

THE INFLUENCE OF HOT AND COOL EXECUTIVE FUNCTION ON SOCIAL
NORM LEARNING AND SHARING IN PRESCHOOL CHILDREN

BY

SARAH DANIELLE ENGLISH

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Abstract

Research indicates that norm understanding, as indicated by complying to and enforcing social norms, develops during the preschool years. In addition, children refine prosocial behaviours during this time. While hot and cool executive function (EF) abilities have been explored as independent systems, few studies have investigated the impact of their interaction on more complex cognitive abilities. Therefore, the current study examined the effects of both hot and cool EF on preschool children's sharing behaviours after viewing an Ultimatum-style norm paradigm. The sample consisted of 101 three- and four-year-old children ($M = 3.58$ years, $SD = 0.50$) including 55 females and 46 males from daycares in rural New Brunswick and Nova Scotia, Canada. Participants completed a number of tests of EF including working memory, inhibitory control, as well as a version of the Preschool Gambling task. Participants also completed a task to assess social norm learning which included three phases: baseline sharing, norm learning, and post-manipulation sharing. Whether children observed a generous or stingy model of sharing did not influence subsequent sharing behaviour on its own. Rather, a cluster analysis resulting in three distinct groups differing on baseline sharing and rejection rates suggested that individual differences may be more important in determining sharing behaviours. Moreover, the findings suggest that a balanced combination of both hot and cool EF abilities are necessary for understanding and complying to social norms. The findings of this study will help to inform the field about the early processes which underlie social norm learning, and more broadly, prosocial development.

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Table of Contents

Title Page	i
Abstract	ii
Acknowledgements	iii
List of Tables	viii
List of Figures	ix
List of Appendices	x
Introduction	1
Executive Function	1
Iowa Gambling Task (IGT)	5
Children’s Gambling Task (CGT)	7
Norm Learning, Compliance, and Enforcement	8
Social Norms and Prosocial Behaviour	12
Neural Networks of Norm Formation, Compliance, and Enforcement	15
Present Study	18
Method	19
Participants.....	19
Materials	20
Procedure	21
Results	27
Effects of Age and Condition	28
Exploring Individual Differences	29
Effect of Condition by Cluster	31
Exploring Differences in Hot and Cool EF.....	32
Group Performance on Moral and Conventional Reasoning.....	34
Discussion	35
Influence of Condition on Norm Learning and Sharing	36
Combined Influence of Hot and Cool EF on Sharing Tendencies.....	39

Group Performance on Moral and Conventional Transgression Reasoning	44
Limitations and Future Research	47
Summary and Conclusion	49
References	50
Appendix A	58
Consent Form	58
Appendix B	60
Tasks	60

List of Tables

Table 1: Mean and Standard Deviation of all variables

Table 2: Intercorrelations among Big Boss and EF variables

Table 3: EF Loadings on the Discriminant Functions

Table 4: Summary of Cluster Characteristics

List of Figures

Figure 1: Cluster scores on Baseline Sharing, Post-Manipulation Sharing, and Rejection

Figure 2: Big Boss Cluster Scores on the Discriminant Functions

List of Appendices

Appendix A: Consent Form

Appendix B: Tasks

The Influence of Hot and Cool Executive Function on Social Norm Learning and Sharing in Preschool Children

From a young age, we learn that how we act affects our interactions with others; however, we are not born with inherent knowledge of socially appropriate behaviour. Consider 3-year-old Sam, for example. During the preschool years, Sam will begin to develop an understanding of various social norms (Schmidt & Rakoczy, 2018), like waiting their turn in line to wash their hands, and sitting quietly during circle time. This understanding is demonstrated by the compliance to, and enforcement of such norms (Rakoczy, 2008; Rakoczy, Hamann, Warneken, & Tomasello, 2010); abilities which are essential in order to successfully function in society. Additionally, the preschool years are a time in which Sam will begin to develop prosocial behaviours; intentional behaviours which result in benefits for another person (Greener, 2000). These behaviours include actions such as comforting a friend, and sharing toys with other children. Sharing is considered to be a complex prosocial behaviour as it is often costly to oneself (Paulus & Moore, 2012). Numerous developmental changes associated with both hot and cool executive functions, such as decision-making abilities and inhibitory control, affect the extent to which children adhere to social norms and engage in prosocial behaviours. Therefore, the purpose of the present study is to examine the influence of hot and cool executive function abilities on social norm learning and sharing behaviours in preschool children.

Executive Function

Executive function (EF) abilities are adaptive, goal-directed behaviours which allow an individual to override pre-established thoughts and automatic responses. EFs

begin to develop during the first five years of life and act as a foundation for the development of higher cognitive processes (Garon, Bryson, & Smith, 2008). This higher order group of abilities aids in numerous areas including planning ahead, reasoning, novel problem solving, and paying attention (Barkley, 2012). Research has indicated that these abilities develop most rapidly during the preschool years, suggesting that this is a highly malleable period during development (Zelazo & Carlson, 2012).

Recently, a distinction has been made between “hot” and “cool” executive functions (Zelazo & Carlson, 2012). Cool EFs are more strongly associated with the regulation of cognition and behavioural responses and allow for adjustment and persistence when resolving a conflict. Think back to 3-year-old Sam; at first, they may not immediately understand why they must wait in line for a turn on the playground slide. Rather than becoming frustrated and upset, Sam could refer back to a similar instance, such as waiting in line to wash their hands, and use that information to guide their behaviour in a new context – waiting for a turn on the slide. On the other hand, hot EFs are more strongly associated with the regulation of motivation and affect during conflict resolution (Garon, 2016). If Sam and Alex become interested in the same toy during playtime, Sam must decide how desperately they want the toy; they could insist on taking the toy and disregard Alex’s feelings, or choose to play a different game until the toy becomes available again. When engaging EFs, one activates existing representations in long-term memory. Cool EFs tend to rely on more stable and unchanging long-term memories, like the repetitive nature of waiting one’s turn; while hot EFs utilize representations that are more malleable, allowing for quicker, although more variable

responses during an environmental change (Garon, 2016), such as the toy one chooses to play with on a given day.

Cool EFs typically deal with the control of cognitive processes such as abstract problem solving and effortful regulation of thoughts and behaviours (Zelazo & Muller, 2002). Working memory, response inhibition, and set shifting are all examples of cool EF abilities. Working memory is a temporary store in which information relevant to the task at hand is held and manipulated, and is necessary for other complex cognitive tasks such as reasoning and language comprehension (Baddeley, 1992). Response inhibition requires an individual to use task-specific rules held in working memory to override a dominant response (Garon et al., 2008). This ability has been shown to improve with the maturation of the prefrontal cortex. While three and four-year-old children may know that they are not supposed to do something, they are unable to inhibit an inappropriate response due to an immature inhibitory mechanism (Dowsett & Livesey, 2000; Zelazo, Mueller, Frye, & Marcovitch, 2003). Task shifting, or set-shifting requires an individual to shift from one mental set to another and involves two phases (Garon et al., 2008). During the first phase, the individual forms an association between a stimulus and a (correct) response, while the second phase requires the individual to shift to a new mental set that is in conflict with the first mental set. This mental flexibility is critical in order to successfully shift between sets and allows an individual to attend to the appropriate stimulus while ignoring distractors (Garon et al., 2008).

In comparison to cool EF, little research has been done exploring hot EF; in particular, research regarding hot EF in preschool children is sparse (Garon, 2016). In contrast to cool EF, hot EFs are more reliant on bottom-up, stimuli-driven processes that

begin to develop in children between the ages of three and four (Garon, 2016; Kerr & Zelazo, 2004). Central to hot EF is emotion regulation and future-oriented decision-making; abilities that have been associated with the ventromedial prefrontal cortex (vmPFC; Garon, 2016). These processes are essential in emotional and motivational contexts, providing the flexibility needed to reappraise a situation when deciding whether to approach or avoid a salient stimulus (Semenov & Zelazo, 2018).

In addition to the distinct research on hot and cool EF, investigating the interaction between the two aspects is equally important for understanding social and cognitive development (Zelazo, Qu, & Kesek, 2010). Recently, researchers have utilized methods of investigation which integrate aspects of both hot and cool EF. In a popular “Less is More” game, Carlson (2005) asked children to choose between two piles of jellybeans; one pile contained five jellybeans while the other contained two. However, children were told that the pile they selected would go to a puppet, and the child would be given the unselected pile. This task required children to inhibit their automatic gravitation toward selecting the larger pile for themselves. Carlson (2005) found that when in a “hot” context; for instance, a situation in which decision-making is done in a motivational context (involving potential gains and losses; Garon, 2016), it was more difficult for children to follow explicit instructions; in this case, inhibiting their own personal desires to obtain a particular reward. Considering this, cool EF appears to be necessary for success in tasks that require a rule-based decision, such as the child remembering to select the pile they *do not* want; however, this can often be disrupted by an attractive stimulus such as candy or small toys, which activates the hot EF system.

Iowa Gambling Task (IGT)

The Iowa Gambling Task (IGT) is a popular test of hot executive functioning. Developed by Bechara, Damasio, Damasio, and Anderson (1994), the task simulates personal, real-life decision-making by incorporating both gains and losses over a series of choices. The goal of the IGT is to maximize profit on an initial loan of \$2000 (fake money) by selecting cards. Participants are presented with four decks of cards, where two decks are advantageous, and two decks are disadvantageous. The magnitude and frequency of gains and losses differ between the decks. Participants are asked to select one card per trial and are unaware of which decks are advantageous/disadvantageous; nor are they aware of the number of trials they will complete. To maximize profit, participants must choose from the advantageous decks. These decks offer lesser gains on each trial (i.e., \$50) and fewer, recurring losses. In contrast, the disadvantageous decks offer a greater gain on each trial (i.e., \$100); however, they also contain larger, recurring losses (Bechara et al., 1994; Zelazo et al., 2010).

The IGT was initially developed to assess decision making in patients with damage to the vmPFC (Bechara et al., 1994), an area in which proper functioning is necessary for hot EF. Individuals with damage to this brain area exhibit dramatic disturbances in personality and behaviour, including poor decision-making, inappropriate social behaviours, and blunted emotional experience. Importantly, they lack impulse control and insight into the potentially adverse repercussions of their actions (Boes et al., 2011).

Bechara et al. (1994) used the IGT to evaluate decision-making in patients with damage to the vmPFC, and compared performance to individuals with no vmPFC

damage (healthy controls). They found that, in a sharp contrast to healthy controls, vmPFC patients chose significantly more cards from the disadvantageous decks than from the advantageous decks. While the performance of healthy controls improved after selecting a certain number of cards, vmPFC patients did not show the same improvement (Bechara et al., 1994; Bechara, Tranel, Damasio, & Damasio, 1996).

