Horwitz, Schab-Stone, Leventhal, & Leaf, 2000). Understanding the connection between delay-of-gratification abilities, self-regulatory abilities, and different forms of intervention is imperative for detecting ways that social support systems (such as schools, parents, and communities) could help foster self-control in young children. If something as simple as touch could increase compliance and thus help inhibitory control in children, this would have immediate implications for therapeutic techniques as well as in understandings of parenting and teaching.

Since this is one of the first studies in the new domain of research on touch in children, a compliance task was chosen with the hope of replicating the robust finding that touch increases compliance in adults. To target the growing concern about self-regulatory behavior in preschool-age children, the compliance task used in this study asks children to wait for a reward. Hence, the current study uses a task that requires children to exercise self-control in order to succeed at being compliant. This is a separate, but related skill to compliance, and therefore may also be affected by the touch manipulation.

The task in the current study uses a variation of Walter Mischel's original marshmallow delay-of-gratification task (Mischel & Ebbesen, 1970) in order to better manipulate compliance. In the original task, children were given the option to either eat one marshmallow immediately, or wait and eat two marshmallows after a few minutes. In the current study, modified from Vaughn, Kopp, and Krakow (1984), children are told that they cannot look for or eat a hidden candy until they receive permission from the experimenter. Half the children are touched on the back by the experimenter when given this instruction. The experimenter then leaves the room for ten minutes to see how well the child can wait and how well they follow the directions to not touch or eat the candy. Thus, children's compliance is measured by if they wait to receive permission to look for and eat the candy and how long they wait to eat the candy. This study aims to emulate the compliance procedures that were used in adult touch and compliance studies, but geared more toward children, and focused on inhibitory control.

In addition to this task, children were also tested on executive function prior to the touch intervention. One reason executive function was tested was to ensure that samples were randomly assigned to condition by checking that the distribution of executive function scores was equal in both conditions. Furthermore, since executive function scores are related to delay-of-gratification performance (Eigsti et al., 2006), but not identical to the self-regulatory abilities in this particular task (Miyake et al., 2000; Garon et al., 2008), executive function scores were used to ensure that the differences between conditions were really a function of the touch manipulation and not a side effect of sampling.

Based on previous adult findings (e.g. Kleinke, 1977; Crusco & Wetzel, 1984; Hornik & Ellis, 1988; Willis & Hamm, 1980), it was hypothesized that children who were touched when given directions would comply with directions better than those children who were not touched. Specifically, children who were touched were hypothesized to be more likely to not search for or eat the candy without permission and to wait a longer amount of time before eating the candy. Children in the touch condition were also hypothesized to have better delay-of-gratification because touch is predicted to increase compliance and complying in this task requires good self-control.

Methods

Subjects

Participants were 30 4- and 5-year old children (range = 49 to 71 months; mean age = 58.9 months; 18 female and 12 male). Three additional children were tested but not included in the final analyses because they expressed fear and/ or sadness at being alone in the room and thus did not complete the study. All participants were recruited from central Connecticut and tested at the Cognitive Development Laboratory at Wesleyan University.

Procedures

All protocols received IRB approval through the Wesleyan University IRB. Informed consent was obtained in accordance with IRB policies.

Setting. For the whole experiment, the child was seated in a square room with few distractions. There was a tripod with a video camera and curtains against each wall. The child was seated, facing the video camera, in front of a small, low table. In the executive function task, the experimenter sat across the table from the child and in the food reward task, the experimenter sat caddy corner to the child. Two experimenters administered the tasks; both were women of similar age and demeanor.

Parent Survey. Before children were tested, parents were given a questionnaire developed for this study (see Appendix A). The questionnaire included questions about basic demographic information, parent's rating of their child's comfort and experience with touch, and parent's rating of their child's waiting behavior. These ratings were made on a 1-7 Likert scale (7 being very comfortable/ often and 1 being very uncomfortable/ not often). The questionnaire was administered to gain background information on the child's physicality and self-control in order to better interpret the findings.

Executive Function Task*.* This task was adapted from procedures used by Davidson, Amso, Anderson, and Diamond (2006) and Carlson and Moses (2001). The age group used in this study sometimes reaches ceiling effects on simple executive function tasks with incongruent blocks. A way to avoid this is to use a more difficult manipulation with mixed blocks with congruent and incongruent trials. The modified executive function task used in this study was based on Adele Diamond's Dots task (Davidson et al., 2006). The Dots task consists of three conditions: congruent, incongruent, and mixed block. In the congruent condition, children learned a rule. In the incongruent condition, children learned a new rule, requiring inhibition of the previously learned rule. In the mixed block trial, congruent and incongruent trials were intermixed, requiring memory of the previous rules.

The Dots task was modified for this study without the use of a computer. Two puppet characters were introduced to the child, much like the 'Bear-dragon executive function task' (Carlson & Moses, 2001). One puppet was the 'nice' elephant and the other was the 'mean' crocodile. The experimenter put out two 'buttons' in front of them (two push lights without batteries) and told the child 'this is my friend the nice elephant. He's very nice, so when he pushes the button, we raise our hand on the same side.' The experimenter then has the elephant puppet push buttons for two practice trials in which the children's moves were corrected if needed, followed by four trials with no corrections provided. Next, the experimenter introduced the 'mean' crocodile and said 'this is my other friend, the mean crocodile. When he pushes the button, we're going to be silly and do the *opposite* of what we're supposed to do. So when he pushes a button, we're going to raise our hand on the opposite side of the button!'. Once again, two practice trials with correction were followed by four trials with no correction. These two phases comprised the congruent phase (elephant trials) and incongruent phase (crocodile trials). The mixed block trial comprised of the crocodile and the elephant pushing buttons in a fixed, pseudorandom order for twelve trials with no correction. Thus the child had to remember the rules for each puppet and inhibit responses. The children were allowed to push the buttons after the puppets did instead of raising their hands if they preferred. The child's behaviors were coded as correct (0 points), self-correct (1 point), and incorrect (2 points). The total child's score was added up, with 0 being perfect and 24 being all wrong answers.

Food Reward Task. This task was adapted from a procedure used by Vaughn et al. (1984). In this task, children were told not to look for or eat a candy without permission from the experimenter. Half the children received a friendly touch on the back from the experimenter during this instruction. The experimenter then hid a candy under one of three cups and left the participant alone in a bare room for ten minutes. Meanwhile, the experimenter watched and coded behavior from a hidden camera. The child was provided with a bell to ring if they wanted the experimenter to come back. The experiment ended when the child ate the candy, after the child rang the bell for a fifth time, or after the ten minute waiting period. At the end of the experiment children, were praised and given a reward (for full experimental protocol, see Appendix B).

The behaviors that were coded were the number of times the child touched the cups (looking for the candy), the number of times the child rang the bell, and the length of time the child waited until finally eating the candy. The number of times the child touched the cups was recorded to measure the degree to which children complied with the direction to not search for the candy without permission. The bell ringing behavior was coded as it might signal discomfort and anxiety, which could relate to children's overall performance on the task. To record a measure for compliance and delay-of-gratification, the total time until the child ate the candy was coded. Further, it was noted whether the child received permission to eat the candy before they ate it, another important measure of compliance to directions.

