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The effects of guilt on preschoolers' cognitive flexibility and inhibition

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ABSTRACT

The current study examined the effects of guilt on two aspects of children's cognitive functioning: cognitive inhibition and flexibility. Three- to 5-year olds were induced into a guilt state or a neutral state and then completed the Shape School task and the Dimensional Change Card Sort. Results indicated that 3- to 4.5-year-olds in the guilt condition had worse inhibitory control scores than those in the neutral condition; however, the two groups' flexibility scores did not differ significantly. Further, the effect of guilt on cognitive inhibition was only evident for the younger children; no significant effects emerged for 4.5- to 5.9-year-olds. We discuss the implications of the current findings for developmental models of emotion and cognition.

1. Introduction

In everyday life, children experience a range of emotions that serve as a context in which demanding tasks are completed (Keltner & Horberg, 2015). A rich literature documents the impact of emotion valence (i.e., positive vs. negative) on social functioning (Barnett, King, & Howard, 1979; Fuchs-Beauchamp, 1994; Underwood, Froming, & Moore, 1977) and cognitive functioning (e.g., Greene & Noice, 1988; Moore, Clyburn, & Underwood, 1976; Schnall, Jaswal, & Rowe, 2008; Schwarz & Pollack, 1977; Toner, Lewis, & Gribble, 1979). In the domain of cognition, the majority of research has compared the effects of happiness and sadness on a variety of skills (e.g., Qu & Zelazo, 2007; Rader & Hughes, 2005).

In the current study, we examined the effects of guilt on children's cognition. Children's experience and understanding of guilt increases substantially during the preschool years (Kochanska, Gross, Lin, & Nichols, 2002) and has implications for their psychosocial development. Specifically, normative social development necessitates moderate levels of guilt; extremely low levels are associated with increases in externalizing behaviors (Stillman & Baumeister, 2010) and extremely high levels are associated with internalizing disorders (O'Connor, Berry, & Weiss, 1999). Thus, moderate guilt responses enable children to navigate social transgressions successfully.

In contrast to the psychosocial domain, little is known about the effects of guilt on cognitive functioning. We targeted executive function, which is composed of cognitive processes that engage conscious control of thoughts, emotions, and actions (Zelazo, Qu, & Müller, 2005). We were interested in executive function because it develops rapidly during the preschool years (Carlson, 2005) and is crucial to children's academic success. For example, executive function skills are related to language development (see Marcovitch, Jacques, Boseovski, & Zelazo, 2008; Weiland, Barata, & Yoshikawa, 2014), literacy (Nesbitt, Farran, & Fuhs, 2015) and mathematics achievement (Clark, Pritchard, & Woodward, 2010). We were interested in the effects of guilt on two executive function components: inhibition (suppression of irrelevant responses) and flexibility (switching between responses based task demands; Diamond, 2013). There is growing evidence that executive control is influenced by affective processes. The engagement of "hot" executive function (the conscious control of motivationally significant responses) is typically more challenging than "cool" executive function (i.e., conscious control of neutral responses; Carlson, Davis, & Leach, 2005; Kerr & Zelazo, 2004; Kramer, Lagattuta, & Sayfan, 2015).

Although there is considerable evidence that the addition of emotional task components can affect preschoolers' executive function performance (Zelazo & Carlson, 2012), less is known about how task-unrelated emotions affect "cool" executive function performance. Some studies demonstrated that task-unrelated negative emotions, such as sadness, affect inhibitory control and flexibility (e.g., Derryberry & Reed, 1998; Schel & Crone, 2013; Toner et al., 1979). Thus, there is reason to believe that guilt will also affect these skills. Aside from assessing the effects of guilt on children's executive function empirically, we address theoretical accounts of children's experience of guilt with age. In early childhood, the valence dimension of emotions (i.e., positive or negative) is considered especially salient (Widen & Russell, 2008). With increasing age, motivational aspects of emotions become increasingly significant and impact children's cognition differentially, as described below.

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2. Theoretical accounts of emotion effects on cognitive performance

It has long been proposed that emotions influence cognitive functioning by triggering specific information processing styles (see Forgas & Eich, 2013). The feelings-as-information theory suggests that processing styles are triggered by the experience of emotion valence (Schwarz, 2001). Of relevance to the current study, negative emotions engage systematic processing that involves heightened inspection of information and little reliance on general knowledge. Conversely, motivational theories of emotion suggest that the motivational tendencies that are triggered by emotions produce distinct impacts on cognitive performance, regardless of emotion valence (Rothbart & Hwang, 2005). For example, emotions such as happiness and guilt evoke approach motivations, which are tendencies to focus on the maintenance or promotion of positive end-states (e.g., preservation or pursuit of academic achievement). In contrast, emotions such as sadness and relaxation evoke avoidant motivations to withdraw from goal pursuits and to conserve resources (e.g., disengage from academic pursuits). Evidence for this motivational account in young children is sparse and limited (Hom & Arbuckle, 1988). Further, when relevant developmental factors are taken into account (e.g., development of emotion knowledge and utilization), it seems likely that valence may be more significant than motivational aspects of emotions early in life (Berti, Garattoni, & Venturini, 2000; Widen & Russell, 2008, 2010). Below, we detail the evidence and developmental considerations for each account.

