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Awareness and Symbol Use Improves Future-Oriented Decision Making in Preschoolers

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A child version of the Iowa Gambling task was used to explore the development of decision-making during the preschool period in two experiments. One hundred eighty-one children, 3.5 and 4.5 years of age, were asked to choose between a "bad" deck with higher immediate but lower long-term rewards and a "good" deck with lower immediate but higher long-term rewards. Experiment 1 explored age differences and the association of the gambling task with a delay of gratification task. Age differences in performance were found, supporting previous findings (Kerr & Zelazo, 2004) of a development difference between 3- and 4-year-old children in future-oriented decision making. Performance on the gambling task was found to be significantly associated with delay of gratification for 3.5-year-old children only. Experiment 2 explored the effect of labeling and symbol use on performance. Although having 4.5-year-old children label decks as good or bad improved their performance on the task, this labeling had no effect on 3.5-year-old children's performance. However, having 3.5-year-old children place a symbol representing "good" and "bad" next to the decks did improve performance, but only for those children who were able to correctly label the decks. These results suggest an interaction between conscious awareness, symbol use, and making advantageous future-oriented decisions during the preschool period.

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Adaptive social functioning requires making decisions that are future oriented. Making future-oriented decisions is particularly difficult when current and future rewards are in conflict. This type of conflict is common to many everyday social situations. For instance, consider how difficult it is for young children to share a valued item such as a package of candies with peers. In this situation, children must choose to either have all the candies or have fewer candies and more positive future interactions with peers.

The Iowa Gambling task (IGT), which was created to mimic real-life decision making, involves making decisions among four decks of cards. As is true for many real-life decisions, immediate rewards conflict with longer-term net wins in this task. The two disadvantageous decks contain large wins and large losses, leading to a net loss over the course of 10 cards. The two advantageous decks contain small wins and small losses, leading to a net win over the course of 10 cards. Individuals with ventromedial/orbitofrontal cortex (OFC) lesions have been repeatedly found to show impairment on this task (Bechara, Damasio, Damasio, & Anderson, 1994; Bechara, Tranel, Damasio & Damasio, 1996; Fellows & Farah, 2005; Tranel, Bechara & Damasio, 2000).

FEELING CATEGORIES, AWARENESS, AND DECISION MAKING

Similar to typical category learning tasks, the IGT involves learning over repeated instances (Kéri, 2003). It has been hypothesized that during the IGT, the OFC network enables normal participants to build abstract representations of the reinforcement information (Kéri, 2003; Krawczyk, 2002). Along this line of thinking, Damasio (1994) suggested that the OFC enables individuals to build somatic markers or affective reactions to classes of situations. What is being learned, then, during the IGT may be something like a “feeling category” for each deck. For instance, normal individuals develop a “hunch” midway through the game that some decks are riskier (Bechara, Damasio, Tranel & Damasio, 1997).

Based on reported conscious knowledge during the IGT, Bechara et al. (1997) reported three stages of learning in the IGT that corresponds with awareness of the game (prehunch, hunch, and conceptual). During the prehunch stage, normal participants began to show anticipatory skin conductance responses (SCRs) to the decks. Halfway through the game, all normal participants reached the “hunch” stage, where they reported knowing that some decks were riskier, but could not explain why these were riskier. The largest shift toward the good decks occurred during this stage. Finally, by about card 80, 70% of controls reached the “conceptual” stage, where they could explain why some decks were riskier. The OFC patients never developed anticipatory SCRs. Even those (50%) who developed knowledge that some decks were riskier still did not avoid these decks, suggesting dissociation between knowledge and performance.

It is interesting to note that the data in this study suggest that it is not until participants are aware of which deck is riskier that they make a large shift toward the good decks. In fact, during the prehunch stage, when participants are showing skin response (presumably reflecting implicit knowledge), there is only a small trend to choose more from the good decks. This suggests an interesting difference between making decisions based on an emotional reaction to a particular deck (somatic marker) and making decisions based on explicit knowledge of that emotional reaction to a deck. The difference between the prehunch stage and the hunch stage may reflect the shift from using an implicit feeling category to an explicit feeling concept. The shift may have important implications for performance on this task, with the implicit phase being tied to a slower more gradual shift to the good deck and explicit phase tied to a more dramatic shift, as it is for other types of category learning tasks (Rehder & Hoffman, 2005).

DEVELOPMENTAL RESEARCH ON DECISION MAKING

Research using the IGT (and child variants of the IGT) with children and adolescents suggests a progressive development of the ability to make complex future-oriented decisions in children and adolescents (Crone & van der Molen, 2004; Crone, Vendel, & van der Molen, 2003; Garon & Moore, 2004; Kerr & Zelazo, 2004; Overman, 2004). In recent work with young children, a two-deck version of the IGT has been found to differentiate between 3- and 4-year-old children (Kerr & Zelazo, 2004). Whereas 3-year-old children chose more from the disadvantageous deck, 4-year-old children chose more from the advantageous deck as the task proceeded.

This finding is in line with research on a simpler future-oriented decision-making task, which suggests improvements in future-oriented decisions at 4 years of age (Lemmon & Moore, 2001; Moore, Barresi & Thompson, 1998; Thompson, Barresi & Moore, 1997). This delay of gratification paradigm involves making a series of choices between a small, immediate reward and a larger, delayed reward.