Given that the IGT requires decision-making based on no prior or explicit knowledge of the contingencies of the decks, participants must rely on emotion-based “gut feelings” when selecting a card. Damasio (1994) proposed the somatic marker hypothesis in an effort to explain the poor decision-making noted in vmPFC patients during the IGT. Typically measured through skin conductance responses, somatic markers derive from bioregulatory processes which help to guide and maintain attention, and are often associated with an increased heartbeat, or feelings of nausea (Damasio, 1994; Damasio, Everitt, & Bishop, 1996; Bechara et al., 1996). In regard to the IGT, somatic markers may aid in alluding to the nature of the outcome of each deck of cards and in turn, bias choice selection. A substantial amount of evidence supporting the somatic marker hypothesis comes from studies involving the IGT (Dunn, Dalgleish, & Lawrence, 2006). During the task, both healthy controls and vmPFC patients generated skin conductance responses in reaction to gains and losses. However, as healthy controls became more experienced with the task, they began to develop skin conductance responses prior to selecting a card; vmPFC patients failed to develop this anticipatory response entirely (Damasio, 1996; Bechara et al., 1996; Dunn et al., 2006). The absence of such responses in vmPFC patients is correlated with poor decision-making on the IGT (Dunn et al., 2006). One suggestion is that biasing signals are regulated and represented

in the emotional centre of the brain; specifically, the vmPFC may be responsible for tracking gain contingencies (Damasio, 1996; Bechara et al., 1996; Dunn et al., 2006). Failure to activate a somatic marker occurs when bioregulatory processes function improperly. As such, vmPFC patients remain insensitive to the possibility of further punishment by continuing to select from the disadvantageous decks (Dunn et al., 2006).

Children's Gambling Task (CGT)

In 2004, Kerr and Zelazo adapted the IGT in an effort to assess this decision-making in preschoolers. Up until that point, hot EF in preschoolers had most commonly been assessed with the use of delay of gratification tasks (Mischel, Shoda, & Rodriguez, 1989). Numerous aspects of the Children's Gambling Task (CGT) differ from those of the traditional IGT. Participants are required to select cards from two decks, rather than four decks, and the number of trials is reduced from 100 trials to 50 trials. Further, cards depict happy/sad faces which corresponded to gains/losses, and toys and candy were used as rewards in place of fake money.

Successful completion of the CGT differs between preschool children in respect to their age, where four-year-olds have been found to choose more cards from the advantageous deck, and three-year-olds from the disadvantageous deck (Garon, 2016). Age differences are shown to emerge over the course of the task such that the four-year-olds performance improved as they completed more trials, whereas three-year-olds did not show improvement in performance (Kerr & Zelazo, 2004; Garon & Moore, 2007a, Garon & Moore, 2007b; Heilman, Miu, & Benga, 2008; Zelazo et al., 2010). Additionally, studies have found that three-year-olds make more choices from the disadvantageous deck than predicted by chance, while four-year-olds make more choices

from the advantageous deck than predicted by chance (Kerr & Zelazo, 2004; Hongwanishkul, Happaney, Lee, & Zelazo, 2005).

An important aspect of the IGT is the ability to utilize feedback to adjust behaviour, something that is necessary for surviving in a complicated social world. Fellows (2016) proposed that the vmPFC network underlying hot EF is necessary for using feedback to form value-based representations, and using these representations to adjust behaviour. Bechara et al. (1996) showed that despite having explicit awareness of the “good decks”, patients with vmPFC lesions were unable to adjust their behaviour to correspond with this information and continued to select cards from the “bad decks”. As explained by Damasio (1996), failure to adjust behaviour may be explained by a lack of anticipatory somatic responses. Previous studies have suggested that the vmPFC is responsible for tracking gain contingencies, and may aid in eliciting somatic responses and biasing selection towards the advantageous decks (Damasio, 1996; Bechara et al., 1996; Dunn et al., 2006). Studies involving patients with vmPFC lesions have shown that these individuals are unable to produce somatic responses before choosing from the bad decks, leading to poorer decision-making when compared to healthy controls (Dunn et al., 2006). The finding that three-year-olds make choices comparable to individuals with vmPFC lesions has been taken as support for a functionally immature vmPFC network (Kerr & Zelazo, 2004).

Norm Learning, Compliance, and Enforcement

Norms are defined as standards of behaviour governed by shared expectations of how individuals ought to act in a specific situation (Chang & Koban, 2013; Fehr & Fischbacher, 2004). From the time we are young, we are aware of a number of different

rules and norms that we are expected to follow. Whether on the playground, at a hospital, or in line at the grocery store, we learn from an early age that how we behave affects our interactions with others. The ability to understand and enforce simple social norms begins to develop by two to three years of age (Schmidt & Rakoczy, 2018). Much of what we know and learn comes from observing those around us. The majority of research on norm learning has focused on the extent to which children observe and generalize behaviour they consider to be “normative” (Schmidt & Rakoczy, 2018). Research indicates that children are selective in who they choose as a model for norm learning. For instance, Rakoczy, Warneken, and Tomasello (2009) manipulated the reliability of a model such that preschool children were presented with a novel game by a puppet considered to be “reliable”, or one considered to be “unreliable”. It was found that children were more inclined to imitate actions performed by the reliable model; treating those actions as normative, as demonstrated by their protests in response to the unreliable puppets actions (Rakoczy et al., 2009). To establish that imitation was not random, the researchers posed questions following the game. In addition to explicitly stating that the reliable puppet had played the game correctly, children could also restate the rules of the game according to the way the reliable puppet had played (Rakoczy et al., 2009).

In most everyday situations, explicit information regarding the reliability of a potential model is often lacking. In such instances, previous studies have suggested that when faced with a novel conventional activity, children prefer to selectively learn from adult models when compared to peer models (Rakoczy et al., 2010). Rakoczy et al. (2010) introduced three and four-year-old children to the objects used in a novel game called ‘Daxing’. The experimenter explained to the child that they would first watch a

video of two people (a child actor and an adult actor) playing the game, and then it would be their turn to play. In the video, the adult actor played the game by a specific set of rules, while the child actor played by a different set of rules. Each actor played according to their set of rules two times. Following the video, the child was handed the objects and told it was their turn to 'Dax'. Once the child had played the game, a puppet joined and played the game as well. In the control condition, the puppet acted according to the rules of the adult actor, while in the experimental condition, the puppet acted according to the rules of the child actor. Results showed that children imitated the actions of the adult actor significantly more often than the child actor. Further, children protested against the puppets actions significantly more in the experimental condition than in the control condition (Rakoczy et al., 2010). Such findings support those of Zmyi, Daum, Prinz, & Aschersleben (2008) who found that children as young as 14-months selectively imitated an adult model more often than a peer model when learning a novel action (Rakoczy et al., 2010). Moreover, Hardecker, Schmidt, and Tomasello (2017) found that children as old as five years viewed game rules created by adults to be more normative and therefore less alterable than game rules created by a child and their peers. Taken together, these findings suggest that children are more likely to imitate actions performed by a reliable, adult model; while protests and objections to third-party actions discordant with such models suggest that children understand these actions to be normative in nature, and should be followed and enforced as such (Rakoczy et al., 2010).

Normative thinking changes considerably during the preschool period (Schmidt & Rakoczy, 2018). Part of this change has to do with general development in social cognition, such as the ability to understand and integrate observable behaviours, as well

as the unobservable mental states of others (Schmidt & Rakoczy, 2018). These changes in social cognition allow one to develop an understanding of normativity and are hypothesized to consist of two processes: a fast, but inflexible system for tracking “belief-like” states, and a slower, but more flexible system for dealing with explicit reasoning about beliefs and attitudes (Schmidt & Rakoczy, 2018). Research findings exploring children’s understanding and reasoning about norms indicates a shift from reliance on this inflexible system to the more flexible system. At age two, children can understand the prescriptive nature of norms, while the ability to understand context-relativity (the idea that norms are flexible) develops at age three (Rakoczy, 2008; Rakoczy, Brosche, Warneken, & Tomasello, 2009; Wyman, Rakoczy, & Tomasello, 2009). By the age of four, children are able to distinguish between moral and conventional norms (Schmidt & Rakoczy, 2018).

According to the social domain theory, children actively strive to interpret and make sense of the social world (Smetana, Jambon, & Ball, 2014). It is hypothesized that there are three distinct forms of social knowledge: moral, social-conventional, and psychological (Smetana et al., 2014). Children’s personal experiences of harm and fairness during interpersonal interactions aid them in developing a generalizable understanding of moral concepts and how one ought to behave towards others (Smetana et al., 2014). The social domain theory defines morality in terms of understanding acts that have consequences for others welfare, fairness, and rights; while conventions are described as context-relative, agreed upon, and contingent upon specific rules that are alterable (Smetana et al., 2014). Conventional transgressions are viewed as less serious and less deserving of punishment than moral transgressions, which are considered serious

and universally wrong, even in the absence of an explicit rule (Smetana et al., 2014; Smetana, 1981).

One method for studying children's increasing understanding of norms is the use of norm violation paradigms. While the enforcement of norms is widely considered to be the responsibility of an adult and children have been labelled as passive norm followers (Schmidt, Rakoczy, and Tomasello, 2012), researchers have shown that children will protest in response to norm violations by a third-party (Rakoczy, 2008; Rakoczy et al., 2010). To investigate children's understanding of moral and conventional norms; in particular, the scope of which they view these norms, Schmidt et al. (2012) looked at the extent to which children would enforce social norms on two groups: in-group members, and out-group members. It was shown that children did not enforce all norm transgressions equally (Schmidt et al., 2012). When presented with a conventional norm transgression, children were more likely to protest to in-group, but not out-group, members. Interestingly, when presented with a moral norm transgression, children protested equally to violations by both in-group and out-group members (Schmidt et al., 2012). Such findings posit that children understand conventional norms to exist within the scope of their own social group, while moral norms pertain to a much wider scope of people; such that violations of these norms are unacceptable regardless of group membership (Schmidt et al., 2018).

Social Norms and Prosocial Behaviour

Prosocial behaviour is defined as voluntary, intentional actions that result in benefits for another person (Greener, 2000). While there are many forms of prosocial behaviour, three main subtypes have been discussed extensively in the literature: sharing,

helping, and comforting (see Paulus & Moore, 2012 for a review). Of these, sharing is considered to be more complex in that it involves a sacrifice of personal resources in order to distribute them with another (Paulus & Moore, 2012).

Numerous studies have suggested that sensitivity to fairness and equal allocation of resources is present within the first two years of life (Geraci & Surian, 2011; Brownell, Svetlova, & Nichols, 2009; Schmidt & Sommersville, 2011). Geraci and Surian (2011) examined 12- to 18-month-olds preferential looking behaviours. Children were presented with animated videos depicting equal and unequal distributions of resources, with results indicating that older infants looked longer at equal distributions, compared to unequal. Supporting these findings, Schmidt and Sommersville (2011) investigated fairness sensitivity and altruistic behaviour in 15-month-olds. Children viewed a third-party distribution task which was followed by a sharing task to measure behavioural responses. Results showed that infants possess a sense of fairness as illustrated by more time spent looking at the videos in which resources were allocated equally (Schmidt & Sommersville, 2011). Interestingly, in the sharing task, while children did engage in sharing behaviour, the majority of children opted to share non-preferred toys, compared to preferred toys (Schmidt & Sommersville, 2011). This highlights the presence of a self-serving bias held by young children when they may benefit in resource distribution situations (Smith, Blake, & Harris, 2013).

Despite explicit knowledge, children do not always align their behaviours with the principles of fairness (Blake, McAuliffe, & Warneken, 2014). Smith et al. (2013) noted that when asked to make judgements about distributing resources to a third party, young children were in favour of equal allocations; however, when observing children in

naturalistic settings, instances of sharing with peers were few and far between in preschool-aged children. Moreover, when faced with standardized sharing paradigms, preschool children tend to allocate more resources to themselves (Smith et al., 2013).

