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Cognitive skills, individual differences, and nonverbal interview methods in children's eyewitness recall

Christiana Iordanou*, Melissa L. Allen[†] and Lara Warmelink

Department of Psychology, Lancaster University, Lancaster, UK

ABSTRACT

This study investigated the interaction between internal characteristics and external prompts (drawing and dramatisation) in children's eyewitness recall. Eighty-one 3- to 6- year old children witnessed a live event involving an altercation between two actors in their schools. They were asked to tell what happened (Verbal condition), draw what happened while talking about it (Drawing condition), or show and tell by using gestures and mime (Dramatisation condition), one day, two weeks, and approximately six months after the event. Independent measures of temperament, mood, symbolic skills, and language ability were taken. Children in the Drawing condition reported significantly more details about objects than children in the Verbal condition after a two-week delay. Symbolic skills and shyness affected children's recall. Our findings suggest that considering young children's cognitive skills and temperamental traits may help facilitate their eyewitness recall.

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Drawing; dramatisation; eyewitness recall; temperament; symbolic skills; language ability

Nonverbal interview techniques such as drawing and dramatisation can successfully facilitate children's reporting of past events and emotional experiences, even after long delays (e.g. Gardner et al., 2020; Gross & Hayne, 1998; Iordanou et al., 2021; Katz & Hershkowitz, 2010; Lev-Wiesel & Liraz, 2007; Macleod et al., 2013; Wesson & Salmon, 2001). These methods have been used as supplementary aids to increase children's recall, as very young children (e.g. three-year-olds) tend to provide brief reports about past experiences (Hammond & Fivush, 1991; Lamb et al., 2003). Here we investigate how these techniques may interact with individual differences (e.g. temperament, cognitive and symbolic skills) to affect recall ability in children aged 3–6.

Drawing allows children to generate their own retrieval cues (Gross & Hayne, 1998) and make them more concrete (Butler et al., 1995; but see Davison & Thomas, 2001; Strange et al., 2003 for

research respectively showing that drawing leads to impaired recall or more confabulations). It facilitates the reporting of objects and descriptive information, as these items are easier to depict than actions (Barlow et al., 2011; Gross & Hayne, 1998; Wesson & Salmon, 2001). Drawing has also been found to enhance the recall of children with autism spectrum disorder (Mattison et al., 2015) and older adults (Dando, 2013). However, drawing is not always associated with positive outcomes for children; to be effective, drawing has to be directly linked to the event in question (i.e. to not ask children to freely draw anything they want) and the event has to be salient rather than mundane (Macleod et al., 2016; Salmon & Pipe, 2000). Further, drawing has negative effects when paired with suggestive questions (e.g. Bruck et al., 2000; Gross et al., 2006).

Asking children to dramatise by “showing and telling” what happened at a specific situation can

CONTACT Christiana Iordanou  c.iordanou@kent.ac.uk  School of Psychology, Keynes College, University of Kent, Canterbury, Kent CT2 7NP, UK

*Present address: School of Psychology, Keynes College, University of Kent, Canterbury, Kent, CT2 7NP, UK

[†]Present address: School of Education, University of Bristol, 2.31, Helen Wodehouse Building, 35 Berkeley Square, Clifton, Bristol, BS8 1JA, UK

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supplement their verbal reports (Liwag & Stein, 1995) by helping them communicate information that is unclear or missing from their statements (Pipe & Salmon, 2008). Previous work has shown that movement involving gestures facilitates children's recall of discourse information, working memory, and memory of past experiences and events (Llanes-Coromina et al., 2018; Ping & Goldin-Meadow, 2008; Stevanoni & Salmon, 2005). Young children may benefit from such actions, as using gesture, mime, and physical movements is easier and do not require the development of specific skills which are needed for drawing (Wesson & Salmon, 2001). Furthermore, gesture is ubiquitous (Goldin-Meadow, 2011) thus, all children have the capacity to use gestural communication. As young children have a greater need for external aids to successfully recount past experiences (see Salmon, 2001), providing them with the opportunity to gesture might augment their verbal reports.

From a theoretical standpoint, the effectiveness of drawing and dramatisation can be explained by embodied cognition theory, according to which cognition (e.g. recalling a past event) is not only based on cognitive processes in the brain (e.g. perception, introspection) but also bodily movements which help create simulations of past experiences (Kiefer & Trumpp, 2012). Previous work showed that when participants were asked to recall a list of action verbs, they performed better when they combined verbal recall with the corresponding movement compared with a condition in which they simply read the words (Engelkamp et al., 2004; Engelkamp & Jahn, 2003). This suggests that episodic memory is based on the reinstatement of sensory and motor experiences (Engelkamp & Zimmer, 1994). Thus, drawing a past event or using bodily movement (dramatisation) while narrating it can lead to better recall compared to a verbal interview, because these activities create sensory and motor memory traces which enhance recall (Kiefer & Trumpp, 2012).

