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Children's knowledge of deceptive gaze cues and its relation to their actual lying behavior

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Abstract

Eye gaze plays a pivotal role during communication. When interacting deceptively, it is commonly believed that the deceiver will break eye contact and look downward. We examined whether children's gaze behavior when lying is consistent with this belief. In our study, 7- to 15-year-olds and adults answered questions truthfully (*Truth* questions) or untruthfully (*Lie* questions) or answered questions that required thinking (*Think* questions). Younger participants (7- and 9-year-olds) broke eye contact significantly more when lying compared with other conditions. Also, their averted gaze when lying differed significantly from their gaze display in other conditions. In contrast, older participants did not differ in their durations of eye contact or averted gaze across conditions. Participants' knowledge about eye gaze and deception increased with age. This knowledge significantly predicted their actual gaze behavior when lying. These findings suggest that with increased age, participants became increasingly sophisticated in their use of display rule knowledge to conceal their deception.

Keywords

Deception; Nonverbal behavior; Eye gaze; Display rule knowledge; Social cognition; Eye contact; Averted eye gaze; Children

Introduction

The quest to uncover how people deceive extends beyond law enforcement to encompass numerous disciplines and professions such as philosophy, psychology, sociology, history, advertising, medicine, politics, and education (e.g., Barnes, 1994; Bok, 1978; Halligan, Bass, & Oakley, 2003; Harrigan, Rosenthal, & Scherer, 2005; Hartley & Karinch, 2005; Hausman, 2000; Shulman, 2007). Even laypersons have a keen interest in unraveling the mystery of deception. This universal interest in deception may stem from the fact that despite people's negative views, lying is a common part of interpersonal communication among adults. Evidence shows that adults tell lies on a daily basis (DePaulo & Kashy, 1998; DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996).

Extensive research has focused on the telltale signs of deception and identified a so-called "deceiver stereotype" or commonsense beliefs that laypeople have regarding the signs that reveal deceit (e.g., DePaulo et al., 1996; Ekman, O'Sullivan, & Frank, 1999; Global Deception Research Team, 2006; Leathers, 1997). For example, liars are commonly believed to have lags in speech, to fidget, to break eye contact and look down, and to smile inappropriately (Akehurst, Köhnken, Vrij, & Bull, 1996; Global Deception Research Team,

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2006; Leathers, 1997; Vrij & Semin, 1996; Zuckerman, Koestner, & Driver, 1981). However, despite knowledge of this deceiver stereotype, trained observers are no better at detecting lies than are untrained observers (Ekman & O'Sullivan, 1991; Leach, Talwar, Lee, Bala, & Lindsay, 2004). Both groups can detect lies only at or near chance levels (DePaulo, Zuckerman, & Rosenthal, 1980; Kraut & Poe, 1980; for a review, see Bond & DePaulo, 2006). Mann, Vrij, and Bull (2004) noted that in many cases people would be more accurate at detecting lies if they simply guessed.

Perhaps failure to accurately detect adults' lies is the result of an erroneous expectation that adults display deceptive cues consistent with the deceiver stereotype. The deceiver stereotype is widely known among adults (e.g., Global Deception Research Team, 2006; Leathers, 1997). It is possible that adult lie-tellers use their knowledge of the deceiver stereotype to conceal deceptive behaviors that are consistent with this stereotype and simulate behaviors associated with honesty. In so doing, they increase the likelihood of duping others who rely on the deceiver stereotype for lie detection. If this hypothesis is true, lie-tellers who have limited knowledge of this stereotype should display more of the behaviors prescribed by the stereotype. Thus, the lies of such naive lie-tellers should be readily detectable.

One approach to testing this hypothesis is to examine adults from cultures that hold different deceiver stereotypes. Unfortunately, a recent study involving participants from 75 countries on all continents of the world revealed that this deceiver stereotype is universally held (Global Deception Research Team, 2006), rendering this approach untenable. Another approach is to test this hypothesis by examining children's beliefs about deception and their actual lying behavior because the deceiver stereotype is presumably acquired during socialization in childhood. At younger ages, children might not have acquired knowledge about the deceiver stereotype; therefore, their behaviors when lying would be consistent with what is expected based on the stereotype. However, as age increases and children become increasingly knowledgeable about the deceiver stereotype, their deceptive behaviors may deviate more and more from what would be prescribed by the stereotype. The current study tested this possibility. Specifically, we focused on one major component of the deceiver stereotype, namely, the universal belief that honest people maintain eye contact, whereas liars break eye contact and look down (Global Deception Research Team, 2006; Leathers, 1997). The reason to focus on this particular aspect of the deceiver stereotype is that this belief is the most widely and consistently held one by people around the world (Global Deception Research Team, 2006; Leathers, 1997).

Despite this belief being widely accepted, there is inconsistent evidence to suggest that children and adults actually break eye contact and look down when lying. Some researchers (Barnlund, 1968; Exline & Greenberg, 1971, cited in Burns & Kintz, 1976; Exline, Thibaut, Hickey, & Gumpert, 1970) who examined adult gaze behavior when lying have reported that people maintained less eye contact when lying than when truth-telling, whereas other researchers have reported opposite results (Bond, Kahler, & Paolicelli, 1985; Burns & Kintz, 1976; Sitton & Griffin, 1981). In addition, there is little research examining children's gaze behavior when lying. Thus, the current eye gaze literature cannot address the question of whether there exists a linkage between eye gaze display and deception.

However, evidence suggests that there is a close relationship between eye gaze and other mental activities. For example, researchers have long established that direction of gaze alone can indicate a person's desires, preferences, and direction of attention (e.g., Argyle & Cook, 1976; Einav & Hood, 2006; Kleinke, 1986; Lee, Eskritt, Symons, & Muir, 1998). Abnormalities in eye gaze behavior are sometimes diagnostic markers for autism, schizophrenia, and depression (e.g., Phillips, Baron-Cohen, & Rutter, 1992; Rutter &

Stephenson, 1972; Santarcangelo & Dyer, 1988). Although it is well established that adults believe that liars avert their gaze, extensive evidence shows that adult liars do not consistently display such behaviors. As discussed above, this lack of relationship between lying and eye gaze may be due to the fact that adult liars, having acquired knowledge of the deceiver stereotype regarding gaze display, may deliberately avoid averting their gaze when lying. In contrast, children might not have such knowledge and may still avert their gaze when telling lies.

To test this possibility, the current study examined the eye gaze patterns of children between 7 and 15 years of age, as well as adults, as they responded to questions with either truthful answers or convincing lies. The questions that were used in this study were designed such that participants readily knew the answers (e.g., “What is the name of the street you live on?”) and were similar to the types of questions used in previous studies with adults (e.g., Bond et al., 1985). When answering these questions truthfully, we can simply recall the answers from memory. However, when answering these questions with an untruthful or deceptive answer, we must first recall the correct or truthful answer and then *think* about a convincing deceptive answer. Ekman and Frank (1993) suggested that thinking cues may leak deception. Thus, it is possible that our eye gaze display when lying could resemble that occurring when thinking. To examine this possibility, we also asked participants to truthfully answer questions that required thinking to derive the answers. McCarthy, Lee, Itakura, and Muir (2006) found that participants looked upward when thinking about the answers to questions. Thus, if Ekman and Frank (1993) were correct, participants should look upward when lying, not downward as suggested by the deceiver stereotype.

Participants were also assessed in terms of their display rule knowledge about others’ gaze behavior when lying, telling the truth, or thinking about answers to questions. Specifically, we asked participants to identify where people should look when they want others to know they are telling the truth or when they want others to know they are thinking about the answer to a question. We also asked participants to identify where people should look when they are lying if they want to conceal their lie and appear honest. We predicted that participants with knowledge of the deceiver stereotype would identify eye contact as the gaze behavior associated with honesty and, therefore, would respond that people should maintain eye contact if they are telling the truth or if they want to conceal a lie. We also predicted that participants who had this knowledge about how to conceal deceptive gaze cues would display this “honest” gaze behavior when lying themselves. However, we predicted that participants without this knowledge would display the stereotypical gaze behavior associated with lying. To test this possibility, we examined whether participants’ responses on these display rule questions were related to their actual gaze behavior.

