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Are Eyes Windows to a Deceiver's Soul? Children's Use of Another's Eye Gaze Cues in a Deceptive Situation

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Abstract

Three experiments examined 3- to 5-year-olds' use of eye gaze cues to infer truth in a deceptive situation. Children watched a video of an actor who hid a toy in 1 of 3 cups. In Experiments 1 and 2, the actor claimed ignorance about the toy's location but looked toward 1 of the cups, without (Experiment 1) and with (Experiment 2) head movement. In Experiment 3, the actor provided contradictory verbal and eye gaze clues about the location of the toy. Four- and 5-year-olds correctly used the actor's gaze cues to locate the toy, whereas 3-year-olds failed to do so. Results suggest that by 4 years of age, children begin to understand that eye gaze cues displayed by a deceiver can be informative about the true state of affairs.

For humans and other animals, eyes not only function to see things but also serve as stimuli to be seen by others. In the animal world, eyes serve important inter- and intraspecies communicative functions. Specifically, eye gaze provides information about aggression, dominance, submission, attention, and affiliation (Argyle & Cook, 1976; Hare, Brown, Williamson, & Tomasello, 2002; Povinelli & Eddy, 1997; Rutter, 1984). Human use of eye gaze information includes, but also goes beyond, the above functions. Foremost among human-specific functions is the transmission of information about mental states and activities, information we interpret routinely (Argyle & Cook, 1976; Rutter, 1984). Nevertheless, this may not be true of everyone: It has been suggested that insensitivity to eye gaze is related to impairments in social and cognitive functioning, as in autism and Asperger syndrome (Baron-Cohen, Campbell, Karmiloff-Smith, Grant, & Walker, 1995; Baron-Cohen, Joliffe, Mortimore, & Robertson, 1997; Leekam, Baron-Cohen, Perrett, Milders, & Brown, 1997; Leekam, Lopez, & Moore, 2000; Philips, Baron-Cohen, & Rutter, 1992).

There has been extensive research on adult perception of eye direction and use of eye gaze information. Research consistently indicates that adults are extremely sensitive to eye contact and direction of eye gaze, with accuracy of detecting eye contact and direction near the level of visual acuity (Cline, 1967; Gibson & Pick, 1963; Symons, Lee, Cedrone, & Nishimura, in press). Furthermore, evidence shows that adults readily make attributions about personality traits, such as competence and intelligence, and about physical attraction on the basis of eye gaze patterns (see Kleinke, 1986, for a review). Eye gaze cues are also used by adults to make inferences about others' cognitive activity, including their focus of attention, intention, desire,

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and knowledge about the current state of affairs (Argyle & Cook, 1976; Baron-Cohen et al., 1997; Kleinke, 1986).

Research investigating the early development of children's sensitivity to eye gaze is also extensive (for a review, see Baldwin & Moses, 1994). Sensitivity to adult eye gaze display emerges at birth (e.g., Caron, Caron, Roberts, & Brooks, 1997; Farroni, Csibra, Simion, & Johnson, 2002). Between 3 and 6 months, infants are highly sensitive to adult gaze shift (Hood, Willen, & Driver, 1998; Symons, Hains, & Muir, 1998; Vecera & Johnson, 1995). Shortly after, at 6 months of age, infants begin to follow gaze if directional information is conveyed by both head orientation and eyes (Butterworth & Itakura, 2000), and at about 18 months of age, they follow gaze when directional information is conveyed by eyes alone (Moore & Corkum, 1998). Studies have revealed that infants begin to use others' eye gaze information to achieve joint attention between about 12 and 18 months of age (Brooks & Meltzoff, 2002; Butler, Caron, & Brooks, 2000; Butterworth, 1991; Butterworth & Jarrett, 1991; Carpenter, Nagell, & Tomasello, 1998; Deák, Flom, & Pick, 2000). Between 18 and 24 months of age, they use it along with other directional cues, such as pointing and head orientation, for word learning (Baldwin, 1993, 1995; Poulin-Dubois & Forbes, 2002) and social referencing purposes (Repacholi, 1998). Finally, between age 2 and 3 years, children begin to use the directional information provided by dynamic eye gaze displays to make inferences about mental states, such as desires (Lee, Eskritt, Symons, & Muir, 1998), and mental activities, such as thinking (Baron-Cohen & Cross, 1992; Flavell, Green, & Flavell, 1995). Furthermore, 4- and 5-year-olds are sensitive to the frequency and duration of eye gaze cues displayed by an individual when making inferences about the person's mental states (Einav & Hood, 2004; Montgomery, Bach, & Moran, 1998). Baron-Cohen (1995a, 1995b) suggested that this ability to “mind-read” on the basis of eye gaze is one of the critical building blocks in the development of children's theory of mind understanding (also see Gopnik & Slaughter, 1994).

As the above evidence shows, young children's ability to use eye gaze information in cooperative situations emerges in early infancy and develops rapidly in early childhood. However, eye gaze information also plays an important role in deceptive communication. Eye gaze cues have long been assumed by lay people and theorists alike to be a major nonverbal behavior through which deceptive individuals may leak information about both deceptive intent and the truth (see Kleinke, 1986; DePaulo et al., 2003, for reviews). For example, information about where an object or person is hidden may be revealed by the unintentional gaze of a person who claims ignorance about the hiding location. Indeed, studies have found that adults readily use another individual's eye gaze displays to detect and infer deception (Hemsley & Doob, 1978; Kraut & Poe, 1980). In the developmental literature, however, whether and how children use eye gaze cues when an individual is deceptive and communicates untruthful messages has not been examined. Given that eye gaze information plays an important role in deception and its detection, research on this issue is needed to obtain a more comprehensive understanding of the development of eye gaze processing in children. This should also contribute to current theoretical debate about the role of eye gaze in sociocognitive development and its impairments (e.g., Baron-Cohen, 1995a; Tomasello, 2000).

Furthermore, research on children's use of eye gaze information in deceptive contexts provides insight into how they understand and deal with deceptive communication. Albeit relatively infrequent and socially undesirable, deceptive communication is a part of children's social life (Dunn, 1991; Newton, Reddy, & Bull, 2000; Wilson, Smith, & Ross, 2002). The ability to process information during deceptive communication is critical for children to adapt well in interactions with individuals such as siblings, friends, and strangers, who may have reason to deceive them. Research to date has revealed that children from as early as 3 years of age begin to appreciate deception. They perform better in several cognitive tasks (e.g., false belief representation and appearance–reality distinction) when the tasks are situated in deceptive

contexts (e.g., Rice, Koinis, Sullivan, Tager-Flusberg, & Winner, 1997; Sullivan & Winner, 1993). Studies have also revealed that children as young as 3 years of age are able to carry out deceptive acts (Lewis, Stranger, & Sullivan, 1989; Talwar & Lee, 2002). Although it is still controversial whether 3-year-olds do so with an explicit intent to deceive (Chandler, Fritz, & Hala, 1989) or just as a result of associative learning (Peskin, 1992; Sodian, 1991) or punishment avoidance (Kaplan, 1990), there is little doubt that young preschoolers have first-hand experience with deception. It should be noted, however, that research has consistently shown that relative to 4- and 5-year-olds, 3-year-olds are significantly less inclined to perform deceptive acts spontaneously (Lewis et al., 1989; Talwar & Lee, 2002), and, if they do deceive, their deception in some cases tends to be less successful than that of older children (e.g., Polak & Harris, 1999; Peskin, 1992; Talwar & Lee, 2002).