However, in comparison to the choice delay of gratification task, the IGT represents a more complex form of future-oriented decision making. Although both tasks assess the ability to choose better future options, the crucial difference lies in the amount of knowledge children have about the choices. In the delay of gratification task, children are told what choice is best in the future. In contrast, in the gambling task, children must learn over multiple choices which option is the best over time. It is not until options become more conscious that the two tasks resemble one another. The two tasks, then, assess different, but overlapping types of future-oriented decision making.

The main aim of this study was to further explore the development of future-oriented decision making in preschool children using a child variant of the IGT. Whereas Kerr and Zelazo (2004) reported that this ability develops at approximately 4 years of age, this finding has yet to be replicated. Further, we wanted to expand upon their findings by exploring the possible role of conscious knowledge on IGT performance in preschoolers. To do this, we manipulated labeling and symbol use in Experiment 2.

EXPERIMENT 1: DEVELOPMENT OF DECISION MAKING IN THE PRESCHOOL PERIOD

The primary goal of the first experiment was to examine future-oriented decision making in 3.5- and 4.5-year-old children. Given past findings, it was expected that 4.5-year-olds would choose significantly more from the good deck than 3.5-year-olds. A second goal was to explore the relation of the gambling task to delay of gratification. Given the hypothesized similarity between the gambling task and the delay of gratification task (i.e., beneficial future choice), it was expected that performance on the two tasks would correlate in the last phase of the gambling task when decision making becomes more conscious.

A version of the IGT modeled on the one used by Garon and Moore (2004) was administered. However, in contrast to the Garon and Moore version, in this study the number of decks was reduced to two to make the task more comparable to that used by Kerr and Zelazo (2004). In addition, 60 card turns rather than 40 card turns were used, so that there would be more opportunity to observe a switch from bad deck preference to good deck preference.

Method

Participants

Participants were 23 3.5-year-old children (13 boys, 10 girls), ranging in age from 41 months to 47 months (mean age = 3.8 years) and 21 4.5-year old children (11 boys, 10 girls), ranging in age from 55 months to 59 months (mean age = 4.10 years). Children were predominantly from middleclass families in a small Canadian city.

Some children failed to finish the tasks due to fatigue. It was decided that only data from children who had made at least 50 choices would be used in the analysis of the gambling task. Using this criterion, only one child (a 3.5-year-old boy) did not complete this task. The final analysis for the gambling task therefore included 22 3.5-year-old children and 21 4.5-year-old children. Two other children only made 50 choices (again 3.5-year-old boys). Given that some children had not made all 20 choices on the last block, proportions rather than number of choices were used in the analysis. Finally, for the delay of gratification task, two children failed to finish this task (2 3.5-year-old boys). The analysis of this task, therefore, included 21 3.5-year-old children and 21 4.5-year-old children.

Apparatus

Two decks of cards were used for the modified version of the IGT. The bad deck had two bears on each card, whereas the good deck had one bear on each card. Bear symbols indicated a win. Some of the cards had pictures of tigers, indicating a loss (see Appendix for reward/loss contingencies). Each deck was either green or yellow, with color counterbalanced across two sets of decks so as to minimize the possibility of color preference. Children were given a choice of candy (Smarties or Skittles) or stickers as their reward.

For the delay of gratification task, a wide variety of stickers were used, chosen to be attractive to children of this age. Children were given a choice between three colorful sticker books: a book shaped like a bus, star, or frog.

Procedure

Gambling task. The administration of this task was modeled after Garon and Moore (2004). Children were told they were going to play a card game. They were told that the bear symbol would lead to a win of one reward and the tiger symbol would lead to a loss of one reward. They were told the goal of the game was to accumulate as many rewards in their bin as possible because they would keep all the rewards at the end of the game. Once the game had been explained, children were asked to choose between the two decks. After 40 card turns, children were given the first awareness test. This test consisted of asking the children which deck was better and why. Similarly, they were asked which deck was worse and why. Children were not given feedback on whether their answers were correct. Children received one point for each correct answer for a total possible score of four. The experimenter then asked the children to make some more choices. After 60 cards, the game stopped. The same four awareness questions were asked at the end of the game.

Delay of gratification task. This task was modeled after the modified choice-based delay of gratification task used by Thompson et al. (1997). Children were given three choices in which they could take one sticker immediately or two stickers for the end of the game. If they chose to have the sticker now, they were allowed to put the sticker in their sticker book. If they chose to delay, the stickers were placed in an envelope, which was given to them after all the tasks were finished. Children were given one point for each choice to delay (range 0–3).

Results

Age Differences in Choosing From Advantageous Deck

The 60 choices were divided into 3 blocks of 20 choices. The data were analyzed using a mixed analysis of variance (ANOVA): 2 (Age Group) × 2 (Sex) × 3 (Block), with proportion of choices from the advantageous deck as the dependent variable. It should be noted that the Greenhouse-Geisser test was used for significance level whenever Mauchley's test of sphericity was significant. In order to control for Type I error, *t* tests with Bonferonni adjustments were used to follow up on significant effects. For each follow-up, alpha was divided by the number of *t* tests conducted, with overall alpha being set at .05.

