High Cognitive Load During Cross-Examination: Does It Improve Detection of Children's Truths and Lies?

Christine Saykaly^a, Angela Crossman^b and Victoria Talwar^a

^a*Department of Educational and Counselling Psychology, McGill University, Montreal, QC Canada;*

^b*Department of Psychology, John Jay College of Criminal Justice CUNY, New York, NY, USA*

The current study used a high cognitive load cross-examination procedure to determine whether this would improve undergraduate students' ability to detect deception in children aged 9 to 12 years. The participants ($n = 88$) were asked to determine whether children's accounts of an event included a true denial, false denial, true assertion or false assertion about a game played during a home visit occurring one week prior. Overall, the high cognitive load cross-examination did not improve detection rates, in that participants were at chance level for both direct examination (49.4%) and cross-examination (52.3%). Accuracy for true stories was greater than for false stories. Cross-examination improved the detection rates of the false stories, but worsened the accuracy for the true stories. The participants did however rate younger children's true reports to be more credible and believable than their false reports. Participants rated older children's false reports as more credible and believable than their true reports.

Keywords: child witnesses; cognitive load; cross-examination; deception detection; fabricated reports.

Introduction

Professionals working with children may often be challenged to decide whether a child's convincing statement is true or false, such as an assertion or denial of bullying or abuse. When the statement is intentionally false, detecting the deception is crucial, particularly when the deceptive statement leads to potentially serious negative outcomes, such as a false allegation against an innocent party or a false denial that could result in the return of a child to an unsafe home. In cases where children are asked to testify, they might then face the additional burden of bearing witness for or against a loved one (Talwar, Lee, Bala, & Lindsay, 2004). Indeed, in some cases, children may choose to, or be coached to, lie in court in

order to protect a loved one (Paine & Hansen, 2002; Yuille, Tymofievich, & Marxsen, 1995). Various professionals who work with children must be able to identify false denials and allegations, despite the fact that adults accurately determine the veracity of children's statements at chance levels (Stromwall, Grahag, & Landstrom, 2007; Tye, Amato, Honts, & Devitt, 1999; Vrij, Akehurst, Brown, & Mann, 2006). Therefore, developmental researchers, legal practitioners and forensic professionals continue to seek improved methods of differentiating between children's true and false reports. The goal of the current study is to explore one promising method of interviewing children to enhance lie detection accuracy – namely, increasing cognitive load demands.

Correspondence: Victoria Talwar, McGill University, 3724 McTavish #104, Duggan House, Montreal, QC, H3A 1Y2, Canada. Phone: +514-398-8059. Email: victoria.talwar@mcgill.ca

Children's Lie-Telling

In recent years, researchers have examined children's ability to tell lies and give false reports (Bottoms, Goodman, Schwartz-Kenney, & Thomas, 2002; Lyon, Malloy, Quas, & Talwar, 2008; Saykaly et al., 2013; Talwar et al., 2004; Williams, Kirmayer, Simon, & Talwar, 2013). While preschool children's lies are simple, using few words (Evans & Lee, 2013; Lewis, Stanger, & Sullivan, 1989; Talwar & Lee, 2002b), older children are able to formulate more complex and elaborate lies, suggesting that older children's lies may be more difficult to identify. As children develop, their reports, regardless of their veracity, increase in length, complexity, and descriptive detail (Craig, Sheibe, Raskin, Kircher, & Dodd, 1999; Goodman & Reed, 1986; Pipe, Lamb, Orbach, & Esplin, 2004; Vrij, 2005), and children become increasingly more adept at maintaining their lies (Evans & Lee, 2011). Indeed, lie-telling may reflect a child's emerging cognitive maturity, as the child begins to understand others' mental states and behaviours while simultaneously learning to control his or her own behaviour (Lee, 2013; Talwar et al., 2011; Talwar & Lee, 2008).