While drawing and dramatisation can provide supportive *external* scaffolding for recall processes, children's recall of a past event may also be influenced by their internal characteristics such as temperament, language, and symbolic ability (Lewis et al., 2000). Although the impact of such cognitive abilities (e.g. Lewis et al., 2000), personality (e.g. Roebbers & Schneider, 2001), or nonverbal techniques such as drawing and dramatisation (e.g. Butler et al., 1995) has been studied extensively

in isolation, it is possible that external scaffolding techniques *interact* with children's internal characteristics (Salmon et al., 2003). Such an interaction would necessitate the need for flexible interview techniques to account for individual differences (Saywitz et al., 2017). Given that, to date, very few studies have examined temperament, language ability, and drawing and dramatisation concurrently (e.g. Salmon et al., 2003), and *none* have examined the interactive effects of these with symbolic skills on 3- to 6- year old children's recall, we set out to investigate this question. We also measured mood before and after each recall session to ascertain that the interviews were not distressing for the children and to test whether mood affects recall.

Interviews are inherently social situations in which children are required to interact with unfamiliar individuals (Chae & Ceci, 2005), thus, children's temperament may affect their ability to cope in such contexts. Shy children in particular have been shown to be less accurate than more sociable children when answering cued recall questions (e.g. "What did the gang leader do after the fight?", Roebbers & Schneider, 2001, p. 12) about a video or an event they saw (Chae & Ceci, 2005; Roebbers & Schneider, 2001). This reduced performance is likely due to inhibition associated with unfamiliar situations (Kagan et al., 1987). Emotionality and activity may also relate to children's recall; however, studies on their effects are scarce. Although most studies on emotionality have yielded non-significant effects (e.g. Burgwyn-Bailes et al., 2001; Chae & Ceci, 2005), Gordon et al. (1993) found that 5-year olds total correct recall was positively correlated with emotionality. Further, bodily actions and movements have been shown to facilitate linguistic processing and development (Iverson & Goldin-Meadow, 2005; Willems & Hagoort, 2007) as well as encoding and retrieval (Cook et al., 2010). This suggests that children who are more active may show better verbal recall than less active children.

These temperamental traits may interact with external supports in different ways. Compared to sociable children, for instance, shy children may be less able to benefit from the opportunity to use dramatisation when verbally recalling an event, as they may feel less at ease acting out an event due to fearfulness of the novel social situation or embarrassment (Buss & Plomin, 1984; Colonnese et al., 2010). For these children, drawing may facilitate recall to a greater extent. Drawing helps reduce the anxiety

associated with the interview and shifts the attention from the unfamiliar interviewer to the activity, allowing children to start recalling the target event (Butler et al., 1995; Jolley, 2010). Further, for young children who tend to express negative emotions more intently, recall may be facilitated by nonverbal communication, such as gestures (Gordon et al., 1993). In addition, active children may perform better in a dramatisation condition, as the motoric element of gestures may help them retrieve more information (Cook et al., 2010; Stevanoni & Salmon, 2005).

Cognitive functions such as language and symbolic skills may also affect children's mnemonic ability due to language's and memory's shared cognitive and neural foundations (Gupta & MacWhinney, 1997). Some studies have shown a positive link between language skills and young children's recall (e.g. Boland et al., 2003; McGuigan & Salmon, 2004). Salmon et al. (2003) found a positive relation between expressive language and recall of autobiographical experiences in 5- to 7-year-old children who were asked to verbally report their memories. Receptive language skills may also contribute to amount of information reported; children need to understand the instructions of the interviewer to successfully answer open-ended and particularly closed-ended questions, which are typically used with younger participants (Butler et al., 1995). To our knowledge, only Salmon et al. looked at the intersection between temperament, cognitive skills, and drawing and dramatisation in children's recall. Nevertheless, they did not consider children's symbolic skills. Interview techniques that ask children to draw or dramatise while providing reports may be related to symbolic ability, given the links between symbolic skills and language (Lewis et al., 2000) and the symbolism inherent in drawing and re-enactment (Cox, 1992; Meltzoff, 1995). If this is true, then allowing children with high symbolic skills to use gestures and mime or draw during the interview may facilitate their recall to a better extent than verbal only interviews.

The nature of the event children describe may also affect recall. In some studies examining the effects of nonverbal prompts on children's reports, children are either asked to reflect upon different time points and salient events in their own lives (e.g. Gross & Hayne, 1998) or are actively involved in staged events [e.g. visits to a fire station (Butler et al., 1995), chocolate factory (Gross & Hayne, 1999), and a pirate show (La Rooy et al., 2005)].

These fun experiences differ from eyewitness situations because they are more positive in valence and often have an interactive element. Positive events may elevate participants' mood, which affects memory recall in children aged 9–13 (Raes et al., 2010). Interactive events may also be remembered differently. Hope et al. (2016) showed that active adult witnesses of a stressful situation reported significantly less accurate information than non-active observers. In some forensic situations, witnesses are passive viewers of an event, which may evoke different memory processes (e.g. Bates et al., 1999).