Directly after the child was touched, their physical and emotional reactions were coded. Children's physical reactions included flinch, neutral, and bubbly. Children's emotional reactions included positive talk, negative talk, smile, grimace, and no reaction. These reactions were coded to see if children's behavioral response to touch would affect their compliance behavior.

During the ten-minute waiting period, the child's behaviors were coded each minute as either distraction, self-soothing, gazing at reward, exploring room, none, or other. Distraction behavior included any behavior the child exhibited that focused their attention away from the reward (besides exploring room). Self-soothing behavior included rocking, holding, and stroking themselves. 'Other' behavior was any behavior that did not fit into the above categories. Broadly speaking, there were two main behavioral categories: distracting and non-distracting behavior. Distracting behavior included distraction and exploring the room, while non-distracting behavior included gazing at the reward, self-soothing behavior, and no behavior. These behaviors were coded because previous literature has found that distracting behaviors improve delay-of-gratification performance (Mischel et al., 1989), so waiting behaviors are of interest to the outcomes of this study. The behaviors were broken down within the two main categories (distracting and non-distracting behavior) to better understand how different types of behavior can affect performance on the task more specifically.

Inter-coder reliability

All data was video recorded and double coded by a second observer with 100% inter-coder agreement.

Results

Wait Time

The two main outcome measures of compliance in this task were wait time and following the directions to not look for or eat the candy without permission. Both age and executive function were balanced across the touch and no touch conditions (all $p > .23$; see Table 1). Initial analysis revealed a significant effect of condition on wait time, $t(28) = -1.77$, $p = .044$, one-tailed (see Figure 1). Children who were in the touch condition waited significantly longer to eat the candy than children in the no touch condition. However, a univariate ANOVA with wait time as the dependent variable, condition as the independent variable, and age, sex, and executive function scores as covariates, yielded a significant effect of age, $F(1, 25) = 4.29$, $p = .049$, but not of condition, $F(1, 25) = .283$, $p = .559$ (see Figure 2).

A closer look at the age distribution led to the discovery that four out of the five youngest participants were in the no touch condition and all three oldest participants were in the touch condition. This age inequality across conditions confounds the effect of condition on wait time since older children waited longer than younger children no matter the condition. Follow up analyses excluded these youngest and oldest children in order to more evenly distribute ages across the two conditions (see Table 2). All further analyses concerning condition and wait time were conducted with these eight participants excluded[1]. A univariate ANOVA on wait time, controlling for age, sex, and executive function, showed an effect of age, $F(1, 19) = 13.77$, $p =.002$, an effect of executive function, $F(1, 19) = 4.71$, $p =.044$, and a main effect of condition, $F(1, 19) = 4.55$, $p =.048$ (see Figure 3). A hierarchical linear regression on wait time showed that adding condition (touch or no touch) increased the variance explained by 11.5% [change $R^2 = .115$, $F(4, 17) = 5.61$, $p = .005$] over that explained by just age, sex, and executive function [R^2 without condition = .454, $F(3, 18) = 4.98$, $p = .011$].

The effect of condition on wait time could be driven by more children in the touch condition waiting the full ten minutes than in the no touch condition. However, there was no association between waiting the full ten minutes and condition, χ^2 (1, $n = 22$) = 0.21, $p = .647$. In the touch condition, 8 out of 11 participants waited the full ten minutes, and in the no touch condition 7 out of 11 waited the full ten minutes. It was predicted that no matter the condition, certain children would wait the full ten minutes. Thus, taking the children who waited the full time out of the data and analysis shows the real effect of condition: touch significantly increases the wait time of children who were unable to wait the full ten minutes, $t(5) = -3.33$ $p =.020$. Excluding the participants who waited the full ten minutes, the mean wait times were: no touch (n = 4) = 70.75 s, touch (n = 3) = 335.00 s. The executive function scores for this subsample were: no touch M(SD) = 6.0(2.16), touch M(SD) = 7.0 (6.08).

[1] All of the analyses were double-checked with the truncated age group and came out with a similar pattern.

Direction Following

Only 2 of the 30 participants (6.67%) ate the candy without permission. Both of these participants were in the no touch condition.

Fourteen of the participants (46.67%) looked for the candy, but did not eat it. While about half of the children in the study did break the request to not look for the candy, this was not associated with condition, χ^2 (1, n = 30) = 0.57, p = .464. There is a trend in the direction of the no touch condition children searching for the candy more times than the touch condition children, even though the means are not significantly different because of high variability, $t(28)$ = .564, p = .577. The mean (SD) number of times children searched for the candy was 1.27 (2.55) for the touch condition and 1.73 (1.94) for the no touch condition.

The remaining 14 participants (46.67%) did not look for nor eat the candy (fully compliant). Of these 14 participants, 6 were in the no touch condition and 8 were in the touch condition. Condition was not significantly associated with compliance on eating behavior, χ^2 (1, n = 30) = 2.14, p = .143, nor searching behaviors as mentioned earlier. Further, age did not predict compliance on eating behavior, $t(28)$ = 1.27, p = .214, nor searching behavior, $t(28)$ = 1.43 p =.164. Overall, most of the children complied with the critical request to not eat the candy without permission.

Executive Function

As predicted, executive function was correlated with age, $r(28) = .516$, $p = .004$ (see Figure 4), with executive function skills increasing with age. In this experiment, executive function was reverse coded, with 24 being the worst score and 0 being the best. The mean (SD) raw score of 4-year old participants was 9.59 (4.66) with a percent correct score of 56.69% (20.00), while the mean raw score of 5-year old participants was 4.54 (2.73) with a percent correct score of 81.09% (11.36).

Although no full simple correlation was found between wait time and executive function, $r(20) = .15$, $p = .492$, the partial correlation after controlling for age and sex was significant, $r(20) = .45$, $p = .045$.

Parent Survey

One parent did not fill out the parent survey, so 29 of the 30 participant surveys were analyzed ($n = 15$ in touch, $n = 14$ in no touch). The parent reports of how comfortable their child was with family and friend's touch did not significantly differ between conditions [no touch M(SD) = 5.86 (.949); touch M(SD)= 5.54 (1.51); $t(27) = .19$, $p = .850$]. Further, the parent ratings of how often their child seeks touch were not different between conditions [no touch M (SD)= 6.71(.47); touch M (SD)= 7.00 (0); $t(27) = -1.81$, $p = .081$] and the parent ratings of their child being comfortable with touch from a new person were not different across conditions [no touch M (SD)= 6.71 (.47); touch M (SD)= 6.67,

(.82); $t(27) = .69$, $p = .498$]. In general, the data show that children often seek touch and are generally comfortable with touch from both old and new people.

The parent ratings of the number of instances their child had to wait in the past 24 hours was not correlated with their child's wait time, $r(27) = -.15$, $p = .466$. Parents reported that their children had to wait a mean (SD) of 6.43 (2.57) times in the past 24 hours in the touch group and mean (SD) of 6.29 (2.78) times in the no touch group.

Child Response to Touch

The dominant emotional response to touch was 'smile' and the dominant physical response to touch was 'neutral'. The child's physical reaction to the experimenter's touch was not a predictor of the child's wait time, $F(1, 13) = .03$, $p = .877$. There was also no significant effect of the child's emotional reaction to the experimenter's touch on wait time, $F(1,13) = 3.39$, $p = .088$. This was only marginally non-significant; there was a trend towards children with emotional reactions of 'positive talk' waiting longer than children with the emotional reactions of 'smile' and 'no reaction' (see Figure 5). Further, the sex of the child did not affect their emotional or physical reaction to the experimenter's touch [emotional: χ^2 (3, n = 30) = 4.14, $p = .247$; physical: χ^2 (3, n = 30) =3.64, $p = .304$].