When asked to testify in court, children often report an event that involved an interaction between them and an adult transgressor. At times, the child may be asked to keep a 'secret' and thus lie in order to protect the adult who committed the wrongdoing (Lyon et al., 2008; Talwar et al., 2004; Yachison & Talwar, 2012). Older children are more likely than younger children to conceal the transgressions of an adult (Bottoms et al., 2002; Tye et al., 1999). Since such lies are about an interaction involving themselves and another person, children may feel as though they too are implicated in the transgression, causing many to believe that they must cover up their own perceived wrongdoing, a concern substantiated in real-life cases (Katz, 2013). Research further confirms that the majority of children are able to lie for another person to

an unfamiliar adult to cover up a transgression (Redlich & Goodman, 2003; Williams et al., 2013).

Deception Detection

Children's lies would not be problematic if they were readily detectable, but this does not seem to be the case (e.g. Gomez-Garibello, Saykaly, Moore, & Talwar, 2013; Honts, Kassin, & Craig, 2014; Nysse-Carris, Bottoms, & Salerno, 2011; Saykaly et al., 2013). As such, many researchers have focused their attention on identifying better ways to detect deception. The majority of research has focused on abilities to assess the veracity of children's statements 'intuitively'. Intuitive detection implies that raters are assessing testimony and making their decision based on their 'gut feeling', or intuition, and not from a theoretical or research-based rationale. Therefore, decisions regarding the veracity of a child's report are based exclusively on the adult's opinion (Leach, Talwar, Lee, Bala, & Lindsay, 2004).

Previous research on intuitive lie detection has indicated that adults are poor at determining the veracity of children's statements (Gomez-Garibello et al., 2013; Saykaly et al., 2013; Stromwall et al., 2007; Talwar, Crossman, Gulmi, Renaud, & Williams, 2009), although findings have been inconsistent. Some studies have found a tendency in adult raters to hold a truth bias when evaluating children's statements (Saykaly et al., 2013; Stromwall et al., 2007; Talwar, Lee, Bala, & Lindsay, 2006), while others report higher accuracy rates in assessing deceptive statements (Crossman & Lewis, 2006; Edelstein, Luten, Ekman, & Goodman, 2006; Talwar, Crossman, Williams, & Muir, 2011). Regardless of biases, researchers who have investigated the detection of children's deception by untrained observers have found that, overall, detection rates hover around chance levels (e.g. Edelstein et al., 2006; Saykaly et al., 2013; Talwar et al., 2006).

Taxing Cognitive Load

One recent, promising development in the adult literature on lie detection is the finding that interviewers can increase lie detectability by taxing the interviewee's cognitive load (e.g. Vrij et al., 2008, 2009). The act of lying itself is cognitively taxing, given the amount of information one must create, maintain, and recount consistently (Gilbert, 1991; Zuckerman, DePaulo, & Rosenthal, 1981). Research with adults' reports has found that further taxing the cognitive load of interviewees by using alternative questioning styles can yield higher lie detection rates. For instance, Vrij et al. (2009) questioned pairs of adult participants individually about an outing at a restaurant. Half the pairs had actually gone to the restaurant, while the other half were asked to create a story about a dinner at the restaurant. Researchers hypothesised that asking unanticipated questions would yield higher rates of deception detection. Unanticipated questions were questions related to an outing at a restaurant that are not typically asked, such as spatial questions (e.g. 'where were you sitting in relation to the door?') and temporal questions (e.g. 'who finished first?'). The results indicate that asking unanticipated questions enhances lie detection, as lie-tellers' responses to the unanticipated questions are significantly worse than those of truth-tellers. Therefore, the use of unanticipated questions may increase deception detection in forensic settings.

Exploring another alternative questioning strategy, Vrij et al. (2008) investigated whether increasing cognitive load through story order would facilitate deception detection. That is, half of their subjects were asked to recount their story in reverse order to tax cognitive load (high cognitive load condition), while controls were asked to recount their story in chronological order. Then, video of these participants' stories were shown to police officer trainees. The results indicate that the accuracy rate is superior under the high cognitive load condition

compared to the control condition. Raters reported that liars looked more nervous and appeared to have to think more about their responses. Thus, this interviewing strategy yielded more accurate detection rates than traditional interview procedures.

