Exploring the Effects of Imagining the Future Self on Delay of Gratification in Preschoolers

BY

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Abstract

The ability to delay gratification is observed beginning in early childhood and due to the positive outcomes associated with this ability, there is growing interest in mechanisms that can be used to facilitate the development of this skill. The current study aims to investigate whether encouraging preschoolers to imagine their future selves improves delay of gratification. In the first study, 64 children, 36 three-year-olds and 28 four-year-olds (28 males and 36 females), completed a delay of gratification task. Fifty-seven children, 23 three-year-olds and 34 four-year-olds (31 males and 26 females) participated in the second study. There were four conditions across the two studies, where children were primed to imagine their present selves, their future selves, their present selves in conjunction with their future selves, and not primed to engage in imagining the self. Results indicated that preschoolers made significantly more choices to delay when they were primed to imagine their future selves. These results suggest that engaging in future-oriented thinking of the self may be employed as a strategy to help children delay gratification.
Table of Contents

Title Page ................................................................................................................................. i
Abstract ..................................................................................................................................... ii
Table of Contents .................................................................................................................... iii
Table of Figures .......................................................................................................................... v
Acknowledgements .................................................................................................................. vi
1. Introduction .......................................................................................................................... 1
   1.1 Delay of Gratification ........................................................................................................ 2
   1.2 Future-Oriented Thinking ................................................................................................. 9
   1.3 Hot and Cool Executive Functions ............................................................................... 18
   1.4 Conclusion ....................................................................................................................... 29
   1.5 Rationale ........................................................................................................................ 30
2. Method .................................................................................................................................. 31
   2.1 Participants ....................................................................................................................... 31
   2.2 Materials .......................................................................................................................... 32
   2.3 Procedure ......................................................................................................................... 34
3. Results .................................................................................................................................. 38
   3.1 Study 1 .............................................................................................................................. 38
       3.1.1 Descriptives ............................................................................................................... 38
       3.1.2 Inferential Statistics .............................................................................................. 40
   3.2 Study 2 .............................................................................................................................. 44
       3.2.1 Descriptives ............................................................................................................... 44
       3.2.2 Inferential Statistics .............................................................................................. 45
4. Discussion .................................................................................................................................. 49
   4.1 Study 1 .................................................................................................................................. 49
   4.2 Study 2 .................................................................................................................................. 54
   4.3 Implications .......................................................................................................................... 58
   4.4 Limitations and Future Research ......................................................................................... 62
   4.5 Conclusion ............................................................................................................................ 65
5. References .................................................................................................................................. 67
6. Appendices .................................................................................................................................. 80
   6.1 Appendix A: Experiment 1 Protocol ...................................................................................... 80
   6.2 Appendix B: Experiment 2 Protocol ...................................................................................... 93
   6.3 Appendix C: Supplementary Tables ..................................................................................... 97
Table of Figures and Tables

Figure 1: Descriptives for Study 1.................................................................39

Table 1: Correlations for Study 1.................................................................40

Table 2: Unstandardized Coefficients for Self-Primed..............................42

Table 3: Unstandardized Coefficients for Control....................................43

Figure 2: Descriptives for Study 2.................................................................44

Table 4: Correlations for Study 2.................................................................46

Table 5: Unstandardized Coefficients for Hybrid DoG..............................48

Table 6: Unstandardized Coefficients for Hybrid DoG..............................49
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Exploring the Effects of Imagining the Future Self on Delay of Gratification in Preschoolers

Everyone, beginning from a very young age, makes use of executive functions (EF) in a variety of everyday situations. While there have been inconsistencies and debates regarding the definition of executive functions, most agree that they refer to the psychological functions that help people to regulate their emotions, cognition and behaviour in pursuit of a future goal (Barkley, 2012; Garon, 2016). Executive functioning is involved in the motivation to achieve a goal, in planning the necessary steps to reach a goal, and in taking action and evaluating one’s own performance (Barkley, 2012; Zelazo & Müller, 2010). It has been suggested that EF evolved to help humans solve problems and to reach goals effectively (Barkley, 2012).

EF has been further divided into two distinct yet overlapping “types”: cool EF and hot EF (Barkley, 2012; Garon, 2016; Metcalfe & Mischel, 1999). Cool EF refers primarily to the processes involved in cognitive and emotionally neutral tasks (Garon et al., 2008). Three main cool EF processes have been established: working memory, shifting and inhibition (Garon et al., 2008). Hot EF, however, is commonly elicited in emotionally salient and motivationally significant situations (Garon et al., 2008; Zelazo et al., 2010). EF undergoes significant development over the preschool period, with notable improvements in EF skills occurring as children age (Garon et al., 2008).

Cool and hot EF interact at least to some extent in tasks assessing EF, with some tasks being hot or cool dominated (Metcalfe & Mischel, 1999). One commonly used and extensively studied task is delay of gratification (DoG) which is viewed primarily as a hot EF task (Garon, 2016). DoG involves having participants choose between a smaller,
or less preferred immediate reward and a larger, or preferred delayed reward (Garon, 2016; Mischel et al., 1989; Zelazo & Müller, 2010). In order to succeed in delaying gratification, one must manage the conflicting desires and motivations of their present and future self (Garon, 2016). One way to improve DoG is to increase the subjective value of the future, delayed reward (Garon, 2016). Engaging in future-oriented thinking about the self allows individuals to take into consideration their future selves desires which consequently increases the value of the delayed reward (Garon, 2016). While research has been conducted examining the effects of future-oriented thinking on DoG in older children (Daniel et al., 2015) and in adults (Benoit et al., 2011) more extensive research must be conducted examining this effect with preschool children. Through an increased integration of the hot and cool systems as children age (Metcalfe & Mischel, 1999) along with the use of strategies such as imagining the future self, performance on DoG should improve. By identifying and measuring core skills underlying EF abilities in early childhood, it may be possible to develop interventions (Semenov & Zelazo, 2018) and strategies that help improve executive functioning across the lifespan.

**Chapter 1: Delay of Gratification**

The ability to delay gratification, which involves forgoing an immediate reward for a larger future reward has been extensively studied and successful performance has been linked to a variety of positive life outcomes (Garon, 2016; Mischel et al., 1989). The most common way to assess DoG in preschoolers is by administering a child-friendly DoG task of which there are three main types: DoG Wait tasks, DoG Choice tasks and DoG Temptation tasks.

**Common Delay of Gratification (DoG) Tasks**
DoG Wait Task

The Delay of Gratification Wait task (DoG Wait) is the most frequently used and well known of the various tasks assessing DoG. This task, first developed by Walter Mischel in 1970, involves giving participants the option of either receiving an immediate, smaller reward or a delayed, larger reward (Garon et al., 2008). In Mischel and Ebbesen’s famous “Marshmallow Task” (1970), the experimenter presented a child with a single marshmallow and instructed them to refrain from eating the treat until the experimenter returned to the room. The child was told that they would receive two marshmallows under the condition that they did not consume the marshmallow prior to the experimenter’s return (Mischel & Ebbesen, 1970). However, if the child desired to terminate the waiting period and receive the single marshmallow immediately, they could summon the experimenter by ringing a bell (Mischel & Ebbesen, 1970). This initial experiment preceded a multitude of replications and variations of the task, including the Delay of Gratification Choice task (DoG Choice) (Garon, 2016).

DoG Choice Task

The DoG Choice task involves instructing participants to choose between a smaller, immediate reward or a larger, delayed reward repeatedly over a series of trials (Garon, 2016). For example, participants could choose to receive an immediate reward (i.e. one sticker) or to wait for a larger reward (i.e. two stickers) (Thompson et al., 1997). Versions of this task differ in the reward offered, the number of rewards offered after each delay period, and the length of the delay period itself, which can range from a few minutes to weeks (Garon, 2016). Unlike the DoG Wait task, the experimenter remains with the participant during the trials and the dependent variable is the number of
choices to delay, rather than the length of the delay period as is the case for the DoG Wait task (Garon, 2016). However, both tasks fall under the category of those measuring simple response inhibition (Garon, 2016) and both involve placing conflicting demands on the participant: inhibiting their desire to obtain an immediate reward in favour of receiving a reward of greater magnitude in the future (Garon, 2016). In spite of these similarities, only a weak to moderate correlation has been found between the DoG Wait and the DoG Choice tasks, reflecting that the underlying processes of each overlap, yet differ (Duckworth & Kern, 2011).

**DoG Temptation Task**

The third main task is the Delay of Gratification Temptation task (DoG Temptation). In this task, the experimenter instructs the child to refrain from participating in an enjoyable activity or playing with a desirable toy upon it being presented to them (Garon, 2016). The amount of time that the child is able to delay engaging in the activity or playing with the toy is then measured (Garon, 2016). Similar to the aforementioned tasks, a conflict is presented to the child; however, DoG Temptation involves a conflict between receiving an immediate reward and eliciting social sanctions from the experimenter and waiting for a reward and receiving a positive evaluation (Garon, 2016). Thus, the delay does not result in a larger reward, but in the experimenter’s approval (Garon, 2016). Additionally, as the negative outcome of terminating the delay period is made salient in DoG Temptation (there is no small, immediate reward as in DoG Wait and Choice but only a negative response), the child may be motivated to wait in order to avoid unwanted outcomes (Jensen & Buhanan, 1974).
In comparing the DoG Wait and the DoG Temptation, however, there are similarities, particularly in regard to the strategies children typically employ during the delay period to aid in their resistance of temptation (i.e. self-verbalization and distraction) (Abe, 1980; Ebbesen et al., 1975). Despite the differences between each of these tasks, all three involve similar processes, including response inhibition, the regulation of conflicting emotions, and affective decision making in a non-ambiguous situation (where explicit instructions and the value of each choice are provided) (Garon, 2016). Lastly, significant age differences have been found in the performance on all three tasks, with substantial development taking place during the preschool period (Garon, 2016).

**Developmental Trajectories**

**DoG Wait Task**

A significant age difference in performance has been observed on the DoG Wait task between the ages of two and four years (Steelandt et al., 2012). In a cross-sectional study by Carlson et al. (2005), the DoG Wait task was conducted with children aged two to four years. Half of the two-year-olds in this sample were able to delay for 20 seconds, 85% of three-year-olds delayed for one minute and 72% of four-year olds waited for five minutes (Carlson et al., 2005). These results demonstrate a significant increase in the length of the delay period as children age. Notably, as the size of the delayed reward increased, the three- and four-year-olds waited for longer periods, while the size of the reward did not seem to influence the two-year-old’s choice to delay (Steelandt et al., 2012). Additionally, whereas size of the delayed reward seemed to affect the delay period for three-year-olds in the DoG Wait task, this was not the case for the DoG
Choice task, where three-year-olds tended to choose the immediate, smaller reward (Lemmon & Moore, 2007). These findings suggest that while three-year-olds are indeed capable of increasing wait time in order to obtain a larger reward, that this process is difficult for them (Garon, 2016).

**DoG Choice**

Similar to DoG Wait, significant age differences have been observed in the performance on the DoG Choice task between the ages of three and five years old, with four-year-olds choosing to delay significantly more than three-year-olds (Garon et al., 2012). However, when testing a sample of preschoolers between the ages of two and four years on this task, performance tends not to be linear, but to be U-shaped, with two-year-olds making a higher number of choices to delay (Garon et al., 2012). This stands in contrast to the results from the DoG Wait task, where two-year-olds typically delayed for the shortest periods (Steelandt et al., 2012). The explanation for these counterintuitive findings rests on the theory that two-year-olds make the choice between an immediate, small reward and a larger, delayed reward based solely on reward quantity, in part due to their inability to hold representations of their future selves (Garon et al., 2012). Three-year-olds, however, are generally capable of considering both quantity and time in their decision, and thereby tend to choose the immediate option, resulting in the drop in performance scores (Garon et al., 2012). Similar to three-year-olds, four-year-olds also take both quantity and time into consideration but are more efficient at resolving this conflict and are able to justify the extra waiting time with the difference in reward size (Zelazo & Mueller, 2002).

**DoG Temptation**
Age differences in performance on the DoG Temptation task mirror those on the DoG Wait task, with delay time increasing with age between two and four years (Pecora et al., 2014). As DoG Temptation involves obtaining a social reward (approval from the experimenter) as opposed to a larger, physical reward (Garon, 2016), it is possible that the age differences in performance reflect an increase in preschooler’s desires to obtain social approval as they age.

**Factors Influencing Delay of Gratification**

**Attention**

A child’s ability to selectively attend is imperative for success in all tasks assessing EF, (Metcalfe & Mischel, 1999) with delay of gratification being no exception. In particular, it is a child’s ability to shift their attention away from the hot, affective properties of a reward (i.e. the taste) that is associated with increased wait time during DoG (Mischel, 2014). When the arousing qualities of a reward are made salient to children, this results in an approach-oriented response (Carlson et al., 2005) and consequently preschoolers have an increasingly difficult time delaying gratification (Metcalfe & Mischel, 1999). There are multiple ways in which to decrease the salience of the reward thereby lengthening wait time in preschoolers. Firstly, encouraging preschoolers to focus on the cool or abstract qualities of the reward in lieu of the arousing or attractive qualities has had a significant positive effect on delay times (Zelazo et al., 2010). Secondly, the manner in which a child cognitively represents a reward has been found to be more influential to wait time than the reward itself (Moore et al., 1976). For example, preschoolers delayed for a longer period when imagining the reward as an image versus when imagining the reward as real (Moore et al., 1976).
Notably, a child’s focus on a reward alone has been associated with a shorter delay period, regardless if the reward is physically present in the child’s environment (Mischel et al., 1972). This finding has led to the use of internal and external distractors, which have proven effective in increasing wait time (Zelazo et al., 2010). Mischel et al., (1972) found that encouraging children to have “fun” thoughts during the delay period increased wait time as opposed to when no thoughts were suggested. External distractors, particularly those with hot, attractive properties (i.e. an appealing object or treat other than the reward to be delayed) have been found to be especially effective in increasing delay time in comparison to “cooler” distractors (Metcalf & Mischel, 1999). Even without distractors being directly provided or indirectly prompted by experimenters, children tend to frequently employ their own strategies, often unconsciously, to distract themselves and thereby decrease the aversiveness of the delay period (Mischel et al., 1989). While preschoolers below the age of four are not typically aware of effective strategies and instead tend to employ those that are self-sabotaging (i.e. focusing on the reward), by age five most children understand and use more productive strategies (i.e. self-distraction) (Mischel & Mischel, 1983) with this continuing to improve with age.

**Distancing**

Distancing oneself physically from a reward during the delay period in DoG Wait tasks has been found to be effective in increasing wait time (Mischel & Ebbesen, 1970), but psychological distancing from the reward has proven effective in choosing to delay during DoG Choice tasks (Carlson et al., 2005). At age three, children typically struggle to distance themselves from both the reward and from their present desires.
(Prencipe & Zelazo, 2005), but the employment of strategies may be helpful. Children may use strategies to decontextualize the reward, for example, by using symbols to internally represent rewards (Zelazo & Müller, 2010). With increased psychological distance, reflection and control may take precedence (Zelazo & Müller, 2010). Children can also distance themselves psychologically from a reward by adopting a third-person perspective on their own situation, viewing themselves as though watching an actor complete the delay task (Barresi & Moore, 1996). The adoption of a third-person perspective and distancing oneself from the current situation are both relevant to the next factor influencing performance on DoG: future-oriented thinking.