The age range of 7 to 15 years is ideal to study developmental changes in children’s understanding of the display rules associated with deception and honesty. Researchers (e.g., Garner, 1999; Gnepp & Hess, 1986; Rotenberg & Sullivan, 2003; Saarni, 1979; Saarni, 1984; Zeman & Garber, 1996) have reported that children’s knowledge of facial display rules significantly increases between 7 and 11 years of age. Given that eye gaze is one crucial component of facial expressions, we predict a similar developmental trend in children’s understanding of the eye gaze display rules that govern honesty and deception. Although existing studies have shown that children as young as 2 or 3 years of age can use others’ gaze display to infer mental states such as desire and thinking (Flavell, Green, & Flavell, 1995; Lee et al., 1998), children’s understanding of deceptive gaze display does not become somewhat reliable until around 5 or 6 years of age (Freire, Eskritt, & Lee, 2004). Furthermore, children’s use of gaze cues to identify deception continues to develop from 6 to 12 years of age (Rotenberg, 1991; Rotenberg & Sullivan, 2003).

The age range of 7 to 15 years is also ideal to study children's actual gaze behavior when lying and truth-telling. Children begin to tell lies around 2 or 3 years of age, but they do not begin to regulate their behavior strategically when lying until around 6 or 7 years of age (Lewis, Stanger, & Sullivan, 1989; Newton, Reddy, & Bull, 2000; Talwar, Gordon, & Lee, 2007; Talwar & Lee, 2002). Research has found that 8-year-olds avert their gaze when answering cognitively demanding questions (Doherty-Sneddon, Bruce, Bonner, Longbotham, & Doyle, 2002). Given the high cognitive demand associated with lying, children of this age may also avert their gaze when trying to answer questions untruthfully. Children also begin to understand that emotional expression can be voluntarily controlled around this same age (Carroll & Steward, 1984; Harris, 1989; Harris, Olthof, & Terwogt, 1981). Thus, if there is any relation between children's gaze behavior when lying and their knowledge about gaze display rules, it should emerge around 7 years of age. We chose 15-year-olds as the oldest children's age group due to existing studies illustrating that adolescents are highly experienced with lying, and their lying skills and display rule knowledge in general are highly similar to those of adults (e.g., Feldman, Tomasian, & Coats, 1999; Gnepp & Hess, 1986; Jensen, Arnett, Feldman, & Cauffman, 2004; Knox, Zusman, McGinty, & Gescheidler, 2001; O'Kearney and Dadds, 2004; Strömwall, Granhag, & Landström, 2007; van Beek, van Dolderen, & Dubas, 2006). Thus, one would expect that by 15 years of age, children's knowledge about the display rules that govern deception and their actual behavior when lying would closely resemble those of adults.

Based on the existing literature (e.g., Flavell et al., 1995), we hypothesized that children as young as 7 years of age will identify upward gaze as a cue to thinking but may have difficulty in identifying eye contact as a cue to honesty. Therefore, they will not say that someone should maintain eye contact when telling the truth or trying to conceal a lie. Knowledge of these associations between patterns of eye gaze and lying and truthful communication will increase with age until around 13 to 15 years of age when children will become adult-like. We further hypothesized that both young and older children will display an upward gaze pattern when answering questions that require thinking to derive the answers, whereas they will maintain eye contact when truthfully answering questions when the answers can be retrieved directly from memory. In contrast, when lying, younger participants will display the stereotypical gaze aversion associated with deception either by looking downward, as predicted by the deceiver stereotype, or by looking upward, as predicted by Ekman and Frank (1993), who suggested that thinking cues (e.g., upward gaze) may reveal deception. With increased age, however, participants' eye gaze display will become indistinguishable between lying and truth-telling. Furthermore, this age change is expected to be significantly related to participants' increased display rule knowledge about eye gaze during truthful and untruthful communication.

Method

Participants

Participants were middle-class Trinidadians of general Indian ancestry and representative of the general population of Trinidad. We chose Trinidadian children and adults to participate in this study because previous research has shown that Trinidadian adults, similar to Western adults, hold beliefs consistent with the deceiver stereotype for eye gaze behavior (Global Deception Research Team, 2006). Thus, we can use this population to examine how knowledge of the deceiver stereotype develops and how knowledge of the deceiver stereotype might be related to gaze behavior when lying and telling the truth.

The children were 6 boys and 6 girls (all right-handed) in the following five age groups: 7-year-olds (mean age = 7.3 years, $SD = 0.4$), 9-year-olds (mean age = 9.3 years, $SD = 0.3$), 11-year-olds (mean age = 11.3 years, $SD = 0.3$), 13-year-olds (mean age = 13.4 years, $SD =$

0.3), and 15-year-olds (mean age = 15.2 years, *SD* = 0.2). The adults were 6 men and 6 women (all-right handed, mean age = 21.1 years, *SD* = 2.1). An additional 6 7-year-olds and 3 9-year-olds were tested but not included in the study because they answered all of the questions truthfully regardless of condition (i.e., they did not lie as instructed). Informed consent was obtained prior to beginning the test session.

Materials and procedure: Eye gaze behavior

Participants were seen individually in a single test session that lasted approximately 20 min. Each participant sat at a table and directly faced an interviewer, who was seated at the other side of the table. A video camera was placed on the table between the participant and the interviewer and was used to record the participant's face during the test session. This video recording was later digitized to allow for frame-by-frame scoring of eye position.

Before beginning the test session, the interviewer told the participant that he or she would be answering a set of questions. For some questions the participant was to respond with the truthful answers, and for other questions the participant was to answer with convincing lies. The interviewer told the participant that prior to asking each question, she would hold up a card that had either "Truth" or "Lie" written on it. When the card had "Truth" written on it, the participant was to answer the question that followed with the truthful answer. When the card had "Lie" written on it, the participant was to answer the question that followed with a convincing lie. The interviewer then told the participant that she would have no knowledge of what was written on the card and that she would be trying to determine when the participant was answering a question untruthfully. The participant was told that if he or she successfully concealed the lies (i.e., the interviewer could not detect which questions were answered untruthfully), then he or she would receive a prize. The prize served as an incentive for the participant to lie convincingly. All participants received a prize regardless of performance. The materials and procedure used in this study were similar to those used in previous research with adults (e.g., Bond et al., 1985; Burns & Kintz, 1976; McCarthy, Muir, & Lee, 2004; McCarthy et al., 2006; Sitton & Griffin, 1981) but were modified for use with children. Specifically, the question difficulty was modified so that it matched the cognitive ability of children at each age. For example, for math questions, 7-year-olds were asked simple addition or subtraction questions, whereas 15-year-olds were asked more complex questions involving multiplication or division.

After explaining the procedure to the participant, the interviewer began the test session. The interviewer held up the first card that had either "Lie" or "Truth" written on it. The participant recorded the "Truth" or "Lie" instruction on an answer sheet, and the interviewer then asked the participant the first question. The participant knew that the interviewer could not see the answer sheet because it was placed on the table behind a small stack of binders, thereby blocking it from the interviewer's view. After the participant answered the question, the interviewer held up the next card, and the process continued until the interviewer asked the participant a total of nine questions.

Given that the direction of the interviewer's gaze could potentially influence the gaze behavior of participants (e.g., Friesen, Ristic, & Kingstone, 2004; Ristic, Friesen, & Kingstone, 2002), we minimized this potential influence by having the interviewer keep her face and eyes forward regardless of the participant's behavior (i.e., she did not shift her gaze in the direction of the participant's gaze). During the face-to-face interaction, the interviewer picked a card from the shuffled deck, looked at the question, and then maintained eye contact with the participant while asking the question. The interviewer either continued to maintain eye contact (when the participant maintained eye contact with the interviewer) or looked straight ahead at the participant's face (when the participant broke eye contact and looked away) until the participant responded with the answer. Given that the interviewer's

gaze was consistent across participants, this was not a factor in the gaze behavior displayed by participants.