Finally, Liu et al. (2010) asked unanticipated questions of children aged 10 to 12 years who were reporting a true event or a false event. Children asked to give a false account reported planning their story more than truth-tellers and were more willing to respond and provide information to the unexpected questions compared to truth-tellers. With the exception of Liu et al., there has been no investigation of the influence of increasing cognitive load during questioning (either through unexpected questions or reverse-order reporting) on children's reports or their credibility. Given that developmental research suggests that children's abilities to be skilled lie-tellers are still developing (Evans & Lee, 2010), it may be that such questioning techniques significantly increase adults' abilities to detect children's veracity.

As indicated by Liu et al. (2010), because liars are creating their stories, they must plan what to say during an interview in advance. They must anticipate what questions the interviewer may ask so they can plan for a correct or plausible response. However, if asked an unanticipated question, liars are faced with the difficult task of attempting to reconcile their story and create a plausible response or, feign ignorance by stating, 'I don't know' or 'I can't remember'. These responses may lead the interviewer to question the credibility of the whole statement; therefore, the lie-teller must determine, on the spot, what their best course of action may be. This task may be more difficult for younger children, and thus their perceived credibility and believability may be questioned. However, the impact of the combination of unanticipated questions and story order, in terms of increasing cognitive load, has yet to be examined among children.

The Current Study

The aim of the current research was to examine whether raters could more accurately discriminate between truthful and fabricated statements made by children when cognitive load demands were increased. Specifically, this study examines whether increasing cognitive load with the use of unanticipated questions and reverse-order questions during cross-examination would yield more accurate judgements regarding the veracity of children's statements during a mock judicial proceeding.

To do so, children were asked to play games with a research assistant during a home visit. Only half the children played the target game, but all children were told they would be interviewed about what they did with the researcher a week later. Children were given different instructions based on condition assignment: (a) *false denial*: children played the target game and were asked to lie on behalf of the researcher and state that they did not play the game; (b) *true denial*: children did not play the target game and were not given further instructions; (c) *false assertion*: children did not play the target game and were asked to lie on behalf of the researcher and state that did play the game; or (d) *true assertion*: children played the target game and were not given any further instructions. One week later, children were questioned in a mock-courtroom context, with mock lawyers and a mock judge. These interactions were videotaped and clips of their direct examinations and cross-examinations were generated. Adult participants later viewed the direct examinations and cross-examinations of four children: one from each condition. After both the direct examinations and cross-examinations were viewed, participants were asked to determine the veracity of each child's statements. Adults were also asked follow-up questions about the credibility and believability of each child's testimony. Although in practice jurors are not asked to do so between direct examination and cross-examination, the

current procedures were used to determine whether cross-examination would lead adult participants to change their initial decisions.

Research clearly shows that adults have difficulty determining the veracity of children's statements during open-ended questioning (e.g., Bond & DePaulo, 2006; Edelstein et al., 2006, Saykaly et al., 2013; Talwar et al., 2006). Recent research on the detection of adults' lies has yielded significant improvements in detection rates when the cognitive load of the adult interviewees is taxed (Vrij, Fisher, Mann, & Leal, 2006; Vrij, Granhag, Mann, & Leal, 2011; Vrij, Granhag, & Porter, 2010). Therefore, the first hypothesis is that increasing the cognitive load demands on children under cross-examination will also yield lie detection rates significantly above chance compared to direct examination. The second hypothesis is that participants will find children in the control group (true assertion, true denial) more credible and believable across both direct examination and cross-examination than children in the false conditions (false assertion, false denial). In addition, developmental trends in children's lie-telling behaviour have shown that younger children are more likely to reveal incriminating information than older children (Evans & Lee, 2011; Polak & Harris, 1999; Talwar & Lee, 2002a). Therefore, the third hypothesis is that adults will be more accurate at determining the veracity of younger children than older children. Finally, given that false assertions may require more elaboration than false denials, the fourth hypothesis is that false assertions will be easier to detect than false denials.

Method

Participants

The participants consisted of 88 undergraduate students ($M = 20.43$ years, $SD = 1.45$; 74 females) from a major metropolitan area. Participants were recruited through an undergraduate psychology research pool

and through advertisements placed on a university classified website. Participants recruited through the psychology research pool received one extra percentage point on their psychology course final grade. Half ($n = 44$) of the participants were recruited through the advertisements and received no compensation.