Chapter 2: Future-Oriented Thinking

Future-oriented thinking refers to a collection of processes including conceiving of, imagining, and planning for the future, as well as making decisions that will have an impact on the future in some way (McCormack & Hoerl, 2020). Additionally, the concept of future-oriented thinking encompasses how one represents the future mentally and one’s accompanied attitudes towards the future, including how much focus or significance is accorded to their future (McCormack & Hoerl, 2020). There has been continued debate over the accurate measurement of future-oriented thinking, namely regarding the validity of the tasks claiming to measure this construct (Dickerson et al., 2018). Regardless, a general consensus has been reached regarding the three main types of future-oriented thinking, those being planning, imagining the future and delay of gratification (McCormack & Hoerl, 2020).

Types of Future-Oriented Thinking

Planning
One main category of future-oriented thinking is planning, which involves the ability to recognize the variability and uncertainty of future outcomes and to determine an appropriate sequence of action for achieving a desired outcome in lieu of the possible alternatives (McCormack, 2015). For instance, in planning how to solve a problem, one must consider all of the possible outcomes of different approaches to the problem and decide on the sequence of actions necessary to achieve the goal of solving it. Most commonly, children’s ability to plan has been assessed by administering tasks where the child must describe their plan for solving a problem, without actually engaging in the action of solving it (Zelazo & Müller, 2010). Performance on this task has been shown to improve with age (Klahr & Robinson, 1981) and it has been suggested that most children do not plan or prepare for more than one possible future outcome at a time (McCormack & Hoerl, 2020). It is possible that children younger than four have difficulty conceiving multiple possible outcomes at once and are less effective planners as a consequence.

**Imagining the Future**

A second type of future-oriented thinking is known simply as imagining the future. Imagination refers to the process of thinking of and considering objects or events without these being perceivable in one’s immediate environment (Moore & Barresi, 2013). Therefore, imagining the future involves conceiving of a future event or experience, one that differs from an individual’s present state of being. The ability to imagine an object or event while interacting in an environment where these are absent typically develops during the second year of life (Moore & Barresi, 2013). Notably, the age at which a child is able to use their imagination is dependent on the content of said
imaginary scenario. For instance, while a two-year-old child is able to imagine an object or event (Suddendorf & Whiten, 2001), the capability to imagine one’s own future needs typically develops only by late preschool (Suddendorf & Busby, 2005).

**Delay of Gratification**

The third, and most extensively studied, type of future-oriented thinking is decision making regarding the future, in particular intertemporal choice or delay of gratification (Read & Read, 2004). Using measures of DoG, it is possible to examine whether children choose a reward based on their immediate desires or in the best interest of their future selves (McCormack & Hoerl, 2020) which in turn reflects a child’s ability to engage in future-oriented thinking. In particular, DoG has been found to measure future-oriented prudence which reflects not only the ability to engage in future-oriented thinking, but the awareness of the temporally extended self, a concept which will be discussed in following sections (Moore & Barresi, 2013). It is important to note that the type of DoG task used matters in assessing future-oriented thinking, as in there is a difference between using a DoG Wait task versus a DoG Choice task (Mischel, 1974). This primary difference lies in the fact that in DoG Choice tasks, a child’s decision to wait for a reward is reflective of their interest in that particular reward (Mischel, 1974). To elaborate, in a DoG Choice task assessing future-oriented thinking, children are typically given the choice to either allocate a reward to their current or future selves thereby reflecting whether the child prioritizes their current or future interests (Moore & Barresi, 2013). In contrast, performance on DoG Wait tasks has not been found to be significantly improved by future-oriented thinking, (Atance & Jackson, 2009) likely
because it reflects the ability to resist temptation more so than it measures the value attributed to immediate and future selves’ desires (McCormack & Hoerl, 2020).

**The Effects of Future-Oriented Thinking on Decision Making and DoG**

Future-oriented thinking is not solely engaged when making choices specific to the delay of gratification, but when making any decisions that will have an effect on our future selves (Barkley, 2012). People tend to make decisions based on the future consequences that may arise from these decisions, whether those be positive or negative for themselves or for others (Barkley, 2012). Future-oriented decision making, despite the different measures available for this construct, has typically been measured through delay of gratification tasks (Read & Read, 2004). In particular, the effects of employing future-oriented thinking on DoG performance have been examined, most extensively with adolescents and adults, but increasingly with children as well (McCormack & Hoerl, 2020). In research examining the use of prospection, which involves simulating the future self, a positive effect has been observed on children’s performance on DoG (Garon et al., 2015). Specifically, having children engage in prospection (imagining themselves with the future reward) can encourage them to choose a delayed reward over an immediate reward (Garon et al., 2015). To explain these findings, it has been suggested that engaging in prospection may activate the hot EF network (Sellitto et al., 2010).

Research has also been conducted on the effect of episodic future thinking (EFT) on DoG (Loewenstein & Prelec, 1992; Read & Read, 2004). EFT is a type of future-oriented thinking that involves mentally simulating future events involving the self (Atance & O’Neil, 2001) and children are typically able to engage in this process by the
beginning of preschool (Moore & Barresi, 2013). In order to engage in EFT, one must be able to mentally represent time as unified and linear, comprised of a sequence of events, with the present being one specific point on this timeline (McCormack & Hoerl, 2020). Then, it is necessary for the individual to remove themselves from the present reality and imagine themselves as occupying a different point in time, whether that be in their past or future (McCormack & Hoerl, 2020). Having this understanding of past, present and future events and the ability to represent oneself in these noncurrent time frames is referred to as temporal decentering (Cromer, 1971). In addition, by engaging in EFT, people, to an extent, “pre-experience” the possible future event which they are imagining (Moore & Barresi, 2013). EFT has been shown to have significant effects on DoG performance, namely, engaging in EFT increases the salience of one’s future emotional states (Boyer, 2008). It is possible to propose that as children become aware of their future desires and are able to mentally “put themselves in the shoes” of their future selves, that they will consequently choose to delay larger or preferred rewards in the best interest of their future selves. A study by Chernyak et al. (2017) examined this hypothesis by having children discuss future personal events with an experimenter prior to completing a task involving inter-temporal choices. While the engagement in future-oriented thinking did enhance performance on the future-oriented task of planning, no effect was observed on DoG (Chernyak et al., 2017). The hypothesized effect was however seen in similar studies performed with adult participants (Peters & Büchel, 2010). One key difference between these studies is that adults were primed to engage in EFT before each testing session, whereas children were only primed at the beginning of the study (Chernyak et al., 2017). It would therefore be valuable to conduct studies
where EFT is either repeatedly or continuously cued during a DoG task with children. Priming has shown to be beneficial in DoG tasks as it increases activation of “cool” nodes, which in turn makes the re-activation of these nodes more likely (Metcalf & Mischel, 1999).

In administering DoG tasks while employing future-oriented thinking, it is not only necessary to take into account in what manner the thoughts are cued, but also the length of the delay period before receiving the reward (McCormack & Hoerl, 2020). It has been found that a longer delay did not significantly affect preschooler’s performance on a DoG task (Caza & Atance, 2019). Another variable to take into consideration is how much cognitive demand future-oriented thinking is placing on the child completing the task (Burns et al., 2019). Studies with adults have shown that when a task is less demanding, future-oriented thinking is more likely to occur (McCormack & Hoerl, 2020). Reflecting these findings, studies measuring children’s performance on DoG after cuing future and past oriented thinking demonstrated that thinking about noncurrent events can be a demanding task for children and consequently decrease their ability to delay gratification (Burns et al., 2019). It is therefore necessary to create a situation that primes future-oriented thinking without providing children with too large of a cognitive load.

The Self and its Influence on Future-Oriented Thinking and DoG

The self is a construct that has been relatively neglected in studies of executive functioning (Barkley, 2012). In spite of this, awareness of the self has been found to be central in future-oriented thinking (Ghetti & Coughlin, 2018). Having a mental representation of the self is a prerequisite to being able to imagine oneself in future
situations (Ghetti & Coughlin, 2018). For instance, children’s awareness of their own self-concept has been found to predict their ability to engage in EFT (Coughlin et al., 2017). Awareness of the self, or of one’s own personal identity, involves two components: individuality and continuity (Moore & Barresi, 2013). Individuality refers to the awareness that one is a person, the same as others who also have their own respective selves, but that one is also distinct and different from other people (Barresi & Moore, 1996). Continuity is the ability to view the self as extending over time, over one’s past, present and future (Moore & Barresi, 2013). The first type of self-awareness, individuality, typically develops during the second year of life, concurrent with a child’s emerging imagination (Brownell et al., 2007). Imagination is a concept related to and necessary for both individuality and continuity (Moore & Barresi, 2013). As children develop their imagination, they become able to see themselves from a third person perspective instead of solely experiencing life from a first-person point of view (Moore & Barresi, 2013).

It has been hypothesized that young children imagine their current selves in the first-person perspective and their noncurrent selves (past or future) in the third person (Moore & Barresi, 2013). By the middle of the third year of life, these two views of the self tend to converge, and children begin viewing their future and past selves as the same self that exists in the present moment (Moore & Barresi, 2013). The awareness of the temporally extended self (continuity) develops later than individuality and is not fully developed until the child is also able to recognize the connection between the past, present and future self (Moore & Barresi, 2013). That is, that the child becomes aware that the past self affects the present self and that the present self in turn affects the future
self (Moore & Barresi, 2013). This awareness typically develops by the end of preschool (Moore & Barresi, 2013) and it is likely that this ability is important for success on DoG tasks. For instance, a child being able to comprehend that the decisions they are making in the present are going to affect future outcomes (i.e. choosing an immediate reward will result in them forgoing the larger or preferred future reward) would likely improve the chances of them choosing to delay gratification.

**Developmental Trajectory of Future-Oriented Thinking and DoG**

During the preschool period, children’s ability to engage in future-oriented thinking develops substantially (Suddendorf et al., 2011). Significant age differences have been observed when administering tasks assessing the use of future-oriented thinking, particularly between the ages of two and five years (Suddendorf et al., 2011). In order for a child to imagine themselves in a future state, it is necessary for them to first have a grasp on the concept of time itself (McCormack et al., 2020). Four stages have been proposed to describe the developmental trajectory of understanding temporal concepts (McCormack & Hoerl, 2017). Firstly, before age two, it has been suggested that toddlers are aware of specific events and the sequence in which they occur, such as the steps in their bedroom routine, but that they lack a concept of time itself (McCormack & Hoerl, 2017). Consequently, when performing on DoG tasks, two-year olds tend to choose between an immediate and future reward based on quantity alone as they are not yet able to engage in future-oriented thinking (Garon et al., 2012). Between two and three years of age, children typically represent time solely in respect to events, specifically whether those be alterable (future) or unalterable (past) events (McCormack & Hoerl, 2017). By age three, children are beginning to develop a sense of their future
selves but during DoG tasks are often unable to cope productively with the conflicting interests of their present and future selves, with their current desires typically taking precedence (leading to choosing the immediate reward regardless of the quantity of the future reward) (Garon et al., 2012). In particular, three years olds have a difficult time distancing themselves from their current desires (Prencipe & Zelazo, 2005) and it is possible that this is where the use of “cooling” strategies may become helpful. Between the ages of four and five, significant improvements have been found in the ability to engage in future-oriented thinking (McCormack & Hoerl, 2017). During this stage, children view events as specific points in time, falling in a linear sequence (McCormack & Hoerl, 2017). Children are able to engage in “temporal decentering” which involves mentally placing themselves in noncurrent points in time (McCormack & Hoerl, 2020). Consequently, during DoG tasks, four-year olds tend to take their future interests into account and were hence more likely to delay as rewards increased (Lemmon & Moore, 2007). It is possible that four-year olds are better able to reconcile their present and future desires because of their developing cool EF skills, such as shifting between attention sets (Zelazo & Mueller, 2002). Additionally, by age four, preschoolers typically view themselves as temporally continuous, meaning that they are aware that their current self persists across time and that their future and past selves are the same as their immediate self (Moore & Barresi, 2013). Between the ages of four and five significant development of imaginative abilities also takes place and children increasingly become skilled in mentally representing the same thing in different ways (Moore & Barresi, 2013). When these representations are conflicting, children are also becoming better in relating them (i.e. current and future interests) (Moore & Barresi,
Finally, by age five and beyond, children have a representation of time that can be unrelated to specific events, involving telling time on a clock and using a calendar (McCormack & Hoerl, 2017).

**Chapter 3: Hot and Cool Executive Functions**

There has been a long-standing debate over the components which comprise executive functioning, and consequent inconsistencies in the operational definition of the concept (Barkley, 2012; Zelazo & Müller, 2010). It has been established that EF is composed of distinct yet overlapping constructs (Miyake et al., 2000). While there continues to be disagreements on the specific psychological functions that constitute as executive functions, some main components widely recognized as crucial to EF have included self-regulation, working memory, sequencing of behaviour, flexibility, response inhibition, planning, and organizing behaviour (Barkley, 2012). These processes interact and aide in regulating cognitive, emotional and behavioural functions, as well as in attending to relevant information in order to plan and execute problem solving behaviour leading to a desired goal, typically in a novel situation (Barkley, 2012). One key process involved in most theories of EF is that of top-down processing or regulation (Garon, 2016). Historically, psychometric tests have been used in the evaluation of EF; however, the performance on these tests is not typically correlated with ratings of the executive functioning of the participant, nor are they correlated with the daily impairment in functioning this individual may experience (Alderman et al., 2003). It has been noted that, while current tests of EF have generally evaluated the “cooler” aspects of EF (i.e. cognitive functioning) they have neglected to measure the hot, emotional or motivational aspects of EF, which are also essential functions involved
In goal directed behaviour (Castellanos et al., 2006). Notably, it is commonly the emotional, social impairments in EF in comparison to cognitive impairments that are the most visible and debilitating in individuals with disordered EF (Eslinger, 1996). It is evident that emotional, social and motivational factors must be increasingly assessed and evaluated through the development of new EF measures.

**Distinctions Between Hot and Cool EF**

In spite of the debates surrounding the definition and measurement of EF, most have agreed that there are two main “types” into which EF can be divided (Barkley et al., 2012; Garon et al., 2008). Cool EF, historically the most extensively researched (Zelazo et al., 2010), is a collection of cognitive processes suggested to work at a higher level of processing (Garon, 2016) and has typically been employed in and measured by tasks involving abstract problem-solving void of emotional charge (Metcalf & Mischel, 1999). Hot EF, in contrast, is elicited during emotionally and motivationally salient contexts that often involve the possibility or expectation of rewards and/or punishments (Garon, 2016). In other words, cool EF refers primarily to the regulation of cognition and behaviour whereas hot EF encompasses processes related to the regulation of emotion and motivation (Zelazo & Mueller, 2002). Both hot and cool EF have been repeatedly linked to the prefrontal cortex (PFC) (Miller & Cohen, 2001). There are substantial developmental changes in the PFC over the preschool years, leading to a notable improvement in skills associated with both hot and cool EF (Diamond, 1985). While the function of the PFC is not synonymous with EF, injury and developmental abnormalities in the PFC have often resulted in disordered EF (Zelazo & Müller, 2010).
Apart from the PFC, there exists many other influential factors in the successful development of EF.