A relatively understudied issue is whether young children are able to detect and foil another's deceptive acts. Several investigators have examined how children use nonverbal behaviors of a deceiver to determine the true state of affairs (DePaulo & Jordan, 1982; Feldman, Jenkins, & Popoola, 1979; Feldman & White, 1980; Morency & Krauss, 1982; Rotenberg, Simourd, & Moore, 1989). This research has found that until early adolescence, children are generally poor at processing and using truth-revealing nonverbal cues displayed by deceptive individuals. This finding, however, may be due to the fact that earlier studies have primarily focused on detection and interpretation of subtle and intentionally masked nonverbal cues (e.g., feigning a smile to fake liking a drink). Children may have difficulty in detecting these subtle cues, let alone making use of them. In contrast, as mentioned earlier, sensitivity to eye gaze cues not only emerges early in life but also develops very rapidly. Thus, children may develop skill at using eye gaze information in deceptive situations at an earlier age than other nonverbal cues.

Another reason for young children's poor performance in the above-mentioned deception detection studies is that children may have a general difficulty in dealing with situations in which verbal and nonverbal cues convey inconsistent messages. A robust finding in the literature is that when verbal information is included in such a context, the content of the verbalization strongly influences children's behavior. For example, Solomon and Ali (1972) created an audio recording of a series of statements made by a teacher that included all combinations of positive, neutral, or negative content and positive, neutral, or negative intonation. The statements were evaluated for their objective meaning by participants ranging from kindergarten to college. Solomon and Ali found that young children's judgments of meaning were strongly related to the specific utterance of the teacher rather than her intonation, with gradually more reliance on the affect of the voice as the age of participants increased. Similar findings of young children's lexical bias have been reported in a number of more recent studies, which show verbal content overriding paralinguistic cues such as vocal inflections and facial expressions as reflecting the true state of affairs (e.g., Demorest, Meyer, Phelps, Gardner, & Winner, 1984; Eskritt & Lee, 2003; Friend, 2000, 2001, 2003; Friend & Bryant, 2000; Morton & Trehub, 2001; Volkmar & Siegel, 1982; see Friend, 2003, for a review). It is important to note, however, that such lexical bias is found in experimental conditions in which the rationale for inconsistent communication is typically not made clear to children. Furthermore, highly artificial experimental paradigms are often used (e.g., in Volkmar & Siegel, 1982, an experimenter instructed children to “come here” while hand gesturing them to go away). It is possible that children can overcome the lexical bias and use nonverbal cues (e.g., eye gaze cues) to infer the true state of affairs when they are explicitly informed of the deceptive intent of an individual who conveys inconsistent verbal and nonverbal messages.

The present study aimed to test this possibility and to investigate the emergence and development of young children's use of eye gaze cues in deceptive situations in which an individual's eye gaze display and verbal statement convey inconsistent messages. Specifically, we focused on whether and how 3-, 4-, and 5-year-olds use eye gaze information displayed by

an individual whose deceptive intent was explicitly conveyed to them. We situated children in a hide-and-seek game in which they watched a video and had to infer the location of a toy hidden by an actor in one of three cups. The only information available to accomplish this was the nonverbal cues displayed by the actor. The use of video to present the nonverbal cues has several advantages (Hood et al., 1998; Lee et al., 1998; Mumme & Fernald, 2003). It ensures the cues to be displayed more naturalistically than was the case in some previous studies where eye gaze cues were presented in pictures and photographs (e.g., Baron-Cohen et al., 1995). Also, the video presentation of eye gaze cues allowed for precise stimulus control such that different children would view exactly the same displays of eye gaze cues. In Experiment 1, after the actor hid the toy, she stated that she did not know where it was. In the eye deceptive condition, the actor glanced toward one of the cups with eyes only, keeping her head still, while making this statement. In the hand deceptive condition, the actor's hand was placed on the top of the baited container when stating that she did not know the whereabouts of the toy. This condition was included to examine whether the salience of the nonverbal cue played any role in children's use of nonverbal information in deceptive situations (see Figures 1A and 1B for video captures of conditions in Experiment 1). For each trial, children were asked in which cup they thought the toy was hidden. To examine children's use of nonverbal information in a cooperative situation, two control conditions were included wherein they were informed of the actor's cooperative intent. In the eye cooperative condition, the actor stated that she knew where the toy was hidden and glanced toward the baited cup; in the hand cooperative condition, she stated that she knew where the toy was and placed her hand on top of one of the cups.

In Experiment 2, cooperative and uncooperative eye gaze conditions of Experiment 1 were modified to include salient head movement in combination with eye gaze (see Figures 1A–1C for video captures of conditions in Experiment 2). This modification was made to increase the salience of the eye gaze cue. In Experiment 3, the deceptive actor displayed eye gaze cues conveying information directly contradicting her verbal message about the location of the toy. This experiment examined whether children would rely on the verbal or eye gaze cues displayed by a deceptive individual to infer the truth when the cues were in direct conflict with each other.

Experiment 1

Method

Participants—Ninety-seven predominantly White middle-class children (49 girls, 48 boys) participated after their parents provided informed consent. Children were recruited from area day cares and kindergartens. There were 32 three-year-olds (mean age = 3 years 6 months, *SD* = 5 months, range = 2 years 7 months to 3 years 11 months), 31 four-year-olds (mean age = 4 years 6 months, *SD* = 3 months, range = 4 years 0 months to 5 years 0 months), and 34 five-year-olds (mean age = 5 years 7 months, *SD* = 4 months, range = 5 years 1 month to 6 years 4 months).

Materials and procedure—Children were seen individually in three phases. In the first phase, the warm-up phase, children were told,

> You are going to watch a video and play a hide and guess game. A person named Julie is going to hide a toy in some cups and you have to look very carefully so that you can find it, OK, because sometimes Julie is very tricky.

In the video, a female actor is seated behind a table, on which there are three plastic cups. The actor introduces herself, then reiterates that she and the child will play a hide and guess game. She holds up a small rubber dog that squeaks when she squeezes it and says that the toy's name

is Squeaky. She explains that she will hide Squeaky in one of the cups and that the child is to guess in which cup the toy is hidden.

Three practice trials ensue, which the actor explains will show the child how to play the game. For each, the actor says that she is going to hide Squeaky. The screen then goes blank and when the image reappears, the actor is sitting with the cups in front of her, with Squeaky's head visible in one of the cups. The actor, with her gaze directed toward the audience, asks “Where is Squeaky hiding?” If the child responded quickly, the tape was allowed to run. Else, the experimenter paused the tape and asked the child, “Where do you think Squeaky is hiding, in which cup?” When the child answered, the experimenter allowed the tape to continue. Two additional practice trials in which Squeaky was still visible in one of the cups followed. The actor then explained that it was time to give the real game a try, so Squeaky would no longer be visible in the cup.

