Published in final edited form as:
Psychiatr Psychol Law. 2012 August 1; 19(4): . doi:10.1080/13218719.2011.615808.

The Effects of Repetition on Children's True and False Reports

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Abstract

As children are often called upon to provide testimony in court proceedings, determining the veracity of their statements is an important issue. In the course of investigation by police and social workers, children are often repeatedly interviewed about their experiences, though the impact of this repetition on children's true and false statements remains largely unexamined. The current study analysed semantic differences in children's truthful and fabricated statements about an event they had or had not participated in. Results revealed that children's truthful and fabricated reports differed in linguistic content, and that their language also varied with repetition. Discriminant analyses revealed that with repetition, children's true and false reports became increasingly difficult to differentiate using linguistic markers, though true reports were consistently classified correctly at higher rates than false reports. The implications of these findings for legal procedures concerning child witnesses are discussed.

Keywords

children; linguistic differences; repeated reports; veracity

As the number of children appearing as witnesses in the court system has risen steadily in the past two decades, concerns regarding the process of interviewing children has become a focus of investigation in legal and psychological research. Extensive research has established that children are capable of producing highly accurate accounts of events that they have experienced or observed and can make competent witnesses (e.g., Bruck & Ceci, 1999; Quas, Goodman, Ghetti, & Redlich, 2000; see review in Fivush & Schwarzmueller, 1995). However, studies have also revealed that children can be coached to tell convincing

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fabricated reports or to maintain secrets (Lyon, Malloy, Quas, & Talwar, 2008; Orcutt, Goodman, Tobey, Batterman-Faunce, & Thomas, 2001; Pipe & Wilson, 1994; Talwar, Lee, Bala, & Lindsay, 2006; Tye, Amato, Honts, Devitt, & Peters, 1999; Vrij, Akehurst, Brown, & Mann, 2006). As a result of continued concern regarding children's ability to produce reliable reports (Bala, Ramakrishnan, Lindsay, & Lee, 2005), veracity detection has received increased attention in recent years.

Veracity Detection Techniques

Extensive research has established that adults tend to be highly inaccurate and rarely above chance levels at differentiating between 3- and 16-year-olds' true and deceptive statements (Bala et al., 2005; Crossman & Lewis, 2006; Edelstein, Luten, Ekman, & Goodman, 2006; Leach, Talwar, Lee, Bala, & Lindsay, 2004; Leach et al., 2009; Orcutt et al., 2001; Strömwall, Bengtsson, Leander, & Granhag, 2004; Strömwall, Granhag, & Landstrom, 2007; Talwar & Lee, 2002; Talwar et al., 2006; Tye et al., 1999; Vrij et al., 2006). Additionally, previous studies have demonstrated that experience with children, or with lie-telling in general, does not appear to impact upon lie detection rates as teachers, police officers, lawyers, and social workers do not perform significantly above chance levels (Bala et al., 2005, Bond & DePaulo, 2008; Ekman & O'Sullivan, 1991; Leach et al., 2004; Strömwall et al., 2007; Vrij, 2005). Adults have difficulty seeing through children's deceptive strategies (Strömwell et al., 2007), which has significant implications for the court system.

In an attempt to establish systematic methods of lie-detection, researchers have investigated the potential linguistic differences between true and false statements. Such methods are based on the *Undeustch Hypothesis*, which posits that true and false reports are, by nature, different (Undeutsch, 1982). One linguistic analysis method entitled Criteria-Based Content Analysis considers the presence of specific variables to indicate truthful statements (Vrij, 2005). An alternative linguistic method, Reality Monitoring, posits that true reports are derived from reality and therefore will contain more sensory, contextual, affective, and temporal information, while false reports, which are generated by thought processes, will contain more cognitive operations (for review, see Sporer, 2004). These methods can discriminate between truth and lies, with classification accuracy ranging from 64% to 90% (for review, see Sporer, 2004; Vrij, 2005). While these classification rates are significantly above chance levels, the methods are most effective with lengthy statements, which is problematic as younger children's reports tend to be brief and contain fewer details (Goodman & Reed, 1986; Pipe, Lamb, Orbach, & Esplin, 2004; Vrij, 2005; Vrij, Akehurst, Soukara, & Bull, 2004). Furthermore, both methods of classification require extensive training, are labour intensive to complete, and are typically subjective.

In considering objective methods to detecting deception, patterns in semantic language use have had some success in differentiating adults' true and false reports. Automated linguistic software programs, such as the Linguistic Inquiry Word Count (LIWC) software program, have been applied to detect semantic speech patterns (Pennebaker, Francis, & Booth, 2001). Previous studies with adults have revealed that false reports tend to contain fewer first person pronouns, fewer exclusive terms (e.g., except, without), more relativity terms (motion and spatial terms), and fewer negative emotional words (Bond & Lee, 2005; Newman, Pennebaker, Berry, & Richards, 2003). This linguistic pattern of false reports likely reflects the lie-teller's attempt to reduce the cognitive load when producing convincing untruthful statements. This explanation is consistent with other research which suggests that deceptive statements generally require more cognitive effort and higher processing abilities than telling the truth (Sporer & Schwandt, 2006; Vrij, Fischer, Mann, & Leal, 2008). Furthermore, by using fewer self-references and more motion terms, the

individual may be creating distance between themselves and the lie, and thus redirecting the listener's attention (Bond & Lee, 2005; Newman et al., 2003).