**Typical and Atypical EF Development**

As early as the first year of life, as the PFC develops, so do aspects of EF (Diamond, 1985). The PFC is slow to develop, making it particularly susceptible to early environmental influence and dysfunction but also malleable and therefore receptive to intervention if the need arises (Garon et al., 2008; Semenov & Zelazo, 2018). The preschool period in particular is an especially sensitive period for EF development (Semenov & Zelazo, 2018). The development of EF skills is not linear and according to the integrative EF model, development of simple cognitive skills precedes those that are more complex, which are formed from the coordination of the simple skills (Garon et al., 2008). Development of EF is also contingent upon the development of attention, with the ability to selectively attend and to shift attention as prerequisites to EF (Garon et al., 2008). During preschool, before the age of three, many of the necessary basic EF skills are still in the process of developing (Garon et al., 2008). Between three and five years of age, there is a significant improvement in working memory, inhibition, and shifting in particular, as well as in complex skills, which is partially due to a strength in connection between attention and EF networks (Carlson et al., 2005). Other theories have attempted to describe and explain the development of EF, such as the Cognitive Complexity and Control theory (Zelazo et al., 2003). This theory follows the premise that as children age, the rules that children are able to conceive and follow increase in complexity, leading to improvement in EF skills (Zelazo et al., 2003).
Impairment in EF skills are often symptoms of various emotional and behavioural disorders such as depression, anxiety disorders and schizophrenia (Salehinejad et al., 2012; Semenov & Zelazo, 2018). However, it is also possible for poor EF skills to be misdiagnosed as disordered behaviour, such as that seen in Attention Deficit Hyperactivity Disorder (ADHD) (Semenov & Zelazo, 2018). Injury, in particular lesions of the PFC, can also have a significant impact on EF development leading to impairments in goal directed behaviour and social functioning (Barkley, 2012).

**Models of Executive Functioning**

**Conflict Model**

One model used to describe the structure and function of EF is Metcalfe and Mischel’s (1999) two systems model. Metcalfe and Mischel (1999) distinguished between the cool and the hot system, each being a part of the larger construct of cool and hot EF. They characterized the hot system as reflexive, initiating one to act based on impulse, drive and emotion. In contrast, the cool system was described as contemplative and strategic, allowing one to self-regulate and make rational decisions (Metcalfé & Mischel, 1999). Metcalfe and Mischel (1999) suggested that factors such as stress, developmental level and individual differences in self-regulation determine the relative activation of either system. The hot system develops in advance of the cool system, thereby offering a potential explanation for the dominance of emotion-driven behaviour in the early years of life (Metcalfé & Mischel, 1999). However, as the cool system develops and both the hot and cool work increasingly in coherence with one another, typically between the ages of three and four, both performance on EF tasks and in real-
life emotionally charged social situations improves as the cool system increasingly regulates the hot (Metcalf & Mischel, 1999).

**Top-down Regulation Model**

Further research has been conducted on the activation of brain areas during DoG, specifically on the neural systems associated with the choice to receive an immediate reward versus to delay gratification (McClure et al., 2004). McClure et al. (2004), using functional magnetic resonance imaging (fMRI) while participants engaged in a delay discounting task, found that there were different, distinct neural streams activated when choosing the immediate reward versus choosing to delay. They found that the ventral striatum, medial orbitofrontal cortex (OFC) and medial PFC were active when participants chose the immediate reward and that the lateral PFC, primary visual and motor cortices were activated regardless of the participant’s choice. The neural stream associated with the choice of immediate gratification was found to be associated with the limbic system, and when activated, individuals placed more subjective value on the immediate reward and less value on future rewards (McClure et al., 2004). The neural stream associated with delay however was associated with the lateral PFC and related structures, and activation was associated with an individual’s ability to evaluate future rewards favourably (McClure et al., 2004). McClure et al. (2004) have also suggested that any factor that precedes limbic activation (such as the sight or smell of the reward) can influence individuals to choose the immediate over the future reward. These findings support the body of research on the negative influence of reward salience (particularly of the hot aspects) on one’s ability to delay gratification (Garon, 2016; Mischel et al., 1989; Zelazo et al., 2010).
Interactions Between Hot and Cool EF

Two-System Model

Much debate has existed over whether hot and cool EF are completely distinct, dissociable constructs or whether they are always overlapping to some degree, impossible to be completely exclusive to one another (i.e. the two-system model) (Metcalf & Mischel, 1999). In order to address this question, Nejati et al. (2018) turned to brain imaging techniques to examine activity in specific brain regions during the completion of EF tasks assumed to either assess hot or cool EF. The PFC, as previously stated, has long been established as the central brain area associated with EF (Miller & Cohen, 2001). Nejati et al. (2018) extended these findings to assess the structural and functional interconnectivity of hot and cool EF, using transcranial direct current stimulation (TDCS). The dorsolateral PFC (DLPFC) and the OFC received either anodal or cathodal stimulation (which increases and decreases cortical activity, respectively) at the same time while participant’s performance was measured on hot and cool EF tasks (Nejati et al., 2018). The results indicated that performance on cool EF tasks was positively associated with activation in the DLPFC, while performance on hot EF tasks was associated with activation in both the DLPFC and the OFC (Nejati et al., 2018). Further, The DLPFC and OFC were found to interact to differing extents depending on the degree to which tasks assessed hot or cool EFs (Nejati et al., 2018). This was supported by Salehinjad et al.’s (2021) finding that the degree of hot and cool activation is dependent upon the task features and how much performance on the task involves cognition or emotion.
It has been suggested that a task cannot measure only hot or cool EF exclusively, but that all tasks likely measure both hot and cool, at least to some extent (Zelazo & Müller, 2010). This supports the view of EF as a spectrum rather than a dichotomy of hot and cool functions (Salehinejad et al., 2021). Notably, performance on the temporal discounting task (similar to DoG), was positively associated with increased activity in both the DLPFC and OFC, with the DLPFC being associated with the choice to delay gratification and the avoidance of unwanted results, and the OFC being associated with the evaluation and value attribution of rewards (Nejati et al., 2018). These findings indicate that an interaction between both hot and cool EF is present during DoG (Nejati et al., 2018). One possible explanation for this finding is that the task structure of DoG is explicit (participants are aware of the rules and reward contingencies) thereby it activates the cool system more so than would an implicit task that relies primarily on feedback, for example (Garon, 2016). In addition, the Cognitive Affective Processing System (CAPS) theory suggests that both the hot and cool system interact when making a choice, such as when choosing an immediate reward or to delay gratification (Metcalf & Mischel, 1999). Poor choices (i.e. choosing the immediate reward) reflect an imbalance in the two systems, specifically overactivation of the hot and under activation of the cool (Metcalf & Mischel, 1999). Further, a co-operative view of hot and cool systems suggests that hot EF is associated with deciding the value of the available choices (immediate versus delayed reward) and that cool EF provides updated information on goals (i.e. the amount of time left in the delay period before reward acquisition) (Hare et al., 2014).

**Components of EF and Their Function in Delay of Gratification**
There have been many models proposed in attempt to describe the structure and functions of EF, with particular attention drawn to whether EF is a single, unitary, concept or process, or rather if it is a collection of dissociable and partially interconnected processes (Garon et al., 2008). Following Miyake et al.’s (2000) integrative approach, EF has been viewed as one, overarching mechanism with several partially dissociable constructs. In support of this model, Miyake et al (2000) identified three main processes involved in EF (specifically in cool EF): shifting, updating and inhibition, each of these components found to be distinct yet moderately correlated (Garon et al., 2008). Garon et al (2008) conducted further research to examine whether these factors were relevant to EF in preschoolers specifically and identified the three main cool EF components in preschoolers as working memory, response inhibition and shifting.

**Working Memory and DoG**

Working memory (WM), which falls under the category of cool EF, has been viewed as an imperative process for effective executive functioning and involves holding in mind, monitoring and updating task relevant information (Baddeley, 2000). WM can be divided into simple WM, holding information in mind over extended time periods, and complex WM, which refers to updating and manipulating said information (Garon et al., 2008). The former process has been observed before six months of age (Johnson, 2005) with the latter typically developing in the second year of life (Diamond et al., 1997). As children age, the number and complexity of representations and the time in which they can hold these representations in memory increases, particularly between ages three and five (Hongwanishkul et al., 2005). Working memory is central
to the development of EF and as such it has been suggested that development of EF occurs when active memory representations become strong enough to override latent memory representations that reinforce prepotent, engrained tendencies (Munakata, 2001). In relation to DoG, it is possible that when active memory representations (such as holding in mind and updating information on reward size and time contingencies) override latent memory representations (such as the prepotent response of choosing the immediate reward), performance improves. Further, as WM and attention systems become increasingly coordinated, performance on EF tasks, including DoG, improves (Garon et al., 2008).

**Inhibition and DoG**

The second main process imperative to the development of cool EF skills is inhibition (Garon et al., 2008). Simple inhibition is the ability to withhold, restrain or delay from engaging in a previously established, dominant or automatic response (Garon et al., 2008). Complex response inhibition refers to, in addition to inhibiting a prepotent response, holding information on a rule in mind and updating behaviour according to that rule (Garon et al., 2008). Complex response inhibition is therefore a combination of WM and inhibition (Garon et al., 2008). DoG is a measure of simple response inhibition, where the prepotent response is to choose the immediate reward and successful performance relies on the ability to inhibit this response by delaying gratification (Garon et al., 2008). Simple response inhibition typically begins to occur during the first year of life (Garon et al., 2008) while complex response inhibition develops during the preschool period beginning at age two (Kochanska et al., 1996). In particular, preschoolers (typically by age four) develop the ability to use “cool” strategies, such as
forming abstract representations of a reward, allowing them to inhibit prepotent responses with less difficulty (Metcalf & Mischel, 1999). An example of a cool strategy includes “labelling”, where the participant names physical, non-appetitive, characteristics of the reward during DoG (Salehinejad et al., 2021). Linking back to the influence of distancing on DoG performance, children benefit from separating themselves psychologically from the reward (Barresi & Moore, 1996). As children age and integration between hot and cool processes improves, they become capable of inhibiting or suppressing a desired behaviour or activity for longer periods of time (Pecora et al., 2014). Failing to inhibit prepotent or automatic responses is often displayed as preservative behaviour, where children continue to repeat the behaviours that they are supposed to be inhibiting (Zelazo & Müller, 2010). In the case of DoG, preservative errors would occur if participants failed to inhibit the response of choosing the smaller, immediate reward instead of waiting for the larger, future reward.

**Shifting and DoG**

Mental set shifting is the most complex of the three processes as it builds on, and depends on the coordination of, both working memory and inhibition (Garon et al., 2008). In order to successfully shift between two responses to a stimulus for example, one must be capable of both holding the first and second response set in memory, while inhibiting the first response in order to replace it with the second (Garon et al., 2008). The aforementioned scenario is an example of response shifting, one of the two main types of shifting, with attention shifting being the second (Garon et al., 2008).

**Response Shifting**
Response shifting refers to the ability to shift between a previously *learned* response to a stimulus and a novel response to the same stimulus based on feedback alone (Garon et al., 2008). In other words, response shifting involves changing a learned stimulus-motor response association to a new stimulus-response set in accordance with the feedback received (Garon et al., 2008). Preschoolers typically have a difficult time shifting from one response set to another, especially when the first stimulus-response association is particularly strong (Munakata, 2001).

**Attention Shifting**

Attention shifting differs from response shifting in that both the initial and new response sets are taught explicitly by the experimenter, as opposed to the new set being learned solely through feedback (Garon et al., 2008). Additionally, attention shifting involves shifting focus from one feature of the stimulus to another (i.e. shifting from matching stimuli based on colour to matching based on shape) (Rushworth et al., 2005). During response shifting tasks, a conflict is created between two mental response sets and the ability to cope with this conflict develops slowly throughout the preschool period and failure often results from the inability to overcome this conflict (Garon et al., 2008). Performances on tasks assessing attention shifting typically improve by age four (Garon et al., 2008). In relation to performance on DoG, it has been suggested that successful attention shifting allows for preschoolers to better resolve the conflict between choosing an immediate and delayed reward (Mischel, 2014). Additionally, improvements in flexible selective attention as children age facilitates shifting, as children become increasingly able to disengage from initial mental sets (Garon et al., 2008).
Selective Attention

The ability to shift attention between external objects develops between four and six months of age but by the preschool period, most children are beginning to develop the ability to shift between external stimuli and internal representations (Rothbart & Posner, 2001). Both processes are essential to the successful performance on DoG. Children must have the ability to shift their attention between the various physical characteristics of stimuli (the reward) and be able to shift between the external stimuli (the reward) and their internal representations of said reward. For example, switching from focusing on the external aspects of the reward to internal, cool representations such as the reward in symbolic form, is a productive strategy used to increase delay time (Mischel & Baker, 1975).

Conclusion

To summarize, DoG is an extensively studied concept and task on which individuals’ performance has been found to predict important future outcomes (Garon, 2016; Mischel et al., 1989). An improvement in DoG on the three main versions of the task; DoG Wait, DoG Choice and DoG Temptation, has been seen to occur over the preschool period (Barkley, 2012; Garon, 2016). It is likely that as the cool system increasingly regulates the hot system that children are better equipped to make prudent and advantageous decisions (McClure et al., 2004). Other variables apart from age have been found to influence one’s ability to delay gratification, such as attention (Mischel et al., 1989; Zelazo et al., 2010) and the distance one puts between themselves and the reward (Mischel & Ebbesen, 1970; Zelazo & Müller, 2010). DoG is also one way to measure engagement in future-oriented thinking (McCormack & Hoerl, 2020).
Imagining the future self, specifically, has been associated with improved performance on DoG tasks in adolescents and adults (Kim & Zauberman, 2019; McCue et al., 2019) and more research must be conducted examining this association in preschoolers. Specifically, it must be questioned whether scaffolding children’s imagination of their future selves helps to increase the salience of their future selves’ desires and consequently increases DoG (Garon, 2016). The ability to engage in future-oriented thinking improves significantly over the preschool period (McCormack & Hoerl, 2020) and has been associated with the budding awareness of the temporally extended self (Moore & Barresi, 2013). Finally, hot and cool EF have been found to be distinct yet overlapping and interacting systems, with increased integration improving performance on DoG (Metcalfe & Mischel, 1999; Nejati et al., 2018; Zelazo & Müller, 2010). Three processes involved in cool EF specifically have been associated with DoG performance and the ability to engage in future-oriented thinking; working memory, shifting and inhibition (Garon, 2016). Based on the existing literature on EF, DoG, and future-oriented thinking, questions arise regarding the interaction of these constructs, specifically whether future-oriented thinking is associated with choosing to delay gratification in preschoolers.

**Rationale**

The overall goal of the present study was to determine whether having preschool aged children imagine their future selves would influence their performance on delay of gratification tasks. Specifically, this study addressed the question of whether priming preschoolers to think about their future selves, rather than priming them to think of their present selves, or not priming at all, would predict better performance (more choices to
delay) during DoG tasks. This question was addressed in two studies using an experimental design.

The first study examined whether scaffolding a preschooler’s thinking about their future selves would increase the likelihood of children choosing to delay in DoG tasks. Firstly, it was hypothesized that having preschoolers imagine themselves in the future would change the motivational value of the future self, and consequently lead to improved performance on DoG tasks (Bulley et al., 2016). Secondly, it was hypothesized that older children would choose to delay more than younger children. The third hypothesis stated that shifting would be positively associated with delay choices and the fourth hypothesis stated that inhibition would be positively associated with younger children’s choices to delay.