Each participant answered three of the nine questions asked by the interviewer with convincing lies (*Lie* questions). The Lie questions were designed so that the participant knew the answers and could readily retrieve the answers from memory (e.g., "How many pets do you have?"). The remaining six questions were answered truthfully in two different ways. Three of the six questions were designed so that the participant knew the answers (*Truth* questions, e.g., "What street do you live on?"). The remaining three questions required thinking to derive the answers (*Think* questions, e.g., "If a car is traveling at 60 km/hour, how far will it travel in 2 hours?"). Questions were adjusted for age level. By the end of the test session, the participant had answered three questions with convincing lies (Lie questions), three questions with truthful answers (Truth questions), and three questions that required thinking to derive the answers (Think questions). Prior to each test session, the cards that contained these nine questions were placed into one pile such that the pile contained all of the Truth, Lie, and Think questions. These nine cards were then thoroughly shuffled to ensure that each participant received a random presentation of the Lie, Truth, and Think instructions and questions.

The Truth and Lie questions were designed so that the participant had privileged knowledge of the answers. That is, the participant knew the correct answers, but the interviewer did not. Thus, the participant could deceive the interviewer. Given that the interviewer did not know the actual answers to the Truth or Lie questions, we used two measures to determine whether each participant answered the questions according to the "Truth" or "Lie" instruction on the cards. First, prior to each question, the participant recorded the "Truth" or "Lie" instruction on an answer sheet. The responses on the answer sheet were later compared with the participant's video record to confirm that the participant received the instruction on each of the cards correctly. All participants recorded the correct instructions. Second, after each test session, we used information provided by the participant or the participant's parent/guardian/teacher to obtain the correct answers for the Truth and Lie questions asked. We then compared these correct answers with the participant's video record to ensure that the participant answered the questions appropriately. As noted previously, six 7-year-olds and three 9-year-olds answered all of the questions truthfully and, therefore, did not follow the instructions on the cards. Although these participants correctly recorded the Truth/Lie instructions on their answer sheets, they did not follow the instructions. The reason why these children did not follow the instructions is unclear. Perhaps they did not understand the task. But more likely, these children chose to answer all of the questions truthfully for moral reasons. Most of these children commented that it was wrong to lie, and this may have led them to tell the truth on all of the questions. However, the majority of 7- and 9-year-olds, and all of the older participants, followed the instructions and answered the questions accordingly, indicating that they understood the task.

Scoring of eye gaze behavior

To examine each participant's eye gaze when he or she answered Lie, Truth, and Think questions, the participant's eye position was coded for each frame (1/30th of a second) of his or her test session. The test session was divided into three periods: the "question" period when the interviewer asked the participant questions, the "answer" period when the participant gave his or her answers, and the "information processing" period between the question and answer periods. The gaze data for the first two periods were not analyzed for the purposes of this study because (a) during the question period participants maintained eye contact 96% of the time while waiting for the experimenter to finish asking the question and (b) during the answer period participants maintained eye contact 98% of the time while giving their answers. The information processing period was used to assess participants' eye

gaze behavior because it was during this time that participants were processing the questions and formulating their responses. If eye gaze indeed reflects different types of information processing (e.g., answering Truth, Lie, and Think questions), then participants should display these differences during the information processing period. Previous research examining the link between eye gaze and information processing has used the same period for the same reasons (e.g., Doherty-Sneddon & Phelps, 2005; McCarthy et al., 2006).

For each frame of the information processing period, the participant's eye position was recorded as "eye contact" if his or her gaze was directed toward the eyes of the experimenter. The participant's eye position was recorded as "averted" if his or her gaze was directed away from the eyes of the interviewer. The duration of the information processing period varied within the Truth question set, within the Lie question set, and within the Think question set. To control for this variability in duration of the information processing period, we divided each participant's eye gaze durations for eye contact and averted eye gaze by the duration of his or her information processing period, as was done in previous studies (e.g., McCarthy et al., 2006). For each participant, this resulted in two measures for each question: a percentage duration for eye contact and a percentage duration for averted eye gaze. For each participant, we then averaged the eye contact percentage durations across the questions in each question set (i.e., the durations were averaged within the Truth question set, within the Lie question set, and within the Think question set). For each participant, this resulted in three mean eye contact percentage durations: one for the Truth question set, one for the Lie question set, and one for the Think question set (hereafter referred to as the *Truth eye contact duration,* the *Lie eye contact duration,* and the *Think eye contact duration,* respectively). The same was done for the averted percentage duration scores to derive mean averted gaze percentage durations for the Truth, Lie, and Think question sets (hereafter referred to as the *Truth averted duration,* the *Lie averted duration,* and the *Think averted duration,* respectively). The eye contact duration and the averted duration indicated the average proportions of time each participant spent maintaining eye contact and averting their gaze, respectively. When the eye contact duration and the averted duration within each question set are added together, they should equal 100% for each participant.

To identify the direction of each participant's averted gaze, we divided the participant's averted duration into four averted directions: up, down, right, and left. The participant's averted eye position was coded as "up" if it fell between 5° and 175° of the horizontal median and as "down" if it fell between 185° and 355°. The participant's gaze was recorded as "right" if it fell between 175° and 185° of the horizontal median and as "left" if it fell between 355° and 5°. The up, down, right, and left measures were divided by the averted duration to derive mean up, down, right, and left durations, respectively, for each participant (hereafter referred to as the *up duration,* the *down duration,* the *right duration,* and the *left duration,* respectively). When added together, these four durations represent 100% of total averted gaze for each participant.

Interrater agreement on participants' eye positions (eye contact, up, down, right, and left), assessed for each frame of 30 records (n = 5 participants per age group, randomly chosen, 103,145 frames in total), was 98%.

Materials and procedure: Display rule knowledge

After answering the Lie, Truth, and Think questions in the first part of the test session, participants completed a display rule questionnaire indicating where people look when they are lying, telling the truth, or thinking. The display rule questionnaire consisted of six vignettes in which a person was engaged in one of three mental activities: telling the truth, lying, or thinking (two stories for each mental activity). The following is an example:

> Shannon wants to eat a cookie. Her mom says, "Shannon, do not eat any cookies until after dinner." Shannon eats a cookie. Later Shannon's mom asks, "Shannon, did you eat a cookie?" Shannon says, "No, I did not." Shannon told a lie to her mom. She does not want to get caught lying. Where should Shannon look?

Prior to beginning the questionnaire, participants were shown schematic pictures of a person maintaining eye contact (looking straight ahead), looking down, and looking up at an oblique angle. These gaze directions were chosen to directly test our hypotheses about the relationships between (a) eye contact and honesty, (b) downward gaze and deception, and (c) upward gaze and thinking. The presentation order of these drawings was randomized across participants. Participants were asked to identify the direction in which the person in the picture was looking. The interviewer told participants that the person looking straight ahead was in fact looking them in the eye and maintaining eye contact with them. The interviewer then turned to participants and established eye contact, saying "just like this." The interviewer also modeled looking up and looking down while facing participants. This was to ensure that participants understood what was meant by maintaining eye contact, looking up, and looking down. The pictures remained visible to participants as they answered the questions on the questionnaire. To answer the questions, participants could either point to the picture they wanted or answer verbally. The choices for answers were eye gaze in the up direction, eye gaze in the down direction, and eye contact. After each question, the interviewer recorded participants' answers on an answer sheet.

Scoring of display rule knowledge

Participants responded to the six vignettes in the display rule questionnaire by answering each of the following questions twice (two vignettes per question):

1. Where should [story character's name] look when telling the truth? (Truth set)
2. Where should [story character's name] look when trying to conceal a lie? (Lie set)
3. Where should [story character's name] look when thinking about the answer to a question? (Think set)

Participants could respond to each question with either "looking up," "looking down," or "making eye contact" as their answer. For each question set, a participant received three display rule knowledge scores: (a) a Looking Up score with a value of two indicating that the participant responded with "looking up" twice, 1 indicating that the participant responded with "looking up" once, and 0 indicating that the participant never gave the "looking up" response; (b) a Looking Down score when the participant responded with "looking down" twice or once or never gave such a response; and (c) a Making Eye Contact score when the participant responded with "making eye contact" twice or once or never gave such a response. Thus, each participant received nine scores in total indicating their answers on the display rule questionnaire. It should be noted that due to the nature of the scoring scheme, the three scores of Looking Up, Looking Down, and Making Eye Contact are mutually exclusive. In other words, one of the scores is redundant and can be derived from the other two scores. Thus, to avoid redundancy, we used only the Looking Up and Making Eye Contact scores when conducting analyses concerning participants' responses to the display rule questionnaire.