Waiting Behavior

The most common waiting behavior across subjects was 'distraction' (see table 3). More children in the no touch group exhibited behaviors of 'none,' 'distraction,' and 'self-soothing,' while more children in the touch condition displayed behaviors of 'exploring room,' 'gazing at reward,' and 'other'. Of the two children who exhibited 'other behavior,' one just sat patiently the whole time while the other held the bell in her hands for most of her wait time. The waiting behavior was not equally distributed across conditions, χ^2 (5, *n* = 30) = 12.47, *p* = .029 (see table 3). Specifically, all the participants in the touch condition exhibited a waiting behavior, while only 5 out of the 15 participants in the no touch condition exhibited a waiting behavior. A one-way ANOVA on waiting behaviors and wait time showed that waiting behavior was significantly related to wait time, *F* (5, 24) = 10.56, *p* < .001. A Tukey post hoc test showed that the 'no behavior' participants' mean wait time was significantly different from all the other dominant behaviors (all *p* < .011), while the wait times for the other dominant behaviors were not significantly different from each other (all *p* > .710).

When the subject's waiting behavior was grouped into the two broader categories of distraction behavior (distraction, exploring room) and non-distraction behavior (self-soothing, gazing at reward, none, other), there was a relationship between waiting behavior and wait time, *t*(28) = 2.96, *p* = .006. The children who exhibited distraction behavior waited significantly longer than the children who did not exhibit distraction behavior [distraction *M* (SD)= 538 s (121.35), no-distraction *M* (SD)= 313.38 s (281.06)]. However, distraction behavior was not related to condition, χ^2 (1, *n* = 30) = .13, *p* = .713.

The subjects were also coded for the number of dominant waiting behaviors. In the no touch condition, 9 of the 15 participants exhibited more than one dominant waiting behavior and in the touch condition 12 of the 15 participants exhibited more than one dominant waiting behavior. The display of more than one dominant waiting behavior was not associated with condition, χ^2 (1, *n* = 30) = 1.43, *p* = .232. Regardless of the condition, the children who displayed more than one waiting behavior waited significantly longer than the children who displayed only one dominant waiting behavior, $t(28) = -7.54$, $p < .001$.

Siblings

The number of siblings that children had was equally distributed across conditions, [$t(27) = .94$, $p = .353$; touch: *M* (SD)= 1.27 (.884); no touch: *M* (SD)= 1.57 (.852)]. No correlation was found between number of siblings and wait time, $r(28) = .04$, $p = .864$ (see Table 4).

Sex

Sex did not predict wait time, $t(28) = .99$, $p = .331$, eating behavior (eat with permission/ not eat with permission), χ^2 (1, *n* = 30) = 1.43, *p* = .232, nor searching behavior (looked/ didn't look), χ^2 (1, *n* = 30) = 1.43, *p* = .232.

Bell Ringing Behavior

The number of children who rang the bell was equal across conditions, χ^2 (1, *n* = 30) = .68, *p* = .409. Of the 30 participants, 22 rang the bell (12 in touch, 10 in no touch). Bell ringing behavior was not predictive of wait time, *t*(28) = -1.26, *p* = .219. The number of times that children rang the bell in the touch condition, *M* (SD)= 1.4 (1.29), and the no touch condition, *M* (SD)= 1.4 (1.40), were equal, *F*(28) = .52, *p* = 1.00. The number of times a child rang the bell was not correlated with their total wait time, *r*(28) = -.17, *p* = .376.

Discussion

The results were consistent with adult findings and found that touch increased compliance in preschool-age children. The children in the touch condition waited significantly longer before eating the candy than the children in the no touch condition. However, touch did not increase compliance to the direction to not eat the candy without permission; instead most children were compliant with this request no matter the condition. Condition also did not affect children's compliance to the direction to not look for the candy during the waiting period. About half of the children in the study searched for the candy during the waiting period, with equal amounts in both conditions. The more compliant children who waited longer exhibited more distraction behaviors during the ten-minute waiting period. Executive function, sibling number, sex, and bell ringing behaviors were not predictive variables of task performance in terms of wait time.

Compliance

The literature strongly supports the idea that touch increases compliance in adults (Kleinke, 1977; Crusco & Wetzel, 1984; Hornik & Ellis, 1988; Willis & Hamm, 1980). The few studies that have looked at touch and children showed positive outcomes, with reason to believe that the touch and compliance trend would hold true in children (Wheldall et al., 1986; Clements & Tracy, 1977; Kazfin & Klock, 1973). In the current study, compliance was measured by children's wait time before eating the candy and compliance to the directions to not look for or eat the candy without permission. This study found that touch increased the time children waited to eat the candy, meaning that touch increased children's willingness to comply with directions. The children that waited longer tried harder to follow the experimenter's request for the child to wait until the experimenter was done with her work to receive permission to eat the candy. Hence, the main finding of this study is that touch increases children's compliance to wait to eat a candy reward.

There are several reasons why touch may increase children's compliance to wait longer. Touch has been found to decrease stress hormones and reduce perceived stress (Holt-Lunstad et al., 2008; Coen et al., 2006). Sitting in a room alone for ten minutes is a stressful situation in itself for children. Adding a tempting candy that one must resist eating only increases the stress. It may be that the brief touch from the experimenter decreases the child's stress, enabling them to feel comfortable waiting a longer amount of time.

Related to this, touch has also been found to increase attachment (Harlow & Zimmerman, 1958; Field, 2003; Weiss et al., 2000; Hofer & Shair, 1980). The touch could make the child feel more connected to the experimenter and thus more invested in following her directions. This increase in connection between the child and the experimenter could itself improve the child's direction following by making the child more emotionally attached to the experimenter and more interested in pleasing her.

On a neural level, both positive touch and inhibitory control activate the orbitofrontal cortex (Francis et al., 1999; Rolls et al., 2003a; Cardinal, 2006). The orbitofrontal cortex has also been strongly implicated in the assessment of reward value (Rolls, 2003b). Perhaps, positive touch activates the reward pathway through the orbitofrontal cortex, causing children to be more compliant with waiting for a reward. Since the orbitofrontal cortex is also involved in inhibitory control, its activation may also cause an increase in delay-of-gratification from the touch. The relationship between touch and the orbitofrontal cortex should be researched in future studies since the exact neural connection between the two has not been fully explored.

Another neural explanation may be that positive, CT fiber afferent activating touch stimulates the limbic area, causing a positive emotional response to the touch, which would lead to compliant behavior (Olausson et al. 2002). Since the touch in this study takes place on the non-glabrous skin on the back, it activates CT fiber afferents (McCabe et al., 2008). Generally speaking, the activation of the limbic area could cause feelings of positive emotion and make the child more comfortable with the experimenter (supported by studies that found that touch increases feelings of attachment – e.g. Harlow & Zimmerman, 1958; Field, 2003; Weiss et al., 2000; Hofer & Shair, 1980), causing the child to be more invested in complying. This interaction between touch and the limbic system should be investigated in future studies to better understand children's emotional response to touch.