It is important to investigate recall strategies in children as young as three years because young children may forget faster than older children and adults (Baker-Ward et al., 1993). In line with previous work (e.g. Baugerud et al., 2014; Riggins & Rollins, 2015), we tested children between three and six years, as memory ability may change significantly during this period (Riggins, 2014). Due to ethical constraints on child experimentation (Bodén, 2021) which did not allow us to adopt a veridical forensic scenario, we staged a minor altercation between two friends regarding who would read a storybook to the children; during this altercation, a salient object (stuffed monkey) was taken from one of the actors by the other. We selected a developmentally appropriate event, which although is not a true forensic scenario, allowed us to probe memory for a salient event with a negatively valenced component (e.g. altercation). The effects of three interview techniques were tested: Verbal recall only, Drawing, and Dramatisation. We examined children's accuracy in each condition. As young children show significant forgetting after longer delays (Pipe et al., 2004), retention was investigated one day, two weeks, and approximately six months after the event, in line with previous work (e.g. Gross & Hayne, 1999; Sutcliffe Cleveland & Morris, 2014). We conducted repeated interviewing, as multiple interviews allow for additional retrieval and better recall in young children (e.g. La Rooy et al., 2010), as long as they are not contaminated by misinformation (Cassel & Bjorklund, 1995).

Several hypotheses were made. First, we hypothesised that children in the Drawing and Dramatisation conditions will provide more information than children in Verbal condition (Butler et al., 1995; Gross & Hayne, 1998, 1999; Patterson & Hayne, 2011; Stevanoni & Salmon, 2005; Wesson & Salmon, 2001; Woolford et al., 2015); we did not

have a priori hypotheses about which one of these non-verbal techniques would be more beneficial. As drawing helps children make retrieval cues more concrete and represent objects more easily than actions (Wesson & Salmon, 2001), we further hypothesised that children who draw will report more information about objects compared to those in the verbal condition (Gross & Hayne, 1998). The third hypothesis was that over time recall across all conditions would diminish, but children in the drawing and dramatisation conditions will show less reduction compared to those in the verbal condition. The fourth hypothesis was that cognitive skills would interact with condition; children with higher symbolic ability are expected to provide more information in the drawing and dramatisation interviews than children with less advanced symbolic skills. Language ability is expected to relate to overall recall. Finally, we anticipated that temperament will interact with condition and shyness in particular will negatively affect recall in the dramatisation condition.

Method

Participants

Eighty-one children, aged 3–6 years ($M=58.83$ months, $SD=11.05$ months) were recruited from two private nursery schools and two public primary schools in Lancashire, UK. This sample size is sufficient to detect an effect size of $r^2=0.11$, based on a G power sensitivity analysis (assuming $\alpha=0.05$, power = 0.80, $N=81$, Numerator DF = 2, 3 condition and 4 covariates). Considering the possible applied value of this research, we felt that this was below the smallest effect size of interest (we would put the SESOI $\sim r^2=0.2$) and therefore consider the sample size sufficient to test our hypothesis. There were 38 girls ($M=57.63$ months, $SD=10.16$ months) and 43 boys ($M=59.88$ months, $SD=11.79$ months), who were predominantly Caucasian. All children were English-speaking and attended English-speaking nursery and primary schools. They were randomly assigned to one of three conditions: Verbal ($n=27$, $M=58.89$ months, $SD=13.24$ months), Drawing ($n=28$, $M=58.48$ months, $SD=9.77$ months), or Dramatisation ($n=26$, $M=59.11$ months, $SD=10.26$ months). Initially, 97 children were recruited. However, four children refused to participate, two were not English speaking, and the remaining 10 were not present on the

day of the event. One child did not attend the second interview (80 children returned for a second interview), and one child's parents did not fill out the EAS Survey for Children. Out of the 81 children, 66 returned for a third interview ($M=60.29$ months, $SD=11.66$ months) six months after the event. There were 29 girls ($M=59.51$ months, $SD=10.87$ months) and 37 boys ($M=60.89$ months, $SD=12.36$ months). Children received a colouring book and a packet of crayons as a thank you for their participation.

Material

The Test of Pretend Play (ToPP; Lewis & Boucher, 1998)

The ToPP assesses symbolic play abilities in children between 18 months and 6 years through elicited, instructed, and modelled play in four sections. It measures three different types of symbolic play: substituting one object for another (e.g. using a cloth for a blanket to put a doll to bed), attributing an imaginary property to an object (e.g. pretending the teddy bear feels poorly), and referring to an absent object as if it were present (e.g. pretending to lick an ice-cream cone). The ToPP has good inter-rater reliability ($\kappa=0.68$) and validity (i.e. 75.8% of the children identified as either normal or exhibiting developmental problems, Clift et al., 1998).

The Preschool Language Scale (PLS-4; Zimmerman et al., 2002)

The PLS-4 assesses receptive and expressive language ability from birth to 6 years 11 months, in areas such as attention, play, social communication, gesture, vocal development, vocabulary, concepts, phonological awareness, language structure, and integrative language abilities (Zimmerman et al., 2002). It consists of Auditory Comprehension (AC) and Expressive Communication (EC) subscales. The test has good validity and reliability (test-retest reliability and internal consistency scores range between .66 to .96 for all subscales, Zimmerman et al., 2002).