Results of this analysis indicated that the age main effect approached significance, $F(1, 39) = 3.35$, $p < .08$, with older children choosing more from the good deck. The block main effect approached significance, $F(2, 78) = 2.71$, $p < .08$. More importantly, the Age × Block main interaction was significant, $F(2, 78) = 7.17$, $p < .01$.

Follow-up Age × Block interaction was significant for block 2 to 3 only, $F(1, 39) = 6.73$, $p < .05$. To follow-up this significant interaction, the block effect was examined within each age group. For 3.5-year-old children, the block effect was nonsignificant, $F(1, 21) = .31$, $p > .05$, indicating that 3.5-year-old children did not learn to choose more from the good deck as choices progressed (see Figure 1). For the 4.5-year-old children, the block effect was significant, $F(1, 20) = 6.32$, $p < .05$, indicating that the 4.5-year-old children learned to choose more from the good deck from block 2 to block 3.

Follow up *t* tests were conducted to examine whether choice from the advantageous deck differed from chance on the second and third block. With Bonferroni adjustment ($\alpha = .05/4$), alpha was set at .0125. This comparison indicated that

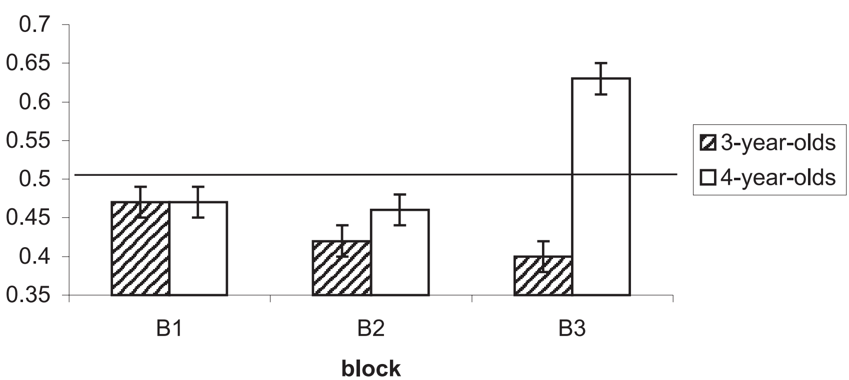

FIGURE 1 Proportion of choices from the good deck as a function of age group in Experiment 1.

4.5-year-old children chose significantly more from the good deck in the third block, $t(20) = 2.47$, $p < .0125$, but not for the second block, $t(20) = 0.69$, $p > .0125$. In contrast, the 3.5-year-old children showed a trend for choosing more from the bad deck in the second, $t(21) = 1.87$, $p = .038$, and third block, $t(21) = 1.98$, $p = .03$.

Awareness of Game

Awareness was assessed midway through the game (after choice 40) and again at the end of the game. A mixed ANOVA was used to analyze the data: 2 (Age) × 2 (Sex) × 2 (Test; Test 1 and Test 2). This analysis indicated a highly significant age main effect, $F(1, 38) = 18.03$, $p < .001$, with 4.5-year-old children outperforming the younger children as expected. Table 1 provides the average score on the awareness tests for each age group. The test time effect approached significance, $F(1, 38) = 4.11$, $p = .05$, with children's awareness of the game improving over time. There were no other significant effects.

Awareness and Performance

In order to explore the possibility that awareness of the game was accounting for the age effects in performance on the game, the score on Test 1 was used as a covariate to remove the variance associated with this variable. The awareness covariate was significant, $F(1, 38) = 11.82$, $p < .01$. Children who scored higher on the awareness test tended to choose more from the good deck. This was true for both age groups, with awareness test score being positively correlated to performance for both 3.5-year-old children, $r = .54$, and 4.5-year-old children, $r = .46$, both ps $< .05$. Although the F-value was reduced, the Age × Block interaction remained significant, $F(2, 76) = 3.68$, $p < .05$, indicating that differences among 3.5- and 4.5-year-old chldren were not entirely attributable to differences in awareness.

Delay of Gratification Task

A one-way ANOVA was performed on the delay of gratification task with age as the independent variable and number of choices to delay as the dependent variable. The age main effect approached significance, $F(1, 40) = 3.10$, $p < .09$. The

TABLE 1
Means of the Awareness Tests as a Function of Age Group in Experiments 1 and 2

	Experiment 1		*Experiment 2*	
Age Groups	*M*	*SE*	*M*	*SE*
3.5-year-olds	1.16	0.19	1.20	0.16
4.5-year-olds	2.79	0.31	1.96	0.26

4.5-year-old children ($M = 1.19$, $SE = .26$) showed a trend toward delaying more than the 3.5-year-old children ($M = .62$, $SE = .19$).

The association between the delay of gratification and the last two blocks of the gambling task was explored using correlational analysis. Age in months was partialed out to control for the variance associated with this variable. For the 3.5-year-old children, one-tailed correlation between the last block on the gambling task and the delay of gratification task was significant, $r(17) = .40$, $p < .05$. This indicated that children who chose to delay tended to also choose more from the good deck in the last block. For the 4.5-year-old children, neither correlation was significant.