The goal of the second study was to determine whether imagining the future self with the delayed reward would increase choices to delay gratification significantly more than thinking about the present self with the rewards. Firstly, it was hypothesized that it is imagining the future self specifically that improves DoG choices, in comparison to imagining the present self. Secondly, it was hypothesized that shifting and inhibition scores would be positively associated with delay choices. The third hypothesis stated that the Hybrid (Wait) DoG task would be correlated with the DoG Choice task. Lastly, it was hypothesized that shifting and inhibition would be positively associated with scores on the Hybrid DoG task.

Method

Participants
For the first study, a sample of 64 participants was recruited from the local daycares and preschool. The sample was comprised of 36 three-year-olds and 28 four-year olds. Twenty-eight males and 36 females participated in the study. Fifty-seven were recruited to participate in the second study, including 23, three-year-olds and 34, four-year-olds. Twenty-six of the participants were females and 31 were males. For both studies, each participant was randomly assigned to an order in which they completed the testing conditions. Incentives for participation included toys and stickers used as rewards throughout the tasks. Participation was completely voluntary, with children’s caregivers choosing to enroll them in the studies and children providing verbal assent.

**Materials**

The first experiment involved three tasks: a delay of gratification task, a shifting task and an inhibition task. The first task was a modified version of the delay of gratification choice task (DoG Choice). This included twelve pairs of small toys and a clear, divided box, with sections labeled 1 through 6. If the participant was in the hot condition, the task included two pictures, the “Now” picture and the “Later” picture. The Now picture was a coloured picture depicting two smiling cartoon characters, an experimenter and a child, sitting at a desk with two objects in front of them; a treat bag and a “waiting” box. Two copies of this picture were used, one depicting a female child and the other a male child, with their use dependent on the gender of the participant. The Later picture depicted the same two, smiling cartoon characters in the Now picture. However, in this picture, the child is being led away from the daycare by a non-descript caregiver. Two copies of this picture were also used depicting either a male or female child. A brown, paper treat bag and a black box (waiting box) were used to hold the
toys, depending on the child’s choices. If the participant was in the control condition, two different pictures were used; one of the treat bag (Now picture) and one of the waiting box (Later picture). The same treat bag and waiting box were used in this condition.

The second task was a child-friendly shifting task. This task included a flip book containing twenty pages. The first ten pages (the pre-shift phase) each had a cartoon cat in the middle of the page, surrounded by either a yellow or green heart or star. On either side of the cat, one flap was either a yellow or green heart and the other was a yellow or green star. The colours of the shapes depended on the trial as listed on the score sheet included in Appendix A. On the reverse side of the “correct” flap, in this case the one with a shape matching the colour around the cat, there was a picture of a happy cat. On the back side of the “incorrect” flap there was a picture of a sad cat. The remaining 10 pages of the book (the post-shift phase) each included a picture of a cartoon owl surrounded by either a yellow or green heart or star. The flaps on either side had a yellow or green heart and star, again depending on the trial. On the reverse side of the “correct” flap, in this case the one with the shape matching the one around the owl, there was a picture of a happy owl, and on the back of the “incorrect” flap there was a picture of a sad owl.

The third task was a child-friendly inhibition task. This included a “tricky box” and a “silly box”. The tricky box contained two doors with clear windows, one on the left and one on the right side, each opened by the nob on their matching side (the left nob opened the left door and the right nob opened the right door). Small toy animals
were placed in one of the two rooms. The “silly box” included two doors which were opened by pushing on the nob located on the contralateral side of the box.

The second experiment involved four tasks: a modified delay of gratification choice task (DoGt Choice), a modified delay of gratification wait task (Hybrid DoGt), and the same two tasks used in the first experiment; a shifting and inhibition task.

The DoG Choice task involved six pairs of toys and a clear box divided into six sections. There was also a paper treat bag and a “waiting” box, the same as was used in the first experiment. In the “present” condition, two pictures were included. The first depicted a cartoon experimenter holding the waiting box and a female child holding the treat bag. The second was identical save for the child was a male. In the “future” condition, a cartoon picture depicted an experimenter and a female (or male) child who is placing the toys from the waiting box into the treat bag.

The Hybrid DoGt Wait task included sixteen stickers and a sticker book. A thirty second sand timer was used along with a box to cover the unavailable stickers.

**Procedure**

For both studies, participation took place one on one with the experimenter in either the daycare or preschool setting, following a within and between-subjects design. The caregivers of the participants filled out a consent form prior to the study commencing. Before beginning the task, the experimenter received verbal assent from the participant and informed the child that they were allowed to stop the tasks at any time.

The first experiment began with the modified DoG Choice task. First, participants were shown six toys and asked to rank them from their favourite to their
least favourite. The experimenter then placed the toys accordingly in the numbered sections of the divided box. Participants were then randomly assigned to either the self-primed condition or to the control condition first. There were four possible orders in which the child could be assigned, as shown in the scoring sheet in Appendix A. In the self-primed condition, the experimenter presented both the Now picture and the Later picture to the child. The experimenter encouraged the participant to imagine the Now picture as themselves currently playing the game and to imagine the Later picture as themselves being picked up after daycare by their caregiver and showing them the contents of their treat bag. Instructions, which are included in Appendix A, were provided to the child. A treat bag and waiting box were presented to the child. For each of the three trials, the experimenter placed either one or two of the less preferred toys (as rated by the child) on the Now picture and one or two of the preferred toys on the Later picture, depending on the child’s choices. The toys used in each trial were dependent on both the trial and the order that the child was in, with a full list of each possible order provided on the score sheet. Depending on the choices made by the participant, the experimenter either placed the toy from the Now picture directly into the child’s treat bag or they placed the toy on the Later picture into the waiting box for the child to then receive at the end of the game. In the control condition, the same procedure was followed for three trials, however the toys were placed on either a picture of the Now bag (the treat bag) or the Later box (the waiting box). Each participant completed a total of six trials and at the end of the task, all toys were placed into the treat bag, which the child was permitted to bring home. Scores for each child were computed on the scoring sheet in Appendix A as follows: they received one point per trial in which they chose to
delay, with a total score ranging from zero to six points, with higher scores indicating more choices to delay.

The experimenter then administered the shifting task. The instructions provided to the child are included in Appendix A. The experimenter began by showing a flap book to the child, starting with the pre-shift phase, which included 10 trials. The children were instructed to choose one of the two flaps to turn over on each page. First, the experimenter demonstrated the correct flap to choose and repeated the demonstration as needed. For the pre-shift phase, the correct response involved choosing the flap that matched the target colour. Both the shape and colour of the target stimuli and the flaps varied depending on the trial (as noted on the score sheet). The child had to respond correctly six times out of ten in order to continue the task. On the subsequent post-shift phase, the experimenter offered a demonstration of the correct response (choosing the flap which shape matches the target shape) and children were instructed to do the same for ten trials. Children scored one point per correct answer, for a total range of scores on the task between zero and twenty, with higher scores indicating better performance.

The last task administered in the first experiment was the inhibition task. The experimenter began by using the “tricky box” for the first ten trials. After placing a toy in either the left or right side of the box (location for each trial included on the score sheet), the experimenter demonstrated that pushing down on one knob (the one on the same side as the toy) opened the door and allowed for the toy to be retrieved. Once a child had successfully completed a trial, they began phase 1, which involved five trials on one side of the box. After performing correctly on at least three trials, phase 2 began, which included another five trials following the same procedure, except with the animal
being placed on the opposite side. For the third phase, after performing correctly on at least six previous trials, the experimenter used the “silly box” and demonstrated that pushing the nob on one side of the box opens the door on the opposite side. There were five trials with the silly box, leading to a total of 15 trials in the task. Each time a child tried to directly reach for a toy instead of pushing on the appropriate nob, they were reminded of the rules and this was noted on the score sheet. Children were marked for each trial whether they made a direct reach for the toy, pressed the correct knob or pressed the incorrect knob. They received one point for each correct response and total scores ranged from zero to fifteen, with higher scores indicating better performance.

The second experiment began with the modified DoG Choice task. Participants began the task by rating six toys based on preference, which the experimenter then ordered accordingly in the sorting box. The instructions were provided to the participant, as outlined in Appendix B, and the child’s understanding of the task was assessed prior to beginning. Participants were randomly assigned to begin in either the present or future condition. During the present condition, which involved three trials, the experimenter showed the picture of the child placing a toy into their treat bag to the participant. The children were then shown a pair of toys, with the preferred one on the waiting box depicted in the picture and the preferred one on the treat bag in the picture. Children were then asked to choose between receiving the toy on the treat bag immediately or waiting to receive the toy on the waiting box at the end of the game. In the future condition, which involved three trials, the experimenter showed the participant a picture of a child placing their toys from the waiting box to their treat bag at the end of the game. The procedure then continued the same as in the present
condition, with the child choosing the less preferred immediate, or delayed preferred toy. After a total of six trials, children were scored one point for each trial in which they chose to delay, leading to a final score ranging between zero and six, with higher scores indicating more choices to delay.

The second task was the hybrid delay of gratification wait task (Hybrid DoGt Wait). For the first two trials, the child was given the option to either take one sticker immediately or to wait one sand timer turn (30 seconds) to receive four stickers, given the option to change their decision at any point during the waiting period. During the waiting period, the experimenter concealed the three unavailable stickers in a small box. For the next two trials, the child chose between either taking one sticker immediately, waiting one sand timer turn (30 seconds) to receive two stickers, or waiting two sand timer turns (1 minute) to receive all four stickers, once again with the option to stop waiting at any point. Total scores ranged from zero to six, with higher scores indicating more choices to delay.

The following two tasks in this experiment; shifting and inhibition, were identical to those in the first experiment. The participants responses on each trial of all tasks were recorded on the corresponding score sheets found in the Appendices.

**Results**

**Study 1**

**Descriptives**

The descriptive statistics for the first study are displayed in Figure 1. The mean proportion of the delay of gratification trials in which the child chose to delay receiving
the reward are presented as a function of condition (control or self-primed), condition order and age.

**Figure 1**

*Mean Proportion DoG Scores by Condition, Condition Order and Age*

As presented in Figure 1, children chose to delay during more trials, on average, in the self-primed condition than in the control condition. This was the case for both the three and four-year-old participants, with the four-year-old’s making more choices to delay than the three-year-old’s in both conditions. All participants performed better on the DoG self-primed task than the control task regardless of condition order. Full tables of means and standard deviations can be found in Appendix C.

The mean proportion scores on both of the executive functioning tasks examined in this study: inhibition and shifting, as a function of age, can be found in Appendix C.
Based on the descriptive statistics presented, four-year olds scored higher, on average, than the three-year olds on both EF tasks. It must be noted that after calculating the Z score for each proportion score, outliers were found in the minimum proportion scores of the three-year olds on the tricky box task ($Z = -6.99$) and in their total inhibition scores ($Z = -4.92$).

**Age-Partialled Correlations**

Age in month partialled correlations were calculated for the proportion scores on each of the EF tasks: inhibition, shifting and DoG, as displayed in Table 1. These correlations were calculated to determine the relationship between performance.

**Table 1**

*Age-Partialled Correlations Between DoG Proportion Scores and Scores on EF Tasks*

<table>
<thead>
<tr>
<th>Scores</th>
<th>DoG Control Scores</th>
<th>DoG Self-Primed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silly Box</td>
<td>.07</td>
<td>.08</td>
</tr>
<tr>
<td>Tricky Box</td>
<td>-.02</td>
<td>.19</td>
</tr>
<tr>
<td>Total Inhibition</td>
<td>.04</td>
<td>.14</td>
</tr>
<tr>
<td>Preshift Phase</td>
<td>.22</td>
<td>.28*</td>
</tr>
<tr>
<td>Postshift Phase</td>
<td>.21</td>
<td>.22</td>
</tr>
<tr>
<td>Total Shifting</td>
<td>.22</td>
<td>.26*</td>
</tr>
<tr>
<td>DoG Control</td>
<td>-</td>
<td>.60**</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$

Inferential Statistics: Mixed ANOVA
A three-way mixed analysis of variance (ANOVA) was conducted to examine the effects of age (three or four years old), condition (control or self-primed) and order of condition (control or self-primed first) on DoG scores. Condition acted as the within-subjects variable whereas age group and condition order to which participants were assigned were the between-subject variables. The dependent variable was the proportion of trials delayed in a DoG choice task. As Mauchly’s test of sphericity was violated, the Greenhouse-Geisser correction was used. A test of within-subject condition effects was significant, $F(1, 60) = 6.22, p = .01, \eta^2_p = .09$, indicating that there were significant differences between DoG scores in the control and self-primed condition.

There was no significant interaction effect of Condition X Age group, $F(1, 60) = 1.88, p = .17, \eta^2_p = .03$, nor was there a condition order effect, $F(1, 60) = 0.43, p = .51, \eta^2_p = .01$. Additionally, there were no three-way interaction effects between condition, age and condition order, $F(1, 60) = 0.24, p = .62, \eta^2_p = .00$.

A test of between-subject effects showed that there was no significant main effect of age group on choices to delay, $F(1, 60) = 1.21, p = .27, \eta^2_p = .02$, which indicates that three- and four-year-old participants performed similarly on the DoG task when holding all other variables constant. There was also no significant order effect on DoG scores, $F(1, 60) = 0.17, p = .68, \eta^2_p = .00$. This indicates that the order participants were assigned to (control or self-primed condition first) did not have a significant effect on choices to delay. Lastly, there was no significant interaction effect of Age group X Order, $F(1, 60) = 0.06, p = .80, \eta^2_p = .00$.

**Regressions**
Two hierarchical regressions were computed to examine age and total proportion scores on the shifting task as predictors of DoG scores (total choices to delay) in the self-primed and control conditions, respectively. Inhibition scores were not added as a predictor due to inhibition scores and DoG scores not being significantly correlated as was shown in Table 1.

Beginning with the scores in the self-primed condition as the dependent variable, age in months was added in the first step and total shifting scores was added in the second. Results indicated that the overall regression model was significant for both age, $F(62) = 4.07, p = .05$ and shifting, $F(61) = 4.42, p = .02$. Unstandardized coefficients are displayed in Table 2.

**Table 2**

*Unstandardized Regression Coefficients for the Total Proportion Scores in the DoG*

*Self-Primed Condition*

<table>
<thead>
<tr>
<th>Model 1 Predictor</th>
<th>$B$</th>
<th>SE $B$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.01</td>
<td>0.01</td>
<td>.048*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2 Predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Shifting Scores</td>
</tr>
</tbody>
</table>

*p < .05

These results suggest that older age was a significant predictor of higher DoG scores in the self-primed condition, $t(63) = 2.02, p = .05$. However, in the second model when shifting scores were accounted for, age was no longer a significant predictor, $t(63) =$
1.65, \( p = .10 \). Higher shifting scores were significant predictors of higher DoG scores in the self-primed condition, \( t(63) = 2.13, p = .04 \).

A second hierarchical regression analysis was then computed examining age and shifting scores as predictors of DoG scores in the control condition. The overall model was not significant for age, \( F(62) = 0.21, p = .65 \), nor shifting, \( F(61) = 1.73, p = .19 \).

Unstandardized coefficients are shown in Table 3.