Impact of Repeated Interviewing

In addition to discovering methodology to differentiate between true and false statements, the manner in which children's statements are obtained must be considered. Before testifying in court proceedings, children are commonly exposed to repeated investigative interviews concerning the events in question (Ceci & Bruck, 1993; Garven, Wood, Malpass, & Shaw, 1998; Goodman et al., 1992; Malloy, Lyon, & Quas, 2007; Quas et al., 2007). Repeatedly interviewing witnesses, especially children, can have both positive and negative impacts on the quality of the report. In terms of positive influences, the literature suggests that repeatedly recalling an event may increase the strength of the mental representation of the event and may lead to more accurate event recall at future times (Fivush & Schwarzmueller, 1995; Pipe, Sutherland, Webster, Jones, & La Rooy, 2004; Schwartz & Reisburg, 1991; Thompson, Wenger, & Bartling, 1978; Wheeler & Roediger, 1992). Through repetition, children and adults alike may be able to consolidate their event memory and may recall additional details that were not reported in the initial interview (Fivush, McDermott Sales, Goldberg, Bahrick, & Parker, 2004; Fivush & Schwarzmueller, 1995; Gee & Pipe, 1995; Goodman, Bottoms, Schwartz-Kenney, & Rudy, 1991; Gordon, Ornstein, Clubb, Nida, & Baker- Ward, 1991; Peterson & Whalen, 2001; Pipe et al., 2004). Further, across multiple interviews, children generally give consistent and accurate statements concerning events, and the amount of incorrect information remains low and does not increase across repetitions (Dent & Stephenson, 1979; Fivush & Schwarzmueller, 1995).

On the other hand, interviewer biases, inaccurate suggestions, or untruthful statements made during an interview may become incorporated into the child's future statements, potentially creating less accurate accounts over time (Melnyk & Bruck, 2004; Middleton & Edwards, 1990; Quas et al., 2007). Further, both children and adults' reports have been found to be negatively influenced by misleading or suggestive questioning procedures, which can alter their future recall (Ceci & Bruck, 1993; Fivush & Schwarzmueller, 1995). Thus, increasing the frequency of interviews also increases the risk of potential contamination of a child's report.

The Present Study

The present study was conducted to determine the ways in which children's true and false reports vary linguistically with repetition by using an automatic, objective linguistic analysis methodology. To consider the effect of repetition, children played a game with a research assistant and were later interviewed three times about the game they played (true report) as well as a game that they were coached to say they played but actually did not (false report). Children's reports were analysed by considering the linguistic differences in true and false reports as well as changes that occur with repeated interviews.

Based on previous findings of adults' reports of true and false events, children's true reports were expected to be longer than their false reports (Bond & Lee, 2005; Newman et al., 2003). Further, it was hypothesised that children's false reports would be less semantically complex and contain more simple terms (such as Sensory/ Perceptual Processes, and relativity terms such as Motion and Temporal words), fewer self-references, and would be told with less confidence (more Tentative terms). This hypothesis was based, in part, on the belief that less complex reports are simpler and decreases the cognitive demands on the liar (Bond & Lee, 2005; Newman et al., 2003). We also expected that repetition would make it more difficult to differentiate between the true and false reports due to the fact that

repeatedly telling the same true or false stories would reduce cognitive demands for the false stories, making them more similar to the true reports.

Method

Participants

A total of 34 4- to 10-year-olds (M = 6.91, SD = 1.71; 15 females) participated in this study including: 8 4- to 5-year-olds (M = 4.50, SD = .53), 13 6- to 7-yearolds (M = 6.69, SD = .48), and 13 8- to 10-year-olds (M = 8.61, SD = .77). Participants were recruited from a small Canadian city through newspaper advertisements, flyers, and through a university database of interested participants. Informed consent was obtained from all parents and verbal assent was obtained from all children prior to the beginning of the first phase, and then again before the second phase of the study.

Materials and Procedure

All children participated in two phases. The first phase involved a play session between the child and the research assistant. The second phase involved three separate interviews about the initial play session by a different research assistant. Each phase is described in turn below.

Phase I: Play Session. All participants were visited by a female research assistant (RA1) in their homes. Children played one of three possible interactive games with the research assistant in a single 30-minute session. The three possible games were as follows:

Doctor Game. The Doctor game was a modified version of the board game ‘Operation’. Children were required to use tweezers to remove body parts from a game board. Once a body part was removed, children selected a sticker and RA1 placed the sticker on the part of the child’s body that mirrored the location of the body part removed from the board game. For example, if the child successfully removed a hand, the sticker would be placed on the child’s hand. The game ended once the child had successfully removed three body parts.

Guessing Game. In the Guessing game children had to guess the identity of an image held by the RA1. Children could ask questions and were given visual hints to facilitate guessing. Once the image was identified, the child was given a sticker that RA1 placed on the child’s body. The game ended when the child gave three subsequent correct answers for three pictures.

Picture Game. The Picture game was a modified version of the game ‘Memory’. In this game pairs of pictures were placed face down in random order. Children were asked to flip up two cards at a time and attempt to find the two cards that matched. After correctly identifying a pair, children selected a sticker which was then placed on their body by RA1. The game finished when they matched three pairs and the third sticker was placed.