EAS survey for children: parent rating (Buss & Plomin, 1984)

The EAS Survey assesses the dimensions of Emotionality (proneness to distress), Activity (behavioural arousal), Sociability (preference to being in the company of others versus being alone), and

Shyness (tendency to be timid and tense with strangers and acquaintances). The EAS Survey is a 20-item questionnaire through which parents rate their children's behaviour on a 5-point Likert scale ranging from "not characteristic or typical of my child" to "very characteristic or typical of my child". The validity and reliability of the questionnaire are consistently found to be good (Masi et al., 2003).

Mood scores

Children's mood was assessed prior and after each interview with a self-report scale comprising a row of five smiley faces which ranged from very unhappy to very happy. This scale was adopted from the Facial Image Scale (FIS) (Buchanan & Niven, 2002). The child's choice of smiley face was converted to a 5-point scale by the experimenter. To investigate changes in mood across the three conditions, mean mood scores were calculated by subtracting scores after each interview from scores prior to each interview to provide a single difference score.

Props

A teddy bear (Teddy) ($H = 32$ cm, $W = 20$ cm), a monkey toy (Monkey) ($H = 33$ cm, $W = 26$ cm), and a children's picture book (Tsoroni-Georgiadi, 2014) were used as aids for the staged event which children witnessed. To make sure the children were not familiar with the content of the story, a Greek picture book which was translated in English by the experimenter was used. The book was age appropriate and of educational value; it is part of a series of picture books that aim to help children express their emotions.

Design

A 3×3 repeated measures design was used. Condition (Verbal, Drawing, and Dramatisation) was the between-subjects factor and Delay [one day (first interview) vs two weeks (second interview) vs six months (third interview)] acted as a within-subjects factor. The following variables were treated as covariates: temperament, symbolic skills, language ability, and mood. The dependent variables were the overall amount of accurate information reported in free recall and the questions phase. We also ran similar analyses for the "objects" category only (dependent variable) and not the other categories we coded for (see,

Coding section), as we expected that children would report more object-related details in the drawing condition than the verbal condition in line with previous work (Gross & Hayne, 1998).

Procedure

Initial testing

Prior to the study, participant information sheets, consent forms, and a copy of the EAS Survey were distributed to parents by teachers at the participating schools. First, all children whose parents had granted permission met twice with the experimenter individually in a quiet room in their school to establish rapport and take the ToPP and the PLS-4 tests. One participant completed this stage after the staged events.

Staged event

Second, the children watched a 7-minute live novel event involving an altercation in their classrooms, with their classmates and teacher present. The event involved a book-reading interaction between two actors. Actor 1 (male) entered the children's classroom, introduced himself, and explained that he had come to read a story about a brave little elephant. He then introduced to the children his two friends, Teddy and Monkey, who would also listen to the story. Two respective stuffed animals were placed in clear view equidistant from the actor. Before he began to read the book, he told them that his friend (Actor 2, female) was supposed to read the story with him, but as she was late, he would start without her. After he read a few pages, Actor 2 stormed in the room and reprimanded Actor 1 for starting the story without her. She said angrily: "*John, you started the story without me? Why did you do that? You were supposed to wait for me! I wanted to read the story! Oh, I'm leaving!*". When she reached the door, she turned back, grabbed the monkey toy, said to Actor 1 angrily "*And, I'm taking Monkey with me!*", And stormed out of the classroom. Actor 1 reassured the children that Actor 2 and Monkey were fine and were probably waiting for him in the schoolyard, and then finished reading the storybook. Actor 1 then told the children that he had a special sticker for each one of them, to go on their left hand, and asked them to put out their hands to place it. If any child refused to allow the actor to place the sticker, they were allowed to put it on their own hand.

Memory interviews

Third, children were interviewed individually by the experimenter, who was not present during the event, after three delays: (a) one day after the event (first interview), $M = 1.09$, $SD = 0.84$, (b) two weeks after the event (second interview), $M = 14.12$, $SD = 0.60$, and approximately six months after (third interview). All interviews took place in a quiet room in the children's schools and were video recorded. First, children completed the mood scores. This procedure was repeated after each interview was over.

All children were randomly assigned to one of three conditions: Verbal, Drawing, or Dramatisation. Each condition comprised two recall phases: free recall and a questions phase.

Verbal condition. The interview started with the free recall phase. Children were asked to provide a narrative account of what happened during the event. In line with previous research (Gross et al., 2009), the experimenter started the interview with the following statement: *"I heard that yesterday/a while ago, something really special happened here in the nursery/school and you were given a sticker like this one (each child was shown a sticker like the one they had been given). I wasn't here. Can you tell me all about what happened? Tell me anything you can remember about when you got the sticker"*. When it was obvious that each child had recounted all the information he or she remembered, a questions phase followed, which comprised four recall prompts: (a) *"tell me who was there"*; (b) *"tell me what the story was about"*; (c) *"tell me if there were any cuddly toys"*; (d) *"tell me where the man put your sticker"*. Following previous work (Gross et al., 2009; Gross & Hayne, 1999), all children were asked to answer these questions, even if they had already provided the relevant information during free recall.

