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Brief Report

Deficient cognitive control fuels children's exuberant false allegations

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ABSTRACT

In eyewitness studies as in actual investigations, a minority of children generate numerous false (and sometimes incredulous) allegations. To explore the characteristics of these children, we reinterviewed and administered a battery of tasks to 61 children (ages 4–9 years) who had previously participated in an eyewitness study where a man broke a "germ rule" twice when he tried to touch them. Performance on utilization, response conflict (Luria tapping), and theory of mind tasks predicted the number of false reports of touching (with age and time since the event controlled) and correctly classified 90.16% of the children as typical witnesses or exuberant (more than 3) false reporters. Results of a factor analysis pointed to a common process underlying performance on these tasks that accounted for 49% of the variability in false reports. Relations between task performance and testimony confirmed that the mechanisms underlying occasional intrusions are different from those that drive persistent confabulation and that deficient cognitive control fuels young children's exuberant false reports.
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Introduction

Since the widely publicized day-care abuse cases during the 1980s and early 1990s, psychologists have been working to identify the environmental and individual difference factors associated with testimonial accuracy and suggestibility. Although young children are not always prone to memory

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errors, the quality of their event reports typically declines more than that of older witnesses in the face of misinformation and challenging interviews (e.g., when questions probe for specific details or are misleading; Principe, Greenhoot, & Ceci, in press). In fact, despite a wealth of information on relations between various cognitive and social variables and performance on eyewitness tasks, age has long been the best child-level predictor of testimonial accuracy among children without major cognitive impairments (see Bruck & Melnyk, 2004, for a review).

The current study explored predictors of false allegations of touching among children who returned for testing after participating in a new eyewitness paradigm. "Mr. Science—Germ Detective!" was inspired by evidence that children acquire the concept of contamination early in development along with a corresponding sense of disgust for contaminated objects and an understanding of contagion (the realization that germs can cause illness; e.g., Stevenson, Oaten, Case, Repacholi, & Wagland, 2010). Capitalizing on this knowledge, the new paradigm converts innocuous touches into inappropriate and memorable touches by leading children to perceive touching as potentially contaminating.

We became intrigued about the characteristics of children who make false reports after assistants commented on the frequency of errors in an initial wave of data collection (e.g., 48% of 4-year-olds made a false report) and the diverse maturity levels of same-aged children (as evidenced by waiting room behavior with toys and the assistants). Because frontal lobe immaturity likely explains why preschool children sometimes have high error rates in eyewitness tasks (Schacter, Kagan, & Leichtman, 1995), we invited some families to return so that their children could complete another interview about the Mr. Science experience and a battery of tasks that broadly reflect cognitive control/executive functioning.

From the developmental literature, we selected three executive function tasks (two versions of the Luria tapping task and the day–night Stroop task) and two theory of mind tasks. Sufficient executive skills are a prerequisite for mature performance on false belief theory of mind tasks (Benson, Sabbagh, Carlson, & Zelazo, 2013), and response conflict tasks such as Luria tapping and Stroop, along with theory of mind tasks, sometimes—but not always—predict eyewitness accuracy and suggestibility (Bruck & Melnyk, 2004; Schaaf, Alexander, & Goodman, 2008).

We also were informed by evidence from the neuropsychological literature that frontal lobe compromise can produce a pattern of behavior in which individuals react to external stimuli in ways that are not appropriate for the situation. In adults, this environmental dependency behavior is captured by recording how often patients spontaneously imitate meaningless gestures (implicit imitation) and manipulate objects despite a rule dictating that target objects should not be touched (i.e., utilization behavior reflecting damage to the right orbitofrontal cortex; Bresnard et al., 2011). If mirrored in the immature brain, these tendencies could influence the accuracy of children's responses to interview props. In addition, other behaviors associated with orbitofrontal damage have implications for eyewitness performance, including poor self-monitoring in social situations (e.g., inappropriate comments despite the ability to verbalize social norms; Beer, John, Scabini, & Knight, 2006) and spontaneous confabulations reflecting memory intrusions that do not pertain to current reality (Schnider, 2003; Wahlen, Nahum, Gabriel, & Schnider, 2011).