All games included the child winning three stickers and having the stickers placed on the child’s arm, hand, knee, foot, or cheek by RA1, with each sticker placed in a different location on the child’s body. These were the only locations where the stickers were placed. After completing the game, RA1 gave parents specific details of the game that was just played and information was provided describing one of the games that was not played. Parents were instructed to coach their children to report both the game they played and a game that they had not played. For example, if the child played the Doctor Game, they would report that they had played the Doctor game (true story) and they would be instructed to pretend that they played either the Guessing Game or the Picture Game (false story). Parents were instructed to practise both reports one time per day. The games that were

actually played and the games that children pretended to have played were counterbalanced across participants.

Phase II: Interviews. One week later, a second research assistant (RA2) went to the child's house and interviewed the child about the game they had played and about the game they had not played with RA1. RA2 was blind to which story was true and which was not true (as the interviews were assigned by RA1). Children were interviewed using open-ended statements, such as 'Tell me about the Doctor Game you played last week'. Once completing a free-recall response to the open-ended question, more specific questions were asked, such as 'where did the stickers go?' Children were interviewed repeatedly about the two games by RA2 across three different sessions. The three interview sessions took place over three consecutive days, with the first interview occurring one week after the play session. The order of reports (true or false) for each interview was counterbalanced between participants.

Coding

All interviews were transcribed word for word, with the experimenter's questions removed, leaving only the child's statements. Transcripts were then formatted according to requirements of the LIWC 2001 manual (see Pennebaker et al., 2001) prior to being processed through the linguistic software program. When using all 79 categories, LIWC accurately categorises 80% of all words (Pennebaker et al., 2001). For the purposes of the present investigation, 25 of the LIWC linguistic categories were selected for further analyses. When using these specific categories, approximately 82% of the words were classified into one of the 25 categories. In line with the procedure used by Newman et al. (2003), categories with low frequencies (occurring less than 0.2% of the time), or categories left up to the discretion of the transcribers (e.g., non-fluencies and fillers, such as 'umm' or 'uh') were excluded. Overall, a total of 14 categories were included for subsequent analyses (for a complete list, see Table 1).

Results

Preliminary analysis revealed no significant sex differences for any of the LIWC categories. Thus, the data of both sexes were combined for all subsequent analyses.

To evaluate whether children's true and fabricated reports differ, a series of 2 (Veracity: true vs. false) × 3 (Interview: Interview 1 vs. Interview 2 vs. Interview 3) mixed measures ANOVAs were performed for the 15 LIWC categories with Age Groups (4- to 5-year-olds, 6- to 7-yearolds, and 8- to 10-year-olds) as a between subject variable. See Table 1 for a complete list of means and standard deviations by age and interview.

Length of Reports

When considering the length of each story, indexed by word count, no significant differences of Veracity were found. However, differences were found by repetition as there was a significant main effect of Interview, $F(2, 62) = 7.30$, $p = .001$, $\eta = .19$. Three follow-up paired samples comparisons between each interview with a Bonferroni correction for all possible comparisons revealed that significantly fewer words were spoken in the third interview ($M = 95.36$, $SD = 28.46$) compared to the first interview ($M = 115.62$, $SD = 43.12$), $t(33) = 3.20$, $p = .003$, CI.95 = [6.90, 31.07] and marginally significantly fewer than the second interview ($M = 107.40$, $SD = 35.28$), $t(33) = 2.52$, $p = .017$, CI.95 = [2.08, 19.45]. No significant difference was found between the first and second interview. Therefore, results suggest that with repetition, children spoke fewer words. No Age Group differences were found in the length of children's reports.

Linguistic Variables

Several linguistic variables were found to be significant. First, we will report significant main effects of Veracity and interactions between Veracity and Age. Second, we will report significant main effects of Interview as well as interactions between Interview and Age. Finally, we report significant Interactions between Veracity and Interview. No significant three-way interactions between Veracity, Interview and Age were found.

Significant Effects of Veracity. The ANOVA with *Sensory/Perceptual* terms as the dependent variable revealed a significant main effect of Veracity, $F(1, 31) = 8.39$, $p = .007$, with significantly more Sensory/Perceptual terms in false reports ($M = 2.19$, $SD = 1.76$) than in true reports ($M = 1.04$, $SD = .89$).

Additionally, a significant interaction was found between Veracity and Age Groups for *Causation* terms, $F(2, 31) = 5.59$, $p = .008$. Follow-up paired samples t-tests with true and false reports for each age group were conducted and revealed that 6- and 7- year-olds had marginally significantly more causation terms in their false reports ($M = .22$, $SD = .35$), than their true reports ($M = .13$, $SD = .26$), $t(12) = 2.10$, $p = .057$, CI.95 = [−.19, .003]. No significant differences in the use of causation terms between true and false reports were found for the youngest or oldest age groups.

Significant Effects of Interview. The use of pronouns was found to vary across interviews as repetition impacted the way children referred to themselves and others. The ANOVA yielded a significant main effect of Interview for *Self References,* $F(2, 62) = 4.35$, $p = .017$. Three follow-up paired samples *t*-tests with a Bonferroni correction for all possible comparisons revealed that children referred to themselves significantly more in Interview 1 ($M = 8.70$, $SD = 3.92$) than in the Interview 2 ($M = 7.76$, $SD = 3.34$), $t(33) = 2.04$, $p = .049$, CI.95 = [.002, 1.88]. However, Interview 3 did not significantly differ from either Interview 1 or Interview 2.