Results

The results of the current study are presented in three sections. The first section, on eye gaze behavior, reports (a) eye contact durations and (b) averted gaze durations (in the up, down, right, and left directions) displayed by participants when they answered the Truth, Lie, and Think questions. The second section, on display rule knowledge, reports participants'

answers on the display rule questionnaire. The third section, on the relation between display rule knowledge and eye gaze behavior, reports the linkage between participants' eye gaze behavior and their answers on the display rule questionnaire.

Preliminary analyses revealed no significant effect of sex, so the data for this factor were collapsed in all of following analyses.

Eye gaze behavior

Eye contact duration—A 3 (Question Type) × 6 (Age) two-way mixed-measures analysis of variance (ANOVA), conducted on eye contact durations for the Truth, Lie, and Think questions, revealed a significant main effect of question type, $F(2, 132) = 19.72$, $p < .001$, $\eta^2 = .23$. Overall, participants maintained significantly less eye contact (38%) when answering the Lie questions compared with the Truth (53%) and Think (52%) questions (collapsed across age). There was also a significant main effect of age, $F(5, 66) = 3.62$, $p < .01$, $\eta^2 = .22$. In general, as age increased, so did duration of eye contact (collapsed across question type). Contrast analyses with 7-year-olds as the comparison group showed that 7-year-olds displayed significantly less eye contact (40%), collapsed across question type, compared with 11- to 15-year-olds and adults (average of 50%).

A significant interaction between question type and age was also found, $F(10, 132) = 6.42$, $p < .001$, $\eta^2 = .33$. As shown in Fig. 1, 7- and 9-year-olds maintained significantly less eye contact when answering Lie questions compared with Truth questions (post hoc paired-sample *t* tests with Bonferroni adjustments for multiple comparisons: 7-year-olds, 15% eye contact when lying vs. 57% when truth-telling, $t(11) = 5.57$, $p < .001$; 9-year-olds, 22% eye contact when lying vs. 54% when truth-telling, $t(11) = 7.26$, $p < .001$). However, 11- to 15-year-olds and adults did not display significantly different durations of eye contact when answering Lie questions compared with Truth questions (11-year-olds: 57% lying vs. 61% truth-telling; 13-year-olds: 46% lying vs. 55% truth-telling; 15-year-olds: 46% lying vs. 45% truth-telling; adults: 48% lying vs. 49% truth-telling).

The 7- and 9-year-olds also maintained significantly less eye contact when answering Lie questions compared with Think questions (post hoc paired-sample *t* tests with Bonferroni adjustments for multiple comparisons: 7-year-olds, 15% eye contact when lying vs. 50% when thinking, $t(11) = 5.65$, $p < .001$; 9-year-olds, 22% eye contact when lying vs. 59% when thinking, $t(11) = 10.07$, $p < .001$). In contrast, 11- to 15-year-olds and adults did not show significant differences in duration of eye contact when answering Lie questions compared with Think questions (11-year-olds: 57% lying vs. 55% thinking; 13-year-olds: 46% lying vs. 43% thinking; 15-year-olds: 46% lying vs. 50% thinking; adults: 48% lying vs. 54% thinking).

Participants did not differ in their durations of eye contact when answering Think questions compared with Truth questions.

Averted up versus down durations—To analyze the averted gaze data, we conducted two separate analyses: one comparing up and down gaze durations and the other comparing right and left gaze durations. A 3 (Question Type) × 2 (Gaze Duration) × 6 (Age) three-way mixed-measures ANOVA, conducted on the up and down durations for the Truth, Lie, and Think questions, revealed a significant main effect of question type, $F(2, 132) = 10.72$, $p < .001$, $\eta^2 = .14$. Overall, participants displayed the most averted gaze (collapsed across direction and age) when answering the Lie questions (90%) compared with the Truth (82%) and Think (81%) questions. A significant main effect of gaze duration was also found, $F(1, 66) = 10{,}240.86$, $p < .001$, $\eta^2 = .99$. Overall, participants looked upward more (80% of averted gaze) than they looked downward (4% of averted gaze), collapsed across age and

question type. The results also showed a significant main effect of age, $F(5, 66) = 2.53$, $p < .05$, $\eta^2 = .16$. Overall, as age increased, so did the duration of participants' averted gaze in the up and down directions. Contrast analyses with 7-year-olds as the comparison group showed that 7-year-olds displayed significantly less averted gaze (79%), collapsed across question type and up/down vertical direction, compared with 13- and 15-year-olds (average of 88%).

There were significant interactions between question type and age, $F(10, 132) = 4.05$, $p < .001$, $\eta^2 = .24$, between question type and gaze duration, $F(2, 132) = 19.03$, $p < .001$, $\eta^2 = .22$, and between gaze duration and age, $F(5, 66) = 5.96$, $p < .001$, $\eta^2 = .31$. There was also a significant three-way interaction among question type, gaze duration, and age, $F(10, 132) = 6.07$, $p < .001$, $\eta^2 = .32$.

The three-way interaction among question type, gaze duration, and age is shown in Fig. 2. All participants displayed more gaze in the upward direction than in the downward direction in the Truth, Lie, and Think conditions (collapsed across age: Truth, 78% vs. 4%, $t(71) = 43.28$, $p < .001$; Lie, 86% vs. 3%, $t(71) = 71.00$, $p < .001$; Think, 77% vs. 5%, $t(71) = 41.51$, $p < .001$). However, 7- and 9-year-olds had greater durations of gaze in the upward direction when answering Lie questions compared with Truth questions (post hoc paired-sample t tests with Bonferroni adjustments for multiple comparisons: 7-year-olds, 93% vs. 71%, $t(11) = 9.77$, $p < .001$; 9-year-olds, 95% vs. 72%, $t(11) = 13.31$, $p < .001$), and Lie questions compared with Think questions (post hoc paired-sample t tests with Bonferroni adjustments for multiple comparisons: 7-year-olds, 93% vs. 69%, $t(11) = 8.55$, $p < .001$; 9-year-olds, 95% vs. 67%, $t(11) = 10.38$, $p < .001$). The 11- to 15-year-olds and adults did not differ in their averted gaze upward or downward when answering Lie questions compared with Truth or Think questions (see Fig. 2).

Averted right versus left durations—A 3 (Question Type) × 2 (Gaze Duration) × 6 (Age) three-way mixed-measures ANOVA, conducted on the right and left durations for the Truth, Lie, and Think questions, revealed no significant findings.

In summary, 7- and 9-year-olds maintained significantly less eye contact and displayed significantly more upward gaze when answering Lie questions compared with Truth or Think questions. However, older children and adults did not differ in their durations of eye contact or averted gaze across conditions.

Display rule knowledge

As discussed previously, participants were asked two display rule questions in each of the Truth, Lie, and Think vignette conditions. Thus, for each of the Truth, Lie, and Think vignette conditions, each participant received a Looking Up score, a Looking Down score, and a Making Eye Contact score of 0, 1, or 2, indicating the number of times the participant chose the given response. Due to the nature of the scoring scheme, the three scores are mutually exclusive. Thus, to avoid redundancy, we used only the Looking Up and Making Eye Contact scores when conducting analyses on the display rule knowledge data.