2.1. Feelings-as-information

Negative emotions have generally been found to impair children's cognitive processes, including problem solving (Barden, Garber, Leiman, Ford, & Masters, 1985; Rader & Hughes, 2005), inhibitory control (Schel & Crone, 2013), creativity (Dunn & Brown, 1994) and memory (Blau & Klein, 2010). The feelings-as-information theory suggests that the systematic processing associated with negative emotion should impair cognitive functions that require broad attention and thinking (i.e., top-down conceptual processing; Dreisbach & Goschke, 2004), including inhibitory control and cognitive flexibility (see Jacques & Marcovitch, 2010). Systematic processing (i.e., perceptually driven processing) should impair these skills because it increases attention to parts of stimuli that should be ignored. Also, this singular focus limits the ability to focus on two parts of a stimulus that are both relevant, but at different times.

Successful inhibition requires the suppression of a response to a stimulus feature that was once relevant by actively diverting attention away from it and focusing on a different feature (Desimone & Duncan, 1995). For example, in the Stroop paradigm, participants see color names that are printed in ink of a conflicting color (e.g., the word "red" printed in blue ink). Participants must state the color of the ink rather than the printed color word (i.e., say "blue"), thus diverting attention from semantic meaning to focus on the color of the text. Similarly, successful flexibility performance relies on children's ability to form a mental set (i.e., a stimulus response association) and shift to a novel mental set that conflicts with the first set (Garon, Bryson, & Smith, 2008). Flexibility also requires the formation of conceptual sets (for review, see Jacques & Marcovitch, 2010). For example, when categorizing stimuli (e.g., blue boats and red bunnies) by color and then shape, children are more successful at shifting when they form conceptual mental sets (i.e., sort according to *color*) rather than sets based on perceptual features (e.g., blue ones in one box vs. red ones in another box; Kharitonova, Chien, Colunga, & Munakata, 2009).

Although this theoretical account posits that negative emotion should impair both inhibition and flexibility, in preschoolers this prediction has only been supported consistently for inhibition. The experience of negative emotions impairs "hot" inhibitory control (Fry, 1975; Schwarz & Pollack, 1977; Toner et al., 1979). For example, Moore et al. (1976) induced preschoolers into a positive or negative mood state through a self-generated imagery procedure. They also included a neutral group of children who were asked to count. Compared to children in the positive or neutral moods, children in a negative mood were less able to inhibit the selection of an immediate, less attractive reward and instead wait for a delayed, but more attractive reward. Negative emotions also impair "cool" aspects of inhibitory control in children. For example, Schel and Crone (2013) had children (6- to 15-year-olds) and adults (18- to 25-year-olds) complete an emotional Go/NoGo task. Participants were presented with pictures of emotional faces (i.e., happy, fearful, and neutral) on a computer and responded with a button press to certain emotional faces, while inhibiting a response to other emotional faces. Fearful faces impaired participants' inhibitory control as compared to happy faces; however, this effect decreased with age. This was likely due to older children's and adults' overall high task performance. These results support the feelings-as-information theory, but suggest that the predictions may apply when individuals are only moderately skilled at the task at hand.

In contrast to inhibition, little is known about the impact of negative emotions on preschoolers' cognitive flexibility. Only one study investigated the effect of negative emotion on preschoolers' cognitive flexibility. Qu and Zelazo (2007) assessed the impact of negative, positive, and neutral mood on 3-year-olds' flexibility by comparing their performance on the Dimensional Change Card Sort (DCCS) to the Emotional Face Card Sort (EFCS). The DCCS (Zelazo, Frye, & Rapus, 1996) is a standard task used to assess flexibility in early childhood. In the task, children sort picture cards by one dimension (e.g., shape) and then switch to sort the same cards by another dimension (e.g., color) that conflicts with their previously established sorting pattern. For successful performance, children must represent items by both dimensions (e.g., color and shape). In the EFCS, children sort photographs of adults and children who display happy, sad, or neutral faces by the age (i.e., old vs. young) and gender of the individuals in the photographs. Children's performance on the sad EFCS, neutral EFCS, and standard DCCS did not differ significantly. Thus in this case, findings did not support the feelings-as-information theory in the context of cognitive flexibility. Given that this is the only study that has examined the effects of negative mood on cognitive flexibility, it is not clear whether this is a robust effect. Thus, we contributed to the literature in examining whether a different negative emotion may affect DCCS performance, as well as other flexibility assessments.