In terms of references to others with *Second Person Pronouns*, a significant interaction between Interview and Age Groups was found, $F(4, 62) = 2.65$, $p = .042$. Three paired samples t-tests were performed across interviews for each age group with a Bonferroni correction for all possible comparisons. Results revealed that 6- to 7-year-olds used marginally significantly more second person pronouns in Interview 2 ($M = 4.90$, $SD = 4.41$) compared to Interview 1 ($M = 2.88$, $SD = 3.06$), $t(12) = 2.74$, $p = .018$, CI.95 = [−3.63, −.41]. No significant differences were found between Interview 3 and either Interview 1 or Interview 2 for the 6- to 7-year-olds. Additionally, no other significant differences were found for 4- to 5-year-olds or 8- to 10-year-olds.

Significant Interactions between Veracity and Interview. The ANOVA on *Six-or- More-Letter* words yielded a significant interaction between Veracity and Interview, $F(2, 62) = 3.52$, $p = .036$. Nine follow-up paired sample t-tests were conducted to compare true reports and false reports between and within interviews. A Bonferroni correction was used for all possible comparisons. Results revealed that children used significantly more words with 6-letters or more in Interview 3 ($M = 8.55$, $SD = 4.15$) compared to Interview 2 ($M = 6.68$, $SD = 3.72$) for true reports, $t(33) = 3.17$, $p = .004$, CI.95 = [−3.06, −.67].

A significant Veracity × Interview interaction was also found for *Second Person Pronouns,* $F(2, 62) = 3.84$, $p = .027$. Nine follow-up paired sample t-tests comparing true and false reports within and between each interview using a Bonferroni correction for all possible comparisons were performed. Results revealed a significant difference, but only for children's false reports. Specifically, children used significantly fewer Second Person

Pronouns in Interview 1 ($M = 2.71$, $SD = 2.86$) compared to Interview 2 ($M = 4.32$, $SD = 3.90$) in their false reports, $t(33) = 3.07$, $p = .004$, CI.95 = [−2.68, −.54].

Finally, a significant Interview by Veracity interaction was found for *Tentative* words, $F(2, 62) = 3.76$, $p = .03$. Nine follow-up paired sample t-tests comparing true and false reports within and between each interview were conducted using a Bonferroni correction for all possible comparisons. Results revealed that in their true reports, children used significantly more Tentative terms in Interview 1 ($M = 1.49$, $SD = 1.16$) than in Interview 2 ($M = 1.04$, $SD = 1.24$), $t(33) = 3.05$, $p = .005$, CI.95 = [.15, .75]. No other significant differences were found.

In summary, children's repeated true and false reports were found to vary based on several linguistic variables. In terms of Veracity, false stories were found to contain more Sensory/Perceptual terms as well as more causation terms (specifically, for the 6- to 7-year-olds). Significant differences were found across interviews with children using more self references in their first interview compared to their second interview, and more second person pronouns in the second interview compared to their first (specifically, for the 6- to 7-yearolds). Finally, significant interactions between Veracity and Interview were found for several variables. Children used more lengthy words (6 letters or longer) in the third interview compared to the second for their true stories, more second person pronouns in the second interview compared to the first for false stories, and more tentative terms in the first interview than the second for true stories.

Discriminant Analysis

Given that there were significant linguistic differences between true and false reports in each Interview, a series of stepwise discriminant analyses using the Wilks' Lamda method were conducted to determine whether the linguistic trends identified by LIWC could predict the veracity of children's statements. The veracity of the statement was used as the classifying variable. Six dependent variables were entered into the analysis, which were Age Group, Sensory/Perceptual Processes, Causation terms, Six-or-more-letter words, Second Person Pronouns, and Tentative terms. These variables were included in the analysis because significant effects of veracity were revealed with the repeated measures ANOVAs. Discriminant analyses were completed in an attempt to differentiate between true and false reports overall, as well as within each interview to determine if the reports could be correctly classified and to investigate the effect of repetition on classification accuracy.

Overall Veracity Classification. A stepwise discriminant analysis was conducted with the above six variables as predictors for all true and false reports. The overall Wilks' lambda was significant, Wilks' $\Lambda = .89$, $\chi^2(1, N = 202) = 24.12$, $p < .001$, indicating that true and false reports could be successfully differentiated based on the six predictors. Specifically, these factors accurately predicted true and false reports 66.7% of the time with leave-one-out classification. A closer analysis of the structure matrix revealed that the Sensory/Perceptual terms variable ($\beta = .97$) was a significant unique predictor above and beyond the common contributions of all other variables. No other variables were found to be significant above and beyond the common contributions.

Veracity Classification by Interview. For each of the three interviews, a separate stepwise discriminant analysis was conducted with the six variables as predictors for the true and false reports and all using leave one out methodology. For all three interviews, the overall Wilks' Lambda was significant, Interview 1: Wilks' $\Lambda = .83$, χ^2 (1, $N = 68$) = 12.56, $p < .001$; Interview 2: Wilks' $\Lambda = .89$, χ^2 (1, $N = 66$) = 7.74, $p = .005$; Interview 3: Wilks' $\Lambda = .93$, χ^2 (1, $N = 66$) = 5.14, $p = .023$. However, the percentage of accurately classified true and

false reports decreased with repetition from 72.1% correct classification for Interview 1, to 66.2% classified correctly for Interview 2, and 63.2% classified correctly for Interview 3.

For each interview, an analysis of the structure matrix revealed that the Sensory/ Perceptual processes variable ($\beta = 1.00$ for each interview) was a significant unique predictor above and beyond the contributions of all variables, with more Sensory/ Perceptual terms in false reports. No other variables were found to be significant above and beyond the common contribution.