The other measure of compliance in this study was whether children followed the directions to not look for or eat the candy without permission from the experimenter. Therefore there were two ways in which children could demonstrate compliance in this study: compliance to not look for the candy and compliance to not eat the candy without permission. Most of the children were compliant with not eating the candy without permission. Either they would wait the full ten-minutes until the experimenter came back to give permission, or they would ring the bell insisting to eat the candy at some point during the ten minutes. In both of these situations, the child complied by getting permission from the experimenter before eating the candy. Hence, touch did not increase compliance with eating behavior; rather most of the children were compliant in both conditions (touch and no touch). Interestingly, the two children that did surreptitiously eat the candy without permission were in the no touch condition, but the low base rate of eating candy without permission makes it hard to draw any strong conclusion.

About half of the participants looked for the candy without permission, but the touch condition did not affect this breach of compliance. Looking for the candy without permission was an easier rule to break than not eating the candy because there was no obvious display of rule breaking. Since the children did not know they were being watched, it was easier to peek under a cup to look for the candy than eat a candy with the obvious repercussions of the experimenter noticing that the candy was gone. Therefore it makes sense that more children would break the rule of not searching for the candy than not eating the candy; the consequences were less obvious.

This study found no relation between touch and compliance in children to the directions to not look for or eat the candy without permission. There are a few reasons why this relationship may not have been found. Since most of the children waited to receive permission before eating the candy (whether it be ten minutes or ten seconds), the manipulation of asking children to wait to eat food may perhaps be too commonplace and practiced in the home and school environment to be a good indicator of how touch affects compliance. For this reason, other measures, such as wait time, were perhaps better indicators of compliance in this study.

The behavior of searching for the candy without permission proved to be difficult to interpret. While coding this study, children were marked as 'searching for the candy' whenever they touched a cup. In some of these situations, the child may have just been playing with the cups out of boredom and not specifically looking for the candy. The cups were also problematic because the children thought they signaled a hide and seek game where they had to remember where the candy was hidden. Thus, children may have been provoked to search for the candy during the wait time to make sure they remembered where it was hidden when the experimenter came back. In future studies, cups should not be used; rather the candy should be placed directly in front of the child.

Delay-of-Gratification

In order to comply with the directions to not eat the candy until given permission, children must utilize good self-control. This study found that touch increases children's total wait time, an indicator that touch also increases children's delay-of-gratification. In other words, the children who were touched tried harder to comply with the directions by waiting longer to eat the candy, and consequently also had to employ better delay-of-gratification. However, the cause and effect of touch increasing compliance, and thus delay-of-gratification or vice versa is hard to dissociate. Perhaps delay-of-gratification is the more appropriate lens to look at this finding since compliance in this task relies so heavily on delay-of-gratification performance. The relationship between touch and delay-of-gratification specifically should be explored in future studies.

Executive Function

Executive function scores were not correlated with wait time in this study independently, but rather were correlated with wait time when age was partialed out. This positive correlation between executive function and wait time replicates previous findings that executive function and delay-of-gratification performance are related (Eigsti et al., 2006). However, this positive correlation might be misleading since both executive function and wait time are so highly correlated with age. It seems that age predicts each variable more strongly than the variables predict each other.

One reason that there was only a relationship between executive function and delay-of-gratification when age was partialled out may be because even though executive functions all stem from the frontal lobe, they are not all part of the same system (Miyake et al., 2000). Miyake et al. (2000) proposed that executive function tasks consist of three components: working memory, inhibition, and mental-set shifting. The executive function task used in the current study required holding a rule in mind, responding to that rule, and then inhibiting the learned prepotent response. This kind of task is classified as 'complex response inhibition' and includes all three executive function components (Garon, Bryson, & Smith, 2008). However, delay-of-gratification tasks require withholding or delaying an automatic, prepotent response, which is classified as 'simple response inhibition' and only comprises the executive function category of inhibition (Garon et al., 2008). Thus, the kind of executive function task used in this study may not have been directly related to the kind of inhibitory control that was needed in the current studies' delay-of-gratification task. Furthermore, the small sample size and restricted range of waiting scores (from all the children who waited ten minutes) reduced the chances of finding a full correlation.

Children and Touch

Two factors were considered when evaluating how children responded to touch: the parent survey and the coding of the child's response to the experimenter's touch. On the parent survey, parents rated that their children were very comfortable with touch from family and friends *and* new acquaintances. When rating how often their child seeks touch, the ratings were even higher. This data shows that preschool-age children like being touched and are comfortable with touch from a variety of people, not just close family and friends.

Supporting the parent survey responses, most children responded positively to the experimenter's touch in this study. The children's dominant physical reaction to the experimenter's touch was neutral, while the dominant emotional reaction was a smile. Although the children's physical and emotional responses were not good predictors of task performance, there was a trend for children who responded to the touch with positive talk (e.g. 'yes,' or 'okay') waiting longer. This could mean that children who respond better to touch are more likely to exhibit beneficial behaviors from touch, such as waiting longer in this task. This could also mean that verbal compliance helps performance or that there is a "fit" between a child's responsiveness to touch and the effectiveness of touch as an intervention for that child.

There has been debate in the touch literature as to whether gender affects behavior in response to touch (e.g. Crusco & Wetzel, 1984; Stephen &

Zweigenhaft, 1986). In the current study the experimenters were two females and the emotional and physical reaction of the children to the experimenter's touch was the same in both genders of the participants. The results showed that sex was not a good predictor of delay-of-gratification performance or compliance. Hence it seems that in this study, gender did not affect behavior in response to touch. It would be useful in a future study to have a male experimenter as well as a female experimenter.

To the author's knowledge, this is the first touch study on children in a lab setting. It is reaffirming that the children responded well to the touch in this experiment. In fact, one child (in the touch condition) rang the bell during her waiting time to give a hug to the experimenter. Thus, the touch in this study was well received by the children.

Waiting Behaviors

Dominant waiting behaviors were coded in this study because past literature has found that children's distraction behaviors on delay-of-gratification tasks affect their performance (Mischel et al. 1989). The waiting behaviors coded on the current task were distraction, self-soothing, exploring room, gazing at reward, none, and other. The most common waiting behavior across conditions was 'distraction'. This is a broad term that can mean anything from playing with the carpet to singing songs. Mischel et al. (1989) found that children who were told by an experimenter to think fun, distracting thoughts during the delay-of-gratification task waited significantly longer than control children. Similar to Mischel's findings, the current study found that children who exhibited dominant waiting behaviors of distraction (distraction, exploring room) waited significantly longer to eat the candy than children who exhibited no dominant waiting behaviors of distraction (self-soothing, gazing at reward, other, none).

Displays of distraction behaviors were equal across both conditions (touch and no touch). Therefore, although touch increases children's wait time, it does not do so by increasing the range of distraction behaviors. Touch must increase children's delay-of-gratification by a different mode. More children in the touch condition displayed the behavior of 'exploring room' and in order to exhibit this behavior, they had to feel comfortable with their surroundings. This supports that idea that perhaps touch reduces stress (explored earlier in this paper) and puts the child at ease, allowing them to wait longer.