Video Stimuli

A total of 88 children between the ages of 9 and 10 years ($M = 9.31$, $SD = 0.66$) and 11 to 12 years ($M = 11.58$, $SD = 0.55$) previously took part in a mock-courtroom study. Children reported on an interaction with a research assistant (RA) with whom they played games in their own homes. Children were randomly assigned to one of four groups: (a) true assertion (TA) – the children played Hasbro's Operation Game® (Toy Story 3 Edition); (b) false assertion (FA) – the children did not play the operation game and were asked to lie on behalf of the research assistant by stating that they did in fact play it when interviewed; (c) true denial (TD) – the children did not play the operation game; or (d) false denial (FD) – the children played the operation game and were asked to lie on the behalf of the research assistant by stating that they did not play it when interviewed. There were equal amounts of children (boys vs girls; old vs young) assigned to each condition.

Six to eight days after their interaction with the RA, children were asked to testify in a mock courtroom before a mock judge (0% attrition rate). Direct examination and cross-examination procedures were reviewed by a lawyer, and piloted to validate the likelihood of such questions being asked in a courtroom setting. RAs were trained to follow the standardised script.

There were two mock lawyers present who conducted the direct examinations and cross-examinations. The direct examination included open-ended (e.g. 'I was told you played some games with the RA when she

came to visit you last week – can you tell me what happened?') and specific (e.g., 'Can you tell me more about that?') questions. Cross-examination differed from direct examination in that its primary purpose was to increase the cognitive load demands on children while they answered questions. First, children were asked to recall their story in reverse order. They were provided with an example of reverse-order testimony. Next, children were asked unanticipated questions (e.g., 'What colour was the operation board?'; 'Did you remove the broken shield when playing the operation game?'; 'Who was sitting closest to the door while you were playing together?'). These questions were related to the main event, but were not core details of the interaction; they were designed to add to the cognitive demands on the lie-tellers to rapidly think of plausible responses. Finally, children were asked to once again recount the events of the interaction, but this time in chronological order. This placed an extra demand on the children given that they needed to appear consistent with their reverse-order recounting. Ground truth was established as the RA from the home visit validated the group assignment post-courtroom procedure. All children included in the videos reported accurately about the Operation Game.

Each child's video segment included both direct examination and cross-examination. Adult participants viewed the direct examinations and cross-examinations of four different children, one from each condition. Participants rated the credibility, believability, and accuracy of lie detection of each child after their direct testimony and again after their cross-examination, making a total of six credibility, believability and veracity assessments per video. Video segments were counterbalanced using a Latin-square design resulting in each child being viewed by four different participants. To control for age and gender biases, participants viewed children of the same age range (9 to 10 or 11 to 12 years) and of the same gender.

Design

A 2 (Veracity: True or False) $\times$ 2 (Story Type: Assertion or Denial) $\times$ 2 (Interview: Direct Examination or Cross-Examination) within-subjects design, with Age (9–10 years or 11–12 years) as the only between-subjects variable, was used to examine participants' lie detection accuracy.

Procedure

Participants were tested individually, with sessions lasting approximately 50 minutes. Each observer viewed a total of eight video clips, with testimony provided by four different children. Participants were instructed that they would be watching videos of children reporting about an interaction that occurred with an RA in the child's home approximately one week before the courtroom interview. They were told that children could be telling the truth or lying, and that the child may or may not have played the game. Participants were informed that after viewing each video clip, they would be asked several questions about the credibility and veracity of the testimony they just viewed.

Participants then viewed four pairs of video segments (two per child). The participants rated the child's credibility, believability, and veracity after viewing each child's direct examination, and they did so again after viewing each child's cross-examination. Specifically, after each video segment, participants were asked the following three questions: 1. 'Do you think the child would make a credible witness?' (Credibility); 2. 'Overall (ignoring minor errors or omissions of detail and focusing only on the central claims of the story), if you were a jury member, would you believe the testimony of this child?' (Believability); (3) Finally, participants were asked to think back to the testimony about the Operation Game, and to select whether they believed the child was telling the truth or telling a lie (Accuracy of Lie Detection).