The experimental deceptive phase consisted of six trials without feedback. The experimenter told the child, “So remember, Julie will hide Squeaky and you have to guess which cup he is in. But Julie is very tricky and she doesn't want you to find Squeaky.” Then, children completed three trials of the eye deceptive condition. In the eye deceptive trials, the actor says, “Now I'm going to hide Squeaky.” The screen goes blank. When the image returns, the actor says, “I don't know where Squeaky is.” However, she looks, with no head movement, toward one of the three cups for 2 s and then shifts her eyes back to look forward (see Figure 1A). The experimenter asked the child the probe question, “Where do you think Squeaky is hiding, in which cup?” To ensure that children had another opportunity to view the sequence, it was repeated on the tape one more time. If the child spontaneously produced an opinion about where the toy was hidden, the tape was allowed to run. Otherwise, the experimenter paused the tape at the end of the sequence and asked the probe question. Once the child answered, the tape was continued and the next trial began. The three hand deceptive trials were similar except that instead of looking toward one of the cups after claiming ignorance about Squeaky's whereabouts, the actor placed her hand on top of the baited cup, covering the opening (see Figure 1B). The order of the eye and hand deceptive conditions was counterbalanced across participants.

In the third phase, the cooperative phase, children participated in the eye cooperative and hand cooperative conditions. There were again three trials for each with no feedback. The trials were identical to the corresponding deceptive phase except that children were told that the actor would no longer be tricky. The experimenter said to the child, “OK, now this time you still have to guess where Squeaky is but Julie isn't going to try to trick you anymore. Now she wants you to find Squeaky.” In the cooperative trials, the actor said, “I know where Squeaky is, he's there” while indicating the baited cup, either by looking at the correct cup (eyes only) or putting her hand over its opening. Following the six cooperative trials, the child was thanked for participating and given a small prize (i.e., a sticker). Two different versions of the video containing the above three phases were used. In each video, Squeaky's hiding places were determined with the use of a randomization table. Children were randomly assigned to view either the first or second video.

Results

All children passed the trials in the first practice phase. For the eye and hand deceptive trials in the second phase, children received 1 point for each trial in which they stated correctly the location of the hidden toy as indicated by the actor's eye gaze or hand cue. Thus, for eye and hand deceptive conditions, children received a score between 0 and 3. The same scoring method was used for the eye and hand cooperative trials in the third phase. Preliminary analyses revealed no effect of the order in which eye or hand trials were completed or version of the tape, so results were combined across order and tapes. An additional analysis indicated no

effect of gender on performance, so data for girls and boys were combined in all subsequent analyses.

Figure 2 shows deceptive and cooperative scores for the eye and hand conditions at each age. Data were analyzed according to a 2 (intention: deceptive or cooperative) × 2 (type of cue: eye or hand) × 3 (age: 3, 4, or 5 years) mixed-factors analysis of variance (ANOVA), with intention and type of cue as within-subjects factors and age as a between-subjects factor. Analysis revealed a significant interaction between type of cue and age. As shown in Figure 2, the age trends in the eye and hand conditions are similar, with performance of 4- and 5-year-olds better than that of 3-year-olds in both eye and hand conditions ($p < .01$). Performance is better in the hand than the eye condition at all ages, but the difference in performance between hand and eye conditions is greater for 3-year-olds than for 4- and 5-year-olds ($p < .05$).

There is also a significant interaction between type of cue and intention. As shown in Figure 2, in both the eye and hand conditions performance is better in the cooperative than in the deceptive conditions, but the difference between the cooperative and deceptive scores is greater in the eye condition than in the hand condition ($p < .01$). The interaction between intention and age and the three-way interaction between intention, type of cue, and age were not significant.

More telling are data at each age, and for each task, compared with what would be expected by chance. Table 1 shows the observed and expected frequency of obtaining scores of 0, 1, 2, and 3 at each age in each of the four conditions of Experiment 1. Expected frequencies are based on a chance distribution of 8/27, 12/27, 6/27, and 1/27 of participants scoring 0, 1, 2, and 3, respectively. Inspection of Table 1 suggests that the distribution of scores of 3-year-olds in the eye deceptive condition is almost identical to that expected by chance. However, many fewer 4- and 5-year-olds than expected by chance scored 0 or 1, whereas many more scored 3, suggesting above-chance performance in the eye deceptive condition. In contrast, score distributions of children at each age suggest better than chance performance for the eye cooperative condition. Inspection of Table 1 also suggests that the distribution of scores of children at each age in both the hand deceptive and hand cooperative conditions favors above-chance performance. Chi-square tests of each of the distributions discussed above confirm that only the distribution of scores of 3-year-olds in the eye deceptive condition is not different from chance. All other distributions are different than chance ($p < .01$).

Discussion

Four- and 5-year-olds in Experiment 1 performed at above-chance levels in the eye deceptive trials, with 34 of 65 making no errors. Although the remaining 4- and 5-year-olds made at least one error despite being told of the actor's deceptive intent, performance of both groups was better than that of 3-year-olds, who scored at chance in these trials. The poor performance of 3-year-olds was not due to their inability to follow eye gaze because the same children correctly used eye gaze information conveyed by the actor when she was cooperative. This result is consistent with Lee et al. (1998), who reported that even 2-year-olds are able to follow correctly a cooperative actor's eye gaze to a target in space. The 3-year-olds' performance was also not due to their failure to understand that there may still be valuable information to be gleaned from a deceptive individual's nonverbal behavior in general. In the hand deceptive trials, the same 3-year-olds who failed the eye deceptive trials performed significantly above chance. Clearly, they used the deceiver's hand position as a cue for information about the hidden toy.

One possibility for 3-year-olds' differential performance in the eye and hand deceptive trials might be that the nonverbal cue in the hand deceptive condition was simply more salient than that in the eye deceptive condition, thereby allowing the children to infer more readily the toy's location. However, there is a second possibility: Although the eye and hand conditions of Experiment 1 are similar in that they both serve to single out a cup, they are qualitatively

different in what they signal. When a deceptive person covers a cup with her hand, it may signal that something is being concealed there. The 3-year-olds might be familiar with this act of concealment, perhaps because of their early experience with hide-and-seek types of games, and therefore showed no difficulty in using the hand cue for inferring the location of the toy. In contrast, the directional information conveyed by eye gaze does not have this function of concealment. Rather, direction of eye gaze, like pointing, is used for indicative or referential purposes. It serves to pick out a target in space that is the focus of the gazer's referential communication, of his or her attention, or both. In other words, eye gaze cues typically serve to reveal, not conceal, information. Thus, the difference in 3-year-olds' performance between eye and hand deceptive conditions may lie not only in whether the nonverbal cue in one condition is more salient than in the other but also in whether it serves to indicate or to conceal. Experiment 2 was conducted to distinguish these two possibilities.