Overall, our results suggest that with each interview, true and false reports are increasingly difficult to differentiate by using linguistic cues. To determine whether true and false reports were more or less accurately classified with repetition, chi-square goodness of fit tests were conducted separately for true and false reports for each interview (See Figure 1). For Interviews 1 and 3, the true reports were correctly classified significantly above chance levels, χ^2 (1, $N = 34$) = 8.47, $p < .05$, and χ^2 (1, $N = 34$) = 4.76, $p < .05$, respectively. However, true reports in Interview 2 were not correctly classified above chance levels, χ^2 (1, $N = 34$) = 2.88, $p > .05$. False reports were not correctly classified above chance levels for any of the interviews.

Discussion

The present study examined the linguistic characteristics of children's statements in an attempt to systematically distinguish truthful statements from fabricated statements, and to consider how the linguistic patterns in children's statements change across repeated interviews.

The results of the present investigation revealed several linguistic differences between children's reports varying in veracity. First, children were found to report significantly more Sensory/Perceptual terms in their false reports compared to their true reports. Interestingly, this variable has not been previously found to assist in differentiating true and false statements in the adult literature using the LIWC software program (Bond & Lee, 2005; Newman et al., 2003). Additionally, these findings are in contrast with Reality Monitoring literature which suggests that true reports by children should contain more sensory terms given that it is derived from reality. However, it is possible that situational and contextual differences influenced the linguistic variables used when reporting events in the present study. For example, while the adult literature mostly focuses on written reports, the present study examined children's verbal reports. Future studies are required to further investigate the potential situational influences on the linguistic content of children's true and false reports.

We speculate that Sensory/Perceptual terms were used by children to facilitate in creating and telling false reports. For example, Newman et al. (2003) and Bond and Lee (2005) suggest that simpler terms are used in false reports while more complex terms (e.g., exclusive terms) are used in true reports. For a child, it is possible that speaking about tangible items that they perceive (sensory terms) might be simpler and accordingly are used in their fabricated reports in an effort to make these reports more convincing. It also is possible that linguistic terms that are simple or easy for adults to use may not be the same for children to use, resulting in different linguistic findings with these age groups. Future studies are needed that include both children and adults to further investigate linguistic techniques used by various age groups in the same paradigm.

Veracity differences also were found for Causation terms which were used significantly more in false than in true reports for 6- and 7-year-olds. It is unclear why this pattern of causation term use is seen within only this age group as these terms are arguably complex

and show sophisticated thinking. Future studies are needed to further investigate this developmental difference.

The present investigation not only found that the use of language varied by veracity but also with the repetition of reports. This is the first investigation to use an automated linguistic software program to examine how linguistic characteristics change across repeated interviews. Firstly, children's reports were found to decrease in length with repetition. More specifically, significant differences in how pronouns were used across children's repeated reports were also found. For example, the use of self-references was found to decrease from Interview 1 to Interview 2, suggesting that with repetition, children begin to refer to themselves less. Further, children tend to include more references about others with repetition (Interview 1 vs. Interview 2), though this trend was only observed for the 6- and 7-year-olds, and was only found for false reports. By referring to themselves less and others more with repetition, children may be distancing themselves from their false reports. Given that the amount of information about the self and others is skewed across multiple interviews, the present study supports the importance of minimising the number of interviews of children in a forensic context. These findings also highlight the importance of video recording initial interviews for later used in court as the initial interview was found to contain the most words and most references to the child. Of course, a serious limitation of this recommendation is that children may be interviewed repeatedly by parents or teachers prior to official involvement of police or social workers.

Additional findings suggest that children's true reports may exhibit more confidence with repetition. Children were found to use larger words in later interviews (Interview 3 compared to Interview 2) as well as fewer tentative terms (Interview 2 compared to Interview 1). While this may suggest a trend in the repetition of true reports and is consistent with some previous research (e.g., Pipe, et al., 2004; Schwartz & Reisburg, 1991; Thompson et al., 1978), these variables were not able to statistically discriminate true from false stories.

Using the linguistic categories that were found to differ between the veracity of statements as well as across repeated reports, a discriminant analysis was performed. Results revealed that we were able to successfully discriminate between true and false reports above chance levels (66.7%). However, the general trend suggests that the ability to statistically discriminate between true and false reports varies by the number of repetitions; the discriminant analysis was more successful at classifying true and false reports in Interview 1 (72.1%) compared to Interviews 2 and 3 (66.2% and 63.2%, respectively). Such findings again support the importance of video recording the initial interview and minimising the number of interviews children are exposed to prior to testifying in court.

One potential limitation that frequently plagues studies examining children's reports of events is the nature of the event children are asked to report. Due to ethical concerns of invoking stress with child participants, researchers typically ask children to report a neutral or pleasant event. As testimony provided in court often relates to stressful events, the generalisability of such studies must be addressed. While the methodology of the present study was not stressful, children's accounts included touching by RA1 when the sticker was placed on their body. By including the component of touch, the ecological validity is increased for sexual and physical abuse cases often reported in court. Further, the establishment of varying linguistic patterns across repetition with reports of non-stressful events provide a foundation for future studies to examine stressful reports. Future investigations are needed to determine whether there are indeed different linguistic patterns between stressful and non-stressful true and false reports.