We proposed that individual differences in environmental dependency behavior would predict eyewitness accuracy because false reports sometimes emerge when children respond thoughtlessly to immediate stimuli (e.g., by erroneously saying "yes" to yes/no questions, by pointing to or handling interview aids inappropriately) and then invent stories (confabulate) when asked to describe the events. To investigate relationships between environmental dependency behavior and eyewitness accuracy for children as a whole, as well as for those who are especially prone to errors, we added two tasks to our battery that elicit this behavior: aged-down versions of the implicit imitation and utilization tasks (Bresnard et al., 2011).

Method

Participants

Children completed the tasks at two U.S. research sites (a midwestern town and a New York City suburb). Invitations to participate were extended to a subset of the 252 families who had completed

the in-progress study, oversampling children who had made a false touch report in the initial study while maintaining the relative ages of initially accurate and inaccurate children. (All families who expressed interest were enrolled.) Children who committed an error shortly after the event comprised 30% of cases in the in-progress study compared with 48% of the current sample. At the first site, initially accurate children were 0.62 years older than inaccurate children in the full sample and were 0.70 years older in the current study's sample; at the second site, mean age differences were 0.27 and 0.30 years, respectively.

The final sample consisted of 61 children who spoke English in their homes and were 4–9 years of age at the time of the event (43% female and 57% male) and when they returned (M_{age} = 6.74 years, SD = 1.32). Most were Caucasian (82%), with 13% of parents describing their children as mixed race and 3% describing them as African American or Asian (one parent declined this question). Overall, 3% of the children were ethnically Hispanic.

Target event

During the in-progress project, children participated in a Mr. Science paradigm (Poole & Lindsay, 2001) that was modified to focus attention on touching. Before the target event, a female assistant discussed germs with each child and explained a new germ rule: Mr. Science used to touch children to help with various activities, but he was not allowed to touch anymore because the staff did not want him to spread the germs that cause colds and flu. The child was also instructed that Mr. Science might forget this new rule and to remind him if he forgot. After repeating the germ rule, the child was brought to a room where Mr. Science delivered germ education activities (e.g., using a spray bottle to simulate sneezes) and attempted to touch the child two times (ostensibly to wipe water off the child's cheek and to shake the child's hand). Children are highly attentive to touching in this paradigm (e.g., the majority of children in the current study refused one or both touches and disclosed attempted or experienced touching before or during an interview conducted 1 week later). Interviews after the target event included presubstantive phases (e.g., practice narrative and ground rules) and a range of questioning techniques (free narrative, general questions about wrongdoing and touching, and general and specific questions with body diagrams).

Current study session tasks, procedure, and scoring

Delays between the target event and the current session tasks ranged from 3 months to 1 year (M = 0.66 year, SD = 0.20); the correlation between age and time since the target event was −.07 (p = .59).

Following informed consent procedures, an experimenter directed each child through the following 10-part protocol.

False reports of touching by Mr. Science

The experimenter displayed three body diagrams, with lines depicting underwear. The experimenter asked, "Which one looks the most like you?" and used the selected diagram to elicit the child's names for nine body parts. After raising the topic of the child's participation in the earlier study, the experimenter asked the general touch question, "Did Mr. Science touch you in any of the places on this picture?" and continued with "Did Mr. Science touch you somewhere else?" until the child said, "No." The experimenter then asked the child to tell what happened when Mr. Science touched (while pointing to each report). Finally, the experimenter pointed to each of nine non-genital body parts and asked specific touch questions ("Did Mr. Science touch you here?" followed by "What happened?" whenever the child reported a touch).

A report was considered as false if Mr. Science had not touched the body part (e.g., feet, stomach), ignoring left–right reversals. Intercoder agreement for individual false reports was 88.71% and 96.55% at the two sites; disagreements were resolved by revisiting recordings with discussion. Reliabilities for making or not making a false report in the initial study were 92.31% and 95.45%, Cohen's ks = .84 and .91.