2.2. Motivational account

Although there is some support for the feelings-as-information theory, much of the developmental research that has assessed the predictions of this theory has confounded emotion valence with motivational tendencies. Specifically, most developmental studies have compared the effects of happiness (i.e., an approach emotion) on cognitive performance to that of sadness (i.e., an avoidant emotion). Thus, it is possible that motivational aspects of emotions, rather than valence, may account for such findings. Indeed, in adults, emotion motivations, valence, and level of arousal all interact to determine the effects of emotion on cognitive performance (Baas et al., 2008). Emotions are motivationally significant from birth (Schunk, Pintrich, & Meece, 2008) and with increasing age, children's experiences of avoidant emotions such as sadness are related to their avoidant achievement motivations (e.g., hopelessness and disengagement; Diener & Dweck, 1978; Smiley & Dweck, 1994). Conversely, approach emotions (e.g., happiness and guilt) are associated with approach achievement motivations (e.g., high self-motivation and engagement; Smiley & Dweck, 1994). It is theorized that avoidant emotions result in poorer task performance and academic outcomes because they encourage children to disengage from tasks, whereas approach emotions encourage children to increase their efforts (He et al., 2013). Based on this motivational account, the approach motivation associated guilt should improve rather than impair cognitive inhibition and flexibility.

There is evidence that avoidant and approach emotion tendencies, regardless of emotion valence, influence preschoolers' emotion regulation strategies (Dennis, Cole, Wiggins, Cohen, & Zalewski, 2009) and task persistence (Ridgeway & Waters, 1987). For example, preschoolers in happy or angry moods (i.e., approach emotions), as compared to those in sad moods (i.e., avoidant emotion), use a greater number of beneficial regulatory strategies (i.e., behavioral distraction and problem solving) in the context of waiting and frustration tasks (Dennis et al., 2009). Additionally, research with 1st and 2nd graders indicates that negative and positive approach emotions (i.e., happiness and anger) both improve flexibility in children's divergent thinking task performance (Russ & Kaugars, 2001). These findings suggest that approach and avoidance tendencies may also be relevant to preschoolers' executive function performance, but to the best of our knowledge no studies have investigated this question directly.

Although emotion motivations have implications for older children and adults' cognitive functioning, this may not be the case for young preschoolers because these children have yet to form elaborate emotion scripts that encompass associations of situations, feelings, behaviors, and motivational cues of emotions (Berti et al., 2000). As children age, these emotion scripts support advanced emotion utilization skills, which allow children to apply motivational aspects of emotions toward constructive goals (Izard et al., 2011). For example, children who are taught adaptive emotion utilization strategies evaluate the experience of sadness more favorably and seek out social support rather than socially withdraw (Izard, Stark, Trentacosta, & Schultz, 2008). Developmental progressions in emotion utilization strategies may also enable children to use the approach motivation of guilt consciously. For example, older children channel feelings of guilt into reparative prosocial behaviors (Weiner & Graham, 1989) rather than self-punishing behaviors (Nelissen & Zeelenberg, 2009). Such developments in emotion utilization may underlie the emergence of emotion motivation effects on cognitive functioning. Thus, we expected that valence may be the most significant dimension early in life, whereas emotions become further distinguished during the preschool years (Widen & Russell, 2008, 2010).

3. Current study

Our goal was to gain insight into how preschoolers' experience of guilt affects their cognitive inhibition and flexibility. Children were induced into a guilt or neutral state and then completed the Shape School task (Espy, 1997) and the DCCS (Zelazo et al., 1996). The Shape School task provides a developmentally sensitive measure of both cognitive inhibition and flexibility. The DCCS is widely used to assess preschoolers' cognitive flexibility (Marcovitch, Boseovski, & Knapp, 2007; Zelazo, Müller, Frye, & Marcovitch, 2003) and has been used to assess the effects of emotion on cognitive flexibility (Qu & Zelazo, 2007). Inclusion of this latter measure ensured that any current results that differed from previous findings were not due to differences in task demands, but rather the manipulation of emotion.

Unlike previous studies that used emotional stimuli to assess the effects of emotion on cognition (e.g., Qu & Zelazo, 2007; Schel & Crone, 2013), participants underwent a guilt induction prior to completing cognitive tasks composed of neutral stimuli. This methodology was selected to replicate the experience of emotions in children's everyday lives. Often, the tasks that children must complete are neutral, but take place in the emotional context of children's social world (Hymel, Schonert-Reichl, & Miller, 2006). This methodology also allowed us to code children's emotion as a manipulation check to show that children of all ages were affected by the guilt induction as expected. We also assessed children's emotional disposition given its relation to cognitive functioning (Bell, Greene, & Wolfe, 2010). We examined the degree to which children displayed a fearful temperament, which is associated with the experience of guilt (Kochanska, 1997). Highly fearful children may be particularly susceptible to the effects of guilt.