Results

Accuracy of Lie Detection

Our first hypothesis is that lie detection rates would be better under cross-examination due to the heightened cognitive load when compared to direct examination. In order to assess this, participants' assessments of veracity judgements were examined after each video clip for each of the four conditions (TA, FA, TD, FD). Accuracy was calculated based upon whether participants selected the correct veracity (true or false). Overall accuracy and accuracy by story type were calculated based on these judgements. Overall accuracy across all eight ratings was found to be 50.90%, which is not significantly above chance (Table 1). One-sample *t*-tests were used to compare accuracy to the level of chance (50%) for total accuracy after direct examination and again after cross-examination, collapsing across story types. As can be seen from Table 1, observer accuracy rates after direct examination (49.40%) and after cross-examination (52.30%) are not significantly higher than chance. A paired-samples *t*-test was conducted to compare the accuracy ratings between direct examinations and cross-examinations. There is not a significant difference between the post-direct-examination and post-cross-examination accuracy scores,

Table 1. Accuracy ratings compared to chance.

Accuracy	<i>M</i>	<i>SD</i>	<i>t</i> (87)	2-tailed significance
Overall	.51	.21	0.38	.70
Direct examination total	.49	.23	−0.23	.82
Cross-examination total	.52	.26	0.83	.41
True assertion [†]	.61	.49	2.18	.03*
False assertion [†]	.39	.49	−2.18	.03*
True denial [†]	.64	.48	2.64	.01**
False denial [†]	.45	.50	−0.85	.40

Note: **p* ≤ .05; ***p* ≤ .01; [†]Final judgement given after cross-examination.

Figure 1. Veracity $\times$ Interview interaction effect on the accuracy of participants' lie detection.

$t(87) = -1.06$, $p = .30$. Thus, the first hypothesis is not supported.

One-sample t -tests were used to compare the accuracy of the final decisions (i.e. after cross-examination) to the level of chance (50%) for each story type. As can be seen from Table 1, participants' accuracy ratings for TA (61%) and TD (64%) are significantly above chance levels. Participants' accuracy for FA (39%) is significantly below chance levels. However, the accuracy ratings for FD (45%) are not significantly different from chance. Thus, the fourth hypothesis, that false assertions would be more easily detected than false denials, is not supported.

Accuracy judgements were entered into a 2 (Veracity: True or False) $\times$ 2 (Story Type: Assertion or Denial) $\times$ 2 (Interview: Direct Examination or Cross-Examination) repeated measures analysis of variance (ANOVA) with Age (9–10 years or 11–12 years) as the between-subjects variable. A significant main effect for Veracity was found, $F(1, 86) = 60.95$, $p < .001$, $\eta^2_p = .42$. Participants were more accurate for the True condition, $M = .66$, $SE = .03$, 95% CI = .61 to .72, compared to the False condition, $M = .35$, $SE = .02$, 95% CI = .28 to .41. There is also a main effect for Age, $F(1, 86) = 6.13$, $p = .02$, $\eta^2_p = .07$. Consistent with the third hypothesis, participants were more accurate at

determining the veracity of the children aged 9–10 years, $M = .56$, $SE = .03$, 95% CI = .50 to .62, than the children aged 11–12 years, $M = .45$, $SE = .03$, 95% CI = .39 to .51. There is a significant Veracity $\times$ Interview interaction, $F(1, 86) = 16.72$, $p < .001$, $\eta^2_p = .16$ (Figure 1). Participants were the least accurate at correctly identifying false statements after direct examination, $M = .28$, $SE = .04$, 95% CI = .21 to .35 but most successful at accurately detecting true statements after direct examination, $M = .70$, $SE = .03$, 95% CI = .64 to .76. This difference is statistically significant, $t(87) = 2.10$, $p = .04$. Interestingly, participants' accuracy increased after cross-examination for false statements, $M = .41$, $SE = .04$, 95% CI = .34 to .49, and decreased after cross-examination for true statements, $M = .62$, $SE = .04$, 95% CI = .55 to .69, with each rate approaching chance (Figure 1). This difference is statistically significant, $t(87) = -3.71$, $p < .01$. These findings do not support the hypothesised main effect of interview on lie detection rates (hypothesis one).