Experiment 2

Three- to 5-year-olds participated in two conditions. The first was a deceptive condition in which the actor looked toward the toy's location but this time turned her head toward the correct cup in addition to providing the eye gaze cue (the head condition; see Figure 1C). Thus, in the head deceptive condition, the nonverbal cue provided by the actor still indicated one of the three cups but was more salient than the eye gaze cue of Experiment 1 and did not involve concealment as had the hand cue. If 3-year-olds' differential performance in the eye and hand deceptive conditions of Experiment 1 was due to the salience of the hand movement in the hand deceptive condition, then they should perform above chance in the head deceptive trials of Experiment 2 because the directional cue was now very prominent. However, if the differential results were due to the concealment element of the hand movement, 3-year-olds should perform as poorly in the head deceptive trials as their counterparts in Experiment 1, whereas the 4- and 5-year-olds, like those in Experiment 1, should still perform significantly above chance.

Method

Participants—Seventy-nine predominantly White middle-class children (43 girls, 36 boys) participated after their parents provided informed consent. Children were recruited from area day cares and kindergartens. None had participated in Experiment 1. There were 26 three-year-olds (mean age = 3 years 5 months, *SD* = 4 months, range = 3 years 0 months to 3 years 11 months), 26 four-year-olds (mean age = 4 years 7 months, *SD* = 3 months, range = 4 years 2 months to 4 years 11 months), and 27 five-year-olds (mean age = 5 years 7 months, *SD* = 3 months, range = 5 years 0 months to 5 years 11 months).

Materials and procedure—Children were seen individually. The procedure was identical to Experiment 1 except for the video used. After the practice trials, children watched three trials of the head deceptive condition. In each trial, the actor says “I don't know where Squeaky is,” and then looks at one of the three cups with a salient movement of the head toward a cup in addition to the eye gaze cue. After deceptive trials, the same children watched three trials of the head cooperative condition, identical to the eye cooperative trials in Experiment 1 except that the actor directed her head and eyes toward the baited cup. Two different versions of the video were used in which the hiding location for each trial was assigned according to a randomization table. Children were randomly assigned to watch one of the two videos.

Results

All children completed the practice trials correctly. The same scoring method as in Experiment 1 was used. Preliminary analyses revealed no effect of gender or tape version on performance. Results were thus collapsed across gender and tapes in subsequent analyses. Figure 3 shows

deceptive and cooperative scores for the head conditions at each age. A 2 (intention: deceptive or cooperative) × 3 (age: 3, 4, or 5 years) mixed-factors ANOVA with intention as a within-subjects factor and age as a between-subjects factor revealed a significant main effect of intention, $F(1, 76) = 26.50$, $p < .01$. As indicated in Figure 3, children were more accurate in the cooperative than in the deceptive conditions at all ages. There was also a significant main effect of age, $F(1, 76) = 14.61$, $p < .01$. Post hoc tests (least significant difference) indicated that 3-year-olds were less accurate than 4- and 5-year-olds, with no difference between the two older ages. The interaction of intention and age was not significant.

As with data in Experiment 1, data in Experiment 2 were analyzed in terms of the frequency of obtaining each score that would be expected by chance. Table 2 shows the observed and expected frequency of obtaining scores of 0, 1, 2, and 3 at each age in the two conditions of Experiment 2. Inspection of Table 2 suggests that the distribution of scores of 3-year-olds in the head deceptive condition is almost identical to that expected by chance, as was the case in the eye deceptive condition of Experiment 1. However, many fewer 4- and 5-year-olds than expected by chance scored 0 or 1, whereas many more scored 3, suggesting above-chance performance. In contrast, score distributions of children at each age suggest better than chance performance for the head cooperative condition. Chi-square tests confirm that the distribution of scores of 3-year-olds in the head deceptive condition is not different from chance, whereas that of 4- and 5-year-olds is different. Score distributions at all ages are different from chance in the head cooperative condition ($p < .01$).

Discussion

Results of Experiment 2 mirror those of Experiment 1. Four- and 5-year-olds scored at above-chance rates in the head deceptive trials, with half completing all three trials without error. Thus, findings of Experiments 1 and 2 are consistent in showing that 4- and 5-year-olds, faced with a deceptive situation in which eye gaze provides a potential clue about a hiding location, can often make use of this cue to infer truth. In contrast, 3-year-olds scored at chance in the head deceptive condition, replicating findings of the eye deceptive condition of Experiment 1 with a much more salient gaze cue. This finding suggests that the differential results of 3-year-olds in the eye and hand deceptive conditions of Experiment 1 were not due to the salience of the hand movement cue. Rather, the results support the interpretation that the difference in performance is attributable to the distinction between a referential eye gaze cue and a concealing hand gesture. The findings regarding 3-year-olds' performance in the eye deceptive conditions of Experiments 1 and 2 appear to suggest that once they are informed of the deceptive intent of an individual, 3-year-olds disregard the eye gaze cues in terms of holding any informational value about the true state of affairs. What remains unclear is whether referential cues in general are problematic for 3-year-olds in deceptive contexts. They might discount the informational value of any referential cues when they know that an interlocutor has a deceptive communicative intent. If this is the case, 3-year-olds should also not rely on the verbal cues provided by an individual to infer the true state of affairs when they know the individual to have a deceptive intention.

Experiment 3

Experiment 3 was conducted to examine whether 3-year-olds would use a verbal referential cue to infer the location of a hidden toy (a ball) in a deceptive context or not, just as they did not use the referential eye gaze cues in Experiments 1 and 2. In the deceptive conditions of the previous experiments, the actor claimed merely that she did not know where the toy was. Thus, although her verbal and nonverbal cues were inconsistent, her verbal cues did not provide specific information about the location of the toy. In contrast, the actor in Experiment 3, again described as deceptive, looked toward the baited cup but verbally suggested that the toy might

be in a different cup. The question of interest was whether 3-year-olds would pick the cup provided in the actor's verbal statement or would again make selections randomly. Three-year-olds, if they again failed to make use of the referential cue, should continue to pick cups randomly. However, if they made use of the verbal referential cue, then they should make incorrect choices corresponding to the actor's statement about the ball's location.

Furthermore, it is important to consider that 4- and 5-year-olds in Experiments 1 and 2 could have responded to the gaze cues not because they understood the informational value of eye gaze cues in the deceptive context but simply because they were the only cues that singled out one of the three cups. In the present experiment, we tested three possibilities: (a) 4- and 5-year-olds, as in the previous experiments, would continue to use the actor's eye gaze cues to infer the location of the hidden toy; (b) they would have a lexical bias (Friend, 2003) and rely on the verbal statement of the actor to infer the location of the toy; or (c) they would treat both the verbal and nonverbal referential cues as uninformative and infer the toy to be hidden in the cup referenced by neither the verbal cue nor the eye gaze cue.

Experiment 3 also examined whether young children could learn to use the eye gaze cue to infer the ball's location over a small number of trials by providing them with feedback about their selections and the actual location of the ball.

Method

Participants—Participants were the same as in Experiment 2 and completed Experiment 3 in the same session. Experiment 3 was always run second, following a short break.