Other Variables

Many variables in this study were equally distributed across conditions, supporting that touch is a main predictor of wait time. Siblings were equally distributed across conditions and were not found to be a good predictor of wait time. One would think that in a household with more siblings, children would have to spend more time waiting than in households with only one child. This was not found in the current study, and to the author's knowledge has not been looked at in other literature. Hence, this may also be the first study to show that number of siblings does not affect performance on a delay-of-gratification task.

More than half the children in the study rang the bring-me-back-bell. The bell ringing behavior could be an indicator of anxiety, a short attention span, or just confusion with the task. One might predict that children who rang the bell more would wait longer both because of constant reminders of the experimenter's request for them to wait and because of the distraction and comfort the experimenter's presence may have provided. On the other hand, children who rang the bell more could be predicted to wait less because bell-ringing behavior could indicate anxiety and fear of being alone. Interestingly, bell-ringing behavior was equal in both conditions and was not a good predictor of wait time.

In the task's current form, bell-ringing behavior is hard to analyze. The original purpose of the bell was to make the children feel safe. Ideally, the bell ringing behavior should not be a factor in predicting performance on this task. Unexpectedly, the authors found that children viewed the bell as a fun distraction. It was often unclear whether the child was playing with the bell or ringing the bell. For this reason, bell-ringing behavior was analyzed in this study, but in future versions of the task, the bell should be less distracting and more obvious when sounded (therefore not an outcome measure, but rather just a part of the protocol).

Limitations

The biggest limitation with this study was its small sample size. A larger sample size would provide stronger statistical power and thus more reliable findings. There should also be an equal amount of male and female participants in future versions of this study.

In order to better tease out the compliance effect, it would be useful to modify the protocol for this study. Perhaps a different compliance task should be used that is less practiced in everyday life. For example, children often have to wait until they can eat dessert at home, a situation that is quite similar to the current task. The future version of this task should also be harder, to avoid ceiling effects. One solution, mentioned earlier, would be to not use cups and have the food in plain sight. This would ramp up the temptation factor of the study as well as decrease the complications of having two compliance factors (searching for candy, eating candy). Instead, compliance would only be measured by whether the child eats the candy with or without permission.

In the current study, five children had to go to the bathroom in the middle of the ten-minute waiting period. In the future, the protocol should include a visit to the bathroom before the testing starts. The children should be told that once the study starts, they would not have a chance to use the bathroom.

Future Directions

The current study opens the doors to the realm of research on children and touch. This study showed a relationship between touch and compliance and delay-of-gratification, but the interplay between these three variables is hard to tease apart. In order to better understand the relationship between them, a different study should look at compliance and touch more directly in children, separate from any measure of delay-of-gratification. For example, the experimenter could ask for help from the child to clean up a room or solve a puzzle (manipulating touch vs. no touch), which requires no delay-of-gratification.

In order to better understand the relationship between touch and delay-of-gratification specifically, a different study should look at touch and delay-of-gratification in children separate from a compliance measure. It might be interesting to use a more common delay-of-gratification task, such as Mischel's original marshmallow task (Mischel & Ebbesen, 1970), to further explore touch's effects. In Mischel's marshmallow task, the child chooses whether they want to wait for a larger reward or eat a smaller reward immediately, hence compliance is not a variable in this task. Another benefit of using this well-replicated protocol is that it would allow for comparisons across touch studies and longitudinal studies on the predictive value of delay-of-gratification tasks (Mischel et al., 1988; Shoda et al., 1990; Mischel et a., 1989; Ayduk et al., 2000).

The current findings support results from past studies that have found a relationship between touch and attentive behavior in the classroom (Wheldall et al., 1986; Kazfin & Klock, 1973). However, in past studies this relationship was confounded since touch was also given with other forms of positive feedback. Hence, this study truly supports touch as the main predictive variable in self-control and tangentially, attentive behavior. Future research should explore the relationship between touch and self-regulation in general, not just through a delay-of-gratification task. One idea might be to look at the effects of touch in a classroom setting on self-control behavior, not just attentive behavior.

Additionally, it might be interesting to look at children's different responses from parent's and experimenter's touch. Most likely, children interpret touch from their parent much differently than they do touch from a new person, which would affect how they might respond to the touch. Children are more familiar with touch from a parent, which may decrease the touch's compliance effects in this situation. A future form of this study could be conducted with a parent giving the directions and administering the touch.

Clements & Tracy (1977) found that touch could be used to increase performance on a task. Perhaps increased performance on a task is a by-product of touch increasing compliance and delay-of-gratification. It would be interesting to look at the effects of touch on increased performance on an intellectual task both in a lab setting and later in a more natural setting like a classroom.

From a developmental point of view, it would be interesting to expand the age range in this study. Perhaps touch would have a much different effect on adolescents, an age when touch starts to develop different meanings. This could help us learn how our understanding and reaction to touch changes as we grow and could help us know when it is important and appropriate to implement touch-based interventions.

Implications

The finding that touch increases compliance, and therefore delay-of-gratification has far reaching implications for touch-based intervention. Delay-of-gratification is a well-studied developmental phenomenon with fascinating longitudinal findings. In Walter Mischel's groundbreaking work on delay-of-gratification, he found remarkable differences between preschool-age children who waited for a larger reward and children who preferred to take a smaller reward immediately. The children who waited longer at 4-years of age in Mischel's original task were described by their parents more than ten years later as adolescents who were more academically and socially competent then their peers (Mischel, Shods, & Peak, 1988). Furthermore, the 4-year olds who waited longer were found to be more attentive, better able to concentrate, and to exhibit greater self-control and frustration tolerance then their peers as adolescents (Shoda, Mischel, & Peak, 1990). These same 4-year olds also scored significantly higher on the verbal and quantitative SATs (Mischel, Shoda, & Rodriguea, 1989). As adults, the children who waited longer on the delay-of-gratification task at 4-years of age were also less likely to use drugs (Ayduk et al., 2000).

This study shows that touch can be used to increase self-control when children are directly asked to wait for something. In a society with a growing number of cases of externalizing disorders (such as ADHD, oppositional defiant disorder, and conduct disorder) the easy intervention of touch is a revolutionary, yet simple way that society can help foster inhibitory control (Lavigne et al., 1996; Briggs-Gowan et al. 2000). Touch is inexpensive and easy for parents and teachers to use. This finding argues that the educational system should reconsider banishing touch in the classroom, as it may help with children's self-regulation and successful behavior later in life.