The tendency to share portions of one's resources increases between the ages of three and eight years of age (Kogut, 2012). Fehr, Bernhard, and Rockenbach (2008) found that during Dictator and Ultimatum-style games, three- and four-year-olds often behaved selfishly, while Kogut (2012) found that five- and six-year-olds, although explicitly aware of fairness norms, also opted to act selfishly more often than they chose to share. Only seven- and eight-year-old children consistently endorsed fairness norms while also adapting their behaviour to align with these beliefs (Kogut, 2012). Moreover, when endorsing fairness norms and predicting sharing behaviours, Smith et al. (2013) also found a distinct age difference. While three- to six-year-old children advocated for an equal distribution of resources and predicted that other children would share equally with them, they asserted that they themselves would not follow the fairness norm; this assertion was found to be true following a subsequent sharing task. In contrast, seven- and eight-year-old children endorsed equal allocation of resources, and correctly predicted that both they, and other children would behave in accordance with the fairness norm and share equally (Smith et al., 2013).

The gap that exists between the understanding of fairness and sharing behaviours in young children may stem from immature inhibitory control when children must choose between adhering to the sharing norm, or impulsively taking more resources for themselves (Smith et al., 2013). As noted in the literature, three- and four-year-old children are shown to have poor inhibitory control; a skill that increases with the

development of the prefrontal cortex (Dowsett & Livesey, 2000; Zelazo et al., 2003).

This developmental shift from an immature inhibitory mechanism, to one that is more stable and mature may explain the increase in behavioural adjustment to correspond with sharing norms as children get older.

Neural Networks of Norm Formation, Compliance, and Enforcement

Involvement of brain networks associated with hot EF. While social norms have been studied extensively in the field of social psychology, little is known about the neural networks involved in social norm learning and compliance (Chang & Koban, 2013). In recent years, social norms have emerged as a popular topic in the area of behavioural economics. Studies involving social dilemmas, such as the Ultimatum Game, have been used in an effort to determine how individuals understand and conform to social norms (Chang & Koban, 2013). In the Ultimatum Game, the proposer offers a split of money to a responder who then accepts or rejects the offer. If the responder accepts the offer, both participants receive the distributed amounts; however, if the responder rejects the offer, both participants receive nothing (Xiang, Lohrenz, and Montague, 2013). Previous research has shown that individuals are willing to reject an unequal offer, even at a cost to themselves, in order to punish the transgressor and enforce the norm (Chang & Koban, 2013). Xiang et al. (2013) used a norm-training paradigm featuring the Ultimatum Game to look at the neural network activation in response to norm violations. Participants were placed in an fMRI scanner and assigned to one of three conditions in order to pre-condition them to low, medium, or high offers. Halfway through the experiment, the splits of money began to differ from previous offers; such that participants who initially received high amounts of money began to receive lower offers,

and those who initially received lower amounts began to receive higher offers (Xiang et al., 2013).

Results showed that individuals who initially received higher offers rejected low offers more frequently than those who initially received low offers (Xiang et al., 2013). At the neural level, the medial orbitofrontal cortex (mOFC) was activated by norm prediction errors and the subjective feelings associated with normative decision making (Xiang et al., 2013). Further, the anterior insula was activated in response to norm prediction errors during norm violations, while activity in the ventromedial striatum was positively correlated with positive norm prediction errors and activity in the dorsolateral striatum was positively correlated with negative norm prediction errors (Xiang et al., 2013). Positive and negative norm errors occurred when the participant received more or less than the expected offer, respectively, where the expected offer was the initial amount that had been offered in the first half of the experiment (Xiang et al., 2013). Chang and Koban (2013) proposed that these neural signals provide the feedback that individuals use to adjust their beliefs about norms and thus, it is this affective error signal that elicits the motivation to conform to and enforce social norms.

Involvement of brain networks associated with cool EF. While conforming to social norms and enforcing these expectations upon others are critical skills to have when navigating the social world, the ability to overcome previous learning and adapt to changing norms is equally as important. Norms are ever-changing in society and individual's attitudes toward such changes are crucial for societal progression (Yomogida et al., 2017). To examine the neural bases of attitude changes both toward and away from a norm, Yomogida et al. (2017) exposed participants to persuasive messages regarding

norms while in an fMRI scanner. Following the persuasion task, participants reported the extent to which they agreed with a norm or belief. Results revealed that messages involving persuasion toward a particular norm activated a set of brain regions including the temporal poles, the temporo-parietal junction (TPJ), and the medial prefrontal cortex (mPFC); while persuasive messages away from a norm recruited the left medial temporal gyrus, and supermarginal gyri (Yomogida et al., 2017). Further, the dorsolateral prefrontal cortex (dlPFC) and the dorsomedial prefrontal cortex (dmPFC) were both found to be associated with self-reported attitude changes about specific norms and beliefs during all persuasion conditions; suggesting they are crucial areas for overcoming previous learning and adjusting norm-based attitudes (Yomogida et al., 2017).

Additional support for the involvement of dlPFC networks comes from studies investigating the neural activation involved in social norm compliance when deviating from the norm may result in punishment (Li et al., 2018). Using transcranial direct current stimulation (TDCS), Li et al. (2018) showed that increasing activity in the lateral orbitofrontal cortex (IOFC) and notably, the dlPFC, resulted in greater norm compliance and increased cooperation as demonstrated by a significant increase in initial endowments given during Ultimatum-style games. These results show a direct link between neural activity and observable behaviour (Li et al., 2018), providing further evidence that the dlPFC is necessary for using norm knowledge to control behaviour.

Moreover, attention to relevant information is required in order to fully understand social norms and consequently, deviations from these norms. Previous research suggests that networks associated with the attention system are responsible for detecting these behavioural errors (Lavin et al., 2013; Wu, Luo, & Feng, 2016; Zhong,

Chark, Hsu, & Chew, 2016). Decision-making and socially driven interactions have been found to result in increased activity in the anterior cingulate cortex (ACC). Lavin et al. (2013) proposed that observing actions which violate a norm elicits an interoceptive marker of negative emotion in the insula and limbic system. They suggest that these areas send an input signal to the ACC regarding the difference between expected and actual outcomes, while the ACC sends this information to the dlPFC network to guide subsequent behavioural responses (Lavin et al., 2013; Wu et al., 2016); once again, highlighting the significant contributions of the dlPFC when utilizing cognitive control to act in accordance with social norms.

Present Study

During the preschool period, children are rapidly developing an understanding and acquisition of social norms; a set of skills which require solid foundational EF abilities. Presently, in comparison to cool EF, there is relatively little research in the area of early hot EF development. Thus, the present study was designed to examine the influence of both hot and cool EF abilities on social norm learning and sharing in preschool children in an effort to further explore the mechanisms and early processes involved in norm development. Children completed a number of tests of EF, including working memory, inhibitory control, as well as a version of the Preschool Gambling task. They also completed a task to assess social norm learning. The first phase of the social norm learning task consisted of children sharing with a puppet in order to obtain baseline sharing tendencies. The second phase (norm learning phase) involved the children learning how to play the game by watching two puppets sharing in a generous or an

unfair (stingy) condition. They then complete the sharing game in a post-manipulation sharing phase with another puppet. Four hypotheses were explored:

- (1) It was expected that there would be a significant difference in children's sharing across the two learning conditions where children in the unfair norm (stingy) condition would share fewer toys than children in the generous norm condition.
- (2) It was expected that there would be an increase in the rejection of offers from the third puppet (who shared only one toy) by children in the generous norm condition, compared to those in the stingy condition.
- (3) It was expected that children who scored higher on the cool EF tasks would be more likely to reject the unfair offers in the generous norm condition.
- (4) It was expected that the number of toys shared by children in the generous norm condition would be correlated with performance on the Preschool Gambling task.

Method

Participants

The sample consisted of 101 preschoolers from daycares in New Brunswick and Nova Scotia, Canada (46 males and 55 females). The mean age of participants was 48.89 months ($SD = 8.15$). Eleven participants were removed from the analysis due to incomplete or missing data. An assortment of toys and stickers were used as incentives and participation was voluntary. All participants returned a consent form signed by a parent and/or guardian. A copy of the consent form is included in Appendix A.

Materials

Big boss task. The Big Boss task consisted of two phases: an initial sharing (control) phase, and a norm learning phase. The sharing phase featured an elephant puppet (Ella) and required four Dumbo the Elephant stickers, four silly putties, and two small containers used as prize bags. The norm learning phase featured two puppets: a cat (Garfield), a dog (Odis), and the post-manipulation sharing phase featured a lamb puppet (Lambchop). The two small containers from the sharing phase were used once again as prize bags. A gold container was used to represent the “Big Boss bin”, and a green container to represent the “garbage bin”. An assortment of toys and stickers (four of each) were used as prizes: smiley face stickers, rings, Baby Shark stickers, slime charms, Secret Life of Pets stickers, erasers, Paw Patrol stickers, and Pokémon figurines. A visual of task materials and the series of events can be found in Appendix B.

Preschool gambling task. The Preschool Gambling task (PGT) required two decks of cards featuring pictures of bunnies and monsters. Gains and losses were determined by the number of bunnies (gain) and monsters (loss) on each card where one deck was more advantageous (more bunnies than monsters per 10 cards), and the other deck was more disadvantageous (more monsters than bunnies per 10 cards). The task also required a magnetized game board which depicted a set of stairs, and a magnetic car which moved up the stairs when a gain card was selected, and down the stairs when a loss card was selected. A visual of task materials and the series of events can be found in Appendix B.

Working memory task. The working memory task consisted of five game boards with a different pattern of doors cut out on each board. Small fabric animal figures were

used and hidden behind certain doors. Children were given 1 x 1 inch laminated pictures of the animals to indicate which doors the animals were hiding behind. A visual of task materials and the series of events can be found in Appendix B.

Response inhibition task. The inhibition task featured two boxes: the Tricky Box and the Silly Box. Each box had a knob on either side, and two transparent doors on the front which were opened by pushing down the knobs. For the Tricky Box, the left knob opened the left door, while the right knob opened the right door. In contrast, when using the Silly Box, the left knob opened the right door, while the right knob opened the left door. Small plastic animal figures (approximately 2 x 2 cm) were placed behind the doors to be retrieved by the children. A visual of task materials and series of events can be found in Appendix B.

Moral and conventional norm transgressions task. One binder was required for this task. The binder contained six laminated pages which featured story vignettes of moral norm transgressions that were either physically or psychologically harmful in nature, as well as vignettes of conventional norm transgressions. Each story was depicted with either a girl or a boy protagonist and children were read the stories in which the protagonist matched their own gender. A 3-point Likert scale with a happy face, a neutral face, and a sad face was used where the faces represented whether the transgressions were “ok”, “a little bad”, or “very bad”, respectively. A visual of task materials and series of events can be found in Appendix B.

Procedure

Consent forms were distributed to the daycares to be sent home with the preschool children (see Appendix A). Parents who gave consent for their child to

participate signed the forms and returned them to the daycare. Verbal consent was obtained from each child before the tasks began, and all children had the opportunity to withdraw from the study at any time. The number of tasks and the order of task completion varied between each child depending on his or her needs at the time of testing.

Big boss task. The Big Boss task began with a baseline sharing (control) phase where the child was introduced to an elephant puppet named Ella. The child was told they were going to play a deciding game where they would get to choose who the stickers go home with. The child was told that if they want the stickers to go home with them, they should put them in the blue prize bin, and if they want them to go home with Ella, they should put them in the red prize bin. They were also told that the stickers could be separated between both prize bins. Children were then questioned on the rules of the game to ensure proper comprehension. In trial 1, four Dumbo stickers were placed in front of the child and they were asked where they wanted the stickers to go (with them, or with Ella), and they placed the stickers in the prize bins. The child repeated the deciding game with four silly putties in trial 2.