Materials and procedure—Children were seen individually. The experimenter said to the child,

> OK, now you are going to watch a different video and play a different hide and guess game. This time there is someone named “Tricky Michelle” and she is going to hide a little ball. She is very tricky and will try to trick you so that you guess wrong. You have to watch very carefully and guess where Tricky Michelle has hidden the ball, OK?

These instructions were repeated on the tape by a female actor who introduces Tricky Michelle. Michelle then appears seated behind a table, on which sit one blue, one yellow, and one pink cup. She introduces herself and reminds children that she will try to trick them into guessing wrong. She then says, “I'm going to hide the ball now.” The screen goes blank, and when the image reappears, Michelle says, “I know where the ball is. I'll give you a clue, maybe it's in the (an incorrect color) cup.” She then looks (but with no head movement) toward the correct cup for 2 s and then resumes the forward-looking posture. The sequence was repeated one more time to ensure that children had another opportunity to view the sequence. If the child provided a response during this interval, the tape was allowed to run. Otherwise, the tape was paused at the end of the sequence, and the experimenter asked the child, “Where do you think Tricky Michelle put the ball, in which cup?” Feedback was then provided: Michelle pulls the ball out and says, “Here it is, in the (correct color) cup. Did you guess right? OK, now I'm going to hide the ball again.” A total of six trials were completed. No cooperative trials were run for this experiment. Two versions of the video were used, with two different orders of the ball's location, determined with the use of a randomization table. Children were randomly assigned to view either version of the video.

Results

Responses were categorized into three types. The chosen cup was either (a) correct, the one toward which the actor looked; (b) the incorrect one mentioned in the actor's verbal clue; or

(c) the incorrect third cup, neither looked at nor mentioned by the actor. For purposes of analysis, the first two types of response are of primary interest. Figure 4 shows, trial by trial, the percentage of children at each age making selections in accordance with either the eye gaze or verbal cue. Figure 4 reveals that 3-year-olds, despite feedback, chose most frequently according to the verbal cue throughout the six trials. Five-year-olds, in direct contrast, chose primarily on the basis of the eye gaze cue throughout. Four-year-olds were more variable in their selections, although in four of the six trials they showed a clear preference for choosing the cup looked at by the deceptive actor. Pearson chi-square tests confirmed that the distribution of children's choices differed significantly with age for each trial: Trial 1, $\chi^2(4, N = 79) = 18.28$, $p < .01$; Trial 2, $\chi^2(4, N = 79) = 17.73$, $p < .01$; Trial 3, $\chi^2(4, N = 79) = 30.23$, $p < .01$; Trial 4, $\chi^2(4, N = 79) = 37.56$, $p < .01$; Trial 5, $\chi^2(4, N = 79) = 24.37$, $p < .01$; and Trial 6, $\chi^2(4, N = 79) = 20.39$, $p < .01$.

Table 3 further illustrates the same developmental shift from a greater reliance on the verbal cue to a greater reliance on the eye gaze cue to infer the location of the ball in terms of individual performance. Table 3 summarizes children's word score and eye score. The word score represents the number of trials in which the child responded on the basis of the misleading verbal clue and ranges from 0 to 6. The eye score represents the number of trials in which the child responded on the basis of the eye gaze cue and also ranges from 0 to 6. Table 3 shows the frequency with which children at each age obtained each score. To assess whether children improved as trials progressed, we divided the six trials into three blocks with two trials in each block. Scores out of two were determined for children corresponding to the number of times they chose the looked-at cup for the first, middle, and final two trials. A 3 (age: 3, 4, and 5 years) × 3 (trials: first, second, or final pair) mixed ANOVA indicated a significant effect of age, $F(2, 76) = 28.81$, $p < .01$. However, the effect of trial pair and the interaction between age and trial pair were not significant: $F(2, 152) = 2.25$, *ns*, and $F(4, 152) = 0.71$, *ns*, respectively. Thus, overall, feedback did not increase children's reliance on the eye gaze cue for responding.

Discussion

When verbal and eye gaze cues were placed in direct conflict, 3-year-olds and older children relied on different information to infer the location of the toy. Five-year-olds, from the outset, made selections corresponding to the actor's eye gaze cue. In contrast, 3-year-olds inferred the toy's location on the basis of what was said by the deceptive actor. They chose the incorrect cup provided verbally as a clue, despite being warned repeatedly about the actor's deceptive intent. Furthermore, they were persistent in doing so even though repeatedly shown that their choices were incorrect. Three-year-olds' reliance on verbal cues suggests that they do not have a general deficit in making choices on the basis of a referential cue. Instead, they appeared to have difficulty determining that nonverbal gaze cues are more reliable than verbal cues in a deceptive situation. Four-year-olds appeared to be in transition from a reliance on the verbal cue to consistent use of the eye gaze cue.

General Discussion

In Experiments 1–3, 4- and 5-year-olds identified correctly the location of a hidden toy on the basis of a nonverbal cue provided by a deceptive individual. They did so at above-chance rates, both when the nonverbal cue suggested concealment (i.e., hand deceptive condition) or was referential (i.e., eye and head deceptive conditions). Three-year-olds differed significantly from older children in their responses. Of the deceptive conditions, they completed only the hand deceptive condition successfully, failing to respond to the eye gaze cue in the other deceptive conditions. This pattern of findings suggests that 3-year-olds were unable to use the referential component of the eye gaze cue to infer the true state of affairs in deceptive contexts. In deceptive situations, 3-year-olds appeared to rely on the verbal information provided by the

deceptive actor while ignoring the eye gaze information provided by the same actor. That is, either they chose randomly, as if the actor was unaware of the toy's location (Experiments 1 and 2, in which the actor claimed that she did not know the whereabouts of the hidden toy), or chose systematically in accordance with the incorrect location the actor verbally suggested as a possible hiding spot (Experiment 3).

Our results add to what is currently known about young children's ability to detect and use information provided in another's eye gaze in different contexts. Beginning with the simple following of gaze in infancy, the range of contexts in which this cue is informative for children expands rapidly. Sequentially, children can use it in achieving joint attention by 12 months of age (e.g., Brooks & Meltzoff, 2002; Butterworth & Jarrett, 1991), to pick out an object in three-dimensional space for the purpose of learning the object's name and social valence by 2 years of age (Baldwin, 1993, 1995; Repacholi, 1998), and to infer mental states and activities, such as desire and thinking, by 3 years of age (Baron-Cohen & Cross, 1992; Flavell et al., 1995; Lee et al., 1998). The present study adds to this developmental picture that children begin, at about 4 years of age, to extract truth about a hiding location from the gaze of an individual known to be deceptive. By age 5 years, this ability is further developed and includes the reliance on a deceptive individual's eye gaze cues to infer the true state of affairs in deceptive situations in which verbal and eye gaze cues provide contradictory information.

Before addressing the difficulties of 3-year-olds in the present study, it is instructive to consider what is required to identify correctly the location of the toy in our task. It first requires appreciating that the actor is deceptive. Second, it requires the realization that some of the information the actor conveys is intended to deceive, whereas other information may be truth revealing. The adult approach to such deceptive communication is to favor use of nonverbal information and reject verbal cues because it is assumed that the former is more difficult to control. This heuristic is referred to as the “verbal–nonverbal consistency principle,” akin to the old adage “actions speak louder than words” (e.g., Rotenberg et al., 1989). To succeed in the present study, the child had to realize that the verbal cue is uninformative but that the eye gaze cue provides valuable information about the hidden toy. Realizing this, the child had to be able to follow the actor's eye gaze and make use of it to infer that the looked-at cup is the one in which the toy is hidden each time.