Table 1
Predictions based on valence versus approach motivation by age.

	Valence Only		Approach Motivation	
Age	Flexibility	Inhibition	Flexibility	Inhibition
Younger-Low Mastery	*No Effect*	*Impaired*	Improved	Improved
Older-High Mastery	No Effect	Little to No Impairment	*Improved*	*Little to no Improvement*

Note: Italics represent our expected results.

Based on the theoretical accounts discussed, two outcomes were possible. First, if children experience only the negative valence of guilt, then guilt should have no effect on children's cognitive flexibility and impair cognitive inhibition, similar to sadness (Qu & Zelazo, 2007; Schel & Crone, 2013). Conversely, if children experience the approach focus of guilt, then guilt should *improve* cognitive flexibility and inhibition. In either case, the predicted effects may be small or insignificant for older children given their increased mastery of executive control. In these children, performance would necessitate fewer cognitive resources and result in little or no effects of guilt on cognitive performance (Ellis & Ashbrook, 1988; see Table 1 for complete hypotheses). This may be particularly true for older children's inhibition performance, as inhibitory control skills develop earlier than cognitive flexibility (Carlson, 2005; Diamond, 2013).

We expected these outcomes to vary by age because of the development of more elaborate emotion scripts during the preschool years, which include situational and motivational cues of emotions (Berti et al., 2000). Specifically, the effects of guilt on younger children's cognitive functioning were expected to be consistent with the feelings-as-information account, whereas the effects on older children's cognitive functioning were expected to be consistent with the motivation account. Finally, we expected age-related changes in children's overall task performance and guilt responses. Older children were expected to outperform younger children on measures of flexibility and inhibition (Carlson, 2005). We also expected older children to experience higher levels of guilt than younger children in response to the guilt induction, as the experience of guilt increases with age (Kochanska et al., 2002).

4. Method

4.1. Participants

The sample consisted of 82 younger children (3;0–4;5, M = 3;7.56, SD = 4.86 months, 40 males) and 78 older children (4;6–5;11, M = 5;2.40, SD = 5.08 months, 42 males). Participants were recruited from a midsized southeastern city in the United States. Concerning sample composition, 72.5% of participants were Caucasian, 11.9% African American, 8.1% mixed races, 1% Asian and 6.9% chose not to answer. Participants varied in socioeconomic background, with 47.5% of families reporting an income over $60,000, 15% between $40,000 and $60,000, 15.6% between $20,000 and $40,000, and 4.4% less than $20,000. Socioeconomic information was not reported by 17.5% of families.

4.2. Materials

For the guilt induction (Kochanska, Casey, & Fukumoto, 1995), a toy dog was used that was rigged such that the head fell off when handled by the participant. As part of the debriefing for participants in the guilt condition, an intact exact replica of the toy dog was used. Laminated 3 × 5 in cards depicting yellow flowers, yellow cars, green flowers, and green cars were used for the DCCS (Zelazo et al., 1996). Cards were sorted into plastic containers. The Shape School task materials

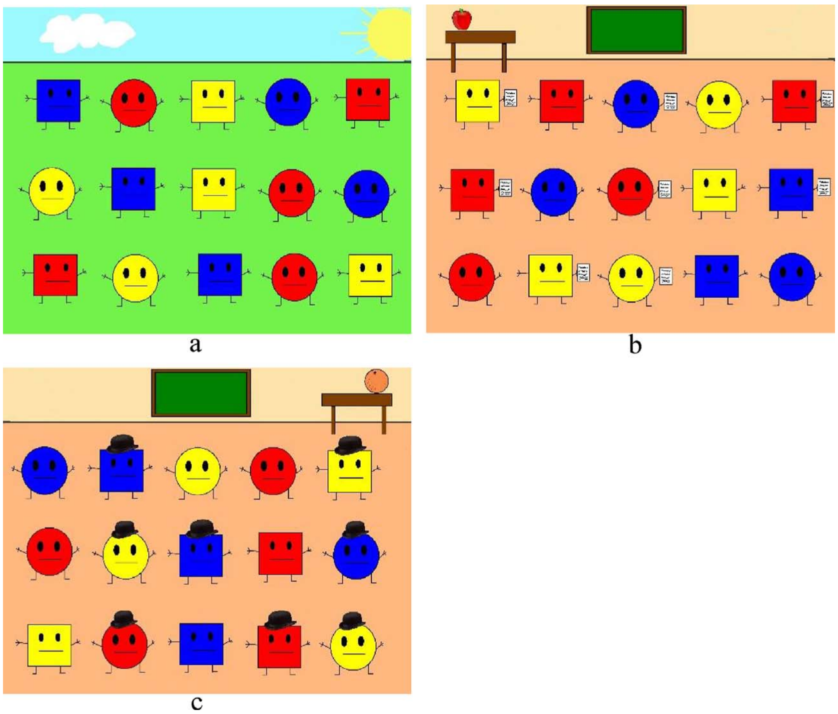

Fig. 1. Shape School Task Stimuli.
(a) Control Trial. (b) Inhibit Trial. (c) Switch Trial.

consisted of laminated pictures of red, blue and yellow circles and squares (Espy, 1997).