Signal detection analysis was used to ascertain adults' sensitivity across all four ratings in discriminating between true and false reports. Signal detection theory is based on the proportion of hit rates (accurately detecting a lie) and false alarms (rating an account

as a lie when it is actually a truthful statement). Discrimination (d') between true and false reports at both direct examination and cross-examination ranged from -0.95 to 0.95 , where a score of zero indicates that there is no discrimination between true and false reports. The one-sample t -test of participants' discrimination (d') at direct examination is not significantly different from zero, $M = -.01$, $SD = .44$, $t(87) = -0.23$, $p = .82$. However, participants did hold a significant truth bias, criterion $c = .28$, $SD = .28$, $t(87) = 9.52$, $p = .00$, as participants had a tendency to favour a true response versus a false response (i.e. to over-assess the children as telling the truth). The analysis was repeated for the cross-examination. Again, discrimination (d') is not significantly different from zero, $M = .04$, $SD = .49$, $t(87) = 0.83$, $p = .41$. However, participants no longer had a truth bias and did not favour a particular response under cross-examination, criterion $c = .13$, $SD = .33$, $t(87) = 3.97$, $p = .06$, indicating that the use of cognitively-taxing cognitive load questions may have a negative impact on the perceptions of truthfulness of children's reports.

Credibility and Believability

Credibility

Our second hypothesis was that truth-tellers would be perceived as more credible and

believable overall than lie-tellers. After viewing each of the eight clips (both the direct examinations and cross-examinations of four different children), participants were asked the following question: 'Overall (ignoring minor errors or omissions of detail and focusing only on the central claims of the story), do you believe this child makes a credible witness?'. Therefore, participants made a total of eight credibility judgements (two per child). Credibility judgements were entered into a 2 (Veracity: True or False) $\times$ 2 (Story Type: Assertion or Denial) $\times$ 2 (Interview: Direct Examination or Cross-Examination) repeated measures ANOVA with Age (9–10 years or 11–12 years) as the between-subjects variable. There is a significant main effect for Interview, $F(1, 85) = 6.99$, $p = .01$, $\eta^2_p = .08$. Children were judged as more credible after direct examination, $M = .70$, $SE = .04$, 95% CI = .62 to .77, than after cross-examination, $M = .60$, $SE = .03$, 95% CI = .54 to .64. There is a significant Veracity $\times$ Age interaction, $F(1, 85) = 6.47$, $p = .01$, $\eta^2_p = .07$ (Figure 2). Participants viewed younger children's true reports as more credible, $M = .67$, $SE = .04$, 95% CI = .58 to .75, than younger children's false stories, $M = .56$, $SE = .06$, 95% CI = .44 to .67. However, the opposite results were found for older children, as participants viewed older children's true reports as less credible, $M = .60$, $SE = .05$, 95% CI = .51 to .69, than their false

Figure 2. Child witness credibility as a function of Age and Veracity.

Figure 3. Child witness credibility as a function of Veracity and Story Type.

reports, $M = .76$, $SE = .06$, 95% CI = .64 to .89. This result provides partial support for our hypothesis, but only for younger children. There was also a significant Story Type $\times$ Veracity interaction, $F(1, 85) = 4.22$, $p = .04$, $\eta^2_p = .05$ (Figure 3). Children in the TA condition were seen as least credible, $M = .58$, $SE = .05$, 95% CI = .48 to .68, while children in the FA condition were seen as the most credible, $M = .70$, $SE = .08$, 95% CI = .56 to .85. For the denial conditions, children were perceived to be slightly more credible in the true conditions, $M = .69$, $SE = .04$, 95% CI = .60 to .77, than in the false conditions, $M = .62$, $SE = .04$, 95% CI = .53 to .70.

Believability

After viewing each of the eight clips (both the direct examinations and cross-examinations of four different children), participants were asked the following question: 'Overall (ignoring minor errors or omissions of detail and focusing only on the central claims of the story), if you were a jury member, would you believe the testimony of this child?'. Therefore, participants made a total of eight believability judgements (two per child). Believability judgements were entered into a 2 (Veracity: True or False) $\times$ 2 (Story Type:

Assertion or Denial) $\times$ 2 (Interview: Direct Examination or Cross-Examination) repeated measures ANOVA with Age (9–10 years or 11–12 years) as the between-subjects variable. There is a significant main effect for Interview, $F(1, 86) = 6.05$, $p = .02$, $\eta^2_p = .07$. Children's reports were judged to be more believable after direct examination, $M = .70$, $SE = .02$, 95% CI = .65 to .74, than after cross-examination, $M = .63$, $SE = .03$, 95% CI = .58 to .68. There is a significant Veracity $\times$ Age interaction, $F(1, 86) = 6.82$, $p = .01$, $\eta^2_p = .07$. Participants viewed the true reports of children aged 9–10 years as more believable, $M = .73$, $SE = .04$, 95% CI = .65 to .81, compared to their false reports, ($M = .61$, $SE = .04$, 95% CI = .54 to .68). However, the opposite results were found for children aged 11–12 years, as participants viewed their true reports as less believable, $M = .61$, $SE = .04$, 95% CI = .53 to .70, compared to their false reports, $M = .70$, $SE = .04$, 95% CI = .62 to .78. Hence, as with the credibility ratings, partial support is found for the hypothesis that participants would find children in the true conditions more credible and believable than children in the false conditions, regardless of story type or interview condition. While this was true for the group of children aged 9–10 years,

the children aged 11–12 years were perceived differently.

Discussion

Consistent with previous lie detection literature (e.g. Bond & DePaulo, 2006; Gomez-Garibello et al., 2013; Saykaly et al., 2013; Vrij, 2000), participants made accurate veracity judgements at chance levels, after both direct examination and cross-examination. It was hypothesised that observers would discriminate between true and fabricated reports more effectively after cross-examination, given the recent research findings on the improvement of deception detection in adults when taxing the cognitive load demands of interviewees (e.g. Vrij et al., 2008, 2009), yet the findings of the current study are contrary to the stated hypothesis, as participants were not able to discriminate between children's true and false accounts above the level of chance. Furthermore, contrary to the stated hypothesis, participants rated children to be more credible and more believable after direct examination than they did after cross-examination, regardless of age. These results are consistent with those of Talwar et al. (2006), who found that adults rated children as more credible after direct examination with open-ended questions than after viewing a child's cross-examination. However, in line with previous studies (Saykaly et al., 2013; Talwar et al., 2006), signal detection analyses illustrated a truth bias. Although accuracy of detection was poor, it appears that participants were more likely to assess a child's statements as being true rather than false. This truth bias, however, was only found for judgements made after viewing the direct examinations. After participants saw the cross-examinations, there was no longer a significant truth bias.

Indeed, analyses of accuracy after cross-examination suggest that taxing cognitive load may negatively influence adults' perceptions of children. Participants were able to correctly identify true assertions (61%) and

true denials (64%) significantly above chance levels in their post-cross-examination assessments. However, these rates were lower than the judgements made after direct examination. These findings suggest that while taxing cognitive load reduced the raters' truth biases, it also reduced the credibility of truthful children (as well as improving the detection of deceptive children). Following cross-examination under high cognitive load, raters were more sceptical of children's reports. Although correct discrimination of truthful accounts was above chance levels, it was significantly below chance when children falsely stated that they had played the Operation Game with the RA. Participants appeared to think that the reports of the events were truthful even though they were not. In other words, adults had difficulty determining when the children were describing a false interaction. This result was also replicated by the main effect for Veracity, in which participants had significantly higher accuracy rates for true accounts than false accounts. In a forensic context, this finding is of concern given the potential for children to falsely accuse others at the behest of a loved one. Specifically, it appears that cross-examination with high cognitive load demands makes adults' accuracy for detecting both true and false accounts move closer to chance. It may be that raters find it more difficult to believe the accounts, and therefore rate the stories as deceitful.

It was also hypothesised that participants would perceive children's true reports as being more believable than the false reports. Although participants had significantly higher accuracy rates for true accounts than false accounts, findings on the perceived credibility and believability of children's statements were moderated by age and story type. That is, children's true reports were more credible in some instances, but not others. These results are contrary to the stated hypotheses. Notably, children's false assertions were perceived to be the most credible of all story types, while true assertions were perceived to

be the least credible of all story types. This result is worrisome, as it suggests that true stories of child witnesses may be less likely to be believed. If there is a link between the perceived credibility of a child and judgments of the veracity of a child's statements, the current findings suggest that there may be negative consequences for child witnesses who are truthfully reporting an interaction with an adult.