Implicit imitation

Following Bresnard and colleagues' (2011) procedure, the experimenter started a conversation and performed five gestures (e.g., military salute). Implicit imitation was the number of gestures the child imitated (maximum score = 5, intercoder agreement = 100%).

Utilization—verbal generation task

We modified Bresnard and colleagues' (2011) procedure for eliciting utilization behavior by substituting child-appropriate objects (e.g., wooden beads, string). The experimenter starting by saying, "Now I'm going to ask you to talk about some everyday things. I'm going to put some things in front of you, but the rule is you shouldn't touch or use them. What is the rule?" Next, the experimenter placed four object sets on the table, one at a time, with instructions to tell her how to use the props. The experimenter reminded the child of the rule the first time the child touched an object, and she assessed memory for the rule after conversation about the last object set.

For each object set at each research site, two coders recorded whether the child resisted touching, touched briefly, or handled an object. Intercoder agreement at the two sites was 98.72% and 95.45%, Cohen's κs = .95 and .89. Utilization$_{\text{verbal generation}}$ was the number of trials that elicited object handling.

Luria tapping task–dowel

Using Diamond and Taylor's (1996) procedure, the experimenter explained that when she tapped once with a wooden dowel and passed it to the child, the child should tap twice (and vice versa). Luria$_{\text{dowel}}$ was the number of correct trials out of 16 scored trials.

Theory of mind–location

Using a version of Wimmer and Perner's (1983) mistaken location task, the experimenter enacted a story about two girls who were playing with a beach ball. The ball was placed in a beach bag, and while Sally went swimming Anne moved the ball to a box. Sally then returned and the experimenter asked, "Where will she look first—where does she think it is?" (false belief question) and "Where is the beach ball really?" (reality question). Theory of mind was the number of correct answers to the false belief question for this task and the subsequent unexpected contents task. (All children were accurate on the reality questions; maximum score = 2.)

Luria tapping task–original

The experimenter and child used index fingers to complete practice trials and 16 scored trials of the Luria task (i.e., "I tap one time, you tap two times; I tap two times, you tap one time"). Luria$_{\text{original}}$ was the number of correct trials.

Theory of mind-unexpected contents

In a version of Gopnik and Astington's (1988) task, the experimenter brought out a cracker box and asked, "What do you think is inside the box?" before opening the box to reveal flowers. After closing the box, the experimenter brought out a doll who had not seen inside the box and asked what the doll would think was inside, the crackers or the flowers (false belief), and what the true contents of the box were (reality).

Day–night stroop

Following Gerstadt, Hong, and Diamond's (1994) procedure, the experimenter instructed the child to say "night" when shown a picture of the sun and to say "day" when shown a picture of the moon and stars. Day–night Stroop was the number of correct trials (out of 16 scored trials).

False reports of touching by the research assistant

To explore whether any children would make false reports about recent events, the research assistant put up a new body diagram and asked general touch questions ("When you first came to play these games with me today, did I touch you in any of the places on this picture?" followed by "Tell me everything that happened when I touched you here ..." for affirmative responses) and then specific

touch questions (pointing to each of nine body parts). Intercoder agreement at the two sites for individual false reports was 93.75% and 100.00%.

Intentional imitation task

To determine whether children were attentive and cooperative through the end of the session, the experimenter performed three actions (e.g., arms over head) with instructions for the child to imitate what she did after she said, "Go." Intercoder agreement was 100% at both sites for imitating, and agreement was 96.40% and 95.45% at the two sites for waiting, Cohen's $\kappa = .86$ for both.

Results

Implicit imitation was dropped because only 1 child imitated the experimenter. Descriptive statistics for the remaining predictor variables and the number of false reports of touching by Mr. Science are shown in Table 1. Many children reported non-experienced touches, with 31.15% ($n = 19$) making 1 false report, 11.48% (7) making 2 false reports, 8.20% (5) making 3 false reports, and 16.39% (10) making 4 or more false reports. (The experimenter terminated questioning after1 child made 29 false reports.) Most false reports described innocuous touches, but 2 5-year-olds made concerning reports, with 1 girl reporting a breast touch and 1 boy reporting touches just above and below the groin (out of 22 children under 6 years of age, including 17 who reported touching). Across reports, only 24.48% of errors had also been reported 1 week after the target event, and the consistency of individual children making no errors or at least 1 error across studies was low, $r_{\varphi} = .24$, $p = .055$.