While the linguistic software used in this study presents a unique investigation into children's true and false reports, limitations in this objective measure must be considered. Although results reveal that true and false reports can be significantly differentiated, the software does not allow for such analysis to be completed in real time. While the process of witness testimony can be increased with the use of linguistic software, methods for developing detection methods that are more efficient need to be considered. However, results provide an appropriate background to which future studies and findings can be compared.

Overall, results suggest that while it is possible to differentiate children's true and false reports using semantic linguistic cues, children are quite capable of fabricating reports that resemble truths. Further, children may use different techniques than adults in order to maintain consistency in their false reports. Though children seem skilled at creating and maintaining false reports, it appears as though the initial interview is crucial for differentiating truths and lies, and may lead to the most accurate veracity classifications.

Acknowledgments

The study was funded by grants from the Social Science and Humanities Research Council of Canada, and the National Institute of Health (R01 HD 048962 & R01 HD047290).

References

Bala N, Ramakrishnan K, Lindsay R, Lee K. Judicial assessment of the credibility of child witnesses. Alberta Law Review. 2005; 42:995–1017.

Bond CF, DePaulo BM. Individual differences in judging deception: Accuracy and bias. Psychological Bulletin. 2008; 134:477–492. [PubMed: 18605814]

Bond GD, Lee AT. Language of lies in prison: Linguistic classification of prisoners' truthful and deceptive natural language. Applied Cognitive Psychology. 2005; 19(3):313–329.

Bruck M, Ceci SJ. The suggestibility of children's memory. Annual Review of Psychology. 1999; 50:419–439.

Ceci SJ, Bruck M. Suggestibility of the child witness: A historical review and synthesis. Psychological Bulletin. 1993; 113:403–439. [PubMed: 8316609]

Crossman AM, Lewis M. Adults' ability to detect children's lying. Behavioural Sciences and the Law. 2006; 24(4):703–715.

Dent HR, Stephenson GM. An experimental study of the effectiveness of different techniques of questioning child witnesses. British Journal of Social & Clinical Psychology. 1979; 18:41–51.

Edelstein RS, Luten TL, Ekman P, Goodman GS. Detecting lies in children and adults. Law and Human Behaviour. 2006; 30(1):1–10.

Ekman P, O'Sullivan M. Who can catch a liar? American Psychologist. 1991; 46(9):913–920. [PubMed: 1958011]

Fivush R, McDermott Sales J, Goldberg A, Bahrick L, Parker J. Weathering the storm: Children's long-term recall of Hurricane Andrew. Memory. 2004; 12:104–118. [PubMed: 15098624]

Fivush R, Schwarzmueller A. Say it once again: Effects of repeated questions on children's event recall. Journal of Traumatic Stress. 1995; 5:555–580. [PubMed: 8564273]

Garven S, Wood JM, Malpass RS, Shaw JA. More than suggestion: The effect of interviewing techniques from the McMartin Preschool case. Journal of Applied Psychology. 1998; 83:347–359. [PubMed: 9648524]

Gee S, Pipe ME. Helping children to remember: The influence of object cues on children's accounts of a real event. Developmental Psychology. 1995; 31:746–758.

Goodman GS, Bottoms BL, Schwartz-Kenney BM, Rudy L. Children's testimony about a stressful event: Improving children's reports. Journal of Narrative and Life History. 1991; 1:69–99.

Goodman GS, Pyle Taub E, Jones DPH, England P, Port LK, Rudy L, et al. Testifying in criminal court: Emotional effects on child sexual assault victims. Monographs of the Society for Research in Child Development. 1992; 57 v-142.

Goodman GS, Reed RS. Age differences in eyewitness testimonies. Law and Human Behavior. 1986; 10:317–332.

Gordon, BN.; Ornstein, PA.; Clubb, PA.; Nida, RE.; Baker-Ward, LE. Visiting the pediatrician: Long-term retention and forgetting; Paper presented at the annual meeting of the Psychonomic Society; San Francisco. 1991.

Leach A, Lindsay RCL, Koehler R, Beaudry JL, Bala N, Lee K, et al. The reliability of lie detection performance. Law and Human Behavior. 2009; 33:96–109. [PubMed: 18594955]

Leach A, Talwar V, Lee K, Bala N, Lindsay RCL. Intuitive lie detection of children's deception by law enforcement officials and university students. Law & Human Behavior. 2004; 28:661–685. [PubMed: 15732652]

Lyon T, Malloy L, Quas JA, Talwar V. Coaching, truth induction, and young maltreated children's false allegations and false denials. Child Development. 2008; 79(4):914–929. [PubMed: 18717898]

Malloy L, Lyon TD, Quas JA. Filial dependency and recantations of child sexual abuse. Journal of the American Academy of Child and Adolescent Psychiatry. 2007; 46:162–170. [PubMed: 17242619]

Melnyk L, Bruck M. Timing moderates the effects of repeated suggestive interviewing on children's eyewitness memory. Applied Cognitive Psychology. 2004; 18(5):613–631.

Middleton, D.; Edwards, D. Thousand Oaks, CA: Sage Publications; 1990. Collective remembering: Inquiries in social construction.

Newman ML, Pennebaker JW, Berry DS, Richards JM. Lying words: Predicting deception from linguistic styles. Society for Personality and Social Psychology. 2003; 29(5):665–675.