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Table 1:

Sample Characteristics and Delay of Gratification Measures by Condition: Full Set (n=30)

Characteristics	Group		T (df), P-Value
	Touch n=15 n(%)	No touch n=15 n(%)	
Sex			
Girls	9 (30%)	9 (30%)	
Boys	6 (20%)	6 (20%)	
	Mean (SD)	Mean (SD)	
Age (months)	60.67 (8.13)	57.13 (7.86)	-1.21(28), *p* = .236
Executive Function (raw score)	7.33 (5.31)	7.47 (4.05)	.08(28), *p* = .94
Total time until candy eaten (seconds)	512.93 (165.03)	368.4 (269.56)	-1.77(28), *p* = .043, one-tailed

Table 2:

Sample Characteristics and Delay of Gratification Measures by Condition: Restricted Set (n=22)

Characteristics	Group		T (df); P-Value
	Touch n=11 n(%)	No touch n=11 n(%)	
Sex			
Girls	5 (22.7%)	7 (31.8%)	
Boys	6 (27.3%)	4 (18.2%)	
	Mean (SD)	Mean (SD)	
Age (months)	60.09 (7.11)	58.91 (6.59)	0.40(20), *p* = .69
Executive Function (raw score)	7.45 (4.63)	6.36 (3.80)	-.60(20), *p* = .553
Total time until candy eaten (seconds)	527.73 (132.83)	407.55 (272.72)	-1.31(20), *p* = .204

Table 3:

Waiting Behavior Frequencies Across Conditions

Waiting Behavior	Group	
	Touch n=15 n(%)	No touch n=15 n(%)
None	0 (0%)	5 (33.3%)
Distraction	5 (33.3%)	7 (46.7%)
Self-soothing	1 (6.7%)	2 (13.3%)
Exploring Room	4 (26.7%)	1 (6.7%)
Gazing at Reward	3 (20%)	0 (0%)
Other	2 (13.3%)	0 (0%)

Table 4:

Sibling Number and Mean Wait Time

Number of Siblings	0	1	2	3
Mean Wait Time (sec), SD	332.00 (299.95)	523.47 (174.12)	462.86 (240.04)	197.75 (269.26)

Figure Captions

Figure 1: Effect of condition on wait time. Error bar: + / - 1 SEM

Figure 2: Effect of condition and age on wait time (n = 30). Error bar: + / - 1 SEM

Figure 3: Effect of condition and age on wait time (n = 22). Error bar: + / - 1 SEM

Figure 4: Correlation of age and executive function.

Figure 5: Effect of emotional reaction to experimenter touch on wait time. Error bar: + / - 1 SEM

Figure 1

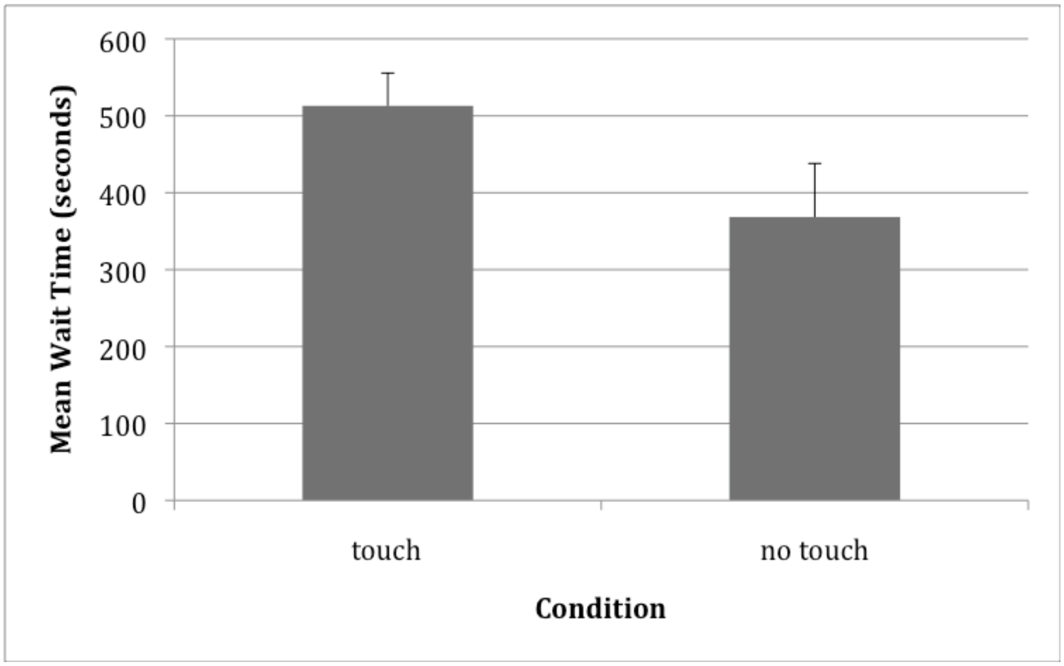

600
500
400
300
200
100
0
Mean Wait Time (seconds)
touch
no touch
Condition

Figure 2

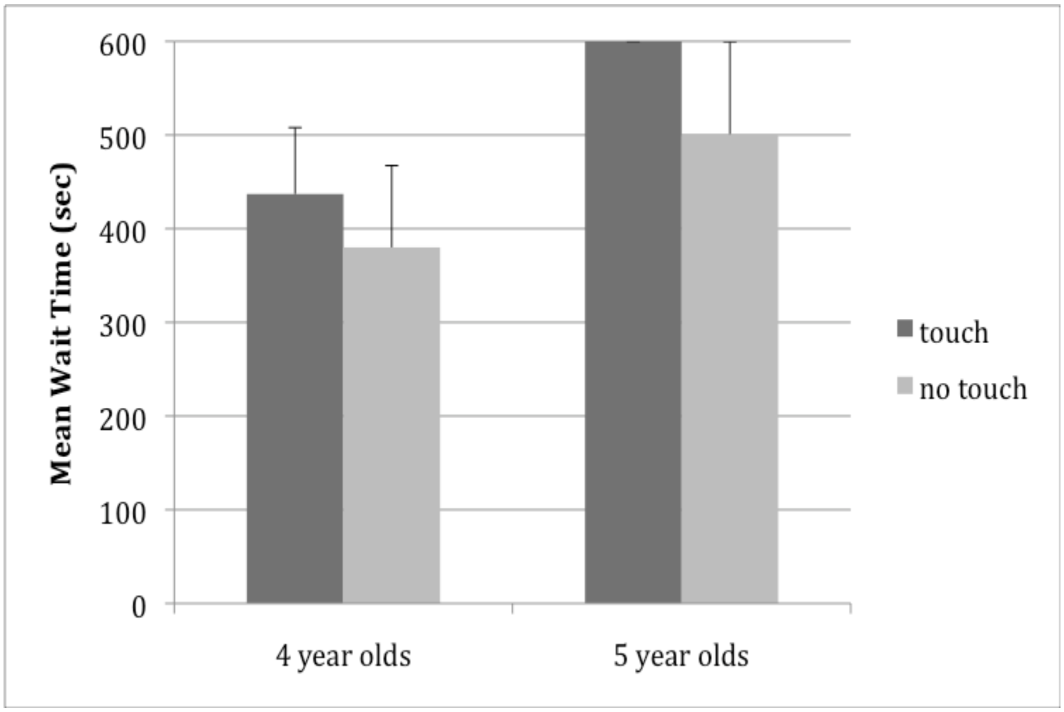

600
500
400
300
200
100
0
Mean Wait Time (sec)
4 year olds
5 year olds
touch
no touch