Failing to detect and follow the actor's gaze are not the reasons for 3-year-olds' difficulty with the task. Except for the statements made in the cooperative and deceptive conditions, the two conditions in Experiments 1 and 2 were identical, yet 3-year-olds were successful in using eye gaze cues in cooperative but not deceptive conditions. The salience of the eye gaze cue is also not a contributing factor to 3-year-olds' poor performance in the eye deceptive condition. Despite that the eye gaze cue was more prominently displayed in the deceptive condition of Experiment 2, 3-year-olds still performed at chance. One could argue that the 3-year-olds might fail to appreciate that the actor was deceptive in spite of being explicitly informed of her intent. This appears not to be the case either: The 3-year-olds consistently responded differentially in deceptive and cooperative conditions. In addition, findings of the hand deceptive condition indicate that 3-year-olds' difficulty is not a result of being unable to use nonverbal cues in general to infer the toy's location in deceptive contexts.

One could also argue that 3-year-olds' difficulty with the eye gaze cue might be more general and not only limited to the deceptive situations. More specifically, they might have difficulty in using another's eye direction to infer mental states even in a cooperative context. This suggestion is inconsistent with the results of both the present and existing studies. In the eye cooperative conditions of the present study, 3-year-olds performed above chance in the cooperative condition in which the cooperative actor shifted her eye gaze toward the baited cup and indicated her knowledge about the whereabouts of the hidden toy. Three-year-olds

also performed above chance in Lee et al.'s (1998) study, in which a cooperative adult shifted her gaze to indicate her desired objects. These results taken together suggest that as long as eye gaze cues are displayed in a cooperative context, 3-year-olds are able to use eye gaze cues to infer the mental states of the gazer.

Three-year-olds' failure in our eye-gaze-related deceptive conditions was likely due to their reliance on different information in deceptive situations than was most frequently used by older children. Four- and 5-year-olds appeared to favor an approach similar to that of adults. By responding on the basis of the eye gaze cues in the three experiments, they showed evidence of invoking the principle that “actions speak louder than words.” Three-year-olds, in contrast, appeared to follow a principle opposite that of 4- and 5-year-olds in the three experiments. Contrary to older children's and adults' belief, 3-year-olds appeared to believe that in a deceptive situation, the verbal cue displayed by a deceiver is more informative about the true state of affairs than the eye gaze cue. In the eye and head deceptive conditions of Experiments 1 and 2, they chose randomly, consistent with the actor's statement that she did not know the location of the toy. In Experiment 3, they chose the cup verbally suggested as a hiding spot rather than the cup looked at by the actor. Thus, in all cases, 3-year-olds responded as if “words speak louder than actions.” That is, they had a lexical bias (see Friend, 2003).

It should be noted that 3-year-olds do not always adhere to this principle. For example, in the hand deceptive condition of Experiment 1, they chose the hiding location of the toy at above-chance levels on the basis of the concealing hand movement displayed by the actor. As suggested earlier, when the nonverbal cue signaled concealment, perhaps 3-year-olds' familiarity with this gesture allowed them to use the nonverbal cue to infer where the toy could be found. In contrast, when the nonverbal cue was referential, as in the eye and head deceptive conditions, they consistently failed to make use of it to deduce the toy's location. Rather, they displayed a lexical bias by relying on the verbal cues provided by the deceptive actor to infer the true state of affairs.

There are at least three reasons why there might be a lexical bias for the 3-year-olds in the context of the present study. First, the verbal cues may be more salient to 3-year-olds than the gaze cues (Eskritt & Lee, 2003). Although performance in the cooperative gaze conditions indicates that they had no difficulty in detecting and following the eye gaze cue, it is possible that the verbal cue may be perceived more saliently than the eye gaze cue by 3-year-olds in deceptive situations. Second, verbal information is generally reliable for 3-year-olds in their daily interactions, and they may simply overgeneralize its reliability to include deceptive contexts. Indeed, it would be maladaptive for very young children to question the veracity of what they are told, and it is reasonable to assume that most verbal information provided by parents and other adults is not deceptive in nature.

Third, and related to the second point, 3-year-olds may not have sufficient experience with deception relative to older children. As mentioned earlier, 4- and 5-year-olds are generally more skilled than 3-year-olds with deception, in terms of both detecting it in others and partaking in it themselves. In fact, the existing studies have consistently shown that when compared with older children, 3-year-olds have more difficulty in detecting another's deceptive acts (e.g., Lee & Cameron, 2000; Lee, Cameron, Doucette, & Talwar, 2002), are less inclined to lie about their own transgressions (e.g., Lewis, 1993; Polak & Harris, 1999; Talwar & Lee, 2002), and, if they do attempt to deceive, tend to be less successful (e.g., Peskin, 1992; Sodian, 1991). A greater exposure to deceptive acts in later preschool years may make them increasingly more sensitive to deception and therefore less willing to accept what they are told at face value (also see Lee et al., 2002).

One discrepancy between the present findings and others demonstrating a strong lexical bias relates to age. A number of studies have suggested that only at approximately age 7 years do children begin to overcome this lexical bias, with some children still exhibiting this bias into adolescence (e.g., Friend, 2000, 2001). In contrast, 4- and 5-year-olds in our study were able to rely on nonverbal cues to infer the true state of affairs. There are several potential contributing factors to the improved performance by 4- and 5-year-olds in the present compared with previous studies. One may be that most of the earlier studies did not provide a clear rationale for why the adult was communicating inconsistently (e.g., Eskritt & Lee, 2003; Volkmar & Siegel, 1982). In the present study, the inconsistent communication was situated in a hide-and-seek game context with which the 4- and 5-year-olds might be highly familiar. Also, the explicit information that the actor was deceptive ("tricky") provided the children with a clear reason why the actor behaved inconsistently in terms of verbal and nonverbal behaviors. The advantage of situating a task in a deceptive situation has also been shown in other related sociocognitive tasks, such as appearance–reality and false belief tasks (e.g., Rice et al., 1997; Sullivan & Winner, 1993). Furthermore, earlier studies (except for Friend, 2003; Volkmar & Siegel, 1982) required children to provide explicit verbal interpretations of the actor's intent or affect. In contrast, children in the present study were not asked to verbalize their understanding of the intentional or emotional rationale for the actor's behavior. Rather, they were only required to use the actor's behavior to guide their search, which is presumably a cognitively and linguistically less demanding task. Of note, Friend (2003) avoided using verbal explanation as a dependent variable and showed 4-year-olds to begin to rely on paralinguistic cues in a social referencing task, a finding in line with the present results.