Mothers completed the Child Behavior Questionnaire (CBQ), a well-established measure of temperament (Rothbart, Ahadi, Hershey, & Fisher, 2001). The inventory consists of statements such as “My child is not afraid of large dogs and/or other animals” that mothers rated on a 7-point scale (1 = *extremely untrue*, 7 = *extremely true*). As in previous research (Kochanska, 1997), three subscales were combined to assess the extent to which children displayed a fearful temperament (α = 0.66): shyness (13 items; α = 0.53), fearfulness (12 items; 0.59), and discomfort (12 items; α = 0.77).

4.3. Procedure

As part of a larger study, participants were tested in a laboratory setting by a female experimenter. Participants were assigned randomly to the guilt or neutral emotion condition. After the guilt induction or neutral interaction, participants completed the DCCS, the Shape School task, and an additional task (i.e., a 5-min picture matching task unrelated to this study) in one of 3 possible counterbalanced orders. Participants in the guilt condition were then debriefed. All mothers completed the CBQ, for which scores were standardized and children were categorized as low (more than one standard deviation below the mean), moderate (within one standard deviation of the mean), or highly fearful (more than one standard deviation above the mean).

4.3.1. Guilt induction

Guilt was induced using a mishap paradigm that is a valid elicitor of guilt responses (Kochanska et al., 1995, 2009). The experimenter told participants, “I brought my favorite toy with me today. Would you like to see it?” All participants indicated that they would like to see the toy. The experimenter took out the toy and continued, “This is my toy puppy and it is my favorite toy! Would you like to play with it?” The toy was rigged to break such that when the participants played with it, the dog’s head fell off. If participants were very gentle in handling the toy and the head did not fall off immediately, the experimenter encouraged them to play with it until the head fell off. Once the toy broke, the experimenter expressed mild regret by saying, “Oh my!” and then sat in silence for 60 s while keeping intermittent eye contact with the participant. Participants’ behavioral responses to this mishap were recorded and later coded to obtain a measure of guilt. After 60 s, the experimenter asked the participants questions about the mishap, “What happened? Who did it? Did you do it?” At the end of the study, participants in the guilt condition were told by the experimenter that they believed that they could fix the toy. The experimenter left the room with the toy and retrieved an intact replica of the toy. The experimenter presented the replica to the participant and said “See the toy is all fixed now. You did not break the toy and it was not your fault. It just came apart. I forgot, it always does that.” All children were praised warmly and received a small prize to assure they left the study in a positive mood.

4.3.1.1. Behavioral coding. Codes were applied to each 5 s segment of the 60 s interval (see Kochanska et al., 2009). Raters watched video recordings of testing sessions and coded for the presence of eight guilt behaviors: avoiding eye gaze, lip biting, twisting, covering or touching the face, squirming, hanging head, hunching shoulders or hugging one’s self. Raters noted the presence of all behaviors in each 5 s increment. Greater frequencies of behavior indicated higher levels of a guilt response. Scores for each behavioral code were summed across all intervals and standardized to obtain a measure of guilt. A single rater coded the guilt responses for all participants. An additional rater coded 50% of the data and demonstrated good interrater reliability (ICC = 0.85; Cicchetti, 1994).

4.3.2. Neutral interaction

The experimenter followed the same script as in the guilt procedures, with the exception that the toy was a plain wooden block. The experimenter gave the block to the child and indicated that he or she could play with it while the experimenter finished some paperwork. The experimenter let the child interact with the block and kept intermittent eye contact for 60 s, as in the guilt condition.

4.3.3. Cognitive inhibition

Children completed the Shape School task (Espy, 1997), in which they were shown a picture array of different colored figures (i.e., squares and circles) with arms, legs, and neutral facial expressions (see Fig. 1). Children were told that these figures were students at the school and that they had to call out all of their names (i.e., figure color). The experimenter pointed to each figure for children to label, moving from left to right. The first trial was used to ensure that children could label all of the students by color, to establish a naming rule that would later need to be inhibited, and to establish the order in which figures were to be labeled. Then, the next picture was presented, in which some of the students had papers and some did not have papers. This inhibition trial required participants to refrain from naming the students without papers, because those students were described as not being done with their work. There were 7 “no-go” students in the display that children had to refrain from labeling and 8 “go” students that children had to label. Children were told to point to each figure as they labeled them. Children received a point each time they correctly labeled or inhibited labeling a student. Thus, the scores ranged from 0 to 15.