Discussion

The goal of this experiment was to replicate age-related changes in decision making on a child variant of the IGT during the preschool period. A second goal was to explore the association of the IGT with a delay of gratification task. Our findings are consistent with Kerr and Zelazo (2004). Although 3.5-year-old chldren showed a trend to prefer the bad deck, 4.5-year-old children showed a preference for the good deck. In addition, the results also indicate a significant age difference in awareness of the game. Despite this age difference in awareness, however, the results of the ANCOVA suggest that the age difference in performance on the IGT was not entirely attributable to this difference in awareness.

The results of Experiment 1 also suggest that some of the same processes are involved in the IGT and delay of gratification. Although the two tasks were significantly associated in 3.5-year-old children, there was no association for 4.5-year-old children. It is not clear why there should be different associations for the two age groups. One possibility is that both developmental and individual differences contribute to variability in the delay of gratification task (Moore & Macgillivray, 2004). As children get older, individual differences play a greater role compared to developmental differences. If there is a common developmental mechanism in both tasks, and it matures by 4.5 years of age, then there would be less variance associated with this mechanism for our older group. Any association due to this mechanism would therefore be significantly reduced or disappear altogether at 4.5 years of age. There are several possibilities for such a mechanism. Work on executive function suggests important changes from 3 to 4 years of age (Hughes, 1998; Zelazo & Müller, 2002), including changes in conscious control of thought and behavior and working-memory ability.

A related issue is whether the version of the delay of gratification task used was sensitive enough to detect individual differences in future-oriented decision making. Perhaps increasing the difference in reward between now and later would have led to more individual variations and correlation with the IGT for 4.5-year-old children. Some research indicates that increasing the reward magnitude of the delayed option increases choice to delay in 4.5-year-old children (Lemmon & Moore, 2006).

Awareness, Labeling, and Symbols

The results suggest that the age differences in performance on the task were not due solely to awareness, yet it remains possible that asking children questions about the decks affected 4.5-year-old children differently from 3.5-year-old children. Asking children questions about the decks may have led them to focus on their knowledge about the deck to categorize the decks as "good" and "bad." Further, our awareness questions seemed to encourage children to verbally label decks. For example, some of the children (approximately 25%) started referring to the decks as the "good one" and "bad one" following the awareness questions. It is quite possible that this labeling had a stronger impact on the older children. Perhaps 3.5-year-old children have more difficulty using reported knowledge to change behavior.

Hence, even if 3.5-year-old children are able to acquire explicit knowledge about the decks, it is very possible they require more help than 4.5-year-old children in making this transition from explicit knowledge to change of behavior. Research suggests that working memory develops from 3 to 4 years of age (Carlson, Davis & Leach, 2005; Gordon & Olson, 1998; Hughes, 1998). One possible explanation for 3.5-year-old children's failure to use knowledge to guide behavior may be less efficient working memory. Recent findings in young children (3–5 years of age) suggest that there is an association between working memory and performance on the IGT (Hongwanishkul, Happaney, Lee, & Zelazo, 2005).

Three-year-old children may benefit from having a more frequent reminder of their categorization of "bad" and "good" decks. In one study, labels led to improved performance in 3-year-old children on an inhibition task when labeling was repeated on every trial (Müller, Zelazo, Hood, Leone, & Rohrer, 2004). Interestingly, in this study, 3-year-old children stopped labeling when the experimenter no longer reminded them. Similarly, Kirkham, Cruess, and Diamond (2003) found that having 3-year-old children label the relevant sorting dimension on every trial improved their performance on the dimensional card sort task. It is possible, then, that 3.5-year-old children may be able to use labels to guide behavior, but need reminders to use them. The use of picture symbols may be one way of keeping a constant reminder. We decided to explore these issues further in the second experiment.

EXPERIMENT 2: USING LABELS AND SYMBOLS WHILE PERFORMING THE IOWA GAMBLING TASK

The main goal of Experiment 2 was to look at the effect of label and symbol use on preschoolers' performance in the child variant of the IGT. Children were randomly assigned to three conditions. The three conditions were identical except for the instructions used midway (after 30 card choices) in the game. In the control condition, children were asked a question that was irrelevant to the game after choosing 30 cards. These questions were used to control for the effects of interruption in the game, which occurs for the other two conditions. In the question condition, children were asked to decide which deck was "good" and "bad" after choosing 30 cards. This condition introduces the opportunity for explicit reflection on the decks and to categorize decks as "good" or "bad." The procedure used in this condition is the same as that used in Experiment 1. In the question + symbol condition, children were also asked to decide which deck was good or bad. In addition, they were given symbols of a "bear" or "tiger" to place next to the decks. Recall that at the beginning of the game, children are told that bears are good and they win smarties/stickers, whereas tigers are bad and lead to the loss of smarties/stickers. This condition encouraged children not only to reflect upon and label the decks, but also to use symbols to remind themselves of the label they had given each deck.

Given previous research, two predictions were made. It was predicted that the question condition would lead to improvements in older children, but not younger children. In Experiment 1, even 3.5-year-old children who were able to correctly tell the experimenter which deck was best did not choose more from this deck in the following block. The older children, on the other hand, chose more from the good deck following questioning about the decks. It was also predicted that the question + symbol condition would help all children.