It is important to emphasize that understanding deception and the ability to use informative cues to infer deception continues to develop well past the ages examined in the present study. For example, although performance of our 4- and 5-year-olds indicated progress in overcoming limitations evident in the performance of our 3-year-olds, detection and inference of deceptive intent itself must develop, a skill not required in the present study because this information was provided. In a real-world scenario, although one may expect another to be deceptive because of some prior knowledge and therefore be attentive for leaked cues, the more typical case involves determining deceptive intent itself on the basis of another's behavior. In a naturally occurring episode of deception, a leaked gaze cue may typically comprise subtle glances with particular temporal and frequency characteristics rather than an overt and prolonged gaze shift, as in the present study. Sensitivity to more subtle glances is therefore required and may develop after the preschool years (see Einav & Hood, 2004). Furthermore, clues to deception may be evident in a number of behaviors, for example, body language, facial expression, prosody of speech, and the content of an untruthful statement (Ekman & Frank, 1993). The detection of deception from such cues may emerge beyond the preschool years and develop well into adolescence (e.g., Feldman & White, 1980; Lee et al., 2002). Nevertheless, the present study shows that the foundations for these important abilities have already been laid during the preschool years.

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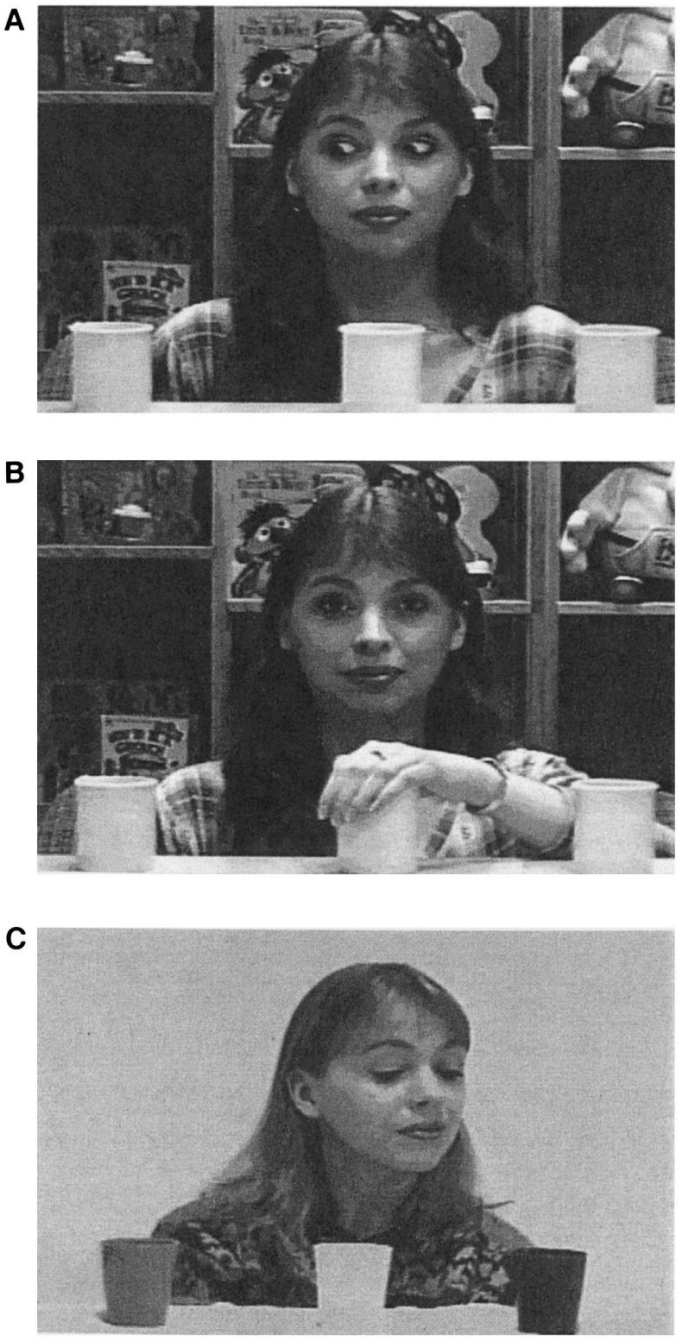

Figure 1.
Example of the cue used in the eye conditions (A) and hand conditions (B) for Experiment 1 and head conditions (C) for Experiment 2.

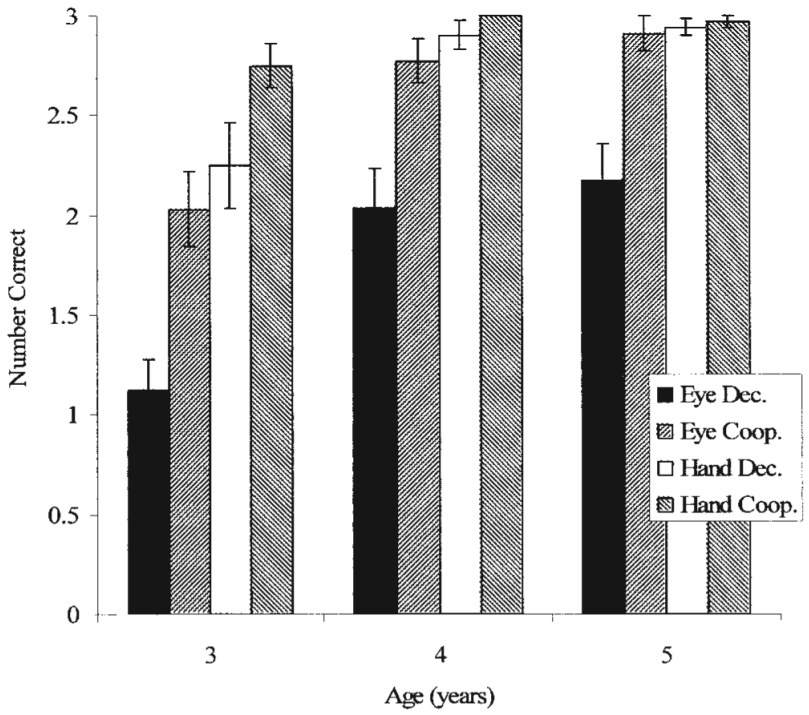

Figure 2.
Mean scores in the eye deceptive (Eye Dec.), eye cooperative (Eye Coop.), hand deceptive (Hand Dec.), and hand cooperative (Hand Coop.) conditions for children in each age group of Experiment 1. Vertical lines depict standard errors of the means.