All tasks except the day–night Stroop significantly predicted the number of false reports with age and time since the event controlled (see Table 2). Nonetheless, these variables could not reliably distinguish between children who were completely accurate reporters and those who were not; $\text{utilization}_{\text{verbal generation}}$, $\text{Luria}_{\text{dowel}}$, $\text{Luria}_{\text{original}}$, and theory of mind correctly classified only 55.74% of children in a discriminant analysis, $p = .62$. However, false reports from children who made just 1 error were often inferences from the event, such as reporting that Mr. Science accidentally touched them during a specific activity, so it is possible that cognitive measures were ineffective at

Table 1
Descriptive statistics.

	Minimum	Maximum	Median	Mean	SD
1. $\text{Utilization}_{\text{verbal generation}}$	0.00	4.00	0.00	0.67	1.36
2. $\text{Luria tapping}_{\text{dowel}}$	5.00	16.00	16.00	14.36	2.70
3. $\text{Luria tapping}_{\text{original}}$	1.00	16.00	15.00	13.46	3.93
4. Day–night Stroop	2.00	16.00	16.00	13.30	4.28
5. Theory of mind	0.00	2.00	2.00	1.69	0.70
6. False reports of touching by Mr. Science	0.00	29.00	1.00	2.36	4.62

Table 2
Partial correlations among variables (age and time since the event controlled).

	1	2	3	4	5	6
1. $\text{Utilization}_{\text{verbal generation}}$	–					
2. $\text{Luria tapping}_{\text{dowel}}$	−.36**	–				
3. $\text{Luria tapping}_{\text{original}}$	−.32*	.63**	–			
4. Day–night Stroop	−.11	−.08	.08	–		
5. Theory of mind	−.33*	.45**	.32*	.18	–	
6. False reports of touching by Mr. Science	.56**	−.58**	−.34**	.01	−.46**	–
7. Exuberant false reporting	.56**	−.41**	−.18	−.06	−.40**	.64**

Note: Exuberant reporting is dichotomous (3 or fewer false reports against Mr. Science = 0, more than 3 false reports = 1).
* $p < .05$.
** $p < .01$.

distinguishing these children from children who made no false reports because children with few errors were engaging in mental review of the target event.

In contrast, there was a strong relation between task performance and a pattern of exuberant (more than 3) false reports ($n = 10$). Utilization$_{\text{verbal generation}}$, Luria$_{\text{dowel}}$, and theory of mind correctly classified 90.16% of children as exuberant false reporters or typical children, canonical $R = .67$, $\Lambda = .55$, $\chi^2(3) = 34.60$, $p = .000$, with 92.16% classification accuracy for typical children and 80.00% for exuberant false reporters. (Prediction was not improved by adding Luria$_{\text{orginal}}$ and remained significant at $p = .000$ with transformed scores that eliminated unequal variances for utilization$_{\text{verbal generation}}$ and Luria$_{\text{dowel}}$ and minimized variance inequality for theory of mind.) Despite the fact that these children were younger than the typical children (by 1.25 years on average), age successfully classified only 67.21% of the total sample, canonical $R = .35$, $\Lambda = .87$, $\chi^2(1) = 7.79$, $p = .005$. Adjusting the definition of exuberant reporting to more than two reports ($n = 15$) returned a similar pattern. The three developmental tasks correctly classified 77.05% of children, $p = .001$, compared to 65.57% correctly classified by age, $p = .012$. A pattern of numerous false reports was uncommon shortly after the witnessed event, but 3 of the 4 children who made more than 3 false reports in the initial study also did so at follow-up.