A second goal of this study was to explore the effect of correct and incorrect labeling using symbols on performance. Being asked to judge something as good or bad introduces the opportunity for incorrect labeling. It was predicted that correctly labeling the decks in the symbol condition would lead to a larger number of choices from the good deck, whereas incorrect labeling would lead to a larger number of choices from the bad deck.

Method

Participants

Participants were 64 3.5-year-old children (32 boys, 32 girls), ranging in age from 36 months to 47 months (mean age = 3.6, *SD* = 4) and 73 4.5-year-old children (31 boys, 41 girls), ranging in age from 48 months to 59 months (mean age = 4.5 months, *SD* = 3 months). Children were predominantly from lower- and middleclass families in a small Canadian city.

Some children failed to finish the entire task due to fatigue. It was decided that only data from children who had made at least 45 choices would be used in the analysis of the gambling task. Using this criterion, only one child (a 3-year-old boy) did not complete this task. Two children made fewer than 60 choices (a 3.5-year-old boy and a 3.5-year-old girl). Given that some children had not made all 30 choices on the last block, proportions rather than number of choices were used in the analysis.

Apparatus

The same apparatus as in Experiment 1 was used. In addition, four cardboard pictures were used. For control condition, a picture of a book and a soccer ball were used. For the question + symbol condition, a picture of a bear and a picture of a tiger were used.

Procedure

Children were randomly assigned to one of the three versions of the task. The administration of this task was the same as in Experiment 1 with one exception. In Experiment 1, the game was interrupted after 40 card turns to ask the awareness questions. In this experiment, the game was interrupted after 30 card turns, and children were given differing instructions, depending on condition.

For Condition 1 (control). Children were asked questions irrelevant to the task. The experimenter showed them two pictures and asked, "What picture do you like best, the ball or book?" Following this, children were asked, "Why do you think it's the best?" They were then asked, "What picture is the worst one?" and next, "Why do you think it's the worst picture?"

For Condition 2 (question). Children were asked to rate the decks. The experimenter asked, "Which deck was the best to pick from?" Following this, children were asked, "Why do you think this was the best to pick from?" If children chose the advantageous deck, they were awarded a point. If children were able to give an answer to the second question indicating the ratio of bears to tigers was higher for the advantageous deck, they were awarded two points. They were then asked, "Which deck is the worst to pick from?" and then, "Why do you think it was the worst to pick from?" Children were awarded a point for each of the questions they answered correctly (range 0–4).

For Condition 3 (question + symbol). Children were asked to rate the decks in the same way as the question condition. In addition, they were asked to place pictures of the bear and tiger next to the decks to symbolize which was the best and worst deck. The experimenter showed the bear card and said the following, "Remember the bears are good in this game. They mean you win stickers/smarties. I want you to put this bear card in front of the deck you think is the best one." Once the child had completed this, they were shown the tiger card and told the following, "Remember tigers are mean in this game. They mean you lose stickers/smarties. I want you to put this tiger card in front of the deck you think is the worst one."

Instructions after 60 card turns (all children). After 60 cards, all children were asked to rate the decks (exactly the same midway instructions as in Condition 2) at the end of the game.

Results

The 60 choices were divided into 2 blocks of 30 choices. The data were analyzed using a mixed analysis of variance (ANOVA): 2 (Age Group) × 2 (Sex) × 3 (Condition) × 2 (Block), with proportion of choices from the advantageous deck as the dependent variable. As for Experiment 1, all follow-up *t* tests used Bonferroni-type adjustment for number of comparisons. Figure 2 shows the performance of children as a function of age group and condition.

There was a significant effect of age, $F(1, 124) = 4.51$, $p < .05$, with older children (mean = .51, $SD = .13$) choosing significantly more from the good deck overall than younger children (mean = .46, $SD = .15$). This main effect of age was qualified by a three-way interaction of Age × Condition × Block, $F(2, 124) = 3.37$, $p < .05$. No other effects were significant.

The three-way interaction was followed up with a Condition × Block ANOVA for each age group. There were no significant effects for the 3.5-year-old children. For the 4.5-year-old children, there was a significant Condition × Block effect, $F(2, 67) = 3.75$, $p < .05$. Follow-up analysis indicated that the condition effect was not significant for the first block, $F < 1$, indicating that the children were not behaving differently before the manipulation. As expected, the condition effect was significant for the second block, $F(2, 67) = 3.79$, $p < .05$.