Figure 3

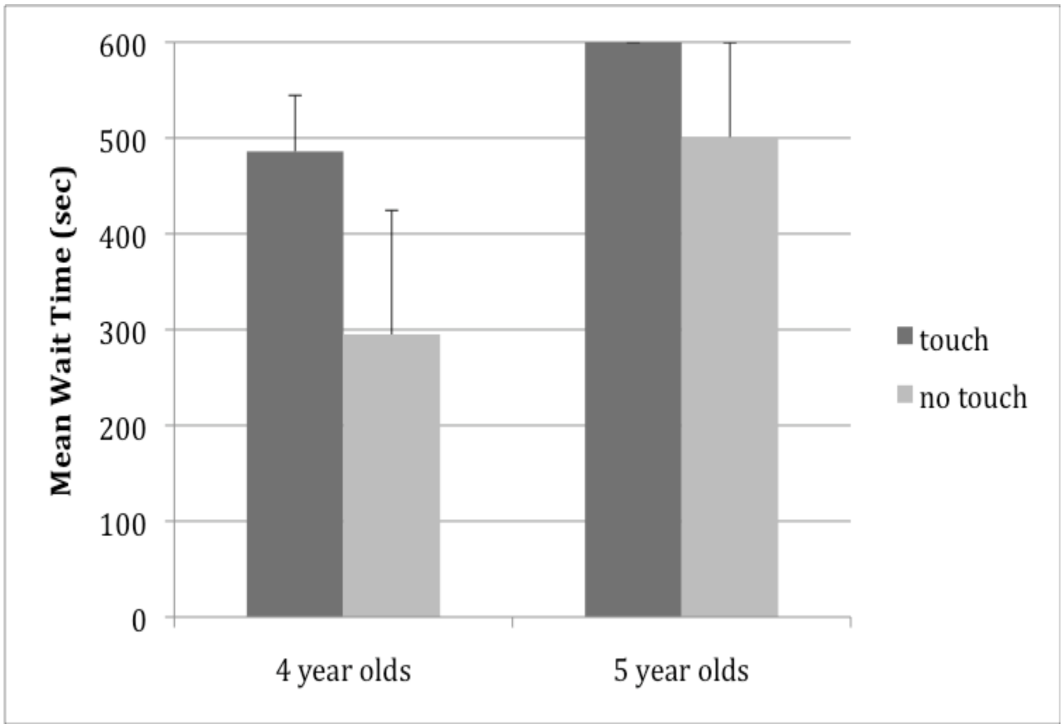
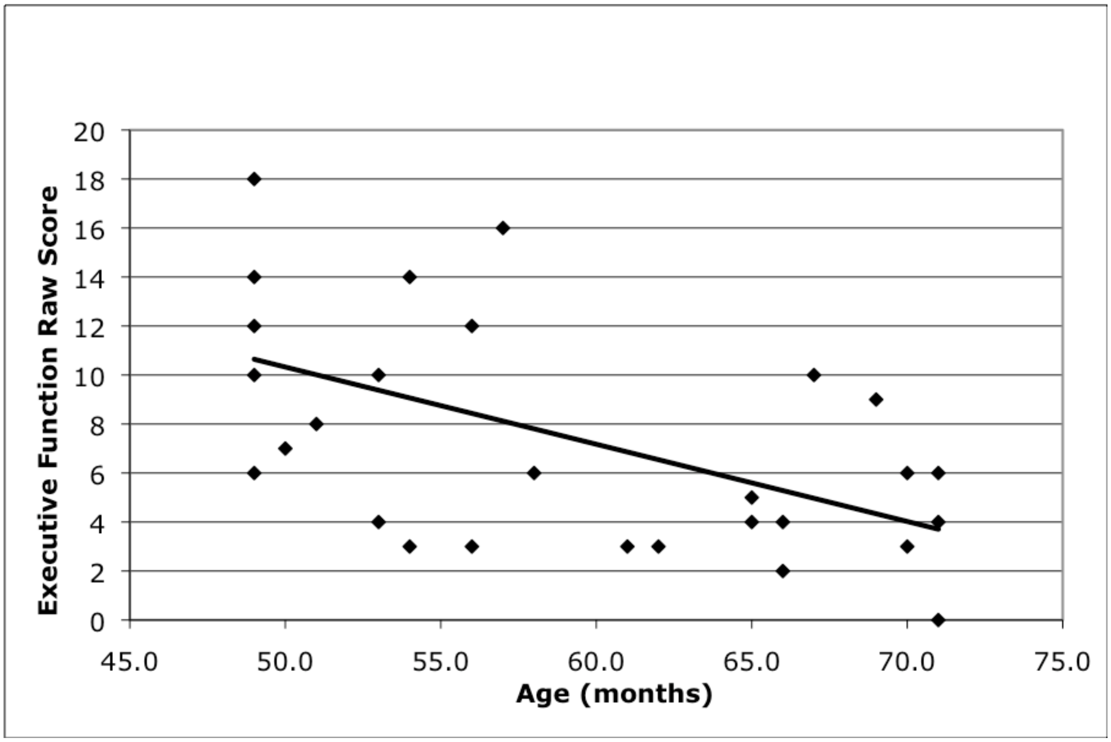
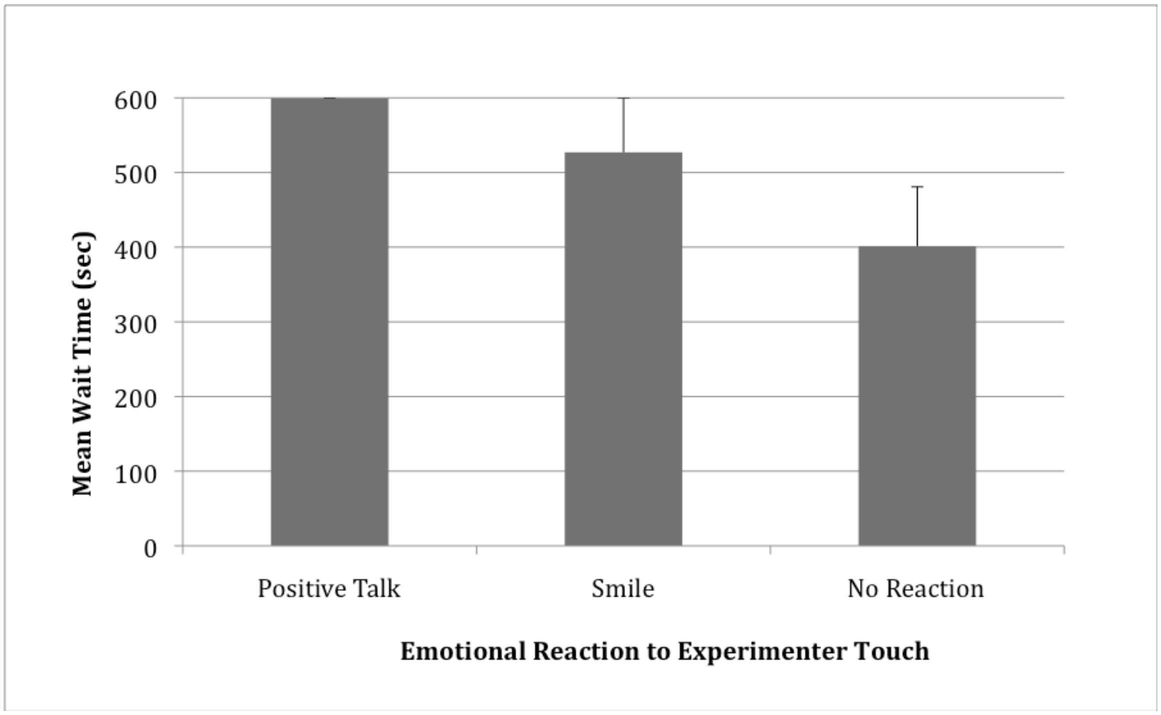

600
500
400
300
200
100
0
Mean Wait Time (sec)
4 year olds
5 year olds
touch
no touch