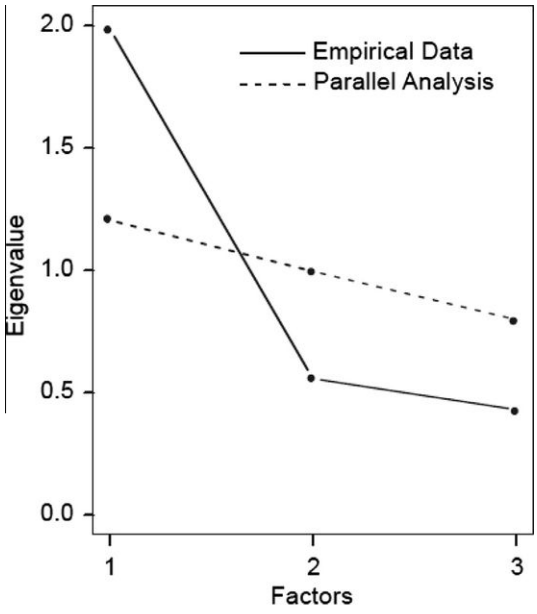
In addition to worse performance on the predictor tasks, there were other striking characteristics of exuberant (more than 3) false reporters: most were boys (90% vs. 51% of typical children, $p = .03$) and younger than 6 years. Regarding age, exuberant children represented 20% of 4-year-olds ($n = 1$), 41% of 5-year-olds ($n = 7$), 10% of 6-year-olds ($n = 1$), and 6% of 7-year-olds ($n = 1$). Although these percentages are likely higher than typical for our paradigm due to oversampling children who erred in the initial study, there was not a significant relation between making or not making a false report shortly after the event and exuberant status after a delay, $r_{\varphi} = .20$, $p = .12$. As a result, an age trend was evident even among initially accurate children: No child 6 years of age or older at follow-up who had not erred in the initial study was an exuberant reporter, whereas 33% of previously accurate 5-year-olds were exuberant reporters. (Only 1 initially accurate 4-year-old was still age 4 at follow-up, and this child remained an accurate reporter.)

Importantly, it was not the case that exuberant children were simply inattentive. The experimenter neglected to ask 1 child about the touching rule after the utilization task, but the remaining exuberant children correctly recalled the rule. In addition, only 1 of these children did not successfully complete both of the first 2 scored trials on all response conflict tasks. Most were also cooperative until the end of the session: Although 1 child refused to imitate the experimenter at the end of the session and 1 child required prompting, the remaining children imitated and waited for the "Go" signal on at least 2 of the 3 trials (as did the child who required prompting). Finally, 80% of exuberant reporters had already made more than 3 false reports before interviewers asked specific yes/no questions about the nine body parts.

Despite being cooperative, exuberant children clearly had difficulty in using internalized rules to guide their behavior. For example, half of them handled all four object sets during the utilization$_{\text{verbal generation}}$ task despite the reminder compared with only 3.92% ($n = 2$) of typical children, $p = .001$. Along with a pattern of repeatedly pointing to body diagrams, this behavior raised the possibility that exuberant reporters were displaying perseverative behavior in which they could not stop responding. This idea was not supported by a post hoc analysis of Luria data, however, because exuberant children had similar accuracy on trials that required them to tap once versus twice, $p = .77$.

Most interesting was converging evidence that exuberant reporters had a general tendency to confabulate: Despite the fact that each child and the experimenter had walked into the testing room only minutes earlier and sat on opposite sides of a table, 7 of the 10 exuberant reporters said that the experimenter had touched them, and 2 of these children reported multiple touches that they did not withdraw after the experimenter clarified that she was asking about touches to the child rather than previous touches to the body diagram. For example, 2 children reported that touching had occurred during the tapping game, and 1 child said, "You touched me here so you could feel me am I burning up or not." In contrast, only 3.92% of typical children accused the assistant of touching, $p = .000$.