Performance on the two experimental conditions were compared to the control condition using Bonferroni-adjusted *t* tests ($\alpha = .05/3$). Children in both the question and question + symbol conditions were found to choose significantly more

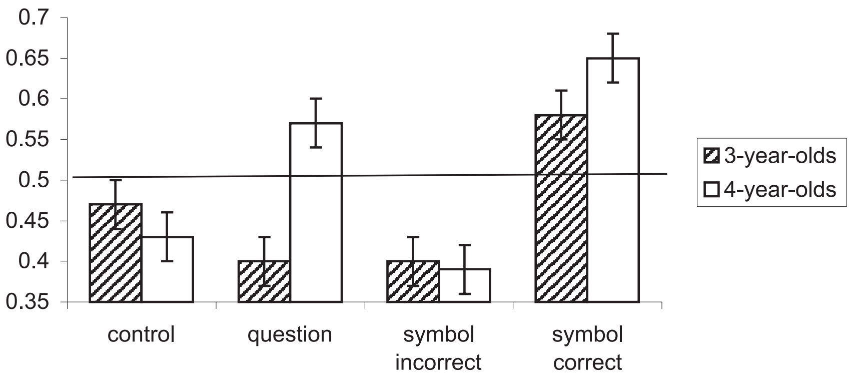

FIGURE 2 Proportion of choices from the good deck on the last block as a function of condition and age group in Experiment 2.

from the good deck compared to children in the control condition, $t(46) = 2.43$, $p < .017$ and $t(46) = 2.68$, $p < .017$, respectively. However, the question and question + symbol conditions did not differ from one another, $t(48) = .12$, $p > .017$.

Choices on the last block were compared to chance, with Bonferroni adjustments made ($\alpha = .05/2$). As the question and question + symbol condition did not differ, they were combined together to increase power. Directional *t* tests indicated that the 4-year-old children in the control condition did not choose significantly more from the good deck when compared to chance, $t(22) = 2.41$, $p > .025$, whereas the 4.5-year-old children in the experimental conditions did, $t(49) = 2.16$, $p < .025$. This suggested that only 4.5-year-old children in the experimental conditions were choosing significantly more cards from the good deck in the last block.

Awareness of the Game

An ANOVA was used to analyze awareness of the game: 2 (Age) × 2 (Sex) × 3 (Condition). This analysis revealed a significant main effect of age, $F(1, 122) = 12.47$, $p < .01$, with older children having higher scores on awareness (see Table 1). This age effect was qualified by an Age × Sex interaction, $F(1, 122) = 5.12$, $p < .05$. Follow-up analyses within each age group indicated no sex effect for the younger children, $F(1, 55) = 1.18$, $p > .05$. However, there was a significant sex effect for older children, $F(1, 67) = 4.50$, $p < .05$, with boys ($M = 2.39$, $SE = .26$) outperforming girls ($M = 1.63$, $SE = .23$) on this test.

The Effect of Correct Symbol Use

Not all children were able to label decks correctly. Within the symbol condition, 17 children (3.5-year-olds = 10, 4.5-year-olds = 7) labeled the decks incorrectly and 29 labeled them correctly (3.5-year-olds = 12, 4.5-year-olds = 17). Labeling the bad deck with the “good” bear symbol may lead children to choose more from that deck rather than the good deck. To explore the effect of correct labeling on performance, the data were analyzed using a mixed ANOVA: 2 (Age) × 2 (Sex) × 2 (Symbol; correct/incorrect) × 2 (Block) with proportion of choices from the good deck as the dependent variable. This resulted in a main effect of symbol, $F(1, 38) = 15.19$, $p < .001$, which was qualified by a Symbol × Block interaction, $F(1, 38) = 5.26$, $p < .05$. The symbol effect was significant in the second block only, $F(1, 38) = 12.76$, $p < .01$. Follow-up *t* tests with Bonferroni corrections ($\alpha = .05/2$) indicated that children who correctly labeled the decks chose significantly more from the good deck when compared to chance (.5) in the second block, $t(28) = 3.31$, $p < .025$. In contrast, children who incorrectly labeled the decks chose significantly more from the bad deck in second block when compared to chance, $t(16) = 2.28$, $p < .025$.

Discussion

The main goal of this experiment was to explore the effect of label and symbol use on IGT performance in preschoolers. As predicted, the question condition in which the experimenter asked children to categorize a deck as "good" or "bad" midway through the game improved performance in 4.5-year-old children when compared to the control condition. Adding a picture symbol had no additional benefits for these children. Unexpectedly, 4.5-year-old children in the control condition were not found to choose significantly more from the good deck. In fact, if a directional *t* test had not been used, the proportion chosen from the bad deck would have been significant, $p < .05$. It appears then that 3.5- and 4.5-year-old children in the control group were behaving similarly.

At first glance, this finding appears to conflict with findings of Experiment 1. In this experiment, when the variance associated with awareness level was removed, the age difference remained, suggesting that the age difference in awareness level was not the only variable causing the difference in performance between 3.5- and 4.5-year-old children. Why are 3.5- and 4.5-year-old children in the control group behaving similarly then? The answer is that the simple act of asking an awareness question may be having a differential effect on the two age groups. As suggested in the discussion section of Experiment 1, it is possible that having 4.5-year-old children focus on their reaction to the decks may help them transform implicit category information into an explicit category. This conscious knowledge can then be held in working memory and used to guide behavior. If they are not made to focus on the information as occurred in the control condition, then performance suffers.