Drawing condition. Here, participants were provided with a sheet of paper, 10 colouring pencils, a pencil, and an eraser and were asked to draw what they saw, while narrating. The free recall phase was the same as per the verbal condition, with the experimenter asking the following question: *"Can you draw and tell me all about what happened? Draw me anything you can remember about the time when you got the sticker"*. Although previous research found that children of this age usually narrate while they draw (e.g. Butler et al.,

1995; Gross & Hayne, 1998, 1999), we found that most of the time children did not narrate while drawing. If a child did not spontaneously narrate while drawing, he/she was asked to do so through prompts such as *"Please draw and tell me"*, and *"What are you drawing now?"*. In the questions phase, the experimenter asked the same four questions as per the verbal condition, but this time each child was asked to *"draw and tell"* their answers.

Dramatisation condition. In this condition, participants were asked to show and narrate what they witnessed through gestures and mime. The experimenter said: *"Can you show and tell me all about what happened? Show me anything you can remember about the time when you got the sticker"*. Children were further asked to show and tell what happened *"by using your hands and your legs, like this"* (experimenter moves hands and legs). To ascertain they understood the task, the experimenter used the following everyday example: *"When I wake up in the morning I open my eyes (experimenter opens eyes, stretches and yawns), I wash my face (experimenter pretends to wash her face), I brush my teeth (experimenter pretends to brush her teeth), I eat my breakfast (experimenter pretends to eat breakfast from a bowl), I drink my milk (experimenter pretends to drink milk), and then I go to school (experimenter pretends to walk)"*. The questions phase followed with the experimenter asking the same four questions as per the verbal condition, but this time each child was asked to *"show and tell"* their answers. If a child did not spontaneously *"show"* while narrating, they were asked to do so through prompts such as *"Please show and tell me"*.

During each interview, the experimenter only responded enough to maintain the conversation. Non-directive prompts were used to maintain the conversational flow such as *"uh huh"*, *"and then what"*, *"tell me more"*, *"show me"*, *"is there anything else you can remember/draw/show me about the time when you got the sticker?"*, and repetitions of a portion of the child's words. These prompts were not given directly in response to a child's answers but were provided more generally. When each child had stated they could not remember anything else, the questions phase followed.

Coding

Interviews of all conditions were video and audio recorded and were transcribed verbatim. Only

verbal responses were coded in each condition. Children's scores in free recall and the questions phase were coded in line with the coding schemes used in previous research (e.g. Gross & Hayne, 1998; Salmon et al., 2003). All details provided as an answer to the initial open-ended question were coded as Free Recall. All responses given to the four questions and any other piece of information that was offered spontaneously at this stage of the interview were coded as questions phase. We coded the amount of accurate information elicited into one of seven content categories listed below (Salmon et al., 2003); each child received a score for each category. We then collapsed all categories (apart from errors) into a *total amount of information* category for free recall and the questions phase ("TotalDetails" in the analysis scripts). Children were only given credit the first time they reported a piece of information. *People* referred to any people present in the event other than the child him/herself and the main characters of the book (e.g. *the lady* took the monkey, *the elephant* was lost). *Actions* involved activities that took place during the event and in the storybook (e.g. he *read* a story). *Objects* included items that were present in the event and the storybook (e.g. the cuddly *toy*). *Places* and *time* included information referring to places and time in the storybook and the event (e.g. he sat *on* a chair, the elephant found his mum *again*). *Affective information* involved any information offered regarding the child's evaluation of the event, the emotions expressed during the event by the actors, and the emotions experienced by the characters of the book (e.g. the lady was *angry*, the elephant was *scared*). *Descriptions* were elaborations of all the categories (e.g. *two* toys, a *black* shirt). Only information relating to the child's description of the event and the storybook was coded. Any verbal information offered which was not true (e.g. the book was about *Gruffalo*) was coded as *error* and was examined in our analyses.

The experimenter coded 100% of the transcripts and a second coder, who was blind to the hypotheses of the study, independently coded 25% of all narratives randomly selected from all conditions and delays (17 transcripts from the first interview, 24 transcripts from the second interview, and 17 transcripts from the third interview). Inter-observer reliability was calculated using Pearson product-moment correlations (Jack et al., 2015). Correlations on total items of each content category yielded a correlation coefficient of $r(15) = 0.99$, $p < .001$ for

the first interview, $r(22) = 0.99$, $p < .001$ for the second interview, and $r(14) = 0.99$, $p < .001$ for the third interview. Three further Pearson product-moment correlation on the amount of errors produced by the participants in both phases of each interview yielded an inter-observer reliability coefficient of $r(15) = 0.93$, $p < .001$ for the first interview, $r(22) = 0.99$, $p < .001$ for the second interview, and $r(15) = 0.94$, $p < .001$ for the third interview. The experimenter's scores were used for analysis.