Figure 4



20
18
16
14
12
10
8
6
4
2
0
Executive Function Raw Score
45.0
50.0
55.0
60.0
65.0
70.0
75.0
Age (months)

Figure 5


600
500
400
300
200
100
0
Mean Wait Time (sec)
Positive Talk
Smile
No Reaction
Emotional Reaction to Experimenter Touch

Appendix A: Parent Survey

Participant number:______________________

Your age in years: __________________

Sex: Male Female

Please circle the correct response:
Highest Level of education:
- Some High School
- High School
- Some college
- Bachelors degree
- Graduate School

Marital status:
- Married or living with partner
- Widowed
- Divorced
- Separated
- Never married

What is your child's racial/ethnic background?
- White/ European American
- Latino/ Hispanic
- African American/ African
- Asian American/ Asian
- Middle Eastern
- Mixed backgrounds, specify____________
- Other, specify _______________

What type of work do you do?
- Business
- Education
- Computer/ Technology
- Construction/ Skilled work
- Artist/ Dance/Theatre
- Other, specify

What is your annual household income?
- Less than $30,000
- $30,000 to$59,999
- $60,000 to $89,999
- $90,000 to $119,999
- $120,000 to $149,999

- $150,000 or more
- Not sure

Does your child have any siblings? If so, please list their ages:
____

Is English the only language spoken in your home? Yes No

What is your child's comfort level with being touched (e.g. hugged) by family and friends?

(not comfortable) 1------2------3------4------5------6------7 (very comfortable)

What is your child's comfort level with being touched (e.g. pat on the back) by people they have recently met (e.g. work colleagues, new friends)?

(not comfortable) 1------2------3------4------5------6------7 (very comfortable)

How often (in a week) would you say your child seeks physical contact with you or a family member?

(never) 1------2------3------4------5------6------7 (often)

In the last 24 hours, how many instances can you think of when your child had to wait for something they wanted? (e.g. wait for dessert after dinner) Ex)___________________________

Appendix B: Protocol for Touch and Delay-of-gratification

SETUP

Small table, camera facing child. No distractions in room close to table (no toys!). stopwatch.

INTRODUCTION
(Adapted from Mischel's self-imposed delay procedure. Acknowledgement: Luke Butler)

Observer (O) introduces herself (always Julia or Talia) to child and engages in conversation. Then (O) shows child toy area and says:

> "Look at all these toys we have. Do you want to play with these toys with me?"

The goal is to interact with the child before the task and make sure the child is comfortable with (O). Also during this time, have the parent fill out paperwork (consent form, demographic form, ask if child is allergic to M&Ms or skittles). This should last for five to ten minutes. If the child does not become interested in the toys, (O) should say:

> 'Some of these toys are fun and most kids like them."

After the child has played for five to ten minutes, (O) says:

> "Ok, later we will have a chance to play with the toys if you want to, but right now I have another fun game to play. Lets go play the other fun game! It's in this room (lead child to room)"

Executive Function Task

Conduct executive function Test

PRACTICE GAME

(O) says:

> "You did great with the last game! Are you ready for a new game?"

Wait for the child's approval. Note: only continue if child approves. Then (O) takes out M&Ms and skittles and says:

> "Look, I brought some treats for you! Now which of these treats do you like the most?"

Give the child time to make up their mind. It's ok if they switch their choices. (O) then says:

> 'Now we're going to play a fun game! I'm going to hide a (candy) under one of these cups (point to three cups on table). In this game, you have to wait until I tell you to and then, when I tell you, you can look for and eat the (candy). ok? So I'm going to hide a (candy) under one of these cups and remember, you have to wait until I tell you to and then you can look for and eat the candy. Do you understand? Do you want to play this game?"

(O) waits for agreement before beginning. If ever the child does not want to continue, the experiment ends there. (O) brings child's attention to the three cups and hides the first item under one of the cups, making sure the child watched where the item was hidden. "Look! I'm hiding it!" (O) then says:

> 'Remember, wait until I tell you before you look for and eat the (candy)."

(O) starts stopwatch for specific trial.

Trial 1: 5 sec
Trial 2: 20 sec

After the allotted time period, (O) tells the child:

> "ok, now you can look for and eat the (candy)."

After the child eats the reward, (O) initiates the next trial, repeating instructions each time ('Remember, wait until I tell you before you look for and eat the (candy)). If the child didn't wait, then (O) says:

"Oops, remember that in this game, you have to wait until I tell you, to look for and eat the (candy). ok?'

Correct the child on the first two practice trials. No sanctions are imposed if the child doesn't wait. Likewise, waiting is not praised. The reward is hidden twice under each cup during the trials.

BRING-ME-BACK BELL

(O) Takes out a bell from a bag and says:

> "You're doing such a good job, so I have one more challenge for you. But first, I want to show you this bell and tell you how it works. See, this is

how it works. (Ring once). Sometimes I have to go out of the room, but you can always make me come back by ringing this bell. This is called the bring-me-back bell. Every time you ring it you make me come back immediately. Let's try it now. I'll go out of the room, and you will make me come back by ringing this bell. "

(O) goes out of the room and comes back immediately at the sound of the bell. (O) then says:

"See, you made me come back! "

ACTUAL TEST:

After the two practice trials are complete, (O) says:

"Great! Now I have one more challenge for you! In this task, I'm going to hide not one, but *five* (candies) under this cup and once again you are going to wait until I tell you to look for and eat the (candy). But this time, I'm going to do some paper work outside. But remember, *I'd really like you to wait until I tell you to look for and eat the (candy).* Ok?"

In touch trial: (O) touches child's back during 'I'd really like you to wait until I tell you to look for and eat the (candy)'. The touch: lightly touch top of back between shoulder blades– no stroking or patting. Just lightly put palm of hand on back.

(O) starts stopwatch, leaves the room and waits ten minutes . Then (O) comes back into the room and brings attention back to child and says (only if child hasn't eaten the reward yet):

"ok, now you can look for and eat the (candy). Great job! Let's go get you a prize!"

If child eats reward before (O) comes back, (O) immediately enters the room and says:

"Oh, look, you ate the candy. We'll we're all done. Great job! Let's go get you a prize!"

If child rings the bell, (O) immediately enters the room and says:

"Hey, are you ok?"

If the child replies that they are un-happy or don't want to continue, terminate study. If the child is merely complaining, (O) says:

> "I just need to do a bit more work. I'll be back when I'm done and then you can look for and eat the (candy). Is it ok if I go back out."

If the child says no, probe them on what they want. Only end the study if the child explicitly says they want to eat the candy now or if they say they want to end the game.

If they ring the bell a second time, (O) immediately enters the room and says:

> "Hey, are you ok? Do you need something from me? Is it ok if I go back outside and do my work?"

Follow same procedure as before in terms of response.

Terminate study after five bell rings.

SEATING AND TIMING:

Make sure that child is seated properly sitting on the ground, facing the reward. This procedure lasts however long the child waits for up to ten minutes. But the procedure will be discontinued if the (O) notices that the child is uncomfortable. For example: if the child cries or calls out in distress. If the child is just frustrated or impatient, but not 'falling apart', then the procedure can continue. To make sure that the child is comfortable when the procedure ends, spend a few minutes playing with the toys at the end and then give the child a reward.