In contrast to the 4.5-year-old children, the question condition did not lead to an improvement in 3.5-year-old children. The results suggest that part of the problem for these younger children may be in keeping the information in mind while choosing cards. Indeed, placing a picture symbol next to the decks seemed to help both 3.5- and 4.5-year-old children make advantageous decisions. Furthermore, those children who placed the "good" symbol next to the bad deck chose significantly more from that deck. This suggests that symbols have an impact on behavior, and that this can lead to good choices or bad choices, depending on whether the symbols are reminding the child of correct or incorrect labels. This finding is consistent with other studies that have found that labeling and symbol use can lead to improvement in preschool performance of executive function tasks (Carlson et al., 2005; Kendler, Glassman, & Ward, 1972; Kendler & Kendler, 1961; Kendler & Ward, 1972; Kirkham et al., 2003; Muller et al., 2004; Towse, Redbond, Houston-Price, & Cook, 2000).

We can draw two conclusions from the findings of Experiment 2. First, asking children to decide which deck was good and which deck was bad improved performance in 4.5-year-old children. For this age group, their memory of the verbal label they gave the deck seemed to be enough to guide choice of deck. In contrast, 3.5-year-old children needed additional help to guide choice. Being able to label the decks correctly was helpful, but they also needed a visible reminder of their labeling.

GENERAL DISCUSSION

This study adds to the growing literature on the development of future-oriented decision making in children. We replicated the findings of Kerr and Zelazo (2004) of developmental differences between 3- and 4.5-year-old children on a child variant of the IGT. Further, this study also expands on the results of Kerr and Zelazo (2004) by exploring the impact of conscious knowledge, labeling decks, and symbol use on performance in preschoolers.

Although 4.5-year-old children in Experiment 1 behaved similarly to normal adults in previous studies, the results of Experiment 2 suggest that they may not be as proficient at the IGT as older children or adults. Although the 4.5-year-old children in the control condition did not make advantageous future choices, the 4.5-year-old children who had an opportunity to think about and label the decks chose significantly more from the good deck when compared to chance by the end of the game. Moreover, adding a concrete reminder of their categories did not further improve performance of 4.5-year-old children. The crucial factor for the older children seems to be the opportunity to think about and label feeling states.

In addition to correct labeling of decks, 3.5-year-old children needed a concrete reminder of their label in order to choose advantageously. This suggests that memory of verbal labels are important in continuing to guide behavior in the youngest children. When the correct label was used in the symbol condition, 3.5-year-old children's performance did not significantly differ from that of 4.5-year-old children. As a group, children who labeled correctly in the symbol condition chose significantly more advantageous cards when compared to chance, whereas the reverse was true of children who labeled incorrectly. However, correct and incorrect labelers were self-selected. It is probable that having children provide their own labels has a stronger effect on performance than having an experimenter-provided label. Labels may have only exaggerated already existing differences.

Another issue is how much symbol use improved performance in 3.5-year-old children. Figure 2 indicates that 3.5-year-old children who were correct labelers chose fewer cards from the good deck than 4.5-year-old children who were correct labelers, which suggests that the significant preference for the good deck in the correct labeler group may be due to performance by 4.5-year-old children. To examine this more carefully, we compared 3.5-year-old children who correctly labeled to chance. Although the t test only approached significance ($p < .1$), it should be noted that the effect size was large ($d = .81$). Furthermore, this group chose significantly more cards from the good deck than 3.5-year-old children in the control ($t = 1.89$, $p < .05$) and the question condition ($t = 2.28$, $p < .05$). These findings suggest that even if correct labeling in the symbol condition did not lead to significant preference for the good deck, it was helpful. Future research using a larger number of 3.5-year-old children is needed to help resolve this issue.

Awareness, Labeling, and the Iowa Gambling Task

The IGT involves a complex interplay of implicit and explicit knowledge (Bechara et al., 1997; Krawczyk, 2002; Maia & McClelland, 2004). Labels may help children transform implicit knowledge about the decks into more explicit knowledge. Although the exact role of explicit knowledge in the IGT is not yet clear (Krawczyk, 2002), there is evidence that explicit knowledge is crucial for optimal performance in adults (Gutbrod et al., 2006; Maia & McClelland, 2004). In support of this, two recent studies found that performance on the IGT improved if verbal instructions hinted that some decks were worse than others (Balodis, MacDonald, & Olmstead, 2006; Fernie & Tunney, 2006). This suggests that adults like preschoolers make more advantageous decisions when they are given instructions that encourage categorizing decks as "bad" and "good."

Given the association between reversal learning and performance on the IGT for OFC patients (Fellows & Farah, 2005), it is possible that verbal labeling helps children reverse a preference for the bad deck. Like the original IGT, our "bad" deck initially appeared to be the best deck until a large loss occurred on card 5. It is possible that preschoolers have difficulty shifting their initial preference for the bad deck and that labeling enables them to reverse their preference more quickly (Kendler et al., 1972; Kendler & Kendler, 1961; Kendler & Ward, 1972). Although this interpretation is consistent with the performance of the 3.5-year-old children, it is not consistent with the performance of the 4.5-year-old children. Re-examination of our data indicated that 3.5-year-old children showed a trend to choose more from the bad deck initially (Exp. 1 & 2, choices 11–20), whereas 4.5-year-old children never showed an initial preference for this deck.