**Table 3**

*Unstandardized Regression Coefficients for the Total Proportion Scores in the DoG Control Condition*

<table>
<thead>
<tr>
<th>Model 1 Predictor</th>
<th>( B )</th>
<th>( SE \ B )</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.00</td>
<td>0.01</td>
<td>.652</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2 Predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Shifting Scores</td>
</tr>
</tbody>
</table>

*\( p < .05 \)

Results indicate that age was not a significant predictor of DoG scores in the control condition, \( t(63) = 0.45, p = .65 \). In the second model, neither age, \( t(63) = 0.13, p = .90 \) nor shifting scores, \( t(63) = 0.33, p = .08 \) were significant predictors of DoG scores in the control condition.

To follow up on the results found in study 1, a second study was conducted to examine whether thinking of the self in the *future* has a significant effect on DoG scores as opposed to simply thinking of the self in *general*. A Hybrid DoG task was also used
to examine correlations between performance on this task and scores on the DoG choice, inhibition and shifting tasks.

**Study 2**

**Descriptives**

Descriptive statistics were then calculated for Study 2, as shown in Figure 2. The mean proportion of trials in which children chose to delay in the DoG choice task are presented as a function of condition (present self or future self), condition order and age.

**Figure 2**

*Mean Proportion DoG Scores by Condition, Condition Order and Age*

When examining the mean proportion scores for the entire sample, scores were higher (increased choices to delay) in the future self condition versus the present self condition.
Three-year olds showed a similar trend whereas four-year olds scored higher (made more choices to delay) in the present self condition.

As shown in the graph, three-year-olds scored higher in the future-primed condition than in the present-primed condition regardless of order. Four-year-olds, however, scored lower in the future-primed condition when they were in the present primed condition first.

The mean proportion scores on both EF tasks: inhibition and shifting, as well as the DoG hybrid task as a function of age are included in Appendix C. Four-year-olds received higher mean scores on inhibition and shifting tasks than the three-year-olds in the sample. However, three-year-olds received higher scores than four-year-olds on the Hybrid DoG task. After calculating the Z scores for the mean scores on each of the tasks, outliers were found in the minimum mean score for total inhibition for the three-year-olds, similar to the first study.

**Age-Partialed Correlations**

Age in month partialed correlations were calculated for the mean scores on each of the tasks: inhibition, shifting, DoG Choice and Hybrid DoG as is shown in Table 4. As noted in Table 4, there were no significant correlations between DoG Choice scores and inhibition or shifting, therefore no further analyses were conducted to examine these as predictors of DoG Choice scores.

**Inferential Statistics: Mixed ANOVA**

In order to examine the effects of age, condition (present-self primed or future-self primed), and condition order (present first or future first) on DoG scores, a three-way mixed ANOVA was conducted. Condition was the within-subjects variable and age
Table 4

Age-Partialled Correlations Between DoG Choice and Hybrid Proportion Scores and Scores on EF Tasks

<table>
<thead>
<tr>
<th>DoG Choice</th>
<th>DoG Choice</th>
<th>DoG Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoG Present Primed</td>
<td>DoG Future Primed</td>
<td>DoG Hybrid</td>
</tr>
<tr>
<td>Silly Box</td>
<td>.01</td>
<td>-.06</td>
</tr>
<tr>
<td>Tricky Box</td>
<td>-.09</td>
<td>-.16</td>
</tr>
<tr>
<td>Total 1</td>
<td>-.09</td>
<td>-.17</td>
</tr>
<tr>
<td>Preshift</td>
<td>.13</td>
<td>-.04</td>
</tr>
<tr>
<td>Postshift</td>
<td>.02</td>
<td>-.12</td>
</tr>
<tr>
<td>Total 2</td>
<td>.07</td>
<td>-.09</td>
</tr>
<tr>
<td>DoG Present</td>
<td>-</td>
<td>.56**</td>
</tr>
<tr>
<td>DoG Future</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. Total 1 refers to total inhibition scores and Total 2 refers to total shifting scores.

*p < .05, **p < .01

and condition order were the between-subject variables. The dependent variable was the proportion of trials delayed in the DoG choice task. Mauchly’s test of sphericity was again violated, and so the Greenhouse-Geisser correction was used.

A test of within-subject condition effect was not significant, \( F(1, 53) = 3.33, p = .07, \eta_p^2 = .06 \). This indicates that there was not a significant difference between DoG scores in the present-primed and future-primed condition.

There was however a significant interaction effect of Condition X Age group, \( F(1, 53) = 6.31, p = .01, \eta_p^2 = .11 \). This finding indicates that the number
of choices to delay in the self and future-primed conditions were different depending on whether the participants were three or four years old.

To follow up the significant interaction, two mixed ANOVA’s were conducted which examined the effects of condition and order on DoG scores by age group.

Beginning with a test of within-subject effects for the three-year-olds, there was a significant condition effect, \( F(1, 21) = 6.26, p = .02, \eta^2_p = .23 \). The Condition X Order interaction was not significant for the three-year-olds, \( F(1, 21) = 0.07, p = .80, \eta^2_p = .00 \). A test of between-subject effects revealed that there was no significant order effect for three-year-olds, \( F(1, 21) = 0.14, p = .71, \eta^2_p = .01 \).

A second mixed ANOVA was then conducted for the four-year-olds. A test of within-subject effects showed no significant condition effect for four-year-olds, \( F(1, 32) = 0.35, p = .56, \eta^2_p = .01 \). There was no significant Condition X Order interaction effect, \( F(1, 32) = 0.98, p = .33, \eta^2_p = .03 \). A test of between-subject effects revealed that there was a significant order effect for the four-year-olds, \( F(1, 32) = 3.85, p = .05, \eta^2_p = .11 \). Specifically, there was a significant order effect for scores on the future-primed task, \( t(33) = 2.17, p = .04, \eta^2_p = .13 \) but not for scores on the present-primed task, \( t(33) = 1.37, p = .18, \eta^2_p = .05 \).

No significant interaction was found for Condition X Order, \( F(1, 53) = 0.12, p = .73, \eta^2_p = .00 \) when the total sample was accounted for. Additionally, there were no significant three-way interaction effects of Condition X Age group X Order, \( F(1, 53) = 0.63, p = .43, \eta^2_p = .01 \).

A test of between-subject effects showed no significant main effects of age group, \( F(1, 53) = 1.27, p = .26 \), or order, \( F(1, 53) = 2.42, p = .13, \eta^2_p = .04 \), on choices.
to delay gratification. There was also no significant interaction effect of Age group X Order, $F(1.53) = 0.10, p = .32, \eta^2_p = .02$.

**Regressions**

Two hierarchical regressions were then computed. The first examined age and inhibition scores as predictors of scores on the DoG Hybrid task (total number of trials delayed). Shifting scores were not added as a predictor as shifting scores and DoG Hybrid scores were not significantly correlated as displayed in Table 4.

With scores on the DoG Hybrid acting as the dependent variable, age in months was added in the first step and total inhibition scores were added in the second. The first model was not significant, $F(55) = 0.01, p = .93$, however the second was significant, $F(54) = 4.15, p = .02$. Unstandardized coefficients are shown in Table 5.

**Table 5**

Unstandardized Regression Coefficients for the Total Proportion Scores on the Hybrid DoG Task

<table>
<thead>
<tr>
<th>Model 1 Predictor</th>
<th>$B$</th>
<th>$SE$ $B$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.00</td>
<td>0.01</td>
<td>.934</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2 Predictors</th>
<th>$B$</th>
<th>$SE$ $B$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.01</td>
<td>0.01</td>
<td>.349</td>
</tr>
<tr>
<td>Inhibition</td>
<td>0.05</td>
<td>0.02</td>
<td>.006**</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01

Results indicated that age was not a significant predictor of Hybrid DoG scores, $t(56) = 0.08, p = .93$. When age was partialled out, higher inhibition scores were a significant predictor of higher Hybrid DoG scores, $t(56) = 2.88, p = 0.01$.  

A second hierarchical regression analysis was computed to examine age, inhibition scores, and scores on the DoG choice task as predictors of DoG Hybrid scores. The first model was not significant, $F(55) = 0.01, p = .93$ however the second model was significant, $F(53) = 4.86, p = .00$. Unstandardized coefficients are presented in Table 6.

**Table 6**

*Unstandardized Regression Coefficients for the Total Proportion Scores on the Hybrid DoG Task*

<table>
<thead>
<tr>
<th>Model 1 Predictor</th>
<th>$B$</th>
<th>SE $B$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2 Predictors</th>
<th>$B$</th>
<th>SE $B$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.01</td>
<td>0.01</td>
<td>.140</td>
</tr>
<tr>
<td>Inhibition</td>
<td>1.20</td>
<td>0.36</td>
<td>.002**</td>
</tr>
<tr>
<td>DoG Choice Scores</td>
<td>0.38</td>
<td>0.16</td>
<td>.022*</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01

These results indicate that age was not a significant predictor of Hybrid DoG scores when inhibition scores and DoG choice scores were held constant, $t(56) = -1.50, p = .14$. Higher inhibition scores were predictive of higher scores on the Hybrid DoG when controlling for age and DoG choice scores, $t(56) = 3.32, p = .00$. Lastly, DoG choice scores were predictive of Hybrid DoG scores when controlling for age and inhibition, $t(56) = 2.36, p = .02$.

**Discussion**

**Study 1**
The present study aimed to examine whether engaging in future-oriented thinking about the self would improve preschool children’s ability to delay gratification. A secondary goal was to assess whether there were age differences in children’s ability to delay. Furthermore, the current study explored whether cool EF skills such as inhibition of responses and shifting of attention and responses, would be associated with performance on DoG. The aforementioned goals were achieved by conducting two studies which involved having three- and four-year-old children participate in tasks assessing their ability to delay gratification (a DoG Choice task and a Hybrid DoG task) and their competency in inhibition and shifting.

The goal of the first study was to measure preschooler’s total number of choices to delay receiving a reward while not being primed to imagine their future selves (the control condition) and then when being encouraged to imagine their future selves. The latter condition is known as the self-primed condition. The results showed that participants did perform significantly better (made more choices to delay) in the self-primed condition than when they were in the control condition, which supported our first hypothesis. The second hypothesis, that four-year-olds would choose to delay more than three-year-olds was partially supported. While overall, four-year-olds did not have significantly higher scores than three-year-olds, older age was a significant predictor of better performance in the DoG self-primed condition, but not in the control condition, when controlling for the impacts of shifting. In addition to condition and age, the effects of condition order on DoG scores for both age groups were examined, and no significant order effects were found. There was no significant difference in performance between children in the control condition first and those in the self-primed condition first. Next,
results of the first study indicated that total shifting scores were a significant predictor of scores in the DoG self-primed condition, but not in the control condition. Thus, our third hypothesis that shifting and DoG scores would be significantly positively correlated was partially supported. Lastly, inhibition scores were not significantly correlated with DoG scores, thereby not supporting our fourth hypothesis.

When comparing these findings with those in the literature, there are both similarities and disparities between the results of the current study and what was found by others researching DoG. Firstly, the finding that children perform better in the self-primed condition, where they are primed to think of their future selves, is consistent with previous studies which demonstrated that having children engage in prospection (imagining themselves with a future reward), encourages choosing to delay gratification (Garon et al., 2015). One possible explanation for our finding is that the increased choices to delay are the result of the child making a connection between their present and future selves. By having the participants imagine themselves at the end of the day, showing their caregiver the reward, they have received, they may have been able to more effectively link their current desires with their future desires and their present actions with future outcomes. In other words, priming children to imagine their future selves may help them to distance themselves from their immediate focus and urges (i.e. the urge to take the immediate reward) and instead allow them to increase their psychological proximity to their later selves. In essence, they are encouraged to “put themselves in the shoes” of their future self. This explanation is supported by the finding that having children distance themselves from their current desires increases choices to delay gratification (Zelazo & Müller, 2010). Additionally, by age three, children’s
representations of their present and future self typically tend to converge so that they see
their future self as the same person who is acting in the present (Moore & Barresi,
2013). This is hypothesized to be a change from younger children typically imagining
their current selves in first person while imagining their noncurrent selves in third
person (Moore & Barresi, 2013). Encouraging children to imagine their future selves,
along with providing visual prompts, may consequently facilitate this convergence of
the selves and lead to improved delay of gratification, as was supported by the current
study.

The second main finding in our study, that four-year-olds perform better on the
self-primed DoG task than the three-year-olds is also supported by the literature. It has
been repeatedly found that four-year-olds tend to delay longer and choose to delay more
than three-year-olds (Garon et al., 2012). It has been suggested that four-year-olds are
more capable of imagining their future selves and of taking their future desires into
consideration (Suddendorf & Busby, 2005). Therefore, it is possible that four-year-olds
have the ability or skill set to engage in future-oriented thinking of the self, and that
when it is primed for them (as was done in the self-primed task in our study), it is
sufficient in improving their ability to delay gratification. Three-year-olds did not
perform as well as the older children on the self-primed task, and this could be due to
them needing further, more extensive help in priming mental representations of their
future selves as they have not yet fully developed the same skills as the four-year-olds
have (i.e. attention shifting). It has also been found that four-year-olds are more efficient
at shifting their attention (i.e. between current and future desires) (Zelazo & Mueller,
2002) and this may partially account for their better performance. It is important to note
that once shifting is removed, age no longer had a significant effect. It is possible that if a child is not able to shift, it will not make a difference whether they are three- or four-years-old, improvement will likely not be seen between conditions. Alternatively, perhaps the self-primed task itself presents too large of a cognitive load for three-year-olds, as this has been found to reduce DoG performance (Burns et al., 2019), whereas the older children may be better able to handle this demand. It is possible to hypothesize that shifting plays a part in this ability, and it is further examined in our third main finding.

The finding that shifting scores were significantly positively correlated with DoG scores in the self-primed condition is supported by the literature, which states that the ability to shift is associated with increased delay of gratification, possibly because of its help in rectifying the conflict between choosing the immediate and delayed reward (Mischel, 2014). Our finding that shifting is associated with the scores in the self-primed condition but not the control condition is intuitive as children likely do not have to employ shifting between current and future selves to such an extent during the control condition. Now lays the question of why order of conditions (control first or self-primed first) did not have a significant effect on performance. One possible explanation for this is that the children who participated in the study who were able to shift between their current and future selves would have done so regardless of the condition order they were in. On the other hand, those participants who were not able to effectively shift would not perform differently regardless of the condition order.

Lastly, our final main finding that inhibition is not significantly associated with DoG scores differs from the common finding that the DoG task relies upon a child’s
ability to inhibit responding to receive the immediate reward (Garon, 2016). It is possible that the nature of the DoG tasks used in the current study was implicated in this result. In the present study, DoG choice tasks are used, where children’s performance on the task is measured by the number of choices they make to delay. Perhaps, this taps into a child’s ability to inhibit responses less than a different type of DoG task, such as a DoG Wait or DoG Temptation task, where wait time is measured. Differences between the processes underlying the DoG Choice and Wait task have been found (Duckworth & Kern, 2011) and possibly one difference is the extent to which they rely on inhibition.