4.3.4. *Flexibility*

An additional trial of the Shape School task assessed children's cognitive flexibility. In this final trial, children were shown a display of students, some of whom were wearing hats. Children had to label the students without hats by color (i.e., continue to use the previously established rule) and those with hats by shape (i.e., switch to labeling with a new rule). There were 15 students in the display: 7 to be labeled by the established rule (i.e., color) and 8 to be labeled with the new rule (i.e., shape). Children were told to point to each figure as they labeled them. Children received a point each time they correctly labeled a student in the display. Thus, the scores ranged from 0 to 15.

We administered the DCCS as an additional measure of cognitive flexibility. This task assesses children's ability to represent one object in two ways (i.e., color and shape). Participants sorted cards by one dimension (e.g., shape) in the pre-switch trials and then sorted the same cards by another dimension (e.g., color) in the post-switch trials. Children completed five of each trial type. Eleven participants did not pass the pre-switch trials and were excluded from data analyses (see Zelazo et al., 2003, for similar procedures). Children received 1 point for each post-switch card sorted correctly. Thus, scores ranged from 0 to 5.

5. Results

To ensure that the guilt induction was effective, children's behavioral reactions to the mishap were examined. After the mishap, children displayed 6.24 behavioral indicators of guilt on average. Older children ($M = 8.56$, $SD = 7.46$) displayed more behavioral indicators of guilt than younger children ($M = 4.06$, $SD = 4.32$), $t(74.43) = -3.65$, $p < 0.01$, in reaction to the mishap.

We conducted 2 (age: 3- to 4.5-year-olds vs. 4.5- to 5-year-olds) x 2 (mood induction: guilt vs. neutral) x 3 (Fearful Temperament: low vs. medium vs. high) between-subjects ANOVAs on children's Shape School scores for the inhibitory control and flexibility trials, as well as their DCCS scores. Regression models with age and temperament as continuous predictors were also tested and produced the same pattern of results; thus, they are not reported here. Potential gender and task order effects were examined for each model. There were no significant effects or interactions involving these variables on any dependent measures; thus, they were excluded from the final models.

On the inhibition trial of the Shape School task, older children performed better than younger children, $F(1, 142) = 17.79$, $p < 0.01$, $\eta_p^2 = 0.11$. Descriptive data revealed that 4.5- to 5-year-olds' performance was near ceiling (see Table 2). There was a trend for condition, $F(1, 142) = 2.98$ $p = 0.08$, $\eta_p^2 = 0.02$; this was qualified by a significant interaction between age and condition, $F(2, 142) = 6.75$, $p < 0.05$, $\eta_p^2 = 0.04$ (see Fig. 2). Three- to 4.5-year-olds' performance was lower in the guilt condition than the neutral condition, $t(79) = -2.72$, $p < 0.01$. Conversely, 4.5–5-year-olds' performance did not differ significantly in the neutral and guilt conditions, $t(44.64) = 1.33$, $p = 0.19$. There was a trend for temperament as a predictor of scores, $F(1, 142) = 2.48$, $p = 0.08$, $\eta_p^2 = 0.02$. Because it did not reach significance, post hoc analyses were not conducted. No other interactions were significant, p's > 0.05.

On the Shape School flexibility trial, older children performed better than younger children, $F(1, 141) = 59.94$, $p < 0.01$, $\eta_p^2 = 0.29$. Older children did not perform at ceiling on this task (see Table 2). No other effects were significant, p's > 0.05. Similarly, for the DCCS, older children performed better than younger children, $F(1, 143) = 22.96$, $p < 0.01$, $\eta_p^2 = 0.13$. Older children performed well on the DCCS, but not at ceiling (see Table 2). There were no other significant effects, p's > 0.05.

6. Discussion

This study is the first to offer insight into the immediate effects of guilt on preschoolers' cognitive inhibition and flexibility. The findings revealed that the induction of guilt impaired the performance of younger children, but not older children, on the inhibitory control trial of the Shape School task. However, older children's ceiling performance on the task made the interpretation of this non-significant effect ambiguous, as discussed further below. In contrast to inhibitory control, guilt had no significant effect on younger or older children's flexibility performance, as assessed by the flexibility trial of the Shape School task and the DCCS.