Orcutt HK, Goodman GS, Tobey AE, Batterman-Faunce JM, Thomas S. Detecting deception in children's testimony: Factfinders' abilities to reach the truth in open court and closed-circuit trials. Law and Human Behavior. 2001; 25(4):339–372. [PubMed: 11501438]

Pennebaker, JW.; Francis, ME.; Booth, RJ. Linguistic Inquiry and Word Count (LIWC): LIWC 2001 manual. Mahwah, NJ: Erlbaum; 2001.

Peterson C, Whalen N. Five years later: Children's memory for medical emergencies. Applied Cognitive Psychology. 2001; 15:7–24.

Pipe ME, Lamb ME, Orbach Y, Esplin PW. Recent research on children's testimony about experienced and witnessed events. Developmental Review. 2004; 24(4):440–468.

Pipe ME, Sutherland R, Webster N, Jones C, La Rooy D. Do early interviews affect children's long-term event recall? Applied Cognitive Psychology. 2004; 18:823–839.

Pipe ME, Wilson JC. Cues and secrets: Influences on children's event reports. Developmental Psychology. 1994; 30:515–525.

Quas JA, Goodman GS, Ghetti S, Redlich AD. Questioning the child witness: What can we conclude from the research thus far? Trauma, Violence, & Abuse. 2000; 1(3):223–249.

Quas J, Malloy LC, Melinder A, Goodman GS, D'Mello M, Schaaf J. Developmental differences in the effects of repeated interviews and interviewer bias on young children's event memory and false reports. Developmental Psychology. 2007; 43:823–837. [PubMed: 17605517]

Schwartz, B.; Reisberg, D. Learning and memory. New York: Norton; 1991.

Sporer, SL. Reality monitoring and detection of deception. In: Granhag, PA.; Strömwall, LA., editors. Deception detection in forensic contexts). Cambridge, UK: Cambridge University Press; 2004. p. 64-102.

Sporer SL, Schwandt B. Paraverbal indicators of deception: A meta-analytic synthesis. Applied Cognitive Psychology. 2006; 20:421–446.

Strömwall LA, Bengtsson L, Leander L, Granhag PA. Assessing children's statements: The impact of a repeated experience on CBCA and RM ratings. Applied Cognitive Psychology. 2004; 18(6):653–668.

Strömwall LA, Granhag PA, Landström S. Children's prepared and unprepared lies: can adults see through their strategies? Applied Cognitive Psychology. 2007; 21:457–471.

Talwar V, Lee K. Development of lying to conceal a transgression: Children's control of expressive behaviour during verbal deception. International Journal of Behavioral Development. 2002; 26(5): 436–444.

Talwar V, Lee K, Bala N, Lindsay RCL. Adults' judgements of children's coached reports. Law and Human Behavior. 2006; 30:561–570. [PubMed: 16941237]

Thompson CP, Wenger SK, Bartling CA. How recall facilitates subsequent recall: A reappraisal. Journal of Experimental Psychology: Human Learning and Memory. 1978; 4:210–221.

Tye MC, Amato SL, Honts CR, Devitt MK, Peters D. The willingness of children to lie and the assessment of credibility in an ecologically relevant laboratory setting. Applied Developmental Science. 1999; 3(2):92–109.

Undeutsch, U. Statement reality analysis. In: Trankell, A., editor. Reconstructing the past: The role of psychologists in criminal trials. Stockholm: Norstedts; 1982. p. 27-56.

Vrij A. Criteria-based content analysis: A qualitative review of the first 37 studies. Psychology, Public Policy and the Law. 2005; 11(1):3–41.

Vrij A, Akehurst L, Brown L, Mann S. Detecting lies in young children, adolescents and adults. Applied Cognitive Psychology. 2006; 20(9):1225–1237.

Vrij A, Akehurst L, Soukara S, Bull R. Detecting deceit via analyses of verbal and nonverbal behavior in children and adults. Human Communication Research. 2004; 30(1):8–41.

Vrij A, Fisher RP, Mann SA, Leal S. A cognitive load approach to lie detection. Journal of Investigative Psychology and Offender Profiling. 2008; 5:39–43.

Wheeler MA, Roediger HL. Disparate effects of repeated testing: Reconciling Ballard's (1913) and Bartlett's (1932) results. Psychological Science. 1992; 3:240–245.