A 3 (Vignette Type: Lie, Truth, or Think story) × 2 (Response Type: looking up or making eye contact) ×6 (Age) mixed-measures ANOVA was conducted. The results showed significant main effects of response type, $F(1, 66) = 19.97$, $p < .001$, $\eta^2 = .23$, and age, $F(5, 66) = 20.63$, $p < .001$, $\eta^2 = .61$. Also, the Response Type × Age interaction, $F(5, 66) = 8.78$, $p < .001$, $\eta^2 = .40$, the Vignette Type × Response Type interaction, $F(2, 132) = 204.17$, $p < .001$, $\eta^2 = .76$, and the three-way interaction, $F(10, 132) = 9.46$, $p < .001$, $\eta^2 = .42$, all were significant.

To further examine this significant three-way interaction, a 2 (Response Type) × 6 (Age) mixed-measures ANOVA was conducted for each vignette type (Lie, Truth, or Think story). For the Lie vignette, the 2 (Response Type) × 6 (Age) mixed-measures ANOVA showed a significant main effect of response type, $F(1, 66) = 45.31$, $p < .001$, $\eta^2 = .41$. As shown in Fig. 3, participants were more inclined to respond that a story character should maintain eye contact than to look up when trying to conceal a lie (average scores: 1.24 eye contact vs. 0.40 up). Results also showed a significant main effect of age, $F(5, 66) = 9.24$, $p < .001$, $\eta^2 = .41$. As age increased, participants were more inclined to respond that a story character should make eye contact when trying to conceal a lie (see Fig. 3). A significant Response Type × Age interaction, $F(5, 66) = 14.35$, $p < .001$, $\eta^2 = .52$, was also found. Both 7- and 9-year-olds were more likely to respond that a story character should look up when lying, whereas 11- to 15-year-olds and adults responded that the story character should make eye contact ($p < .001$, post hoc comparisons with Bonferonni adjustments) (see Fig. 3).

For the Truth vignette, the 2 (Response Type) × 6 (Age) mixed-measures ANOVA showed a significant main effect of response type, $F(1, 66) = 266.54$, $p < .001$, $\eta^2 = .80$. As shown in Fig. 3, participants were more inclined to respond that a story character should maintain eye contact than to look up when telling the truth (average scores: 1.60 eye contact vs. 0.14 up). Results also showed a significant main effect of age, $F(5, 66) = 6.70$, $p < .001$, $\eta^2 = .34$. As age increased, participants were more inclined to respond that a story character should make eye contact when telling the truth (see Fig. 3). A significant Response Type × Age interaction, $F(5, 66) = 9.73$, $p < .001$, $\eta^2 = .42$, was also found. Both 7- and 9-year-olds were less likely to respond that a story character should maintain eye contact when telling the truth compared with 11- to 15-year-olds and adults ($p < .001$, post hoc comparisons with Bonferonni adjustments) (see Fig. 3).

For the Think vignette, the 2 (Response Type) by 6 (Age) mixed-measures ANOVA showed a significant main effect of response type, $F(1, 66) = 163.34$, $p < .001$, $\eta^2 = .71$. As shown in Fig. 3, all participants, regardless of age, predominantly responded that a story character should look up when thinking (average scores = 1.60 up vs. 0.19 eye contact).

Relation between display rule knowledge and eye gaze durations

Regression analyses were conducted to examine whether participants' answers on the display rule questionnaire predicted their actual gaze behavior when they answered the Truth, Lie, and Think questions. We used only participants' upward duration and their eye contact duration as predicted variables in the following analyses because participants displayed little downward gaze when answering the Lie, Truth, and Think questions (see Fig. 2). Because there were two predicted variables per question type, we ran six regression analyses in total. Only two were significant, and the results are reported below.

A hierarchical regression analysis, with eye contact duration when lying as the predicted variable and with age (entered first), six display rule knowledge scores (i.e., Looking Up and Making Eye Contact scores for the Truth, Lie, and Think vignettes) (entered second), and interaction variables of age and display rule knowledge scores (entered last) as predictors, revealed the following significant results. Age was a significant predictor in participants' eye contact duration when lying, $\Delta R^2 = .16$, $F(1, 70) = 13.68$, $p < .001$. As age increased, the duration of eye contact displayed by participants when they were telling lies also increased, part correlation = .40, $\beta = .40$, $t = 3.70$, $p < .001$. After partialling out the effect of age, all of the display rule knowledge scores combined were significant predictors of participants' eye contact duration when lying, $\Delta R^2 = .21$, $F(6, 64) = 3.47$, $p < .01$. Further inspection revealed that the Making Eye Contact score for the Lie vignettes was uniquely correlated with Lie eye contact duration, part correlation = .21, $\beta = .40$, $t = 2.16$, $p < .05$.

Participants who responded more often that people should maintain eye contact when lying displayed greater eye contact durations when telling lies themselves.

A hierarchical regression analysis, with eye contact duration when telling the truth as the predicted variable nd with age (entered first), six display rule knowledge scores (i.e., Looking Up and Making Eye Contact scores for the Truth, Lie, and Think vignettes) (entered second), and interaction variables of age and display rule knowledge scores (entered last) as predictors, revealed that only age was a significant predictor of participants' eye contact duration when telling the truth, $\Delta R^2 = .21$, $F(1, 70) = 19.05$, $p < .001$. As age increased, the duration of eye contact displayed by participants when they answered questions truthfully also increased, part correlation = .46, $\beta = .46$, $t = 4.36$, $p < .001$.

Comparison with previous literature

The Truth questions in the current study were designed so that participants already knew the answers and, thus, could readily retrieve the answers from memory. We expected participants to maintain a high level of eye contact when answering these questions. This is because previous research has shown that both adults and children maintain high levels of eye contact when they answer similar questions (McCarthy et al., 2004; McCarthy et al., 2006). However, participants in the current study broke eye contact and looked up when answering Truth questions (Figs. 1 and 2). Previous research has shown that both adults and children break eye contact and look upward when thinking about the answers to questions (Doherty-Sneddon & Phelps, 2005; McCarthy et al., 2004; McCarthy et al., 2006). The upward gaze displayed by participants when they answered Truth questions appears to be similar to that displayed when they answered Think questions. To examine this possibility, we conducted several exploratory analyses comparing adult and children's eye contact durations and averted gaze durations from this study with eye contact and averted gaze durations found in previous studies for Trinidadian children and adults (McCarthy et al., 2004; McCarthy et al., 2006). These previous studies examined the eye gaze behavior of adults and children when they answered questions to which they either knew the answers (*Know* questions) or needed to think about the answers (*Think* questions). These previous studies used materials and procedures identical to those used in the current study. In addition, the interviewer in the current study followed the same protocol, with respect to asking participants questions, that was followed in previous studies. Specifically, she picked a card from the shuffled deck, looked at the question, and then maintained eye contact with the participant while asking the question. She either continued to maintain eye contact (when the participant maintained eye contact with the interviewer) or looked straight ahead at the participant's face (when the participant broke eye contact and looked away) until the participant responded with the answer. The only difference in procedure was that the previous studies did not have a Lie condition. Participants answered the Know and Think questions in the previous studies with the correct or truthful answers. We used the same questions in the current study. The two previous studies (McCarthy et al., 2004; McCarthy et al., 2006) tested 30 adults and 50 children (10 children from each of the following age groups: 7-, 9-, 11-, 13-, and 15-year-olds).

Truth questions—We examined whether the eye contact durations for participants in the current study when they answered Truth questions differed from the eye contact durations of Trinidadian participants in previous studies (McCarthy et al., 2004; McCarthy et al., 2006). We found that participants in the current study maintained significantly less eye contact when answering Truth questions compared with participants in matched age groups in previous studies who answered similar questions. On average, adults in previous studies maintained eye contact 88% ($SD = 21\%$) of the time, and children maintained eye contact 82% ($SD = 13\%$) of the time. In the current study, adults maintained eye contact only 49%

(*SD* = 5%) of the time, and children maintained eye contact 54% (*SD* = 14%) of the time. This difference in eye contact durations was significant across all age groups (7-year-olds: $t(20) = 2.29$, $p < .05$; 9-year-olds: $t(20) = 4.62$, $p < .001$; 11-year-olds: $t(20) = 3.85$, $p < .005$; 13-year-olds: $t(20) = 8.37$, $p < .001$; 15-year-olds: $t(20) = 11.86$, $p < .001$; adults: $t(20) = 5.01$, $p < .001$).