Modelling

Linear mixed effects modelling (lmem) was used to analyse the coded transcripts. This analysis has two major advantages: first, it allows us to look at the nested structure of the data, investigating possible effects of the location of the study (four different schools) and the exact event that they witnessed (six performances across the schools). Secondly, modelling allows us to investigate the interactions between the conditions and children's individual characteristics in a more direct analysis. The modelling was done in R using the lme4 package (Bolker et al., 2009). ANOVA function was used to compare different models.

A trial was defined as a free recall or a questions phase session of the interviews at each time delay. For each trial the DVs included seven categories: people, actions, objects, descriptions, places, time, and affective information. From these, a total amount of information variable was created: summing all types of correct details (all categories excluding errors). Any trials where this was zero (e.g. because a child was not interviewed, or the child gave no information) were removed from the dataset leaving 361 observations from 80 participants. Not all parents filled in the EAS Survey for all time delays, this reduced the dataset to 357 observations from 79 participants. The modelling was started as an empty model and built up, the cognitive skills and temperament predictors were modelled separately before studying their combined effects. As objects are a subset of the total details variable, they were analysed by using the model found to be the best model for total details (Hypothesis 2). More information about the modelling is given in the supplementary material. Tables and figures in the supplementary materials are marked with "s". Descriptive statistics of the children's scores in the instruments used in the study are presented in the supplementary material (Table s36).

Data transformations

The total details variable was not normally distributed (Shapiro-Wilkes $W = 0.86$, $p < .001$; see Figure s1). The variable was log-transformed and was then normally distributed (Shapiro-Wilkes $W = 0.99$, $p = .24$). All reported tests are done on this log-transformed variable. The objects variable was also not normally distributed (Shapiro-Wilkes $W = 0.87$, $p < .001$; see Figure s2). Because there are meaningful zero values in this variable (a child may report no objects while still performing the task correctly), a Tukey transformation was conducted (using the Rcompanion package). The residuals were not normally distributed (Shapiro-Wilkes $W = 0.97$, $p < .001$; see Figure s2), but the improvement was visible in the Q-Q plot, so the transformed variable was used (see Figure s3).

Results

Preliminary one-way Analyses of Variance (ANOVAs) revealed no significant differences across conditions (all $F_s < 1.67$, all $p_s > .05$) in symbolic play (ToPP), PLS auditory comprehension, PLS expressive communication, EAS emotionality, EAS activity, and EAS shyness. However, there was a significant difference in EAS sociability ($F(2, 63) = 4.05$, $p = .022$, $\eta_p^2 = 0.11$), thus it was used as a covariate in the following analyses.

Interview duration

For each interview, a one-way ANCOVAs with condition (Verbal, Drawing, Dramatisation) as the between-subject factor, age (in months) and sociability as covariates and interview duration as the dependent variable was conducted. There was a significant main effect of condition on interview duration (first interview: $F(2, 75) = 27.79$, $p < .001$, $\eta_p^2 = 0.43$; second interview: $F(2, 74) = 25.71$, $p < .001$, $\eta_p^2 = 0.41$; third interview: $F(2, 61) = 20.81$, $p = .013$, $\eta_p^2 = 0.41$). Post hoc Bonferroni tests (VanderWeele & Mathur, 2019) revealed that in all time delays the

Drawing interviews were significantly longer than the Verbal and the Dramatisation interviews (all $p_s < .001$). Age and sociability did not have an effect (all $F_s < 3.97$, all $p_s > .05$). Descriptives for the duration of each interview in each time delay are presented in the supplementary material (Table s37).

Interviewer's non-directive prompts

The mean rate of prompts per minute for each interview was calculated, and for each interview, a one-way ANCOVA with condition as a between-subjects factor and age and sociability as covariates was performed. The analysis for the first interview revealed no significant main effects (all $F_s < 3.91$, all $p_s > .05$). For the second and the third interview, significant main effects of condition (second interview: $F(2, 74) = 5.39$, $p = .007$, $\eta_p^2 = 0.13$, third interview: $F(2, 61) = 3.54$, $p = .035$, $\eta_p^2 = 0.10$) and age (second interview: $F(1, 74) = 16.10$, $p < .001$, $\eta_p^2 = 0.18$, third interview: $F(1, 61) = 9.58$, $p = .003$, $\eta_p^2 = 0.14$) were found. Further post hoc Bonferroni tests for the second interview revealed a similar pattern to that found in Wesson and Salmon (2001): The mean rate of prompts per minute given in the Drawing condition ($M = 7.98$, $SD = 3.22$) was significantly lower than the Dramatisation condition ($M = 11.42$, $SD = 4.51$, $p = .005$) but not the Verbal condition ($M = 10.35$, $SD = 4.56$, $p = .099$). In the third interview, the mean rate of prompts per minute in the Drawing condition ($M = 6.48$, $SD = 3.21$) was significantly lower than the Verbal condition ($M = 9.33$, $SD = 3.39$, $p = .030$) but not the Dramatisation condition ($M = 7.98$, $SD = 3.31$, $p = .480$).