**Study 2**

As there is a possibility that the improvement in performance seen in the self-primed condition was a result of having the participants imagine their selves in general, rather than imagining their selves in the future specifically, the aim of the second study was to offer further support that it is the future-oriented thinking of the self that has a positive influence on DoG. If *future-oriented* thinking of the self was the cause of increased choices to delay, then it was expected that children would perform better in the future-primed condition than in the present-primed condition, where both conditions involved priming of the self. The results of this second study partially supported this hypothesis. There was not a significant difference in performance of the four-year-olds between the present- and future-primed conditions. However, there was a significant difference in the performance of the three-year-olds between conditions, where the three-year-olds performed significantly better in the future-primed condition than in the present-primed condition. Thus, we can conclude that difference in performance between the conditions was dependent upon age. Additionally, there were no significant
differences in the performance of the three-year-olds and the four-year-olds in this study. As for order effects, none were found for the three-year-olds, but the four-year-olds did score significantly higher in the future-primed condition when they were in this condition first, rather than the present-primed condition first. In other words, four-year-olds performed better in the future-primed condition when it was their first task, rather than their second. The second hypothesis, that shifting and inhibition scores would be positively correlated with DoG choice scores was not supported in this study. Scores on the DoG Choice task and the Hybrid DoG task were not significantly correlated, thus refuting our third hypothesis. However, better performance on the DoG Choice task was a significant predictor of better scores on the Hybrid DoG, when controlling for age and inhibition scores. Lastly, total inhibition scores were significantly positively correlated with scores on the Hybrid DoG, meaning that participants who performed better on the inhibition task would also be predicted to perform better on the Hybrid DoG task. However, shifting scores and the Hybrid DoG scores were not significantly correlated, thus our fourth hypothesis was partially supported.

The first finding, that three-year-olds performed significantly better on DoG when they engaged in future-oriented thinking, is supported by the first study and by the literature which states that imagining the future self does have positive consequences for one’s ability to delay gratification (Garon et al., 2015). Four-year-olds did not differ significantly between the present- and future-primed conditions however, on average, they received high scores in both conditions, and these scores were significantly higher than in the first study. It is possible that four-year-olds performed similarly in both conditions because they are able to engage effectively in future-oriented thinking of the
self without being primed. On the other hand, perhaps priming the self in general was sufficient to prompt four-year-olds to delay gratification. It has been suggested that four-year-olds are also more effective at using other cognitive strategies, such as focusing on the abstract qualities of a reward, rather than the hot, appetitive qualities to help increase their wait times (Mischel, 2014). Therefore, it is plausible that four-year-old’s ability to engage in future-oriented thinking along with employing other cognitive strategies, may lead them to delay gratification well even in the present-primed condition. Additionally, the results of the second study did not uncover any significant age differences in performance, unlike the first study. This could be due to the different ways in which future-oriented thinking was primed in the first and second study. In the first study, in the self-primed condition, children were asked to imagine themselves at the end of the day, being picked up by their caregiver. In the second, future-oriented thinking was primed by having them imagine themselves setting the reward aside for their future selves. It is possible that because in the second study the children did not have to imagine themselves as far into the future, the three-year-olds performed better in the second study, achieving scores closer to those of the four-year-olds.

Another element to explore, is why the condition effect was stronger in the first study than in the second study, meaning that performance between the conditions improved to a greater extent in the first study. One possible explanation for this was mentioned previously: that it may be linking the present and future self that produces the strongest effect on DoG. In the second study, the participants were primed to think of their present-self only during one condition, and their future-self only during the other condition. However, in the first study, in the self-primed condition, present and future
self were primed at the same time. This may suggest that making the connection between the present and future self is integral to achieving even better outcomes on DoG.

While order effects were not found in the first study, they were in the second, with four-year-olds performing significantly better in the future-primed condition when it was the first condition they participated in (with the present condition being the second). This finding is counterintuitive as one would expect that scores in the future-primed condition would be higher when the future-primed condition was second, as this would have allowed the participants to make links between their present and future self. One explanation for these findings is that the children were tired, or had more of a cognitive load, once they reached the future-oriented condition after the present condition, leading to decreased choices to delay, as opposed to when future-oriented thinking was primed at the beginning of their testing session.

The finding that shifting and inhibition were not significantly positively correlated with DoG choice scores in the second study are not generally supported in the literature, as typically it has been found that both abilities are precursors to success in delaying gratification (Garon et al., 2008; Mischel, 2014). Perhaps one reason why shifting was correlated with DoG scores in the first study but not the second, is that the self-primed condition in the first study involved actively shifting between the present and future selves at the same time, therefore relying on shifting ability to a greater extent than the conditions in the second study.

The penultimate finding of the second study, that scores on the DoG choice and Hybrid DoG were not correlated may be due to the Hybrid DoG’s resemblance to the
DoG Wait task, which has not been found to be strongly correlated to the DoG Choice task (Duckworth & Kern, 2011). The main difference between the DoG Choice task and the Hybrid DoG is that the latter involves the participant having to repeatedly wait specific, increasing increments of time throughout the task designated by a sand timer in order to receive rewards that increase in value relative to the time delayed. This element bears semblance to the DoG Wait task, on which performance has not been found to be significantly improved by engaging in future-oriented thinking (Atance & Jackson, 2009). This may suggest that the DoG Choice and the Hybrid DoG place differing demands on the participant. This could also be an explanation for shifting not being correlated with the Hybrid DoG but being correlated with inhibition. A child’s performance on the Hybrid DoG, due to the DoG Wait component, taps into their ability to resist temptation more so than the DoG choice task, therefore making the finding that inhibiting prepotent responses is necessary for success on this task intuitive.

All in all, the results of the two studies imply that in order to secure maximum performance in delaying gratification, one must provide prompts to preschoolers that help them mentally connect their present and future selves and that this may be especially necessary for three-year-olds. Furthermore, depending on the nature of the DoG task at hand, helping children to practice and improve their inhibition and shifting abilities may be advantageous. Overall, the benefits of being able to delay gratification are extensive.

**Implications**

These findings on the importance of EF skills and of improving in one’s ability to delay gratification have many significant real-world applications in clinical,
educational and everyday life settings. Firstly, as EF’s are slow to develop and vulnerable to environmental input (Goldberg, 2002), EF dysfunctions are consequently receptive to treatment (Garon et al., 2008). This means that with effective intervention, there is hope for those suffering with impaired EF. Disordered EF is implicated at least to some extent in almost all mental illnesses and developmental disorders, including depression, anxiety, schizophrenia, autism, ADHD (Salehinejad et al., 2021), conduct disorder and obsessive-compulsive disorder among others (Zelzazo & Müller, 2010). As this is the case, it may be possible for clinicians to treat the components of client’s disorders that are associated with EF and consequently improve their quality of life. The more research that is conducted on EF, the more information will be uncovered on ameliorating the functioning of individuals suffering from mental disorders. In terms of delaying gratification specifically, one’s ability to resist immediate gratification can be negatively impacted by disorders involving impulse control, such as ADHD (Barresi & Moore, 1996). Therefore, it is imperative to have strategies in place to help these individuals to learn to delay gratification in a clinical setting. As was supported by the present study, imagining the self in the future is one such way to achieve this. Clinicians treating children with ADHD may find it valuable to implement tools that prime future-oriented thinking in their clients. For example, having photographs to represent the child’s present and future-self visible to the child may act as a discriminative stimulus, prompting children to delay performing an impulsive action. Once cool nodes have been activated through priming during therapy sessions, this makes reactivation of these nodes, and consequent use of cooling strategies, more likely in other situations (Metcalf & Mischel, 1999). Furthermore, priming helps both the clinician and the
client to have increased control over their cognitions and behaviours (Metcalfe & Mischel, 1999). Teaching clients to use cooling strategies in emotional situations may help them to make more rational, productive decisions. The use of cooling strategies may also be beneficial when helping clients to handle conflict between their present and future desires (Principe & Zelazo, 2005). By encouraging children experiencing executive dysfunction to take into consideration the needs and desires of their future selves, they may be better able to delay gratification. This ability has been associated with the ability to cope with stress (Mischel et al., 1988) and with less physical and verbal aggression (Mischel & al., 1989). Impaired DoG is not only a symptom of mental illness, but goal directed behaviour involved in DoG is also a protective factor against the negative behaviours associated with mood disorders, conduct disorders and antisocial tendencies (Metcalfe & Mischel, 1999). Thus, using strategies and tools to help clients improve their EF skills and their ability to delay has potential in both improving symptoms of mental illness and in acting as protective barriers against these symptoms.

The next area in which the findings of the current study can be applied is education, particularly in early childhood as this is when EF skills are the most sensitive to improvement (Semenov & Zelazo, 2018). By encouraging and scaffolding the development of EF skills and the ability to delay gratification in preschoolers, they may be better equipped to use these skills once they begin school, leading to improved performance. For example, if a child learns how to handle refraining from participating in an enjoyable activity or playing with a tempting toy when it is not the appropriate time, there is hope that as a student the child would be more effective at focusing on
their work rather than succumbing to temptation. A child who learns and experiences the value of waiting for a delayed reward early on could be more inclined to strive for the delayed gratification that comes with working hard in school, rather than always needing immediate reinforcement in order to perform. Teachers can help children delay gratification in ways similar to those in the current study. For instance, teachers could have young students engage in exercises where they must list their current desires and then what their “future self” may desire or need in different hypothetical situations. For example, what they may need to pack for their future selves who are going on a trip. Teaching young children these skills is especially important for students with low socio-economic status (SES), as EF skills are a protective factor against the negative impacts of low SES on academic achievement (Semenov & Zelazo, 2018). Previous implementations of programs aimed to improve EF skills in children experiencing poverty have proven successful in decreasing stress and increasing quality of academic performance (Semenov & Zelazo, 2018). All in all, children with better EF skills are more likely to have higher grades and to graduate high school and university (Semenov & Zelazo, 2018). It is therefore in children’s best interest that teachers provide them with instruction and support to improve EF skills and the ability to delay gratification, the positive consequences of which can last a lifetime.

Not only do the findings of the current study and of past literature have implications for clinical and educational practice, but they are also implicated in fostering personal well-being in day to day life. The inability to delay gratification can lead to serious consequences in regard to one’s health (Metcalfe & Mischel, 1999) and in the most severe instances, can cost people their lives (Mischel et al., 1989). For
example, if an addict is unable to refrain from receiving the immediate gratification of using a harmful substance, this can lead to both immediate and eventual negative outcomes for their physical and mental health. As the ability to delay gratification has historically posed a challenge for most people, it is imperative that effective strategies are developed in order to aid people to conquer this challenge. In general, humans are temporally myopic, or in other words, “short-sighted”, meaning that they are more sensitive to immediate consequences rather than future consequences (Martin & Pear, 2019). This can lead to making impulsive decisions that satisfy the present self’s needs without considering the effects this may have on our future selves. As seen in the results of the current study, by cognitively moving the future-self closer in time to the present-self (through priming), this may help to increase the salience of the future consequences of one’s action. By teaching children how to consider both the desires of their future selves and the consequences of their present actions on their future selves, these children may become adults who are better equipped to make healthier decisions.

**Limitations and Future Research**

One limitation of the current study is that successful performance on the DoG tasks depended not only upon a child’s ability to delay gratification but also on their self-awareness. Being aware of one’s self, including individuality and continuity (Moore & Barresi, 2013) is a prerequisite to engaging in future-oriented thinking of the self (Coughlin et al., 2017). However, in the current study, children’s baseline levels of self-awareness were not assessed. Therefore, it is possible that participants who performed poorly on the DoG tasks did so because they were unable to engage in future-oriented thinking due to an unclear internal representation of the self. In particular, the ability to
understand that one’s present choices affect the outcomes for their future selves does not typically develop until late preschool (Moore & Barresi, 2013). Without this understanding, it would have made delaying gratification, even with the use of the future-self priming prompts, exceedingly difficult. In all, it may have been beneficial to include a measure of the participant’s awareness of their selves over time, such as by using the five levels of awareness by Rochat (2003). This way, it may have been possible to hold awareness of the self constant when assessing the child’s ability to delay gratification. A second limitation of the study is the possible cognitive overload that these tasks placed on the participants. It has been shown that increasing the demands on a young child’s working memory reduces their ability to delay gratification (McCormack & Hoerl, 2020). Therefore, it may be worthwhile to take into consideration the possibility that having children imagine their future selves in various conditions may lead to a decrease in performance due to cognitive overload. A third limitation of the current study is the possible carry-over effects between conditions and between the first and second study. As the activation of cool or hot nodes in the brain becomes more likely if they have been previously primed or stimulated by past experiences (Metcalfe & Mischel, 1999), it is possible that participants performed better in the second study than the first because their cool nodes had already been activated (through the priming that took place in the first study). The final limitation of this study is the sample size. It would be advantageous to replicate this study with larger sample sizes in order to have stronger effect sizes and more generalizable results.

Due to the meaningful and significant applications of findings in this area of research, it is imperative that more studies be conducted on preschool aged children and
their ability to delay gratification when being primed to engage in future-oriented thinking. Further replications of this study must be conducted with different participant samples in order to garner more support for the conclusions derived from the present study. As the current study, similarly to the majority of studies in this area, was cross-sectional, it may be beneficial to conduct more longitudinal studies to assess how a child’s ability to delay gratification and future-oriented thinking changes over the preschool period. There is a need for more studies on temporal discounting and future-oriented thinking of the self in preschoolers, generally, rather than older children or adults. Another possible variation of this study could involve children looking at pictures of the rewards, rather than the physical rewards themselves during the DoG Choice and Hybrid tasks. It has been found that the mere presence of the physical reward leads to a decrease in wait time (Mischel & Ebbesen, 1970), so it would be interesting to replicate this study save for using photographs of the rewards. Photographs of rewards have been found to help children delay gratification as they focus more on the “cool” qualities of the reward, rather than the hot, appetitive qualities (Mischel et al., 1989). Furthermore, it may be interesting for researchers to replicate this study while manipulating how far in the future the participants are imagining their future selves. In the current study, participants were asked to imagine themselves being picked up from daycare at the end of the day (first study) or to imagine themselves taking their toy in the waiting box for after the game (second study). It would be interesting to conduct further studies where the child imagines themselves at a point in time closer to the present (such as during recess before parent pick up) or a point further in time (such as at home in the evening after daycare). Lastly, as we hypothesize that it is in children
making the connection between their present and future selves that improves delay, it would be useful to conduct this study again but with a third condition where participants are primed with visual stimuli that explicitly links the child’s present and future self. For example, a slider could be used with a picture of the child’s present self completing the task at one end and a picture depicting the child’s future self at the other. The child could then manipulate a knob to slide from their present self to future self, thereby visually representing the link. As a child’s ability to engage in temporal decentering and to mentally represent themselves at different points in time is essential for engaging in future-oriented thinking of the self and consequently delaying gratification (McCormack & Hoerl, 2020), providing a visual manipulative may aid children in conceiving these concepts and perhaps even reduce the cognitive load that is placed on the children. In sum, a third condition where children link their present and future selves may help to extend upon the findings of the current study and expand upon the process behind future-oriented thinking improving delay of gratification in preschoolers.