Once the baseline sharing phase of the task was complete, children then completed the norm learning phase. The experimenter explained to the child that in this game there is a Big Boss and a Police, which would be assigned alternatively to the two puppets, Garfield and Odis. The child was told that the puppet with the gold bin is the Big Boss and decides where the toys will go. They were told that they could keep all the toys, give them all away, or keep some and give some away. The child was then told that the puppet with the buttons is the Police. It was explained to the child that the Police can

decide if what the Big Boss did with the toys was ok, or not ok. The experimenter demonstrated to the child that if the Police thinks what the Big Boss did is ok, they press the green button and everyone will get to keep the toys for that trial. If the Police thinks it was not ok, they will press the red button and all the toys from that trial will go in the garbage bin. The experimenter then questioned the child about the rules of the game to ensure proper comprehension of the roles of the Big Boss and the Police.

The norm learning phase consisted of two conditions: the generous condition, and the stingy condition. Each child completed one of the two conditions, which were randomly assigned across participants.

Generous condition. To begin the generous condition, the child was introduced to two puppets: Garfield and Odis. The child was told that the puppets will play the game first. Four toys were placed in the Big Boss bin at the beginning of all trials. The experimenter explained that for trials 3 and 4, Odis would be the Big Boss and Garfield would be the Police. During these two trials, Odis offered Garfield three toys and kept one for himself, and Garfield pressed the green button to accept the offer both times. For trials 5 and 6, Garfield was the Big Boss and Odis was the Police. In trial 5, Garfield offered Odis two toys and kept two for himself. This time, Odis refused the offer by pressing the red button and all toys from that trial went in the garbage bin. In trial 6, Garfield offered Odis three toys and kept one for himself, and Odis pushed the green button to accept the offer.

Stingy condition. As in the generous condition, the stingy condition began with the introduction of the puppets. Four toys were placed in the Big Boss bin at the beginning of each trial. In trials 3 and 4, Odis was the Big Boss and Garfield was the

Police. In these trials, Odis offered Garfield one toy and kept three for himself, and Garfield pushed the green button to accept the offer both times. For trials 5 and 6, Garfield was the Big Boss and Odis was the Police. In trial 5, Garfield placed all four toys in his prize bag and did not offer Odis any toys. Odis pushed the red button to refuse this offer and all toys from the trial went in the garbage bin. In trial 6, Garfield offered Odis one toy and kept three for himself, and Odis pressed the green button to accept the offer.

Once the Garfield and Odis trials ended for both the generous and stingy conditions, the experimenter told the child it was their turn to play the game. In this post-manipulation sharing phase, the child was introduced to a puppet named Lambchop. The experimenter told the child that Lambchop would be the Big Boss for the first two turns (trials 7 and 8) while the child would be the Police, and for the next two turns (trials 9 and 10) the child would be the Big Boss and Lambchop would be the Police. Four toys were placed in the Big Boss bin before each trial began. For both trials 7 and 8, Lambchop offered the child one toy and kept three for herself. The child then chose to accept or refuse the offers by pressing the corresponding button and their answers were recorded. For trials 9 and 10, the child decided how to distribute the toys and the number of toys shared was recorded. Note that Lambchop accepted both offers regardless of the amount that was shared. The task ended once all 10 trials were complete.

Preschool gambling task. The PGT is a version of the Children's Gambling task. Children were shown a magnetized game board featuring a set of stairs and a small magnetic car. The experimenter explained to the child that the object of the game was to make the car climb to the top of the stairs by selecting cards. The experimenter then

presented two animals: Zebra and Giraffe, each associated with a deck of cards. The child was told that some cards had bunnies on them, and some had monsters. The child was shown the bunnies and the experimenter explained that they are good and would make the car go up the ladder (gain). They were then shown the monsters and were told that they are bad and would make the car go down the ladder (loss). The child was then questioned about the rules of the game to ensure proper comprehensions of the bunnies and the monsters.

Next, the child began selecting cards from the decks. Children were given verbal reinforcement when they selected a gain card, “Good job, there are X bunnies so you get to go up X stairs”. The child was also given feedback when they selected a loss card, “Oh no, there are X monsters so you have to go down X stairs. Those scary monsters!” The deck that each card was selected from was recorded on a scoring sheet. After 30 trials, the child completed an awareness test where they were asked which animal was the best to pick from and why, and which animal was the worst to pick from and why. The child then completed 10 additional trials followed by a second awareness test which ended the game.

Working memory task. To begin the working memory task, children were told that they were going to play a hiding game. The experimenter introduced a game board with a pattern of square cut outs on the front covered with felt flaps as doors. The child was told that the experimenter was going to hide animal figures behind the doors and that they had to find them. The experimenter placed an animal behind a pre-determined door, ensuring the child was attending to the location. The experimenter began the task at trial 1, which featured a single animal for three-year-old children, and at trial 3, which

featured two animals for four-year-old children. Once the animals were hidden, a felt blanket was placed over the doors, and the experimenter and the child counted to ten. The child was then asked to place Velcro pictures of the animals on the door they thought the animal was hiding behind. The experimenter provided feedback throughout the trials to ensure the child understood the task, “Great job, you found mouse!” or “Oh no, the mouse isn’t hiding in that room, what a tricky mouse!” Once two trials were completed on each board, the experimenter introduced a new, more complex board. The task ended once the child made an error in two consecutive trials, or once they finished the 10th and final trial.

Response inhibition task. The response inhibition task began by introducing the child to a box with two transparent doors on the front and two knobs which were used to open the doors. This task had two phases: Phase 1 was referred to as Tricky Box, while Phase 2 was referred to as Silly Box.

During the Tricky Box Phase, it was first demonstrated to the child that the right knob opened the right door, while the left knob opened the left door. The child retrieved toy animals five times from behind the right door, and then five times from behind the left door. The phase ended once the child completed at least three correct trials on each side. In the Silly Box Phase, it was demonstrated to the child that the right knob opened the left door, while the left knob opened the right door. The child retrieved the toy animals five more times, alternating sides with each trial. To avoid priming, the experimenter briefly placed both hands over the knobs before the beginning each trial, in both phases.

Moral and conventional norm transgressions task. The experimenter presented the child with story vignettes about moral and conventional transgressions. To assess *severity* of the transgression, children were asked indicated if what the protagonist did was “ok”, “a little bad”, or “very bad” using the 3-point Likert scale. To assess *authority independence*, children were asked, “What if X’s teacher/parent didn’t see? Would it be okay then?”. To assess *deserved punishment*, children were asked “Should X get in trouble? Should X go to the time-out chair?”. Responses were scored using a Yes/No coding system. Children were also asked to indicate why they believed the transgression was wrong. Reasons were coded as “Rule”, “Victim-based”, “Value-based”, or “Other”. Rule-based reasons were based on the idea that the violation of a rule was wrong. An example of this might be, “because it’s the rule that we don’t hit people”. Victim-based reasons included responses which indicated that a child or children other than the transgressor might be hurt by the action. An example of this might be, “because hitting will hurt them”. Value-based reasons were based on an evaluation of the transgression using a value-based judgement. An example of this might be, “because it’s not nice to hit”. “Other” reasons referred to any other answer that could not be categorized.

Results

The mean and standard deviation for all variables are presented in Table 1. Note that baseline sharing was relatively high at a rate of 33%; a percentage comparable to previous findings within a preschool population (Fehr et al., 2008). Moreover, post-manipulation sharing increased to a rate of 41%.

Effects of Age and Condition

A one-way mixed analysis of variance (ANOVA) with age and baseline sharing used as covariates was conducted to determine whether children in the generous condition shared more toys after the manipulation than children in the stingy condition. There was no significant main effect of condition, $F(1, 88) = 2.132, p = .148, \eta^2 = .024$. A significant effect of age was found wherein older children tended to share more post-

Table 1

Mean and Standard Deviations of all variables

	Variable	Mean (SD)
Age (in months)		48.891 (8.149)
Big Boss Game	Number of toys shared at baseline	2.656 (2.304)
	Rejection rate	0.767 (0.808)
	Number of toys shared after manipulation	3.289 (2.10)
Preschool gambling task	Proportion of cards chosen from good deck	0.563 (0.217)
	Proportion of correct responses to awareness task	0.30 (0.404)
Working memory	Proportion of animals found correctly	0.261 (0.136)
Inhibition	Proportion of correct inhibition trials	0.551 (0.212)
Moral transgression	Rule-based reasoning	0.193 (0.505)
	Value-based reasoning	0.434 (0.844)
	Victim-based reasoning	0.639 (0.878)
Conventional transgression	Rule-based reasoning	0.803 (1.005)
	Value-based reasoning	0.124 (0.367)
	Victim-based reasoning	0.111 (0.316)

manipulation than younger children, $F(1, 88) = 7.555, p = .007, \eta^2 = .081$. Additionally, baseline sharing was found to be significant such that greater sharing at baseline was associated with a higher rate of sharing after the manipulation, $F(1, 88) = 6.982, p = .010, \eta^2 = .075$.

A second one-way ANOVA with age and baseline sharing was conducted to determine whether children in the generous condition rejected offers more often than children in the stingy condition. There was no significant main effect of condition, $F(1, 88) = 1.125, p = .292, \eta^2 = .013$. A significant effect of age was found wherein older children were less likely to reject an unfair offer, $F(1, 88) = 5.574, p = .020, \eta^2 = .061$. Moreover, baseline sharing was significant such that the more one shared at baseline, the less likely they were to reject an unfair offer, $F(1, 88) = 2.756, p = .036, \eta^2 = .050$.

Exploring Individual Differences

A cluster analysis was conducted to explore individual differences in children based on sharing and response to Lambchop's sharing behaviour (rate of rejection). Cluster size was determined using Schwarz's Bayesian Criteria (BIC), a measure of model fit, and silhouette scores, a measure of group cohesion and separation (Rousseeuw, 1987). The three main variables used in the study were entered in the analysis: baseline sharing, rejection rate, and sharing after manipulation. Using BIC as a criterion, a 3-cluster solution (BIC = 188.599) was better than a 1- (BIC = 212.644), 2- (BIC = 195.240), or 4-cluster (BIC = 211.197) solution. The average silhouette score (.5) indicated adequate fit for the solution.

Clusters were labelled according to the two variables which most strongly distinguished the groups: baseline sharing (i.e., if children demonstrated fair or unfair sharing at baseline, where fair sharing is defined as 4/8 toys shared) and rejection rates (i.e., if children more commonly accepted or rejected the unfair offer). Cluster 1 was labelled as the Unfair_Accept group. This group included 29 children (15 3-year-olds) and had a low rejection rate, low baseline sharing, and moderate post-manipulation

sharing. Cluster 2 was labelled as the Fair_Accept group. This group included 39 children (9 3-year-olds). It also had a low rejection rate, as well as high sharing at baseline and after the manipulation. Finally, Cluster 3 was labelled as the Fair_Reject group. This group included 22 children (14 3-year-olds) and had high rejection rates coupled with moderate sharing. Cluster scores on all variables are presented in Figure 1.