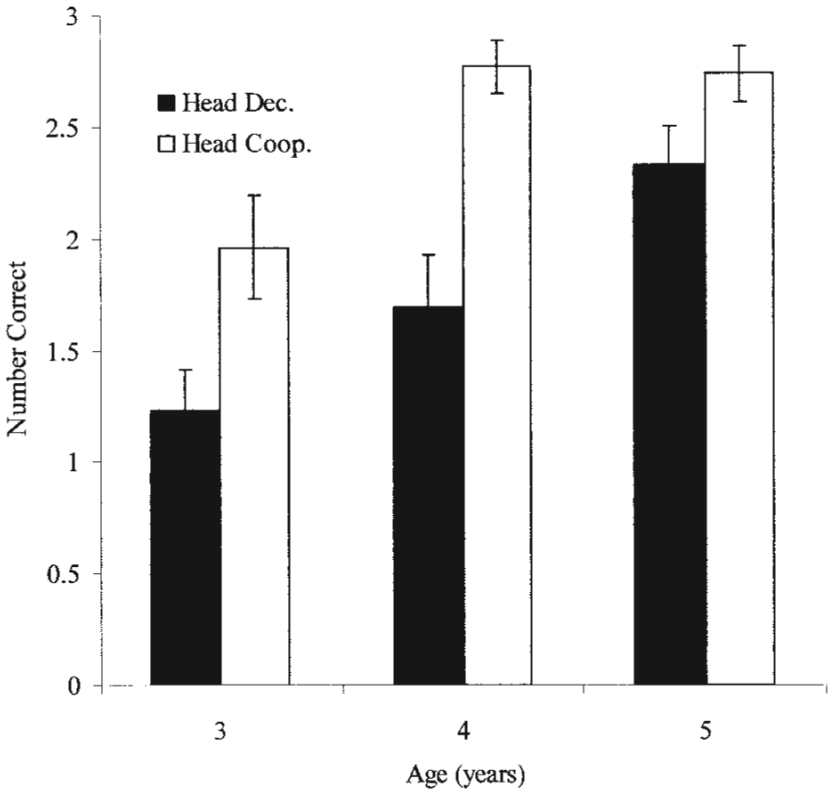

Figure 3.
Mean scores in the head deceptive (Head Dec.) and head cooperative (Head Coop.) conditions for children in each age group of Experiment 2. Vertical lines depict standard errors of the means.

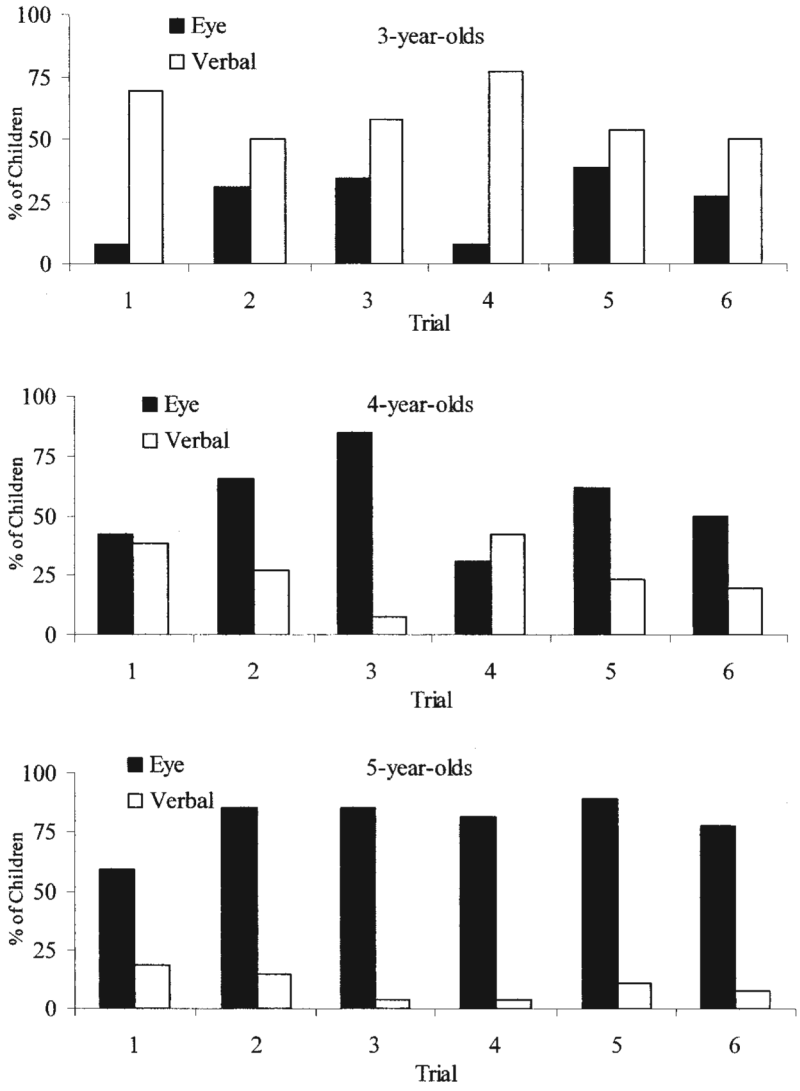

Figure 4.
Percentage of children at each age, for each trial, who chose the cup looked at by the actor (Eye) or indicated in her verbal statement (Verbal) in Experiment 3.

Table 1

Observed (and Expected) Frequencies of Correct Responses for Experiment 1

	Score			
Condition and age	**0**	**1**	**2**	**3**
Eye deceptive				
3 years	7 (9.5)	17 (14.2)	5 (7.1)	3 (1.2)
4 years	4 (9.2)	6 (13.8)	6 (6.9)	15 (1.2)
5 years	3 (10.1)	7 (15.1)	5 (7.6)	19 (1.3)
Eye cooperative				
3 years	3 (9.5)	8 (14.2)	6 (7.1)	15 (1.2)
4 years	0 (9.2)	3 (13.8)	1 (6.9)	27 (1.2)
5 years	1 (10.1)	0 (15.1)	0 (7.6)	33 (1.3)
Hand deceptive				
3 years	5 (9.5)	4 (14.2)	1 (7.1)	22 (1.2)
4 years	0 (9.2)	1 (13.8)	1 (6.9)	29 (1.2)
5 years	0 (10.1)	0 (15.1)	2 (7.6)	32 (1.3)
Hand cooperative				
3 years	0 (9.5)	3 (14.2)	2 (7.1)	27 (1.2)
4 years	0 (9.2)	0 (13.8)	0 (6.9)	31 (1.2)
5 years	0 (10.1)	0 (15.1)	1 (7.6)	33 (1.3)

Table 2

Observed (and Expected) Frequencies for the Head Conditions of Experiment 2

	Score			
Condition and age	**0**	**1**	**2**	**3**
Head deceptive				
3 years	5 (7.7)	13 (11.6)	5 (5.8)	3 (1.0)
4 years	5 (7.7)	8 (11.6)	3 (5.8)	10 (1.0)
5 years	2 (8.0)	2 (12.0)	8 (6.0)	15 (1.0)
Head cooperative				
3 years	2 (7.7)	8 (11.6)	5 (5.8)	11 (1.0)
4 years	0 (7.7)	2 (11.6)	2 (5.8)	22 (1.0)
5 years	1 (8.0)	0 (12.0)	4 (6.0)	22 (1.0)

Table 3

Frequency of Word Scores and Eye Scores by Children at Each Age in Experiment 3

Score	3 years		4 years		5 years	
	Word score	Eye score	Word score	Eye score	Word score	Eye score
0	0[a]	7	6	0	17	0
1	1	8	8	4	8	3
2	6	4	6	6	1	1
3	7	5	3	5	0	1
4	3	2	3	2	1	3
5	7	0	0	6	0	5
6	2	0	0	3	0	14

[a]Number of children who had a 0 word score.