Conclusion

To conclude, there are countless ways in which parents, teachers, clinicians and others can foster skills and competencies in children with the goal of improving their quality of life and increasing their chance of success. Perhaps the most important of these skills are those related to executive functions. A child’s emotional and social well-being is contingent upon the development of the processes that fall under executive functions. These processes; self-regulation, flexibility, response inhibition and shifting attention, among many more are all implicated in one’s ability to delay gratification. Success in delaying gratification is predictive of numerous positive outcomes that
extend far beyond childhood. On the other end of the spectrum, failure to delay gratification is arguably the root of many problems that humans face and can lead to outcomes that are detrimental to one’s psychological well-being and health. Thus, it is of vital importance to instill the ability to delay gratification into children during the period of life where the brain is at its most malleable—early childhood. Employing strategies to aid children succeed in delaying gratification during this time, such as engaging in future-oriented thinking of the self, is undoubtedly a worthwhile cause. Being connected with one’s future self leads everyone, not only children, to empathize with the needs and desires of their future selves and thus make decisions in the present that will benefit this version of our selves. It brings the consequences of one’s actions to the forefront of their mind and consequently encourages people to act with prudence for the sake of their future selves. In all, fostering the ability to delay gratification in young children through imagining the future self has the potential of setting the stage for further positive outcomes that last a lifetime.
References


https://doi.org/10.1016/j.copsyc.2018.06.005

https://doi.org/10.1016/0010-0285(81)90006-2


https://doi.org/10.1111/j.1467-7687.2007.00603.x

https://doi.org/10.2307/2118482


http://dx.doi.org/10.1163/22134468-00002094

http://dx.doi.org/10.1016/bs.acdb.2020.01.008

https://doi.org/10.1016/j.cogdev.2019.04.001

https://doi.org/10.1037/0033-295X.106.1.3


https://doi.org/10.1146/annurev.neuro.24.1.167


stimulation (tDCS). *Neuroscience, 369,* 109-123.

http://dx.doi.org/10.1016/j.neuroscience.2017.10.042


https://doi.org/10.1016/j.jecp.2014.03.008


Appendix A

Experiment 1 Protocol

Tasks used:
Delay of gratification task – 24 small toys (12 pairs of toys), laminated pictures for imagining
Shifting task – Book with flaps
Inhibition – 2 boxes with clear windows, animal figurines
Working memory – 5 houses with doors ranging from 4 to 8 doors, felt animals as targets, laminated pictures of animals

Delay of Gratification Task
Children will be shown 6 toys. E will say, “Which one of these is your very favorite?” E will take out the object and place it in the “1” spot in the divided box. E will focus on the remaining toys and say, “Now out of these ones, which one is your favorite?” E will then take that toy and place it in the “2” spot in the divided box. E will continue until all toys have been rated. E will form the choices based on these ratings. They will be asked to choose their favorite and so on until all toys have been rated. Toys will have a rating of 1 to 6 and this rating will be used to construct the choices. Children will be randomly assigned to within condition hot or control condition first. They will be given 6 trials in which a pair of toys is presented.

In the hot condition, children will be told, E will show the child the pictures of “Now” and “Later”. E will point to the Now picture and say, “Let’s pretend this is a picture of me and you playing this game. See I’m smiling and you are too! We are having fun.” E will show the child the Later picture. “Now let’s pretend this is a picture of you being picked up from daycare today. Do you know who will pick you up?” E will allow child to elaborate. “Now let’s pretend this is a picture of you showing your Mom/Dad/caregiver what you won today in your bag. Wow, you look so happy!” E will then put the pictures side by side on the table. “We are playing a choosing game. Each time, you will pick a toy to put in your treat bag now or another toy to put in the waiting box. If you choose the toy for the waiting box, I will put it in the waiting box and give it to you when we are done the game. If you pick the toy for right now, you can put it in your treat bag right away.” E will then point to the pictures. “We are going to use these pictures to help us remember about the choices. When the toy is for now, I put it on this picture. When the toy is for later, I put it on this picture. Are you ready?” For each trial, the examiner will say, “You can have (less preferred toy) now to put in your treat bag or you can wait until the end of the game and have (preferred toy). If you choose to wait, I will put the toy here” E point to the waiting box. “Remember, if you choose (most preferred), you will have to wait until the end of the game.”

In the control condition, children will be told, E will show the child the pictures of “Now bag” and “Later box”. E will point to the Now picture and say, “Let’s pretend this is a picture of your treat bag.” E will then point to the Later picture. “Now let’s pretend this is a picture of the waiting box.” E will then put the pictures side by side on the table.
“We are playing a choosing game. Each time, you will pick a toy to put in your treat bag now or another toy to put in the waiting box. If you choose the toy for the waiting box, I will put it in the waiting box and give it to you when we are done the game. If you pick the toy for right now, you can put it in your treat bag right away.” E will then point to the pictures. “We are going to use these pictures to help us remember about the choices. When the toy is for now, I put it on this picture. When the toy is for later, I put it on this picture. Are you ready?” For each trial, the examiner will say, “You can have (less preferred toy) now to put in your treat bag or you can wait until the end of the game and have (preferred toy). If you choose to wait, I will put the toy here” E point to the waiting box. “Remember, if you choose (most preferred), you will have to wait until the end of the game.”

Depending on which condition is first, E will just say for the alternate condition, “We are going to use some different pictures to help us remember the choices. E will then introduce the first part describing the pictures but will not re-explain the choices for now and later. Instead, she will say, “The game is going to be the same except we use these pictures instead to remind us of the choices.”

**Cool EF tasks**
**Shifting Task**

The game will be presented in flip book format and there will be 2 phases (pre and post-shift) for a total of 20 trials. For the pre-shift trials, children will match the target stimuli by lifting the flap that matches the colour. For the post-shift trials, children will match according to size.

**Pre-Shift**
- Show child flap book with one flap and lift flap up (for this example, the flap will be red), close flap and say, “When Cat is sleepy, Cat likes to be here” (E lifts correct flap) “When Cat is awake, Cat likes to be here” (E lifts correct flap). “Now you do it! Find Cat when he is sleepy. Find Cat when he is awake.” Demonstrated as many times as needed until the child opens the two correct flaps. For the rest of the pre-shift trials, directions are the same. For every trial, E says, “Find Awake/Sleepy cat”. Keeping reminding child, “When the cat is sleepy, he likes to hide under this one/When the cat is awake, he likes to hide under this one”. Ten trials in which the child must get 6/10 correct to continue

**Post Shift**
Children is told, “we’re going to play another new game and find a different animal” Again, there is one demonstration trial. E says, “When owl is sleepy, owl likes to hide under this one, but when owl is awake, owl likes to hide under this one.” Experimenter lifts the flaps as she is demonstrating. Flaps are reset and E says, “Now you do it. Find Owl when he is sleepy. Find Owl when he is awake.” Demonstrated as many times as needed until the child opens the two correct flaps. Trials continue in the same way.

**Working Memory**
“We are going to play a hiding game!” Take out materials and explain to the child, “Here is a house (point to the whole house) and here are the rooms of the house (open
doors to rooms). I am going to hide animals in the rooms of the house and then we’re going to try and find them.

For the practice trial, the first board should be taken out and placed over the wells. “For example, here’s the pig! I’m going to hide the pig in this room, and now see if you can put the picture of the pig on the door of the room where you think the pig is hiding.” Once child has put the picture on the door say, “Good job, now open the door and see if you’re right.” Make sure that the child understands that you open the door after putting the picture on first. Also, provide as much feedback as needed, so that the child fully understands the game.

**Trial 1:** The first coloured board is left on for the first two trials (holding and updating), as indicated on scoresheet. Explain, “Now I’m going to hide the pig again in another room for you to find.” Place the toy in the appropriate ‘hiding place’ (under the flap in the well or ‘room’; see scoring sheet for location). Ensure that the child is paying attention when the toy is hidden. By moving the toy in front of the child’s face, en route to placing the toy in well, makes the children visually focus on the animal. Then say, “This time before you find the pig, I’m going to put this magic blanket over the house and I’m going to count to 10.” Whether, the child wants to help count is left up to the child, but do not indicate that the child has to count too. Remove the blanket and place the pig picture in front of the child. Ask the child, “Now, can you put the picture of the pig on the room where you think it is hiding?”

**All subsequent trials with multiple animals:**

I’m going to hide the ___ (name of toy animal) for you to find” Place the ________ toy (see protocol for type of animal) in the appropriate ‘hiding place’ (under the flap in the well or ‘room’; see scoring sheet for location). Ensure that the child is paying attention when the toy is hidden. By moving the toy in front of the child’s face, en route to placing the toy in well, makes the children visually focus on the animal. Then say, “This time before you find the pig, I’m going to put this magic blanket over the house and I’m going to count to 10.” Whether, the child wants to help count is left up to the child, but do not indicate that the child has to count too. Remove the blanket and place all of the picture(s) of the animals in front of the child for the appropriate trial. The pictures are numbered and in order on a Velcro sheet. When placing pictures in front of child, place them in order indicated on Velcro sheet. Ask the child, “Now, can you put the pictures of the animals on the room where you think they are hiding?”

If the child successfully finds the toy on the first try say, “Good job, you found the ___ (name of animal).” Correct response = putting the picture on the correct flap. If the child does not place the picture on the correct hiding place or flap then say, “Nice try, or those animals are really tricky” Allow the child to open all of the places where a picture was placed. After all of the flaps with pictures have been opened, the child may voluntarily want to find all of the correct hiding places of the toy. Once animal(s) have been retrieved from the wells, or hiding places and the pictures have been removed, proceed to the next trial.
Inhibition task

**Training:** Place toy in one side of the tricky box (look at score sheet to see left or right; counterbalanced). Demonstrate the lever pushing up and down and say, “see this opens it” and point to door. “This is a little zoo for the animals. I’m going to get (animal name) so he can play outside. Watch me.” Close the door and say, “Now you get the (name animal)”. If child tries a direct reach instead of pushing lever, demonstrate pushing the lever up and getting the toy and say, “Do it this way”. Once the child has at least one successful trial, move to phase 1 of task.

**Phase 1:** Place the toy in the left/right side (look on scoresheet to see which) and close the door. Say, “Now I’m going to ask you to get different animals out to play. Listen carefully. Get (animal name) out of her cage”. Do five trials on this side. If child does direct reaching, demonstrate door opening with lever and say, “Look this is how it opens”. Child must get at least 3 correct to pass onto phase 2.

**Phase 2:** Place the toy in the opposite side. Proceed in same way as phase 1. Repeat until child gets 3 consecutive correct trials, up to 5 trials. Child must get at least 3 correct to pass onto phase 3. Children may get bored with the repetitiveness of this second part compared to phase 1. Phrases such as, “you’re really good at this!” and “wow look at you!” may keep the child more engaged.

**Phase 3:** Use the green box. Say, “Now we are going to play with the silly zoo”. Point to each lever and push open each door, pointing to the door as it opens. Say, “You see, it’s the opposite. This lever opens the opposite door for the animals”. Place the toy on the left/right side and close the door. Say, “Get the (name of animal)”. Allow the child time to find the correct strategy as many will push incorrect and then correct levers. Each time the child fails to use the correct strategy, remind them of the rule by saying, “See this is the one that opens the door”. If the child pushes both levers at the same time, say, “Just one at a time”. Alternate between the left and right sides for each trial and continue for 5 trials.
Delay of Gratification Illustration

**Hot condition Example of a trial**

Pretend this is us playing the game.

Who’s picking you up after daycare? Pretend this is you and your Mom......you are so happy to show her all your new toys.

If you pick a toy on this picture, you can put it right away in your bag.

Would you like this toy for your treat bag for right now?

Or would you like this toy for the waiting box for later?

If you pick the toy on this picture, I will put it in the waiting box for later.
Control condition

Same instructions as hot condition for each trial
4. Cool Executive Function Tasks

Inhibition: Tricky box

Child has to retrieve toy by pushing down the knob on the side of the box

Inhibition: Silly box

Child has to retrieve toy by pushing down the contralateral knob on the side of the box

4. Cool Executive Function Tasks

Inhibition: Tricky box

Child has to retrieve toy by pushing down the knob on the side of the box

Inhibition: Silly box

Child has to retrieve toy by pushing down the contralateral knob on the side of the box
Shifting: Preshift

Child has to match according to color by flipping over the correct “house” that the cat likes.

Child moves correct house flip over the animal and reveals a happy cat on the reverse side.

Shifting: Postshift

Child has to match according to shape by flipping over the correct “house” that the owl likes.

Child moves correct house flip over the animal and reveals a happy owl on the reverse side.
1. Working Memory Task

1. Animal is hidden behind a door.

2. Screen is pulled over the house. Examiner counts to ten with child.

3. Screen is lifted and child is asked to put picture of animal on door they think it is behind.
Participant # _______ gender ___ M/F ______ age ___________

Delay of Gratification Score Sheet

**Condition: control vs. hot**

<table>
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<th>rating</th>
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<tr>
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</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

**Order 1**

- **(bag & box) CONTROL**
  - Trial 7: 1 and 6 Now Later
  - Trial 8: 2 and 5 Now Later
  - Trial 9: 3 and 4 Now Later
  - Trial 10: 1s and 6s Now Later
  - Trial 11: 2s and 5s Now Later
  - Trial 12: 3s and 4s Now Later

- **(child & examiner/parent) HOT**
  - Trial 1: 1 and 6 Now Later
  - Trial 2: 2 and 5 Now Later
  - Trial 3: 3 and 4 Now Later
  - Trial 4: 1s and 6s Now Later
  - Trial 5: 2s and 5s Now Later
  - Trial 6: 3s and 4s Now Later

**Order 3**

- **(bag & box) CONTROL**
  - Trial 7: 1s and 6s Now Later
  - Trial 8: 2s and 5s Now Later
  - Trial 9: 3s and 4s Now Later
  - Trial 10: 1 and 6 Now Later
  - Trial 11: 2 and 5 Now Later
  - Trial 12: 3 and 4 Now Later

- **(child & examiner/parent) HOT**
  - Trial 1: 1s and 6s Now Later
  - Trial 2: 2s and 5s Now Later
  - Trial 3: 3s and 4s Now Later
  - Trial 4: 1 and 6 Now Later
  - Trial 5: 2 and 5 Now Later
  - Trial 6: 3 and 4 Now Later

**Order 2**

- **(bag & box) CONTROL**
  - Trial 7: 1 and 6 Now Later
  - Trial 8: 2 and 5 Now Later
  - Trial 9: 3 and 4 Now Later
  - Trial 10: 1s and 6s Now Later
  - Trial 11: 2s and 5s Now Later
  - Trial 12: 3s and 4s Now Later

- **(child & examiner/parent) HOT**
  - Trial 1: 1 and 6 Now Later
  - Trial 2: 2 and 5 Now Later
  - Trial 3: 3 and 4 Now Later
  - Trial 4: 1s and 6s Now Later
  - Trial 5: 2s and 5s Now Later
  - Trial 6: 3s and 4s Now Later

**Order 4**

- **(bag & box) CONTROL**
  - Trial 7: 1s and 6s Now Later
  - Trial 8: 2s and 5s Now Later
  - Trial 9: 3s and 4s Now Later
  - Trial 10: 1 and 6 Now Later
  - Trial 11: 2 and 5 Now Later
  - Trial 12: 3 and 4 Now Later