Next, we examined whether participants in the current study differed from participants in previous studies (McCarthy et al., 2004; McCarthy et al., 2006) in their durations of upward gaze. We found that participants in the current study had greater durations of upward gaze when answering Truth questions (adults: *M* = 79% of averted gaze, *SD* = 5%; children: *M* = 78% of averted gaze, *SD* = 9%) compared with participants of the same age groups in previous studies who answered similar questions (adults: *M* = 36%, *SD* = 44% of averted gaze; children: *M* = 36%, *SD* = 44% of averted gaze): 7-year-olds, $t(20) = 4.32$, $p < .001$; 9-year-olds, $t(20) = 7.79$, $p < .001$; 11-year-olds, $t(20) = 5.33$, $p < .001$; 13-year-olds, $t(20) = 3.33$, $p < .005$; 15-year-olds, $t(20) = 4.80$, $p < .001$; adults, $t(20) = 6.00$, $p < .001$. In summary, the results from previous studies showed that adults and children tend to maintain eye contact when they answer questions truthfully. In the current study, however, participants maintained significantly less eye contact and displayed a very strong upward bias when they averted their gaze. Because participants in the current and previous studies answered similar questions, we expected the results to be similar across the studies. However, participants in the current study did not display the typical gaze pattern associated with truthfulness. Instead, participants' gaze behavior in the current study resembled the gaze behavior associated with thinking.

Truth and think questions—As discussed previously, participants maintained less eye contact and looked upward longer when answering questions truthfully in the current study compared with previous studies in which participants answered similar questions. This lack of eye contact and longer gaze in the upward direction is similar to the gaze behavior displayed by participants, in the current and previous studies, when answering questions that require thinking to derive the answers. We examined this apparent similarity in more detail by comparing the *Truthful* eye gaze behavior of participants in the current study with the *Thinking* eye gaze behavior of participants in the current study and previous studies (McCarthy et al., 2004; McCarthy et al., 2006). First, we established that the Thinking eye gaze behavior displayed by participants in the current study was similar to that displayed by Trinidadian participants in previous studies. Overall, participants maintained eye contact approximately 53% of the time, across studies, when they answered Think questions. With respect to averted gaze, participants spent approximately 77% of their averted gaze time looking upward when answering Think questions. Thus, participants in the current and previous studies displayed similar durations of eye contact and showed a similar upward bias when they averted their gaze.

Next, we examined whether the Truthful eye gaze behavior displayed by participants in the current study was similar to the Thinking eye gaze behavior displayed by participants in the current and previous studies (McCarthy et al., 2004; McCarthy et al., 2006). When answering Truth questions, participants in the current study maintained eye contact approximately 50% of the time. This is similar to the percentage of time (53%) participants spent maintaining eye contact when answering Think questions in both the current and previous studies. With respect to averted gaze, participants spent 79% of their total averted gaze time looking upward when answering Truth questions in the current study. This is also similar to the averted gaze behavior displayed by participants in the current and previous studies when they answered Think questions given that 77% of their total averted gaze time was spent looking upward. Thus, these results indicate that the eye gaze behavior displayed

by participants when they answered Truth questions in the current study is similar to that displayed when answering Think questions.

Discussion

In the current study, we examined the eye gaze behavior of 7- to 15-year-olds and adults when they answered Truth, Lie, and Think questions. We found significant developmental differences in participants' durations of eye contact and averted eye gaze. With respect to eye contact, 7- and 9-year-olds maintained significantly less eye contact when they answered Lie questions compared with Truth or Think questions. This finding supports the deceiver stereotype that people break eye contact when lying. However, this stereotype for less eye contact appears to be valid only for younger children given that older children and adults displayed similar durations of eye contact across all conditions. With respect to averted eye gaze, the deceiver stereotype states that people look down when lying. However, our results do not support this stereotype given that participants looked upward, not downward, when answering Lie questions. In addition, older children and adults did not differ in their averted eye gaze when answering Truth, Lie, or Think questions.

The developmental changes that we found in participants' eye gaze behavior when they answered Lie questions may be due to differences in their knowledge of display rules. Perhaps young children do not have knowledge of the display rules for lying and, therefore, are not aware of the behavior they should conceal or display to lie successfully. We found that 7- and 9-year-olds thought that people should look up when trying to lie convincingly, but 11- to 15-year-olds and adults responded consistently that people should maintain eye contact when lying if they want to conceal their lies. This age difference in display rule knowledge parallels the developmental pattern we found for participants' eye gaze display when lying.

To examine whether the developmental differences found in participants' display rule knowledge is related to their eye gaze behavior, we conducted regression analyses. We found that participants' display rule knowledge significantly predicted their eye gaze behavior. Children who had less display rule knowledge made less eye contact when lying than when telling the truth. With age, participants' knowledge about the deceiver stereotype increased and their gaze behavior when lying became indistinguishable from their display during truthful communication. These results support the suggestion that children may use their display rule knowledge to regulate their eye gaze behavior when lying and telling the truth.

One noteworthy finding of the current study is that participants, regardless of age, looked up when answering Truth questions. Our analyses comparing the current and previous findings indicated that the eye gaze behavior displayed by participants when they answered Truth questions in the current study is similar to that displayed by participants when they answered Think questions in the current study and in previous studies. This similarity in eye gaze behavior suggests that participants in the current study may have simulated gaze behavior associated with thinking when they answered Truth questions in an attempt to conceal their gaze display when they needed to think to answer Lie questions. Participants may have used this strategy because of the design of the current study. In this study, participants needed to lie "on the spot." That is, they did not have an opportunity to prepare their lies ahead of the time. In such a situation, participants could only think about an untruthful answer after hearing the question. Ekman and Frank (1993) suggested that thinking cues may leak deception. Perhaps participants were aware that they would need to think to answer the Lie questions and that the upward gaze they would display when thinking would reveal their deception. Therefore, in an attempt to conceal their lies, participants may have looked

upward when answering Truth questions, pretending to think about the answers to the questions, even though they already knew the answers. By doing so, their gaze behavior when answering Truth questions would be indistinguishable from that displayed when they needed to think to answer the Lie questions. Participants of all ages appear to have used this strategy in the current study. We speculate that even young children (7- and 9-year-olds) may have attempted to implement this behavioral plan, whereby they look upward when telling the truth and when lying. Even younger children associated upward gaze with thinking. If younger children were aware that people look up when thinking and that they would need to think to develop their lies, then they may also have intentionally looked up when telling the truth in an attempt to hide when they were lying. However, younger participants were not successful in using this strategy because they looked up for longer durations when answering Lie questions compared with Truth questions, thereby revealing their lies and confirming Ekman and Frank's suggestion. It is important to note that the current study was not designed to evaluate strategies used by participants when they tried to conceal their lies. Although our results suggest that participants may have used a simulation strategy when attempting to conceal their lies, additional research is necessary to confirm this suggestion.

The current findings have important implications for our understanding of nonverbal communication. First, we provided the first partial support for the deceiver stereotype that people break eye contact when lying. This stereotype is found valid only for young children who indeed maintain less eye contact when lying than when telling the truth. However, our results do not support the stereotype that people look down when lying because both adults and children looked up when lying. Second, our findings suggest that by early adolescence we may become highly strategic lie-tellers. Our results reveal that both adolescents and adults may modify their gaze behavior when telling the truth so that it matches their gaze display when lying. The specific strategy employed may depend on the specific context in which lying takes place and the time available to develop and practice lies. For example, in the current study, participants did not have time to develop or practice their lies. Perhaps participants, unable to mask their deceptive cues when lying, instead modified their truthful cues when telling the truth so that they became indistinguishable from those displayed when lying. The ability to strategically mask deceptive cues, in more than one way, may be why the adult literature has failed to consistently identify specific gaze cues associated with lying. It may also be the reason why we are so poor at detecting when others are lying (Ekman & O'Sullivan, 1991; Leach et al., 2004). For example, we may use different strategies for concealing our deception in different interactions with the same person, or even within the same interaction, thereby making it very difficult for the observer to identify specific behavior that is displayed when we are lying. Additional studies may provide insight into the different contexts in which specific masking strategies are employed and how such flexible deployment of deceptive strategies develops with age.