These findings provide information about the mechanism responsible for the effects of emotional experiences on cognition early in life. The results suggest that the experience of emotion valence, rather than motivational tendencies, is the predominant influence on preschoolers' cognitive functioning. This is consistent with findings that other negative emotions impair young children's inhibition (Schel & Crone, 2013), but not cognitive flexibility (Qu & Zelazo, 2007). Based on the current findings, it is unlikely that preschoolers experience the approach motivation tendencies associated with guilt. If this were the case, flexibility should have been improved because an approach focus increases motivation and efforts to pursue task mastery. It is also possible that children of this age experience the distinct approach and avoidant emotion tendencies associated with various negative emotions, but that these distinctions may not be salient enough to affect cognitive function. Indeed, there is evidence that the behavioral approach tendencies elicited by guilt are modest in the early preschool years (see Vaish, Carpenter, & Tomasello, 2016). In either case, our results are consistent with previous research (e.g., Kochanska et al., 2002; Zahn-Waxler & Kochanska, 1990) in suggesting that preschoolers' experience of guilt is qualitatively different from that of older children and adults.

It is important to consider reasons why motivational tendencies may not be influential to cognition early in life. First, a complex understanding of emotions emerges in middle childhood. Older children have advanced knowledge of the consequences of emotions and the relation between emotions and situations (Denham, 1998). Second, children develop complex emotion schemas in middle childhood that allow for a more intricate understanding of the relation between emotion, cognition, and behavior (Izard, 2007). Well-developed schemas may be necessary to trigger changes in effort based on motivational tendencies. Further, these schemas are likely strengthened across development by repeated experiences of emotions that co-vary with particular behavioral responses, which are somewhat differentiated by motivational tendencies early in life (e.g., Barrett, Zahn-Waxler, & Cole, 1993; Dennis et al., 2009). Developmental changes in emotion knowledge and schemas likely support emotion utilization and thus, increased effects of emotion motivations on cognitive functioning (Izard et al., 2011).

This study also offers evidence for the role of task difficulty in emotionally laden contexts. Younger children, but not older children, experienced impairment in inhibitory control after the guilt induction. This finding is consistent with our prediction that older children's advanced cognitive skills would serve as a buffer against the effects of guilt (see Ellis & Ashbrook, 1988). It is possible that emotions have a

Table 2
Means, standard errors, and range of scores by age, task, and emotion condition.

Age in Years	Guilt									Neutral								
	SS Inhibit			SS Flexibility			DCCS			SS Inhibit			SS Flexibility			DCCS		
	M	*SE*	Range	*M*	*SE*	Range	*M*	*SE*	Range	*M*	*SE*	Range	*M*	*SE*	Range	*M*	*SE*	Range
3–4.5	9.14	0.69	0 – 15	7.22	0.54	0–15	2.14	0.34	0 – 5	11.97	0.68	2–15	7.43	0.61	1–15	2.14	0.44	0–5
4.5–5	14.49	0.21	8–15	11.91	0.48	4–15	4.04	0.27	0 – 5	13.87	0.41	7–15	12.43	0.51	7–15	3.80	0.37	0–5

Note: DCCS = Dimensional Change Card Sort; SS = Shape School.

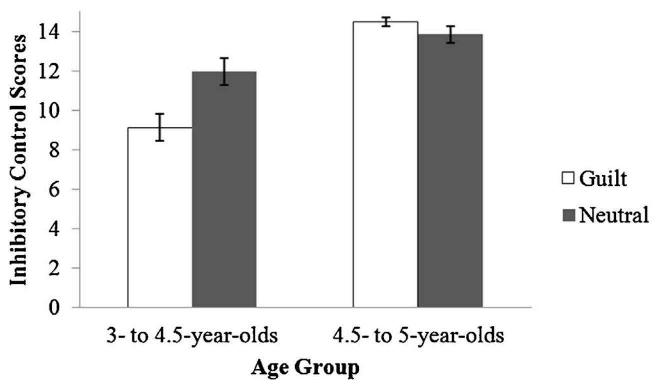

Fig. 2. Mean Shape School inhibitory control scores by emotion condition and age. Error bars represent standard errors.

hierarchical effect on cognitive processes by which performance is only affected by emotion when tasks are moderately difficult. This interpretation could be considered within the Hierarchical Competing Systems Model (HCSM; Marcovitch & Zelazo, 2009) of executive function development. This model posits that both habit and representational systems guide behavioral control. When goal directed behaviors become well mastered and can be controlled by the habit-based system, emotions may be of little consequence. Conversely, emotions may be more influential to the completion of more difficult tasks that require the representational system. This system allows children to engage in active reflection on representations of correct responses. Thus, the information processing styles induced by emotions may affect the accessibility of different representations given that negative emotions are believed to narrow individual's scope of attention (Schwarz, 2001).