- **(child & examiner/parent) HOT**
  - Trial 1: 1s and 6s Now Later
  - Trial 2: 2s and 5s Now Later
  - Trial 3: 3s and 4s Now Later
  - Trial 4: 1 and 6 Now Later
  - Trial 5: 2 and 5 Now Later
  - Trial 6: 3 and 4 Now Later
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<tr>
<td>PS3</td>
<td>green small (sleepy)</td>
<td>green big</td>
</tr>
<tr>
<td>PS4</td>
<td>green small</td>
<td>green big</td>
</tr>
<tr>
<td>PS5</td>
<td>yellow big</td>
<td>yellow small</td>
</tr>
<tr>
<td>PS6</td>
<td>green small</td>
<td>green big</td>
</tr>
<tr>
<td>PS7</td>
<td>yellow big</td>
<td>yellow small</td>
</tr>
<tr>
<td>PS8</td>
<td>yellow big</td>
<td>yellow small</td>
</tr>
<tr>
<td>PS9</td>
<td>green small</td>
<td>green big</td>
</tr>
<tr>
<td>PS10</td>
<td>green small</td>
<td>green big</td>
</tr>
<tr>
<td>Postshift</td>
<td>Target</td>
<td>Correct</td>
</tr>
<tr>
<td>Trial</td>
<td>sort according to size</td>
<td></td>
</tr>
<tr>
<td>teach1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FB1</td>
<td>yellow big (awake)</td>
<td>green big</td>
</tr>
<tr>
<td>FB2</td>
<td>yellow big</td>
<td>green big</td>
</tr>
<tr>
<td>FB3</td>
<td>green small (sleepy)</td>
<td>yellow small</td>
</tr>
<tr>
<td>FB4</td>
<td>green small</td>
<td>yellow small</td>
</tr>
<tr>
<td>FB5</td>
<td>yellow big</td>
<td>green big</td>
</tr>
<tr>
<td>FB6</td>
<td>green small</td>
<td>yellow small</td>
</tr>
<tr>
<td>FB7</td>
<td>yellow big</td>
<td>green big</td>
</tr>
<tr>
<td>FB8</td>
<td>yellow big</td>
<td>green big</td>
</tr>
<tr>
<td>FB9</td>
<td>green small</td>
<td>yellow small</td>
</tr>
<tr>
<td>FB10</td>
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<td>yellow small</td>
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### 1. Working Memory

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<th>Days</th>
<th>Errors</th>
<th>Date</th>
<th>Hold</th>
<th>Hsp</th>
<th>Hsp2</th>
<th>Hsp2_err</th>
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<tbody>
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<td>a</td>
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<td>0</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Stop rule:** error in 2 consecutive trials
Start: try, hold > no errors or go back to hold!
### Cool EF Tasks

**Participant #** | Age 2 / 3 / 4
---|---
**Tricky Box** | Knob - 1
L teach | |
**Side 1** | mark order (1, 2, 3, etc.)
trial 1 | direct knob |
trial 2 | direct knob |
trial 3 | direct knob |
trial 4 | direct knob |
trial 5 | direct knob |
**Side 2** | mark order (1, 2, 3, etc.)
trial 1 | Direct other side C |
trial 2 | Direct other side C |
trial 3 | Direct other side C |
trial 4 | Direct other side C |
trial 5 | Direct other side C |
**Silly Box** | mark order (1, 2, 3, etc.)
R trial 1 | Direct / Same / Correct |
L trial 2 | Direct / Same / Correct |
R trial 3 | Direct / Same / Correct |
R trial 4 | Direct / Same / Correct |
L trial 5 | Direct / Same / Correct |
Appendix B

Experiment 2 Protocol

Tasks used:
Delay of gratification choice task – 12 small toys (6 pairs of toys), laminated pictures for imagining
Delay of gratification wait task – 16 stickers, sand timer, small box to cover unavailable stickers
Shifting task – Book with flaps
Inhibition – 2 boxes with clear windows, animal figurines
Working memory – 5 houses with doors ranging from 4 to 8 doors, felt animals as targets, laminated pictures of animals

Delay of Gratification: Imagining Future vs. Present

E - Experimenter
Rating: This is done before each condition. E will do the first toy rating (either A or B depending on label of the bag). E will show the child the 6 toys and say, “Which one of these is your favorite?” The toy chosen will be put in slot 1 in the sorting box. The experimenter will then show the child the remaining 5 toys and say, “Now out of these toys, which one is your favorite?” This will continue until all toys are rated.
E will make sure the child has a treat bag and say, “We are going to play a deciding game with these toys. You are going to decide whether you want the toy that goes in your treat bag or whether you want the toy that goes in the waiting box. If you decide you want the treat bag toy, it will go right away in your treat bag. If you decide you want the waiting box toy, it will go into this box (point to black box) and you will get that toy when we finish playing the game. Do you understand? What happens if you pick the treat bag toy? What happens if you pick the waiting box toy?” E makes sure child understands before continuing.

Present Condition: E will get out the appropriate picture. “We are going to use this picture to play the deciding game. Let’s pretend this is you right now playing the deciding game. This is you (point to child), this is your treat bag and this is the waiting box (point to each in turn). I’m going to put a toy here and a toy here (point to bag and waiting box on picture). If you pick the toy on the treat bag, I will put that toy in your treat bag. If you pick the toy on the waiting box picture, I will put the toy in the waiting box and you get that toy after we finish the game.”

Future Condition: E will get out the appropriate picture. “We are going to use this picture to play the deciding game. Let’s pretend this is you after we finish the game. See, you are getting the toy out of the waiting box so you can put them in your treat bag! (point to each). I’m going to put a toy here and a toy here (point to bag and waiting box on picture). If you pick the toy on the treat bag, I will put that toy in your treat bag. If you pick the toy on the waiting box picture, I will put the toy in the waiting box and you get that toy after we finish the game.”

Delay of Gratification: Wait
E will start out by getting 1 sticker and 4 stickers out along with the timer. E will say, “See this timer (E points to timer), this is going to help us see how long to wait. When
you choose 1 sticker, you can have it right away to put in your sticker book. When you choose 4 stickers, you have to wait until all the sand is gone from the top of this timer before you can get the 4 stickers. But if you change your mind and decide you don't want to wait, you can take the 1 sticker at any time and we will go onto the next trial. Does that sound ok?” E will then cover 3 of the 4 stickers to show it is not available. If the child waits the full 30 seconds, the 3 stickers are uncovered and children are told they can put them in their sticker book. If the child waits the full 30 seconds for the two trials, E will proceed to 1 minute trials. E will say, “Great, now we will do some harder ones. This time, you will have to wait 2 turns of the sandtimer. Once again, if you change your mind while you are waiting, you can take the 1 sticker. After 1 turn of the sandtimer, I will put 2 stickers out and then reset the sandtimer. If you want to take the 2 stickers before the time is up, you can do that. If you wait some more, you can have the rest of the stickers. Ready, here we go.”

Cool EF Tasks

Exactly the same procedure/materials/scores sheets as Experiment 1
Pictures from Experiment Two

Girl Present Condition

Girl Future Condition

Boy Present Condition

Boy Future Condition
Score Sheet for Delay of Gratification Task

<table>
<thead>
<tr>
<th>Toy DoG</th>
</tr>
</thead>
<tbody>
<tr>
<td>toy name</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Future 1st Order</th>
<th>Present 1st Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Future - Trial 1</td>
<td>Present - Trial 1</td>
</tr>
<tr>
<td>1 and 6</td>
<td>1 and 6</td>
</tr>
<tr>
<td>Now___</td>
<td>Now___</td>
</tr>
<tr>
<td>Later___</td>
<td>Later___</td>
</tr>
<tr>
<td>Future - Trial 2</td>
<td>Present - Trial 2</td>
</tr>
<tr>
<td>2 and 5</td>
<td>2 and 5</td>
</tr>
<tr>
<td>Now___</td>
<td>Now___</td>
</tr>
<tr>
<td>Later___</td>
<td>Later___</td>
</tr>
<tr>
<td>Future - Trial 3</td>
<td>Present - Trial 3</td>
</tr>
<tr>
<td>3 and 4</td>
<td>3 and 4</td>
</tr>
<tr>
<td>Now___</td>
<td>Now___</td>
</tr>
<tr>
<td>Later___</td>
<td>Later___</td>
</tr>
<tr>
<td>Present - Trial 1</td>
<td>Future - Trial 1</td>
</tr>
<tr>
<td>1 and 6</td>
<td>1 and 6</td>
</tr>
<tr>
<td>Now___</td>
<td>Now___</td>
</tr>
<tr>
<td>Later___</td>
<td>Later___</td>
</tr>
<tr>
<td>Present - Trial 2</td>
<td>Future - Trial 2</td>
</tr>
<tr>
<td>2 and 5</td>
<td>2 and 5</td>
</tr>
<tr>
<td>Now___</td>
<td>Now___</td>
</tr>
<tr>
<td>Later___</td>
<td>Later___</td>
</tr>
<tr>
<td>Present - Trial 3</td>
<td>Future - Trial 3</td>
</tr>
<tr>
<td>3 and 4</td>
<td>3 and 4</td>
</tr>
<tr>
<td>Now___</td>
<td>Now___</td>
</tr>
<tr>
<td>Later___</td>
<td>Later___</td>
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</tbody>
</table>

Waiting Trials

<table>
<thead>
<tr>
<th>Trial</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1 (30s)</td>
<td>take 1</td>
<td>full delay - 3 more</td>
</tr>
<tr>
<td>Trial 2 (30s)</td>
<td>take 1</td>
<td>full delay - 3 more</td>
</tr>
<tr>
<td>Trial 3 (1m)</td>
<td>take 1</td>
<td>take 2</td>
</tr>
<tr>
<td>Trial 4 (1m)</td>
<td>take 1</td>
<td>take 2</td>
</tr>
</tbody>
</table>
Appendix C

Supplementary Tables

Table 1

*Proportion of Trials in Which Children Chose to Delay as a Function of Condition and Age*

<table>
<thead>
<tr>
<th>Delay of Gratification</th>
<th>Control Condition</th>
<th>Self in Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-year-olds</td>
<td>0.38 (0.36)</td>
<td>0.42 (0.32)</td>
</tr>
<tr>
<td>4-year-olds</td>
<td>0.42 (0.39)</td>
<td>0.57 (0.35)</td>
</tr>
<tr>
<td>Total</td>
<td>0.39 (0.37)</td>
<td>0.49 (0.34)</td>
</tr>
</tbody>
</table>

Table 2

*Proportion of Trials in Which Children Chose to Delay as a Function of Condition Order and Age*

<table>
<thead>
<tr>
<th>Order and Age</th>
<th>Control Condition</th>
<th>Self-Primed Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control First</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Primed First</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control First</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Primed First</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year-olds</td>
<td>0.35 (0.32)</td>
<td>0.41 (0.40)</td>
</tr>
<tr>
<td></td>
<td>0.40 (0.34)</td>
<td>0.45 (0.31)</td>
</tr>
<tr>
<td>4-year-olds</td>
<td>0.38 (0.47)</td>
<td>0.44 (0.32)</td>
</tr>
<tr>
<td></td>
<td>0.59 (0.41)</td>
<td>0.55 (0.30)</td>
</tr>
<tr>
<td>Total</td>
<td>0.36 (0.38)</td>
<td>0.43 (0.36)</td>
</tr>
<tr>
<td></td>
<td>0.48 (0.38)</td>
<td>0.50 (0.30)</td>
</tr>
</tbody>
</table>
### Table 3

**Scores on the Two Executive Function Tasks as a Function of Age**

<table>
<thead>
<tr>
<th>Age</th>
<th>Inhibition</th>
<th>Shifting</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tricky</td>
<td>Silly</td>
<td>Preshift</td>
<td>Postshift</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year-olds</td>
<td>0.93 (0.18)</td>
<td>0.63 (0.26)</td>
<td>0.60 (0.23)</td>
<td>0.28 (0.30)</td>
<td></td>
</tr>
<tr>
<td>4-year-olds</td>
<td>0.98 (0.03)</td>
<td>0.83 (0.18)</td>
<td>0.69 (0.25)</td>
<td>0.38 (0.30)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.96 (0.14)</td>
<td>0.71 (0.25)</td>
<td>0.64 (0.24)</td>
<td>0.32 (0.30)</td>
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</table>

### Table 4

**Age and Shifting Scores as Predictors of Scores in the DoG Self-Primed Condition**

<table>
<thead>
<tr>
<th>Age</th>
<th>Sum of Squares</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>0.45</td>
<td>1</td>
<td>4.07</td>
<td>.048*</td>
</tr>
<tr>
<td>Residual</td>
<td>6.87</td>
<td>62</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>7.33</td>
<td>63</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Shifting Scores**

<table>
<thead>
<tr>
<th>Age</th>
<th>Sum of Squares</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>0.93</td>
<td>2</td>
<td>4.42</td>
<td>.016*</td>
</tr>
<tr>
<td>Residual</td>
<td>6.40</td>
<td>61</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>7.33</td>
<td>63</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*p < .05
Table 5

Age and Shifting Scores as Predictors of Scores in the DoG Control Condition

<table>
<thead>
<tr>
<th>Age</th>
<th>Sum of Squares</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>0.29</td>
<td>1</td>
<td>0.21</td>
<td>.652</td>
</tr>
<tr>
<td>Residual</td>
<td>8.61</td>
<td>62</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>8.64</td>
<td>63</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shifting Scores</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>0.46</td>
<td>2</td>
<td>1.73</td>
<td>.186</td>
</tr>
<tr>
<td>Residual</td>
<td>8.17</td>
<td>61</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>8.64</td>
<td>63</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>

*p < .05

Table 6

Proportion of Trials in Which Children Chose to Delay as a Function of Condition and Age

<table>
<thead>
<tr>
<th>Delay of Gratification</th>
<th>Present Self Condition</th>
<th>Future Self Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year-olds</td>
<td>0.46 (0.31)</td>
<td>0.65 (0.34)</td>
</tr>
<tr>
<td>4-year-olds</td>
<td>0.67 (0.34)</td>
<td>0.64 (0.36)</td>
</tr>
<tr>
<td>Total</td>
<td>0.58 (0.34)</td>
<td>0.64 (0.35)</td>
</tr>
</tbody>
</table>
Table 7

*Proportion of Trials in Which Children Chose to Delay as a Function of Condition*

*Order and Age*

<table>
<thead>
<tr>
<th></th>
<th>Present Self Primed</th>
<th>Future Self Primed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present First</td>
<td>Future First</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year-olds</td>
<td>0.43 (0.28)</td>
<td>0.50 (0.36)</td>
</tr>
<tr>
<td>4-year-olds</td>
<td>0.59 (0.36)</td>
<td>0.74 (0.30)</td>
</tr>
<tr>
<td>Total</td>
<td>0.52 (0.33)</td>
<td>0.65 (0.34)</td>
</tr>
</tbody>
</table>

Table 8

*Scores on the Two Executive Function Tasks as a Function of Age*

<table>
<thead>
<tr>
<th></th>
<th>Inhibition</th>
<th>Shifting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tricky</td>
<td>Silly</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-year-olds</td>
<td>0.96 (0.09)</td>
<td>0.46 (0.27)</td>
</tr>
<tr>
<td>4-year-olds</td>
<td>0.97 (0.05)</td>
<td>0.67 (0.04)</td>
</tr>
<tr>
<td>Total</td>
<td>0.97 (0.07)</td>
<td>0.58 (0.27)</td>
</tr>
</tbody>
</table>
Table 9

*Age and Inhibition Scores as Predictors of Scores on The Hybrid DoG Task*

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>0.00</td>
<td>1</td>
<td>0.01</td>
<td>.934</td>
</tr>
<tr>
<td>Residual</td>
<td>8.38</td>
<td>54</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>8.38</td>
<td>55</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inhibition Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
</tr>
<tr>
<td>Residual</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

*p < .05

Table 10

*Age, Inhibition Scores and DoG Choice Scores as Predictors of Hybrid DoG Scores*

<table>
<thead>
<tr>
<th>Age, Inhibition and</th>
<th>Sum of Squares</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoG Choice</td>
<td></td>
<td></td>
<td></td>
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*p < .05, **p < .01