To evaluate the extent to which utilization$_{\text{verbal generation}}$, Luria$_{\text{dowel}}$, and theory of mind index a process or processes in common, we performed a principal axis exploratory factor analysis. Results suggested that a single dominant factor accounted for covariance among these tasks (see Fig. 1 for



Factor Loadings	
Utilization	-.61
Luria-Dowel	.78
Theory of Mind	.73

Fig. 1. Scree plots and variable loadings for a factor analysis incorporating three predictors of false reports. Actual eigenvalues (solid line) are accompanied by eigenvalues estimated from a parallel analysis (dashed line) based on 100 random samples.

the scree plot and results of a parallel analysis, a technique that produces eigenvalues from randomly generated data). The correlation between factor scores and the number of false reports was −.70, $p = .000$, indicating that this common process accounted for 49% of the variability in false reports. The point biserial correlation between scores and exuberant or nonexuberant status was −.63, $p = .000$.

Discussion

Professionals who study children's event reports or work on cases cannot help but be struck by the minority of young children who clearly confabulate in response to questions about the past, with some children generating expanding allegations over time. Using an eyewitness paradigm that creates an atmosphere of concern about touching, the current study is the first to demonstrate that deficient cognitive control—the inability to reliably use internalized rules and representations to guide behavior—is a predictor of exuberant false allegations.

The fact that performance on our tasks did not distinguish between completely accurate and inaccurate children is consistent with evidence from amnesic patients. In this group, simple intrusions on memory tests are dissociated from confabulation and are unrelated to specific cognitive measures, whereas confabulations relate to impaired mental flexibility, a tendency to fill gaps in memory, and difficulty in separating relevant memories from irrelevant ones (i.e., reality filtering; Nahum, Bouzerda-Wahlen, Guggisberg, Ptak, & Schnider, 2012). This distinction between occasional and profuse

errors helps to explain inconsistent results regarding the role of cognitive control in suggestibility (Bruck & Melnyk, 2004) because relationships will not be detected unless procedures permit multiple errors with sample sizes that capture a set of error-prone children.

Some interviewers have argued that body diagrams are safe for most abuse investigations involving children 5 years of age and older because representational understanding is usually in place by age 5 (e.g., Anderson et al., 2010). On the surface, the lack of a clear false report of genital touching in the current study supports this idea. However, a minority of children 5 years of age and older do make forensically relevant errors when interviewers use sexually explicit props (see Saywitz, Goodman, Nicholas, & Moan, 1991; Steward & Steward, 1996, p. 95), and it is likely that the protracted developmental course of cognitive control, rather than a lack of representational understanding, best explains these mistakes. Unfortunately, available evidence makes it difficult to weigh the risk of using explicit diagrams with young and cognitively impaired children against the additional true reports obtained by directive questioning because studies have not produced the atmosphere of concern about genital touching that characterizes many cases. Hopefully, future research will expand understanding of the environmental and individual difference factors that underlie false reports so that professionals have more guidance for matching interview strategies to cases with specific features.

Our data suggest that a common process underlying the utilization, Luria, and theory of mind tasks accounts for a high percentage of the variability in false reports among children who experienced the same events and interview strategies, but we cannot speak to the relative roles of deficits in inhibition, working memory, and cognitive flexibility in producing these reports (see Best & Miller, 2010, for discussion of foundational executive functions). It is premature, therefore, to conclude that deficient inhibition drives exuberant false reports. For example, goal neglect (failing to respond in accordance with task demands despite memory for instructions) is associated with working memory capacity (Marcovitch, Boseovski, Knapp, & Kane, 2010), and inefficient information processing (rather than impulsivity per se) is associated with attention deficit/hyperactivity disorder (ADHD)-related errors (Metin et al., 2013).

The idea that some children find it especially difficult to use recently acquired memories to guide behavior is supported by our finding that the Stroop task did not predict false reports. This task sometimes flummoxed even accurate reporters (who quickly responded as soon as a new card was displayed) and was the only task that did not require response decisions based on information that was no longer in view. Of course, there are other possible reasons why the Stroop task did not predict reporting errors, including its late position in the testing sequence (when children may have become less vigilant). It would be valuable to the forensic interviewing community if future studies clarified the foundational mechanisms associated with exuberant false reports because such work could suggest procedures for putting derailed conversations back on track while safely encouraging young children to report inappropriate touching.

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