Accuracy scores and analyses for errors

The total number of items recalled by the children in each condition and recall phase across the three interviews (time delays) is presented in the supplementary material (Table s38). To examine how accurate children were in their responses and whether this differed by condition, we calculated

Table 1. Means (M) and Standard Deviations (SD) of total percent correct accuracy scores in each condition of each interview scores for free recall.

	Verbal M (SD)	Drawing M (SD)	Dramatisation M (SD)
1st interview	96.72 (5.07)	98.08 (3.77)	98.89 (4.28)
2nd interview	97.08 (7.07)	90.60 (23.02)	99.29 (1.64)
3rd interview	81.97 (36.78)	84.17 (31.90)	87.50 (35.35)

Table 2. Means (M) and standard deviations (SD) of total percent correct accuracy scores in each condition of each interview for the questions phase.

	Verbal M (SD)	Drawing M (SD)	Dramatisation M (SD)
1st interview	85.65 (19.82)	90.08 (15.19)	90.34 (14.14)
2nd interview	90.16 (13.59)	80.79 (23.89)	79.17 (31.82)
3rd interview	60.83 (33.97)	60.43 (37.72)	61.12 (37.48)

percent correct accuracy scores in each recall phase (free recall, questions phase) of each interview (see [Tables 1 and 2](#)).

To investigate differences in accuracy in each recall phase across the three interviews, two 3 (condition: Verbal, Drawing, Dramatisation) $\times$ 3 (delay: first interview vs. second interview vs. third interview) repeated measures ANCOVAs with age and sociability entered as covariates were conducted. No significant main effects or interactions were found (all F s < 3.36 , all p s $> .05$). Children generally produced highly accurate responses (except for the questions phase in the 3rd interview), which did not differ statistically across conditions. Two similar analyses were conducted (one for each recall phase) with “errors” as a dependent variable which produced no significant main effects or interactions (all F s < 1.42 , all p s $> .05$).

Modelling total details

Random factors

Models including random effects of both schools and event were tested (see supplementary material, [Tables s1-s4](#)). Neither model was significantly better than a model using only participant as a random factor (Schools $\chi^2 < .001$, $p \sim 1$; Event: $\chi^2 = 0.08$, $p = .78$). In all further models, only a random factor participant was used. The finding that a nested structure is not an improvement on the model suggests that there was little systematic variation caused by the children seeing different events. We took this as a sign that the event was very similar across performances.

Overall best model

The final best model includes a three-way interaction between condition $\times$ recall phase $\times$ delay, plus a main effect of shyness (estimate = -0.19 , $SE = 0.07$, $t = -2.70$), a main effect of symbolic skills (ToPP estimate = 0.05 , $SE = 0.01$, $t = 5.21$), plus a random effect of participant. Age, PLS, and mood score were not significant contributors to this model (see [Tables s29-s30](#)).

The three-way effect (see [Figures 1 and 2](#)) seems to be driven by the steeper decline in performance of children in the drawing condition in the third interview (estimate of third interview: drawing interview = -1.43 , $SE = 0.35$, $t = -4.14$), particularly for free recall (estimate = 1.6 , $SE = 0.46$, $t = 3.47$) (see [Figures 1 and 2](#)). Note that there is no

evidence of any main effects of the variables in the three-way interaction. The model does not support Hypothesis 1, which stated that drawing and dramatisation would lead to more details being provided: any benefit to these methods fades across the delays. Hypotheses four and five, that symbolic skills and temperament would interact with condition and that children higher language skills would provide more detail were also not supported. However, there was a positive main effect of symbolic skills and a negative main effect of shyness.

Modelling object details

In order to test the second hypothesis that children in the drawing condition would report more details about objects than children in verbal condition, the model which derived from the total details analysis was also run on the objects variable. The three-way effect between condition $\times$ recall phase $\times$ delay is also present in the objects variable. Again, this effect seems to be driven by an exceptionally low performance of children in the drawing condition of the third interview (estimate of third interview: drawing condition = -1.19 , $SE = 0.32$, $t = -3.73$), particularly for free recall (estimate = 1.27 , $SE = 0.43$, $t = 2.97$; see [Table s35](#)). As hypothesised, for the objects variable, there also appears to be a main effect of condition (see [Figure 3](#); estimate drawing condition (vs. verbal condition) = 0.47 , $SE = 0.21$, $t = 2.26$; estimate dramatisation condition (vs. verbal condition) = 0.32 , $SE = 0.21$, $t = 1.53$). In the free recall phase of the first and the second interview, drawing elicited more object details (first interview mean number of objects = 1.78 , 95% CI = 1.50 – 2.06 ; second interview mean number of objects = 1.67 , 95% CI = 1.38 – 1.95) than the verbal interviews (first interview mean number of objects = 1.31 , 95% CI = 1.02 – 1.60 ; second interview mean number of objects = 1.49 , 95% CI = 1.16 – 1.83), but drawing elicited fewer objects than the verbal condition in the third interview (third interview mean number of objects in drawing = 0.67 , 95% CI = 0.33 – 1.00 ; third interview mean number of objects in verbal = 1.39 , 95% CI = 0.99 – 1.79) (see [Figures 3 and 4](#)). Again, symbolic skills were significantly (positively) associated with reporting object details (ToPP estimate = 0.03 , $SE = 0.01$, $t = 4.26$). However, shyness was not significant in this model (Shyness estimate = -0.06 , $SE = 0.05$, $t = -1.07$).