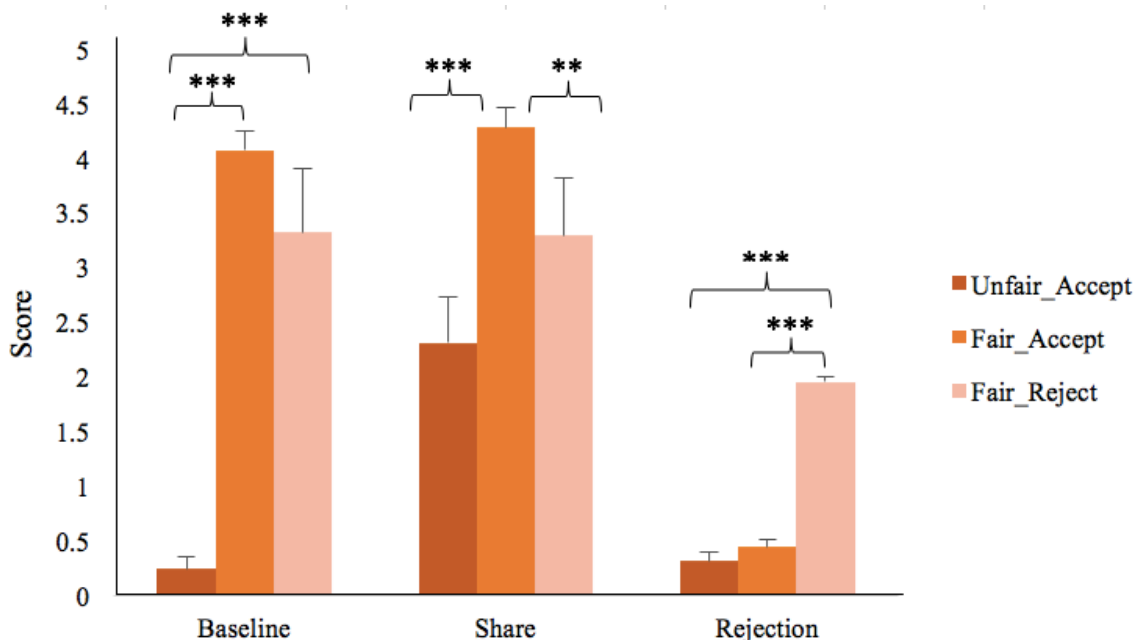


Figure 1. Average score of each cluster on baseline sharing, sharing after manipulation, and rejection.

In order to validate the resulting clusters, t-tests were used to explore differences on the three main variables. Unfair_Accept significantly differed from both Fair_Accept, $t(66) = 17.28, p < .001$, and Fair_Reject, $t(49) = 5.84, p < .001$, on baseline sharing, while Fair_Accept and Fair_Reject did not significantly differ from each other, $t(59) = 1.53, p = .133$. For rejection rates, Fair_Reject significantly differed from both Unfair_Accept, $t(49) = 15.21, p < .001$, and Fair_Accept, $t(59) = 13.47, p < .001$, while no significant differences were found between Unfair_Accept and Fair_Accept, $t(66) = 1.05, p = .299$. Finally, with respect to sharing after manipulation, Fair_Accept significantly differed

from both Unfair_Accept, $t(66) = 4.76, p < .001$, and Fair_Reject, $t(59) = 3.133, p = .003$, while Unfair_Accept and Fair_Reject were not significantly different, $t(49) = .76, p = .451$.

Effect of Condition by Cluster

A one-way ANOVA with age and baseline sharing used as covariates was conducted for each of the Big Boss clusters: Unfair_Accept, Fair_Accept, and Fair_Reject. There was no significant main effect of condition in the Unfair_Accept group, $F(1, 27) = .047, p = .830, \eta^2 = .002$, and no significant effect of baseline sharing, $F(1, 27) = .720, p = .404, \eta^2 = .028$. A significant effect of age was found wherein younger children tended to share less at post-manipulation than older children, $F(1, 27) = 6.728, p = .016, \eta^2 = .212$. With respect to the Fair_Accept condition, no significant main effect of condition was found, $F(1, 37) = 1.248, p = .271, \eta^2 = .034$. There was a significant effect of baseline sharing such that greater sharing at baseline was associated with a higher rate of sharing after the manipulation, $F(1, 37) = 13.762, p = .001, \eta^2 = .282$, while the effect of age was not significant, $F(1, 37) = .038, p = .846, \eta^2 = .001$. In the Fair_Reject group, there was a significant main effect of condition, $F(1, 20) = 5.534, p = .030, \eta^2 = .235$, where children in the generous norm condition displayed an increase in sharing (from baseline), while children in the stingy norm condition decreased sharing rates (from baseline). There was no significant effect of age, $F(1, 20) = .094, p = .762, \eta^2 = .005$, or baseline sharing, $F(1, 20) = .754, p = .397, \eta^2 = .040$. In other words, post-manipulation sharing was wholly determined by condition in the Fair_Reject group.

Exploring Differences in Hot and Cool EF

Uncorrected Pearson correlations were conducted to examine the relationship between Big Boss and EF variables. A significant positive relationship was found between sharing behaviour at baseline and after manipulation, $r(88) = .311, p = .003$, and between EF variables of working memory and inhibition, $r(88) = .230, p = .027$.

Interestingly, a significant negative relationship was found between rejection rate and working memory, $r(88) = -.282, p = .007$, indicating that increased working memory abilities result in lower rates of rejection. Moreover, a significant positive relationship was found between post-manipulation sharing and inhibition, $r(88) = .222, p = .035$, as well as post-manipulation sharing and PGT awareness (emotional intuition related to the PGT), $r(88) = .286, p = .007$, such that greater inhibitory control, and an increased understanding of the PGT resulted in increased sharing after the manipulation.

Additionally, PGT awareness was also significantly positively correlated with PGT total (the ability to learn from feedback during the PGT), $r(88) = .416, p < .001$, as well as working memory, $r(88) = .352, p = .001$, and inhibition, $r(88) = .274, p = .009$, suggesting that higher scores on measures of working memory and inhibition lead to better performance on tasks which require reliance on emotional “gut” feelings. All other correlations were not significant (see Table 2).

In order to explore group differences on hot and cool EF, a discriminant function analysis was performed using the four measures of hot and cool EF (PGT total score, PGT awareness score, inhibition, working memory). Two discriminant functions were derived, with a combined effect of $\chi^2(8) = 25.95, p = .001$. After removal of the first function, there was still a strong association between groups and predictors, $\chi^2(3) =$

Table 2

Intercorrelations among Big Boss and EF variables (N = 90)

	1	2	3	4	5	6	7
1. Baseline sharing		.180	.311**	.097	.206	-.10	.095
2. Rejection			-.059	-.173	-.169	-.282**	-.174
3. Sharing after manipulation				.138	.286**	.060	.222*
4. PGT total					.416**	.116	.196
5. PGT awareness						.352**	.274**
6. Working memory							.230*
7. Inhibition							

Note. * $p < .05$ (2-tailed), ** $p < .01$ (2-tailed).

33.60, $p = .029$. The two discriminant functions accounted for 18.14 % and 10.11%, respectively, of the differences between the three groups which resulted from the cluster analysis.

The loading matrix of correlations between the measures and the discriminant functions indicated that inhibition and PGT awareness loaded onto the first discriminant function, while working memory and PGT total score loaded onto the second discriminant function (see Table 3).

Table 3

Loading of the Four EF Measures on the Discriminant Functions

Variables	Loadings on Functions	
	Discriminant Function 1	Discriminant Function 2
PGT total score		.367
PGT awareness score	.609	
Inhibition score	.844	
Working memory		.898

The first discriminant function was labelled Inhibition_PGT Awareness and maximally separated the Fair_Accept group from the Unfair_Accept, $t(66) = 3.64, p = .001$, and the Fair_Reject group, $t(58) = 3.22, p = .002$. This function did not distinguish between the Fair_Reject and the Unfair_Accept group, $t(48) = .10, p = .923$. The second discriminant function was labelled WM_PGT Learning and maximally separated the Unfair_Accept and the Fair_Reject group $t(48) = 3.06, p = .004$. It also discriminated between the Fair_Accept and the Fair_Reject group, $t(58) = 2.19, p = .032$. In other words, children who shared fairly and were able to refrain from rejecting Lambchop's offer had a combination of high inhibition and awareness of the PGT game coupled with moderate working memory and PGT learning. Children who did not share very much at baseline, but were able to refrain from rejecting Lambchop's offer showed a profile of high working memory and PGT learning, but low inhibition and awareness of what was going on in the PGT. Children who shared moderately but rejected Lambchop's offer showed a profile of poor performance on all EF tasks. Figure 2 shows group scores on the discriminant functions.

Group Performance on Moral and Conventional Reasoning

In an effort to examine differences between groups on moral and conventional reasoning, an additional series of t-tests were performed. The Unfair_Accept group showed significant differences in their ability to reason between moral and conventional transgressions based on victim, such as referring to an individual getting hurt or being sad, $t(21) = 3.169, p = .005$, while no significant differences were found between moral and conventional transgression reasoning based on rule (i.e. "because we're not allowed to hit"), $t(21) = -1.418, p = .171$, or based on value (i.e. "it's not nice to hit"), $t(21) =$

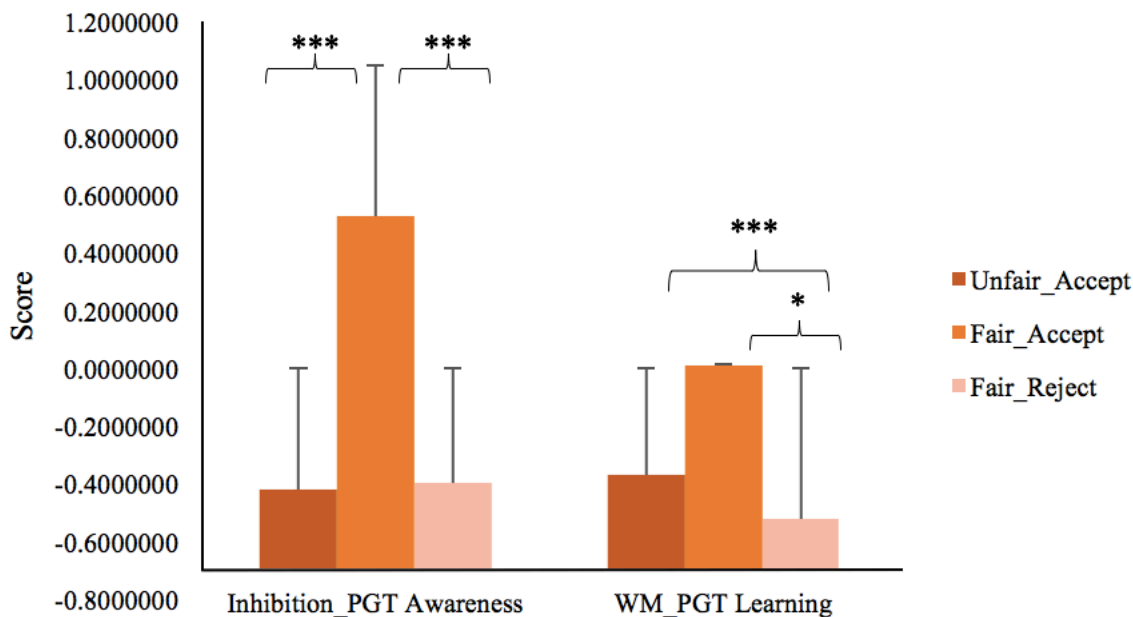


Figure 2. The score of each Big Boss cluster on EF discriminant functions.

.624, $p = .540$. The Fair_Accept group showed significant differences in their ability to reason between moral and conventional transgressions based on rule, $t(37) = -5.187, p < .001$, as well as victim, $t(37) = 4.361, p < .001$, and value, $t(37) = 3.586, p = .001$.

Finally, the Fair_Reject group showed significant differences in their ability to reason between moral and conventional transgressions based on rule, $t(17) = -3.007, p = .008$, and victim, $t(17) = 2.474, p = .024$, while no significant differences were found between moral and conventional transgression reasoning based on value, $t(17) = 1.844, p = .083$.