This proposition must be interpreted cautiously given older children's ceiling performance on the inhibitory control task. For example, it is possible that the effects of guilt would be limited for older children irrespective of task difficulty. However, there is no support for this alternative interpretation, as it has been well established that negative emotions impair children's inhibitory control (Masters & Santrock, 1976; Moore et al., 1976; Schwarz & Pollack, 1977; Yates, Lippett, & Yates, 1981). Also, there is consistent empirical evidence for the task difficulty account. Using a more challenging Go/NoGo task, Schel and Crone (2013) found that negative emotions impaired 6- to 9-year-olds' performance, but not older children and adults', performance.

Nonetheless, given these interpretational issues, we cannot make strong claims about the developmental effects of guilt on older children's inhibitory control. Future research should address this limitation by using a variety of tasks to establish boundaries for the effects of emotional experiences on cognitive functioning. One promising task set is the NIH Toolbox cognitive battery, as this standardized battery provides an assessment of a number of cognitive functions (e.g., flexibility and inhibitory control) for both children and adults (Bauer & Zelazo, 2014). Future research should examine additional developmental factors that may moderate the effects of emotion on cognitive processes between early and middle childhood. For example, preschoolers often complete executive function assessments with the instruction that they are simply playing a game, whereas older children are likely more aware that their abilities are being assessed. Indeed, research with adults indicates that negative emotions have greater effects on cognitive processes when the task is framed as serious (Baas et al., 2008). These contexts should be examined systematically across development to determine how they may relate to the effects of emotions on cognition observed previously.

It is also important to consider individual differences further in future research. We found no evidence that fearful temperament interacted with the guilt induction to affect cognitive performance. Although temperamental emotional dispositions are influential to children's cognitive control (Wolfe & Bell, 2004), we only assessed one dimension of temperament. It is important to investigate additional aspects of temperament that encompass negative emotions beyond fear. For example, dispositional emotional reactivity may increase children's susceptibility to the effects of emotions on cognition. Indeed, dispositional traits such as aggression enhance the effects of negative emotions on social cognition (Harper, Lemerise, & Caverly, 2010). Further, given the relatively modest reliability of the fearfulness temperament subscale (Kochanska, 1997), future studies may be improved with the inclusion of behavioral assessments of temperament rather than parental report measures. Future studies could also include pretest measures of hot executive control skills to examine individual differences in emotion regulation. It is possible that children who are typically better able to manage their emotions to meet their goals are also less susceptible to the effects of induced guilt on their cognitive performance. Indeed, there is evidence that adults who use poor emotion regulation strategies are more susceptible to the effects of emotion induction procedures (Evers, Stok, & de Ridder, 2010).

These results contribute to the literature in many ways. First, the findings replicate previous findings that negative emotions impair inhibition and extend these findings to different cognitive assessments (i.e., Shape School task). We found no effect of negative emotion on children's flexibility performance, similar to previous studies with different assessments (Qu & Zelazo, 2007). The finding that guilt impaired inhibitory control adds to the literature by providing further evidence that negative emotions impair "cool" aspects of inhibition (Schel & Crone, 2013), not just "hot" aspects (e.g., Moore et al., 1976). This distinction is important, as "hot" inhibition tasks elicit emotional responses (e.g., excitement while waiting for a gift; Zelazo & Carlson, 2012) that may interact with induced emotional states. The current replication of an impairing effect of negative emotions on inhibition with an affectively neutral inhibition task (i.e., the Shape School task) increases our confidence that negative emotions impair children's inhibitory control in a variety of contexts. Moreover, it is unlikely that previous findings are an artifact of the specific inhibition tasks used.

Second, our findings suggest that emotion valence effects extend to guilt. The majority of previous studies have investigated happiness and sadness (Masters & Santrock, 1976; Schwarz & Pollack, 1977); thus, the current findings are pertinent to establishing generalizability of these emotion effects to a complex emotion. Third, we observed emotion effects on cognitive functioning using methodology in which emotion induction was conducted prior to task completion. Thus, emotion does not need to be central to task stimuli to affect cognitive functioning. Additionally, given that children completed multiple tasks and emotion still influenced performance, the effect of induced emotion on cognition may be less transient than suggested previously (Qu & Zelazo, 2007).

In sum, preschoolers' experience of guilt is largely related to the valence of the emotion, rather than approach motivations. Accordingly, the subsequent effect of guilt on children's cognitive functioning is similar to the effects of other negative emotions, like sadness. This information is important for the construction of developmentally appropriate models of cognition and emotion. Specifically, theoretical models need to account for the influence of different emotion dimensions on cognition over the course of development. Future research should investigate at which developmental period emotion motivation tendencies become influential to cognition and the emotion processes that contribute to this change. Finally, we provide further evidence that cognitive performance is linked to emotion; therefore, children's emotional well-being should be considered in the academic context (Diamond, 2014).

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