Third, our findings suggest that through development we acquire knowledge about the behavior associated with honesty and deception. This developmental trend is likely a part of larger socialization processes during which we learn how to speak and behave in different social contexts. The exact process by which we acquire this knowledge about deception is unknown, but it is possibly the result of increased experience with lying both as an observer of others and as lie-tellers ourselves. Our results also suggest that through development we incorporate this knowledge with our behavior so that we not only know how to behave appropriately but also are able to put this knowledge into action. It is through such developmental processes that we may learn about other important verbal and nonverbal communication rules such as how to protect a person's feelings when he or she gives us a gift we do not like (Talwar, Murphy, & Lee, 2007).

The developmental change in participants' ability to simulate gaze behavior when answering questions truthfully to match that when lying may involve developments in a number of related cognitive abilities. In addition to display rule knowledge, based on the existing literature, we speculate that a second-order theory of mind understanding and a high level of inhibitory control are perhaps needed. A second-order theory of mind understanding refers to the ability to present beliefs about beliefs, whereas a first-order theory of mind understanding refers to the ability to represent a belief about a state of affairs (Talwar et al., 2007). Inhibitory control refers to the ability to "suppress potentially interfering thought processes or actions" (Carlson, Moses, & Hix, 1998, p.672). Researchers have found that the development of inhibitory control is related to the development of a theory of mind (e.g., Flynn, 2007; Mutter, Alcorn, & Welsh, 2006), which in turn has been shown to be correlated with children's understanding of lying and their lie-telling behavior (e.g., Hogrefe, Wimmer, & Perner, 1986; Talwar et al., 2007). Children's second-order theory of mind understanding develops steadily from mid-childhood to adolescence and is correlated with children's ability to lie successfully.

In addition, research (e.g., Greene, O'Hair, Cody, & Yen, 1985) has shown that adults employ inhibitory control processes when attempting to conceal their deceptive behavioral cues. Carlson and colleagues (1998) found that children had difficulty in deceiving others under conditions that required high levels of inhibitory control. High levels of inhibitory control may have been needed in the current study for several reasons. First, participants had no time to prepare or rehearse their lies in advance. With no time to prepare, participants needed to immediately suppress behavior that would reveal their deception while simultaneously exhibiting behavior that would make it difficult to distinguish when they were lying or telling the truth. Second, participants needed to lie multiple times during the test session. To successfully conceal their lies, participants needed to consistently suppress behavior that would reveal their deception. Third, participants knew that the interviewer was watching them, trying to detect when they were lying, and that they would receive a prize only if the interviewer could not detect their lies. It is possible that this additional social stress may have increased participants' levels of arousal or anxiety, and this may have made the task of concealing their lies more difficult. Thus, it is possible that the 7- and 9-year-olds in the current study failed to successfully conceal their lies because they had limited second-order theory of mind understanding or inhibitory control. The older children may have possessed the necessary knowledge and inhibitory control to allow them to conceal behavior commonly associated with lying. The current study cannot directly address the possible roles of second-order theory of mind understanding or inhibitory control in successful lie-telling, but further investigation is planned.

In summary, the results of the current study provide support for the association between eye gaze and untruthful communication. This study also indicates that through development we acquire knowledge of the deceiver stereotype that honest people make eye contact, whereas liars break eye contact and avert their gaze. This display rule knowledge is a significant predictor of overt behavioral displays when lying. We use our display rule knowledge to increase the likelihood of duping others who rely on the deceiver stereotype for lie detection, and this may be the reason why we are so poor at detecting adults' lies.

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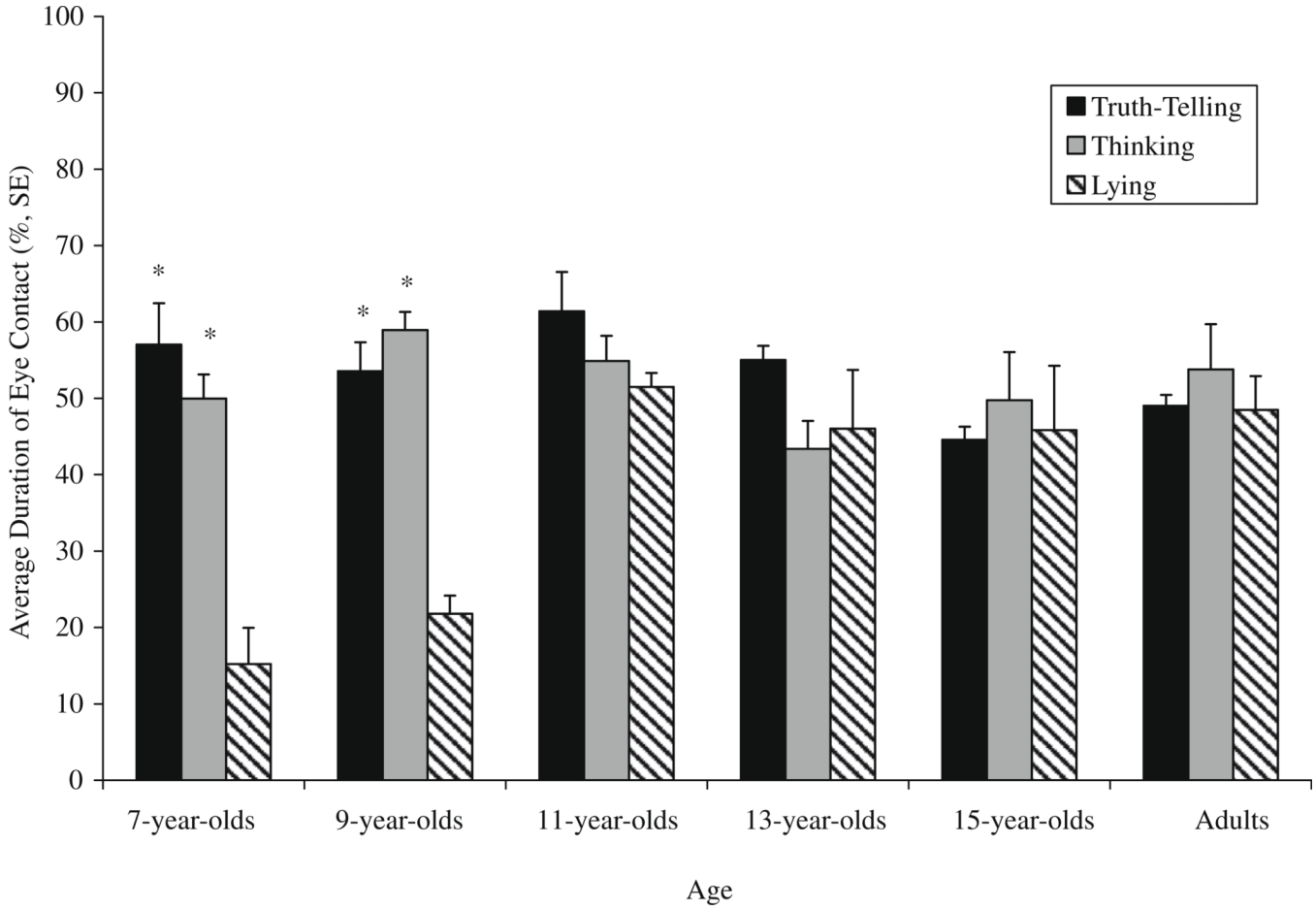

Fig. 1.

Average durations of eye contact when answering Truth, Think, and Lie questions.

Note. * $p < .001$, indicates significantly more eye contact when truth-telling and thinking compared to lying for 7-and 9-year-olds. Error bars are standard errors of the mean.