Furthermore, the IGT is unlike other reversal-learning tasks in that reinforcement varies over the whole course of the game. In a typical reversal task, for instance, participants are consistently reinforced for choosing one stimulus, and then once participants show a consistent preference for the stimulus, reinforcement shifts to the other stimulus. In contrast, even after receiving the first large loss from the disadvantageous decks, participants in the IGT will continue to receive immediate reinforcement from these decks. This leads to continued conflict between immediate reinforcement and longer-term gain. There is evidence that even adults experience difficulty when conflict between immediate and delayed reward is high. In one study, increasing the level of conflict through an increase in the immediate reward of disadvantageous decks led to deterioration in performance on the IGT (van den Bos, Houx, & Spruijt, 2006). Rothbart and Posner (2001) suggest that the executive control network, which enables individuals to deal with conflict and inhibit automatic response, shows significant development during the preschool period. They argue that this network continues to develop throughout childhood and allows children to use more sophisticated strategies such as verbal mediation to self-regulate.

Whether children are having difficulty reversing preference for the bad deck or resisting immediate rewards, labeling the decks may improve performance in a similar way. There is a wealth of evidence that directing attention toward "nonconsummatory" aspects of a reward (e.g., the way marshmallows looks) helps preschoolers wait longer in the delay of gratification paradigm (see Mischel, Shoda, & Rodriguez, 1989, for a review). Labeling may encourage children to redirect attention to more abstract aspects of the IGT, such as the difference in long-term reinforcement represented as "good" and "bad."

Although the results of the present study suggest labeling improves performance, there is evidence that 4.5-year-old children can make advantageous decisions without labeling (Kerr & Zelazo, 2004). Kerr and Zelazo (2004) found that 4-year-old children learned to choose advantageous decks in a child version of the IGT without labeling instructions. A possibly crucial difference in their version of the IGT, however, is in the frequency of loss. Although the loss frequency in our IGT version is 20%, the loss frequency in the Kerr and Zelazo version is 50%. Recently, Crone, Bunge, Latenstein, and van der Molen (2005) found an improvement in performance in a group of 7- to 9-year-old children when loss frequency was increased from 10% to 50%. When losses occur more frequently, they become more immediate, reducing reward conflict by making the disadvantageous deck less immediately gratifying. Perhaps labeling is only helpful when the conflict between the decks is high. In this instance, labels may help children resist the more immediately gratifying deck. Future studies could manipulate both of these variables to explore whether there is an interaction awareness and conflict level.

Conclusions

This study suggests developmental changes in future-oriented decision making from 3.5 to 4.5 years of age. Both experiments suggest that 4.5-year-old children are more likely than 3.5-year-old children to make advantageous future-oriented decisions. This supports findings by Kerr and Zelazo (2004) who found similar developmental changes. However, the study also suggests that when loss is infrequent (20%), 4.5-year-old children need assistance in using knowledge about the decks to guide behavior. Once they have labeled the decks as good and bad, they are able to use this conscious knowledge to make advantageous future-oriented choices. Being reminded of their label does not provide additional help. In contrast, the 3.5-year-old children need reminding of their label in order to guide performance, perhaps due to a limitation in working memory. If they are able to label the decks correctly and place a symbol next to the decks, their performance becomes similar to 4.5-year-olds. Labels may help preschoolers improve performance by redirecting attention to more abstract properties of the game such as differences in reinforcement magnitude. Future work on the child gambling task promises to clarify which processes underlie improvement in future-oriented decision making in preschoolers.

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APPENDIX
Reward and Loss Contingencies

	Advantageous Deck		Disadvantageous Deck	
Card No.	*Win*	*Lose*	*Win*	*Lose*
1	1	0	2	0
2	1	0	2	0
3	1	0	2	0
4	1	0	2	0
5	1	2	2	13
6	1	0	2	0
7	1	2	2	0
8	1	0	2	13
9	1	0	2	0
10	1	0	2	0
11	1	0	2	0
12	1	0	2	0
13	1	0	2	13
14	1	2	2	0
15	1	0	2	0
16	1	0	2	0
17	1	0	2	0
18	1	0	2	0
19	1	0	2	0
20	1	2	2	13
21	1	0	2	0
22	1	0	2	13
23	1	2	2	0
24	1	0	2	0
25	1	0	2	0
26	1	0	2	0
27	1	0	2	0
28	1	2	2	13
29	1	0	2	0
30	1	0	2	0
31	1	0	2	13
32	1	2	2	0
33	1	0	2	0
34	1	0	2	0
35	1	0	2	0
36	1	2	2	13
37	1	0	2	0
38	1	0	2	0
39	1	0	2	0
40	1	0	2	0
41	1	2	2	0
42	1	0	2	0
43	1	0	2	0

(*continued*)

APPENDIX (Continued)

	Advantageous Deck		*Disadvantageous Deck*	
Card No.	*Win*	*Lose*	*Win*	*Lose*
44	1	0	2	13
45	1	0	2	0
46	1	2	2	0
47	1	0	2	0
48	1	0	2	0
49	1	0	2	13
50	1	0	2	0
51	1	0	2	13
52	1	0	2	0
53	1	0	2	0
54	1	2	2	0
55	1	0	2	0
56	1	2	2	0
57	1	0	2	0
58	1	0	2	13
59	1	0	2	0
60	1	0	2	0