Discussion

The current study sought to explore the influence of both hot and cool executive function (EF) abilities on social norm learning and sharing in preschool children.

Participants completed a variety of EF tasks including working memory, inhibitory control, and a version of the PGT, as well as a novel social norm learning task. Contrary to expectations, children who viewed a generous model of sharing did not subsequently

share more than children who viewed a stingy model of sharing. However, a cluster analysis to further explore individual differences in children's performance on the Big Boss task resulted in three unique groups which differed according to sharing rates at baseline, and rates of rejection. With respect to EF abilities, and contrary to expectations, cool EF was not consistently related to rejection. Moreover, only the awareness phase of the PGT was associated with sharing after the manipulation. In addition to the main analysis, performance on a moral and conventional transgression task was explored and, once again, revealed significant individual differences for each group identified in the cluster analysis. Each of these findings are discussed below.

Influence of Condition on Norm Learning and Sharing

Contrary to expected findings, exposing children to norms that vary from typical fair sharing (i.e., distributing resources equally between parties) did not influence children's subsequent sharing behaviours. Specifically, the children who saw puppets model a generous distribution did not subsequently share more than children exposed to a stingy distribution of toys. There are a number of possible reasons for these findings. The first of course, is that children may not be influenced by seeing norms being modelled by puppets. Research looking at how children selectively choose to learn rules and norms points to a preference for reliable, adult models who demonstrate confidence and knowledge (Rakoczy et al., 2009). Importantly, children have also been found to attribute normativity to adult models, as shown by their imitation of actions demonstrated by adults, as well as protests when a third party performs actions demonstrated by a peer, but not when they perform the same actions demonstrated by an adult (see Rakoczy, 2008; Rakoczy et al., 2008). Additionally, children have been found to attribute normativity to

an action that was explicitly and confidently taught, more often than one that appeared to be invented in the moment (Schmidt & Rakoczy, 2018). The current study used two puppets in an effort to demonstrate a norm to the child. Despite the experimenter explaining the role of each player to the child (i.e., the Big Boss and the Police), the rules of the game were not explicitly taught, and as a result, the child may not have attributed normativity to the actions in the norm learning phase. Another possible explanation is that perhaps preschoolers' norms are more strongly influenced by direct experience. If this were true, then children should be more strongly influenced by Lambchop, who proposed a stingy, unfair distribution to children in both conditions. Following this logic, sharing should have decreased from baseline to post-manipulation. However, this explanation is unlikely as mean sharing was higher after the manipulation.

A second possible reason for these findings is that being exposed to only four trials of a generous/stingy norm is not enough for preschoolers to change their own pattern of behaviour. Many studies on norm learning have also used a four-trial approach, where four observational learning trials were shown to be sufficient enough to achieve significant results (Rakoczy et al., 2008; Rakoczy et al., 2010; Wyman et al., 2009; Kenward, 2012; Hardecker & Tomasello, 2017). It is worth noting, however, that many of the studies also included familiarization trials in which the child is introduced to any puppets in the game, and has the opportunity to freely engage with them. While it is possible that children in the current study may not have felt as comfortable with the puppets due to lack of familiarization, and were therefore more hesitant to engage with them during the task, it is unlikely that presenting fewer learning trials than necessary was the reason why children were not influenced by the norm.

A third explanation, which was explored through cluster analysis and correlations, is that strong individual differences in the preschoolers may have been more important in determining sharing. We know that while there are developmental differences (i.e., age differences) in sharing behaviour, there are also individual differences with origins in the preschool years that persist into adulthood (see Eisenberg et al., 1999). A longitudinal study by Eisenberg et al. (1999) found that spontaneously engaging in prosocial behaviours during the preschool years predicted actual prosocial behaviour from childhood to adulthood. They proposed that dispositional differences in inhibitory control, as well as one's degree of concern for others are among the likely causes for variations in prosocial behaviours exhibited in childhood, through to adulthood. As such, it was reasoned that for some children, sharing behaviour may be more strongly influenced by situational variables, whereas other children might be more strongly influenced by internal variables such as their own norm representations, or their EF abilities. In support of this, the covariates of both age and baseline sharing were found to be statistically significant predictors of sharing behaviours. These findings highlighted the effect of age and insistent sharing tendencies as important in predicting post-manipulation sharing, and warranted further exploration.

A cluster analysis resulting in three distinct groups of children strongly supported the presence of individual and age differences as the driving force behind participants' sharing behaviour. Recall that groups were labelled according to the two most distinguishing variables (baseline sharing and rejection rates), and resulted in the following: children who did not demonstrate fair sharing at baseline and had high rates of acceptance of the unfair offer (i.e., the Unfair_Accept group), children who demonstrated

fair sharing at baseline and had high rates of acceptance of the unfair offer (i.e., the Fair_Accept group), and children who demonstrated fair sharing at baseline and had high rates of rejection of the unfair offer (i.e., the Fair_Reject group). When further exploring the influence that viewing either a generous or stingy model of sharing had on each these groups, it was found that a different variable was significant within each group. Age was a significant predictor of post-manipulation sharing behaviour in the Unfair_Accept group, baseline sharing was a significant predictor of post-manipulation sharing behaviour in the Fair_Accept group, while the model of sharing behaviour that was viewed (i.e., a generous or stingy model) was only a significant predictor of post-manipulation sharing in the Fair_Reject group. One likely explanation for the uniqueness of each group is how the children performed on the EF tasks.

Combined Influence of Hot and Cool EF on Sharing Tendencies

Interestingly, the four measures of EF did not load onto the two discriminant functions based on type of EF ability (i.e., hot or cool EF). In other words, the measures of hot EF *did not* load onto one discriminant function while the measures of cool EF loaded onto the other. Rather, a combination of both hot and cool EF was found to load onto each function. The first function (Inhibition_PGT Awareness) had a loading of inhibition and PGT awareness, while the second function (WM_PGT Learning) had a loading of working memory and PGT learning. This combination indicates the possibility that both hot and cool EF are equally as important for tasks such as social norm learning. Each group scored differently on these two functions, which likely influenced their performance on the Big Boss task.

As one of the youngest of the three groups, which included 15 three-year-olds (51.7%), it is unsurprising that the Unfair_Accept group had the lowest rates of both baseline, and post-manipulation sharing (see Table 4). These findings align with past research which indicates that young children have a tendency to behave selfishly during resource allocation, even when they are explicitly aware of fairness norms, (Fehr et al., 2008; Kogut, 2012). Moreover, although sharing rates were low, the Unfair_Accept group had the lowest rate of rejection with only 31% of children rejecting at least one offer; a finding which further supports the idea of a self-serving bias explained by Smith et al. (2013) wherein young children act in an effort to benefit themselves during resource distribution. In the Big Boss game, children in the Unfair_Accept group opted to accept an unfair offer the majority of the time, presumably because they understood that rejecting the offer would result in a loss for them. An additional explanation for low rates of both baseline sharing and rejection in the Unfair_Accept group is the low score on inhibitory control. It is possible that, due to their lack of inhibition, children in this group were unable to resist the impulse to keep all of the toys for themselves during baseline sharing. During the post-manipulation sharing phase, this lack of inhibition may have contributed to children accepting Lambchop's offers because of their sheer desire to obtain the toys, even though Lambchop did not necessarily conform to the norm (i.e., after viewing the generous model of sharing). This theory aligns with findings of Smith et al. (2013), who proposed that it is an immature inhibitory control mechanism which prevents children from following the norm, resulting in selfish behaviours. Furthermore, it is possible that higher scores on working memory and PGT learning made it possible for children in the Unfair_Accept group to utilize what they learned by

Table 4

Summary of Cluster Characteristics

Findings	Clusters		
	Unfair_Accept	Fair_Accept	Fair_Reject
Age in months	46.86 (7.09)	51.28 (7.50); older group	45.36 (7.77)
Baseline sharing	0.24 (0.58) 0% of this group had fair sharing at baseline [±]	4.08 (1.09) 85% of this group had fair sharing at baseline	3.32 (2.77) 50% of this group had fair sharing at baseline
Sharing after manipulation	2.31 (2.24)	4.28 (1.12)	2.82 (2.52)
Effect of condition for each group	No effect	Effect of baseline, no effect of condition	No effect of baseline, effect of condition
Rejection	31% of children rejected once	43% of children rejected once	100% of children rejected at least once; 95% of children rejected both offers
Moral/Conventional transgressions	Intermediate stage distinction (rate Moral as worse than Conventional; can reason based on victim)	Good distinction (good at distinguishing between Moral and Conventional; can also provide reasons why both are wrong)	Early stage distinction (rate Conventional equally as bad as Moral; but can provide reasons for why Moral is wrong)
EF	Low inhibition/PGT awareness; high WM/PGT learning	High Inhibition/PGT awareness; moderate WM/PGT learning	Low on all EF
Possible theories	Difficulty controlling the impulse to keep all toys for self	Good emotion regulation	Difficulty with emotion regulation and inhibition; more rigid interpretation of rules?

[±]Fair sharing is defined as 4/8 or more of toys shared

watching the puppets in the norm learning phase, allowing them to reason out what response was in their best interest, even if it involved accepting an offer that did not follow the norm.

The Fair_Accept group had the highest rate of sharing both at baseline, as well as post-manipulation sharing (see Table 4). The increase in sharing displayed by this group from pre- to post-manipulation sharing posits that these children had a tendency to consistently demonstrate fairness and were not as strongly influenced by external factors, like the actions of others that were discordant with their beliefs. Additionally, this group also had a relatively low rate of rejection (see Table 4). With respect to EF abilities, the Fair_Accept group had high scores on Inhibition_PGT Awareness. As noted in the literature, the prefrontal cortex develops rapidly in three- and four-year-old children, and with this comes a more mature inhibitory mechanism (Dowsett & Livesey, 2000; Zelazo et al., 2003). For this reason, it is worth noting that this group was the oldest in terms of age in months (see Table 4), with only nine three-year-olds out of 39 total children. Consequently, this group may have a more stable and mature inhibitory response mechanism overall, which would explain their ability to accept an unfair offer. Taken together, increased age coupled with high scores of inhibition further indicate that prosocial behaviour increases with the development of inhibitory control as the prefrontal cortex matures; and may explain why this group aligned their behaviour with the widely accepted norms of fairness, sharing (at least) equal portions of the resource. Moreover, with respect to low rejection rates, children in the Fair_Accept group were able to resist rejecting unfair offers; a response that can be supported by moderate scores on WM_PGT Learning. As working memory involves holding a rule in mind and using it to override

automatic responses (Garon et al., 2008), it is likely that this group was able to remember the instance in which Garfield was punished for not following the norm in the previous phase, and adjust their behaviour accordingly. In other words, despite wanting to punish Lambchop for not following the norm (after viewing the generous model), children in this group were able to recall that rejecting an offer would result in punishment for both the one who proposed the offer, and also for themselves, as they would both lose their portion of the toys.