Previous researchers have found a developmental trend when attempting to detect children's deception whereby lie-telling is more easily detected in younger children than in older children (Chahal & Cassidy, 1994; Saykaly et al., 2013). In the current research, the participants were also more adept at detecting false statements in younger children than in older children. Therefore, the third hypothesis is supported. In contrast, the credibility and believability of children's testimony is influenced by age; specifically, the younger children's true reports were seen as more credible and believable than their false reports, while the older children's true reports were seen as less credible and believable than their false reports.

Based on the current results, it appears that taxing the cognitive load of children does not improve adults' overall ability to detect deceptive statements in children, and might actually make them more suspicious of children who are giving true reports. It appears that cross-examination actually alerts adults to a potential credibility concern and, in turn, they consider the testimony to be false, thus reducing the tendency towards a truth bias. Similar to previous research findings, it is possible that trained coders analysing the transcripts of children's accounts may be able to identify differentiations in speech between truth-tellers and lie-tellers. However, untrained individuals such as jurors or the participants in the current study are unlikely to be able to identify these subtle differences. It may be that cognitive load questioning affects adults' lie-telling and makes their false reports more transparent because their

overall cognitive capacities are greater than those of children. However, when children give a report, whether truthful or deceitful, they may already be experiencing cognitive overload, making high cognitive load questioning less likely to differentiate truth from lies. This is consistent with the way in which raters responded to the children after cross-examination; children were less credible overall, regardless of veracity.

Finally, as the results of the current study highlight, participants' accuracy after cross-examination increased when children were being deceitful but significantly decreased when children were being truthful. It is possible that the lack of discrimination is more closely related to the act of cross-examination itself, rather than to taxing cognitive load, particularly because participants rated children as less credible and less believable after cross-examination than after direct examination. Talwar et al. (2006) also found that children are less likely to be believed after adult raters see their cross-examination. In that study, children answered specific questions about the veracity of their reports under cross-examination. However, in the current study, children were asked for specific details of their testimony and were not asked questions about the veracity of their testimony. It may be that seeing children further questioned about their reports in a cross-examination situation may negatively affect adults' perceptions of children's testimony. Based on the results of the current study, it appears that taxing cognitive load during the cross-examination of children may not be beneficial in allowing untrained adults to assess the veracity of their reports.

Limitations and Future Directions

There are some limitations to the current methodological approach. First, although it is representative of undergraduate students in a psychology class, the ratio of female to male participants is quite high. As juries tend to be gender equal and composed of community

members, rather than students, and as law enforcement professionals tend to have more male staff, it would be interesting to see whether the current results would be replicated with a more equal female-to-male ratio and with jury-eligible community members. Furthermore, it is possible that undergraduate students are not representative of the variety of individuals that are found within a jury. Although research supports that undergraduate students can be better detectors than legal professionals (e.g. Leach et al., 2004) and that experience working with children is not related to better detection rates (e.g. Gomez-Garibello et al., 2013), replicating the methodology with a more stratified sample of the general public would be of interest to ensure generalisability. Second, although they testified in a realistic mock courtroom and were asked to lie by the RA, it is likely that the testimony of the children did not elicit the same level of stress as would testifying against a loved one. Within the ethical limitations that arise from such research, the current study attempted to replicate the process of an interaction with an adult who had asked them to lie, and the later testimony in a mock courtroom. Nevertheless, further research is needed to determine whether more emotionally-arousing deceptive requests by an adult would yield similar results.

Conclusion

Overall, it appears that taxing cognitive load at cross-examination with children does not yield the same results as it does in the adult literature. Specifically, cross-examination appears to have the effect of discrediting the witness, not specifically for lie-tellers but for all child witnesses. Furthermore, similar to previous research, it appears that even with the increased cognitive load demands, the participants demonstrate a truth bias, particularly as a result of direct examination. The results of the current study demonstrate that the use of unanticipated and reverse-order questions during cross-examination does not

appear to help raters arrive at the truth. These findings are important, as they suggest that assessing credibility, believability and accuracy in child witnesses continues to be an area of research that warrants further investigation, especially given the importance of the real-life implications.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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