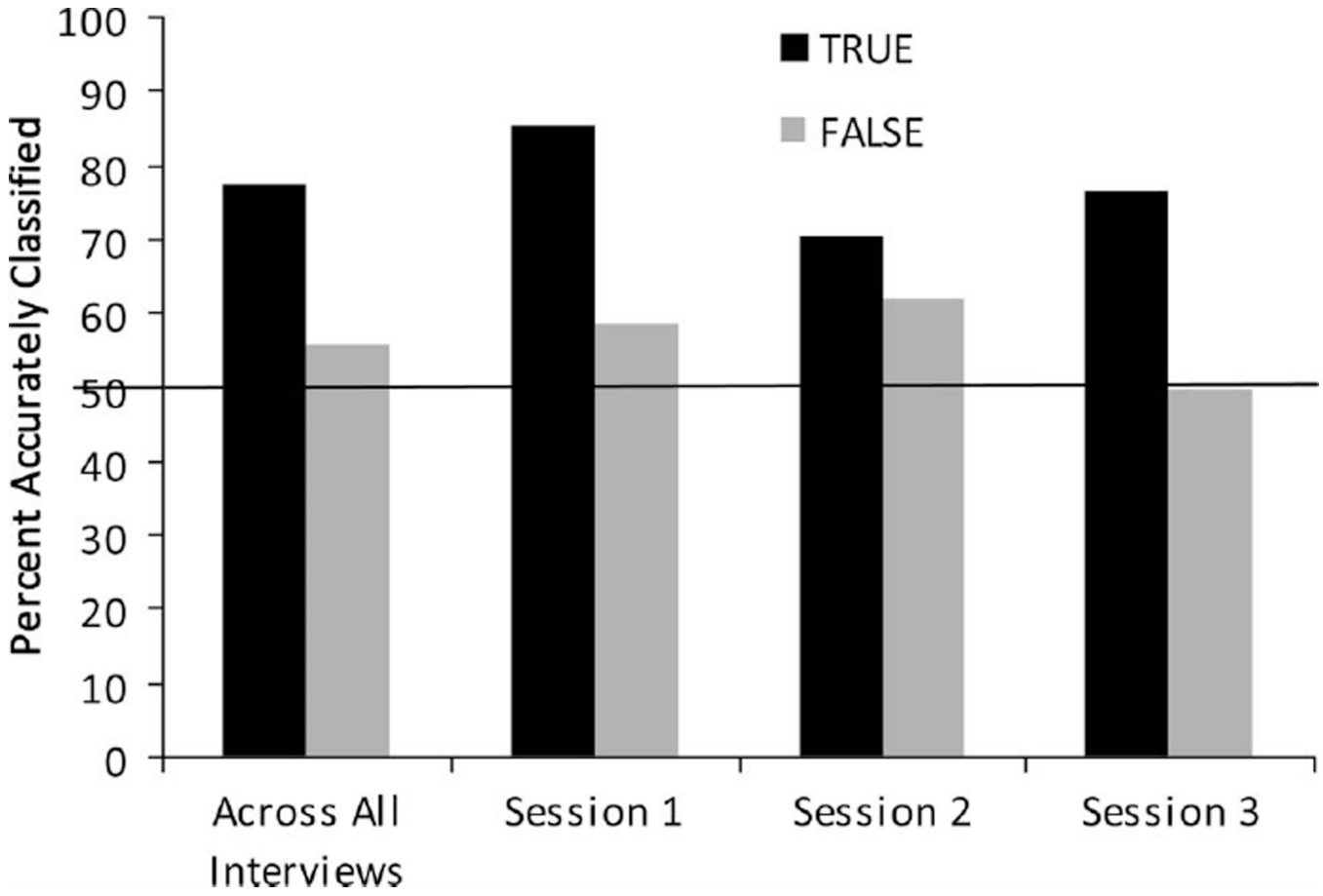

Figure 1.
Classification rates of true and false stories by Interview.

Table 1

Means and standard deviations of LIWC linguistic variables.

LIWC category	Examples	True reports			False reports		
		1 *M (SD)*	2 *M (SD)*	3 *M (SD)*	1 *M (SD)*	2 *M (SD)*	3 *M (SD)*
Word count		115.00 (48.93)	108.97 (42.04)	98.00 (35.73)	116.24 (48.10)	105.82 (45.39)	95.26 (39.47)
Six letter words		7.27 (3.27)	6.68 (3.71)	8.54 (4.15)	7.65 (3.23)	7.69 (3.14)	7.33 (3.06)
Total self references	I, we	8.31 (4.53)	7.91 (3.74)	7.61 (4.12)	9.09 (4.15)	7.61 (4.13)	7.86 (4.64)
2nd person pronouns	You, your	3.77 (3.52)	3.81 (3.94)	3.22 (3.31)	2.71 (2.87)	4.32 (3.90)	3.60 (3.51)
3rd person pronouns	She, their	2.04 (2.54)	2.07 (2.12)	1.76 (1.97)	2.71 (2.03)	2.20 (2.16)	2.46 (1.87)
Affect	Cried, abandoned	1.34 (1.54)	1.16 (1.45)	1.06 (.92)	.94 (1.06)	.78 (1.10)	1.39 (1.46)
Positive emotions	Happy, pretty	1.21 (1.48)	.94 (1.24)	.93 (.81)	.91 (1.04)	.78 (1.10)	1.32 (1.48)
Cognitive mechanisms	Know, ought	4.20 (2.64)	4.17 (2.72)	3.90 (3.20)	4.43 (2.78)	4.40 (3.18)	4.54 (3.03)
Tentative terms	Maybe, guess	1.49 (1.16)	1.04 (1.24)	1.89 (2.19)	1.60 (1.41)	1.93 (2.33)	1.72 (2.39)
Certainty	Always, never	.28 (.48)	.28 (.55)	.14 (.45)	.23 (.50)	.29 (.56)	.28 (.56)
Sensory/perceptual processes	See, touch	.86 (.86)	1.01 (1.17)	1.23 (1.58)	2.17 (1.84)	2.14 (1.97)	2.27 (2.08)
Feeling	Feels, touch	.28 (.47)	.49 (.71)	.42 (.74)	.66 (.99)	.61 (.86)	.65 (.96)
Past	Went, ran	4.43 (2.93)	4.89 (3.34)	4.74 (3.42)	4.76 (3.54)	4.43 (3.03)	5.01 (3.47)
Present	Is, does	7.52 (3.65)	6.77 (3.78)	7.12 (4.52)	7.65 (3.90)	8.66 (4.71)	8.23 (4.93)

Psychiatr Psychol Law. Author manuscript; available in PMC 2013 November 19.