Of the three groups, the Fair_Reject group is perhaps the most interesting. As the youngest group, with 14 three-year-olds (63.6%), this group was comparable to the Unfair_Accept group with respect to age (see Table 4). Children in the Fair_Reject group shared more toys after viewing a generous model, while those who viewed a stingy model subsequently shared fewer toys, indicating that the change in sharing from baseline to post-manipulation was fully determined by the type of model that was viewed. Therefore, it appears that children in the Fair_Reject group were the most malleable, and more easily influenced by the norm being presented to them. This group also demonstrated significantly higher rates of rejection than the other two groups, with 100% of the children rejecting at least one of the two offers (see Table 4). The Fair_Reject group had low scores on both discriminant functions, indicating poor performance on all EF measures. It appears that this group had a more rigid interpretation of social norms and often responded to the situation without considering the consequences. For instance, recall that the Fair_Reject group had high rates of sharing at baseline, presumably because they understood sharing to be a socially acceptable behaviour. Moreover, a high majority of the children rejected both of Lambchop's offers, regardless of whether or not

the offer was reflective of the norm shown in the previous phase. This can be supported by low scores on both hot and cool EF tasks as these children were unable to hold two ideas in mind (i.e., “Lambchop is being unfair, however, Lambchop’s behaviour is reflective of the scenario I just witnessed”) and consequently could not inhibit their automatic reaction of rejecting the unfair offer, despite this resulting in a loss for them as well. The combination of immature and unstable hot and cool EF abilities supports the performance by the Fair_Reject group on the Big Boss task in that they showed a very reactive pattern of responding, particularly when responding to Lambchop’s offers, which is especially indicative of low hot EF and difficulty controlling one’s emotional responding.

Overall, the three groups identified in the cluster analysis showed significant differences on independent measures of hot and cool EF, and provide support for the idea that these individual differences in EF abilities impacted performance on the Big Boss task. Thus, contrary to expectations, neither hot nor cool EFs were shown to be more important for the understanding and adherence to social norms, but rather a balanced combination of both EF abilities is necessary to achieve optimal task performance.

Group Performance on Moral and Conventional Transgression Reasoning

The idea that this novel social norm learning task provides insight to the mechanisms underlying social norm learning in children can be further supported by how children performed on a moral and conventional transgression task. While moral norms pertain to a wide scope of people and exist even in the absence of an explicit rule, different conventional norms exist for different social groups (Smetana et al., 2014). Of the three groups, only the Fair_Accept group was able to distinguish between moral and

conventional transgressions, and provide reasons as to why both types of transgressions were wrong as explained through rule-, victim-, and value-based reasoning. This can be explained by the groups' insistent tendency to demonstrate fair sharing at baseline and post-manipulation, and supports the findings of Eisenberg and Hand (1979) who described sharing as an "other-oriented" behaviour. In other words, children who are other-oriented show a concern for the well-being and rights of others. In their study, Eisenberg and Hand (1979) found that sharing (a behaviour that involves a cost at the child's expense), was associated with better prosocial moral reasoning, where prosocial moral reasoning is defined as the ability to reason about situations in which one person's wants or needs are in conflict with another's (Eisenberg, 1986). Considering this, it is likely that having high-level moral reasoning in a prosocial context contributed to both the high sharing and low rejection rates displayed by children in the Fair_Accept group as they chose to demonstrate fairness by sharing, and avoid inflicting punishment on Lambchop by accepting the unfair offers.

In addition to providing reasons as to why moral transgressions were wrong, children in the Fair_Accept group were also able to reason about conventional norm transgressions. Conventional norms are often attributed to social norm learning, where one must learn what is socially acceptable in a given situation in order to adjust their behaviour accordingly, something that is often achieved by integrating feedback from others. The Fair_Accept group had moderate scores on working memory and PGT learning, where PGT learning was representative of one's ability to learn through the positive and negative feedback received when selecting cards during the task. As such, the ability to use feedback and successfully adjust behaviour during the PGT provides

evidence for why the Fair_Accept group was also able to reason about conventional norms.

The Fair_Reject group was unable to distinguish between moral and conventional transgressions, rating conventional transgressions as equally bad as moral transgressions. Interestingly, this group was able to use rule- and victim-based reasoning when explaining why *moral* transgressions were wrong, but not conventional transgressions. This group would often say “I don’t know”, or fail to provide a response when asked why the transgressions were wrong, suggesting that they lacked their own sense of morality and judgement. Comparably, and in concordance with performance on the Big Boss task, it is possible that children in the Fair_Reject group are more reliant on social models as a means to shape and adjust their own behaviour. This idea can be supported by children’s low scores on all measures of EF. More specifically, the inability to learn from feedback (as indicated by low scores on PGT learning) would be hindering to a child who is beginning to navigate the social world, and determine socially acceptable behaviours across a number of different contexts. Together, these ideas may explain why children in the Fair_Reject group could reason about moral transgressions, but not conventional transgressions, in addition to using reliable social models as a strategy in shaping their own behaviour.

Performance by the Unfair_Accept group on the moral and conventional transgression task fell somewhere in between that of the other two groups. Like the Fair_Accept group, children in the Unfair_Accept group were able to distinguish between the two types of transgressions, rating moral transgressions as worse than conventional transgressions, which can be explained by their high scores on working memory and PGT

learning (relative to the Fair_Reject group). However, this group was only able to use victim-based reasoning (i.e., referring to how the child was hurt or sad) when explaining why the transgression was wrong. Smetana et al. (2014) proposed that young children gain an understanding of how we ought to behave towards one another through their own personal experiences with harm and fairness. Perhaps, when faced with norm transgressions, children in the Unfair_Accept group placed themselves in the situation which enabled them to respond from the perspective of the victim in the story. As the youngest group (see Table 4), it is possible that these children simply have not had enough experience with particular norms to apply rule- and value-based reasoning.

Limitations and Future Research

Given the surprising lack of effect of model type (i.e., generous or stingy) on sharing behaviours, it would be worthwhile to further investigate the reasons behind this null effect in the future. While the current study gives us insight to the contributions of hot and cool EF to social norm learning and prosocial behaviour, there are a few limitations to be addressed. Firstly, the most crucial phase of the task – the norm learning phase – required more observation and relatively little active engagement in comparison to many of the other tasks. This made it difficult to determine whether or not children were being fully attentive during this phase, which may have contributed to the lack of effect of condition.

An additional limitation is that during the post-manipulation sharing phase, some children appeared to be more excited and eager to share with Lambchop than other children. One possible reason for this is that when introducing Lambchop, the experimenter may have been more enthusiastic with some children than with other

children. Therefore, some children may have opted to share more with Lambchop because they believed it would make her happy and further increase the puppets' level of excitement. Moreover, it is possible that some children attributed Lambchop's excitement to the experimenters' satisfaction regarding task performance, and opted to share with Lambchop because of their desire to satisfy the experimenter, rather than their desire to adhere to the norms. Given that the puppet may not always be controlled by the same experimenter, it is important that future studies attempt to standardize task delivery, particularly the introduction of the puppets, to ensure consistency between experimenters and to avoid potentially influencing children's sharing behaviour.

It is important to acknowledge that in this study, children were expected to demonstrate their understanding of social norms through sharing. As previously mentioned, sharing is a costly behaviour which required personal sacrifice of one's own resource in order to distribute them amongst others (Paulus & Moore, 2012). Therefore, it is possible that children chose not to align their behaviour with the given norm as a result of simply not wanting to share, rather than as a result of miscomprehension. Perhaps sharing is a behaviour that is less susceptible to being changed even after being introduced to a new norm. The majority of existing studies on norm learning in children require them to demonstrate their understanding by protesting to norm violations, and enforcing the correct norm following third-party violations (Rakoczy et al., 2009; Rakoczy, 2008; Wyman et al., 2009; Schmidt, Butler, Heinz, & Tomasello, 2016; Hardecker & Tomasello, 2017). Future research may attempt to address this by integrating additional elements of explicit protest, such as Odis stating to Garfield that he is rejecting the offer because Garfield is not following the "rule". This would demonstrate

to the child that they are allowed to object when someone is not following the correct norm, and may encourage the child to protest to Lambchop's discordant behaviour after viewing the generous model of sharing.

Summary and Conclusion

The present study demonstrates that children's prosocial behaviour is not always influenced by viewing situations which deviate from socially acceptable norms. However, while viewing either a generous or stingy model of sharing did not influence children's subsequent sharing behaviour, scores on measures of EF suggest that differences in hot and cool EF abilities may be more important for successfully adapting to new norms. Specifically, results of this study suggest that a balance of hot and cool EF abilities is the most beneficial.

In exploring the mechanisms underlying norm development, the findings of this study will help to inform the field about the early stages and processes involved in social norm development and more broadly, prosocial development. They will also provide validation of current EF measures, as well as highlight potential areas for further refinement of measures of early EF abilities.

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Appendix A

Consent Form



Psychology Department, Mount Allison University

Study Title: **Helping and Sharing in Preschoolers**

Researchers: **Nancy Garon, Sarah English, Clare Maguire, Sruthi Sridhar, and Natalie Lagace**

Our names are Sarah English, Clare Maguire, Sruthi Sridhar and Natalie Lagace. We are students completing an honours thesis under the supervision of Dr. Nancy Garon. **We are inviting you to participate in our study. Below is a summary of the study. If you agree to participate, please fill out the form on the back of this sheet and return to your daycare provider.**

Purpose of the Study: In this study, we are looking at skills that are linked to prosocial and behavior in preschoolers. One type of skills is the ability to use your “gut feeling” to make decisions. Another type of skills is the ability to hold ideas in mind and use these ideas to guide behavior. Both types of ability have been found to help social adjustment and school readiness. In this study, we are interested in whether these skills are important for preschoolers’ prosocial behavior. For example, when a child is being bullied, a child might use their emotional response (e.g., sadness) to guide their response or they might use their memory of a strategy suggested by their parent (e.g., walk away) to guide their response. Each is likely to result in a different outcome.

What will my child do? To look at these things, our study involves 10 short tasks that are presented in a game-like format to make it fun for children. Two of the tasks will consist of a series of simple choices. For Zebra & Giraffe game, children will choose cards from two animals that will let them go up and down stairs. The Favourite Toy game will involve choosing between pairs of toys. In the Story Game, children will say whether the main character was doing something bad (e.g., child teasing another). In the Rule Learning Game, children will be asked to guess what pets the Purple Puff people are allowed to have. One of the tasks will involve helping puppets while another will involve feeding and playing with an electronic baby doll. Two tasks will involve retrieving animals from behind a door in a house. Two of the tasks, (helping the puppet and taking care of the baby doll) will be video-taped. Finally, in one of the tasks, children will decide how to divide up stickers and toys with a puppet. We will divide the tasks into 2 sessions and each session will take about 20-30 minutes. Note that the study will be done *at the daycare* during a time that does not conflict with important activities such as naptime. At the end of the session, children will receive a small gift and all the stickers accumulated during the tasks.

Potential Harms: Although there are no known risks, it is possible that some of the children will become tired or frustrated during the sessions. If your child indicates that he or she is tired, the examiner will take a break and only return to the task when your child is ready. Every effort will be taken to make this an enjoyable experience for your child. As well, during the activities, a member of the daycare staff will be present to insure an enjoyable experience.

Possible Benefits: Although we don’t expect your child to benefit directly from participating in this research, we do expect the games to be interesting and the experience of interacting with the experimenter to be enjoyable for him or her. This study also gives you and your child the opportunity to benefit others in that the results of this study may provide useful information about how children’s social abilities develop.

Termination: Your participation and that of your child is completely voluntary. You and your child may withdraw from this study at any time without penalty.

Confidentiality: *All information obtained in this study will be kept strictly confidential.*

Additionally, assigning each child a code rather than name will protect the confidentiality of you and your child at all times. Written records of your child’s performance will be stored in a locked cabinet for 5 years after publication of this study. Whereas average group results from this project may be published, no individual children will be identified. Please note that at the end of the study, we will send parents a summary of group results, but the results of any individual child’s performance will not be provided.

Appendix B

Tasks

Big Boss Task

Baseline sharing phase

1. Control Sharing trials



Trials: 4 dumbo stickers; 4 putties

We are going to play a deciding game. In this game, you get to decide where the stickers go. They can go to you or Ella. If you want them to go to you, you put them in this bin (E points to bin). If you want them to go to Ella, you put them in this bin.