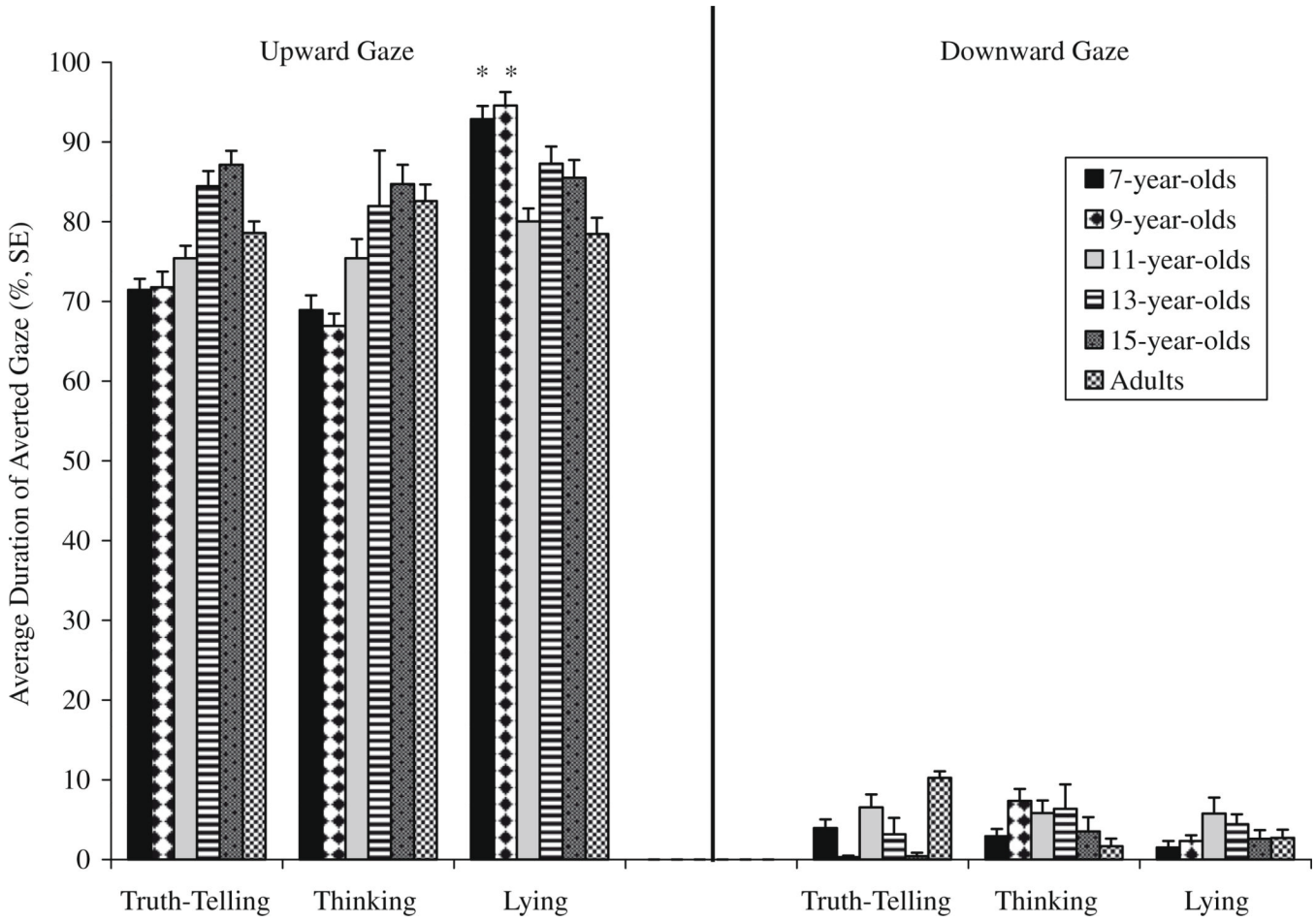

Fig. 2.

Average durations of averted gaze in the up and down directions when answering Truth, Think, and Lie questions.

Note. * $p < .001$, indicates significantly more gaze in the upward direction when lying compared to truth-telling or thinking for 7- and 9-year-olds. Error bars are standard errors of the mean.

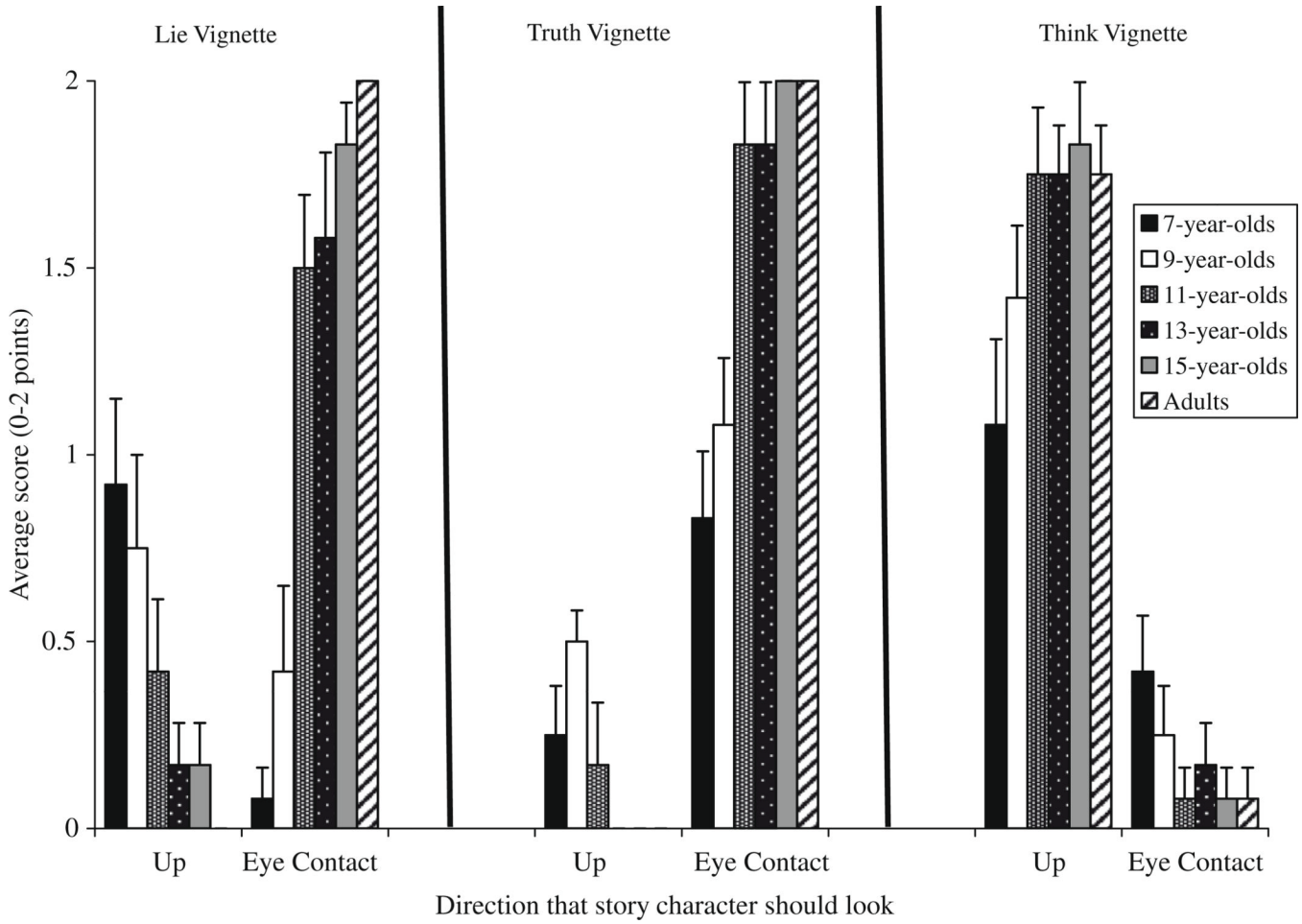

Fig. 3.
Participant responses to where the story character should look in the Truth, Lie, and Think vignettes.
Note. Error bars are standard errors of the mean.