1 Explain deciding game

Where do the toys go if you want Ella to have them? Where do the toys go if you want them to go home with you?

2. Check understanding



Ok – here are four stickers – where do you want them to go?



3. Dumbo trials



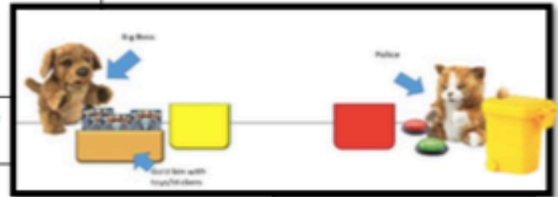
4. Silly putty trials

Norm learning phase

2. Odis and Garfield trials

Trial 3-4 = Odis is Big Boss & Garfield is Police;
 Trial 5-6 = Garfield is Big Boss and Odis is Police

T3=any 4 stickers; T4 = rings; T5 = Baby shark stickers; T6 = slime charms



In this game, there is the Big Boss and the Police. When you have the gold bin, you make the choice of where toys go. The one who has the big boss bin can decide to keep all the toys, give all the toys away, or give some toys away

The one who is the Police will get to decide if what the Big Boss gives is ok or not ok. If the Police decides its ok, the Police will press the green button here. If the Police decides it's not ok, they will press the red button and put the toys in the garbage box here and no one gets any of the toys

Can you tell me what the big boss gets to do? Can you tell me what the Police gets to do?

Ok Odis, you are going to be the Boss first. Garfield, you are the police.

5. Describe Big Boss role in game



6. Describe Police role in game



7. Check understanding



8. Odis Big Boss & Garfield Police

Stingy Condition

Odis gives 1 ✓

Odis gives 1 ✓

Generous Condition

Odis gives 3 ✓

Odis gives 3 ✓



Ok Garfield, you are going to be the Boss first. Odis, you are the police.

9. Garfield Big Boss & Odis Police

Stingy Condition

Garfield gives 0 ✗

Odis gives 1 ✓

Generous Condition

Garfield gives 2 ✗

Odis gives 3 ✓

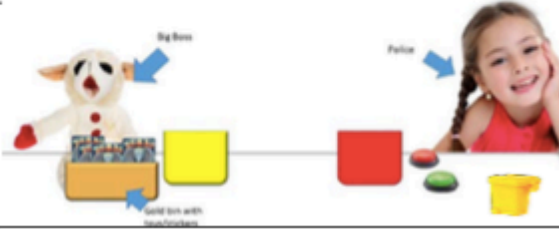


- ✗ Indicates rejection of offer
- ✓ Indicates acceptance of offer

Post-manipulation sharing phase

3. Child and Lambchop trials
 Trial 7-8 = Lambchop is Big Boss & Child is Police;
 Trial 9-10 = Child is Big Boss and Lambchop is Police

T7=Secret life of pet stickers; T8 = erasers;
 T9 = paw patrol stickers; T10 =Pokemons



Now, you and Lambchop will play this game. Lambchop you will be the Big Boss for the first two turns and Child's name will be the Police. Then it will be Child's name to be the Big Boss and Lambchop will be the Police.

[to lambchop]Remember Lambchop since you are the Big Boss, you get to do what you want with the toys and stickers. You can keep all the stickers, give them all away or give some to Child's name.

You get to decide if it's ok or not ok. You can press the green button if it's ok and the red button if it's not ok. If you press the red button, no one gets any toys/stickers though.

If you think it's ok what Lambchop has done, what do you do?

What button do you press if it's not ok? What happens if you press the red button?

10. Introduce Lambchop & Child trials

11. Lambchop is Big Boss

12. Explain Police role to child again

13. Check understanding



14. Lambchop gives child 1 sticker



15. Lambchop gives child 1 eraser

Now, it's your turn to be the Big Boss (to child) and Lambchop will be the Police.

Since you are the Big Boss, you get to do what you want with the toys and stickers. You can keep all the stickers, give them all away or give some to Child's name.

(to lambchop) You get to decide if it's ok or not ok. You can press the green button if it's ok and the red button if it's not ok. If you

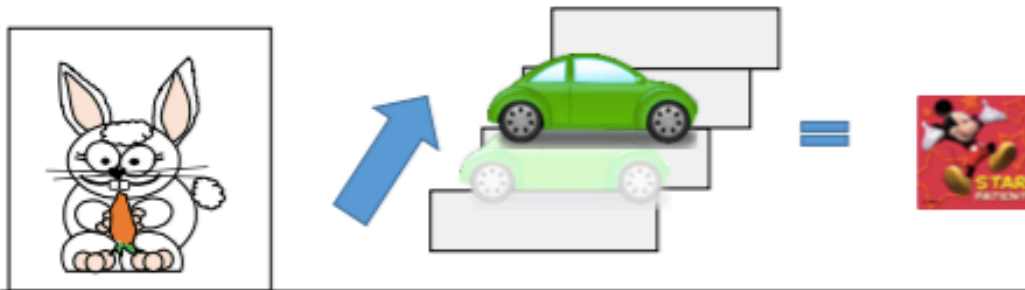


16. Child sticker trial – Lambchop accepts ✓



17. Child pokemon trial – Lambchop accept ✓

Preschool Gambling Task



This is Giraffe and Chick/Zebra. They are going to help us with this game. Giraffe and Chick/Zebra have cards that will tell you what to do in this game.

Point to bunny on demonstration card

Sometimes you are going to see a bunny on the cards. Bunnies are good! They make you win a sticker and go up the stairs. Watch me.

Make the magnet bunny go up on the game board



Point to the monster

Sometimes you are going to see a monster. Monsters are not good – no way. Every time you see the monster, you have to go down one step on the stair and you lose a sticker

The stairs tell you how many stickers you have. I will give you the stickers

Check understanding:

Can you tell me what happens when you see a bunny? Can you tell me what happens when you see a monster?

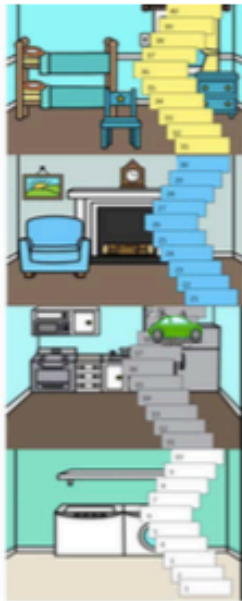
Explain further if necessary

Your bunny will start here in this room. Try to stay out of the basement

OK, let's begin then. Which animal do you want to pick from first?

Give verbal reinforcement when they win stickers such as, *Good for you. There are X Bunnies so you won X stickers.*

When children pick a card that contains a loss, the experimenter will say, *There are X Bunnies so you win X stickers, but oh no, there are X mean monsters so you lost X stickers. Those monsters are not nice.*



*****If the child has chosen from only 1 deck after 10 cards, encourage the child to choose from the other deck – it is necessary to get at least 2 cards from the other deck to have a valid assessment (i.e., need to experience win & loss from that deck)
Why don't we try [animal]?



After Trial 30 and at the end of game -Awareness Test

Which animal did you think was the best to pick from? Why do you think that it was the best? Which animal was the worst to pick from? Why do you think it was the worst to pick from?

Working Memory

Start: 3 y – House 1, 4 y – House 2 – if fail 1 of the two trials, go back to House 1

Stop: 2 or more errors within 2 sequential trials (e.g., could be 1 error in House 2 holding and 1 error in House 2 updating or 1 error in House 2 updating and 1 error House 3 holding trial)

Demonstration: “We are going to play a hiding game!”

“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 felt pig placed next to it.

“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.

Each trial sequence:

1. Get out House 1 and the first animal – look at guide for where to hide pig

2. Hide pig behind the door and pull down the cloth
Count to 10

3. Take out laminated picture of pig from guide and ask child to put it on the door where they think it is

1. I’m going to hide the ____ (name of toy animal) for you to find”
2. Place the _____ toy in the appropriate ‘hiding place’ (under the flap in the well or ‘room’; see scoring sheet or guide 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.

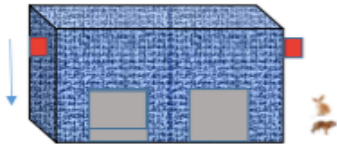
Then say, “This time before you find the pig, I’m going to put this magic blanket over the house and I’m going to count to 10.”

3. 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).” 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”

Response Inhibition

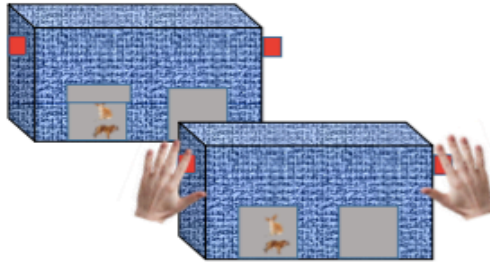
Tricky box



Phase 1: Tricky Box

Demonstrate opening each door by pulling down red knob

Look this is how it opens.



Hide animals in one side (alternate start side across participants)

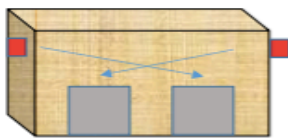
***Put both hands on two red knob before each trial so as not to prime any side

Now you get the toy.

Do 5 trials on each side. If child gets 3 consecutive correct in the 5 trials, start trials on the other side (or go to Silly Box if it's the second side)

If child does not get at least 6 correct out of the 10 trials, do not do the Silly Box trials.

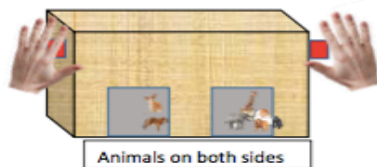
Silly box



Phase 2: Silly Box

Now we are going to play a silly game. Point to each lever and push open each door, pointing to the door as it opens. You see, it's the opposite.

Demonstrate how each knob opens the opposite side



Animals on both sides

Hide animals in both sides so the child is not primed by either side. Make sure to place a hand on both knobs before the start of each trial.

Now get the _____ (name animal)

Left, right, left, right, left
Right, left, right, left, right

Alternate side of starting across participants. Change side of hiding for each of the 5 trials. Do all trials for this phase.

If child uses the same knob or tries direct reaching, wait a few seconds to see if the child spontaneously corrects himself/herself. If the child does not spontaneously correct, remind the child of the rule

See the knobs open the opposite side.



Moral and Conventional Norm Transgressions

I'm going to read you some stories about kids just like you. At the end of each story, I'm going to ask you some questions.

In one of the questions, I'm going to ask you if something they did was ok, a little bad, or very bad. I want you to point to one of these faces (show demonstration card) to show what you think about what the kid did. If you think ok, you point to the happy face. If you think it is a little bad, you can point to this face (the neutral). If you think it's really bad, you can point to this sad face. E will demonstrate and check understanding. If you think it's ok, where do you point? If you think it's really bad, where do you point? If you think it's only a little bad, where do you point? E will correct any misunderstandings.



1. Introduce task



2. explain rating scale



3. read story



3. ask questions

There will be 6 stories in all (3 moral and 3 conventional). Girl stories for girls and boy stories for boys (same stories for each gender) 4 questions.
 1. Is it ok, a little bad or very bad? (do not read 2-4 if child says ok) 2. Why is it a little bad/very bad? 3. Would it be ok if the teacher didn't see [character's name] doing [action described]? 4. Should [character's name] get in trouble?



Read out story and questions on the top of page

Lift flap for second story on bottom of page.