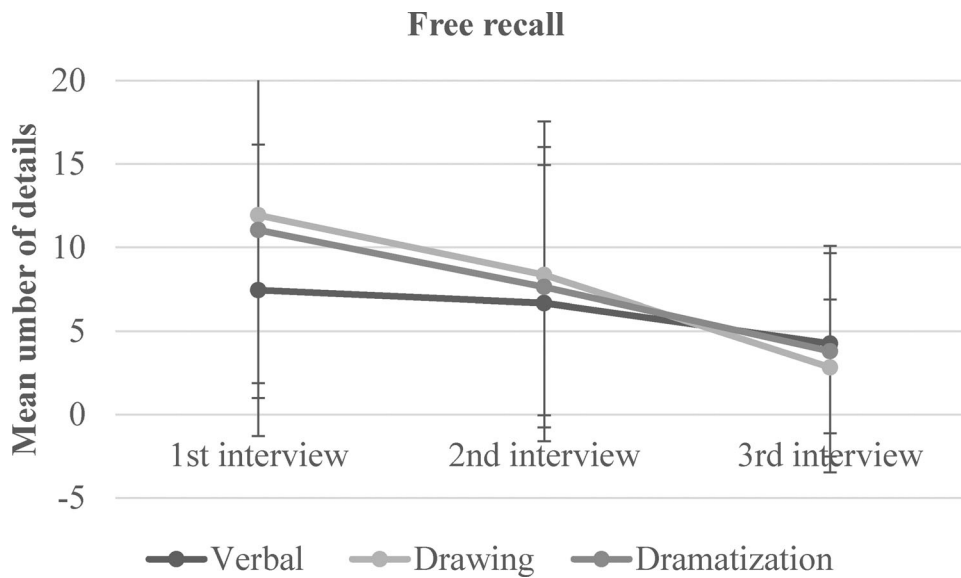


Figure 1. Mean number of details (and error bars of standard deviation) reported in each condition of each interview in free recall.

Discussion

This study used a novel staged event to investigate the interaction between symbolic skills, language ability, temperament, and mood and nonverbal interview techniques in children's recall. The first hypothesis was not supported: the children who drew and those who dramatised did not report significantly more details about the event compared to the children who merely narrated. Confirming the second hypothesis, we found that the children

who drew reported significantly more objects than the children who simply talked in the first two interviews. However, after six months, the children who drew recalled fewer objects than children in the verbal condition. Our fourth and fifth hypotheses were not confirmed; no significant interactions emerged between cognitive skills or temperament and condition. We also found no effects of mood on recall. Nonetheless, children with better symbolic skills recalled more information overall, and shyer children recounted fewer details overall.

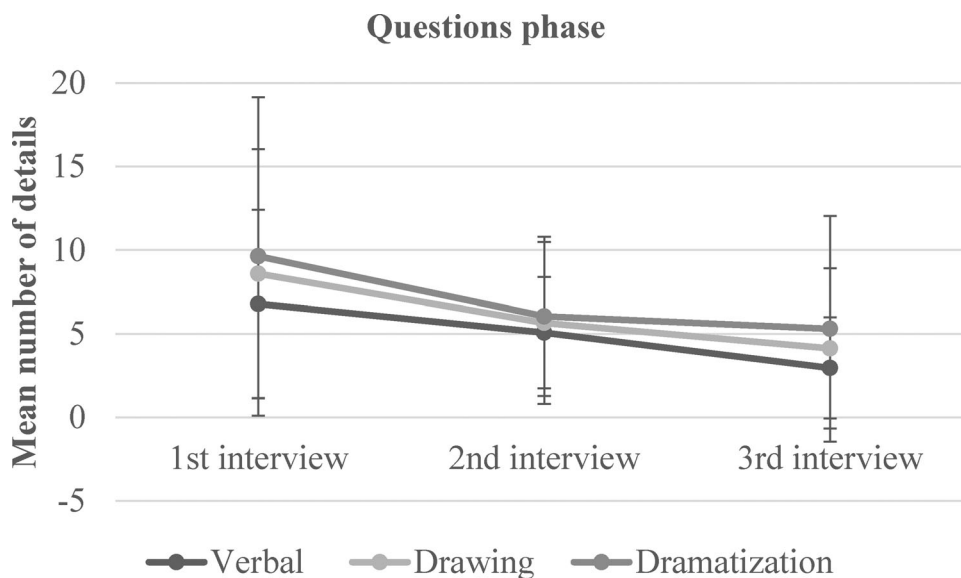


Figure 2. Mean number of details (and error bars of standard deviation) reported in each condition of each interview in questions phase.

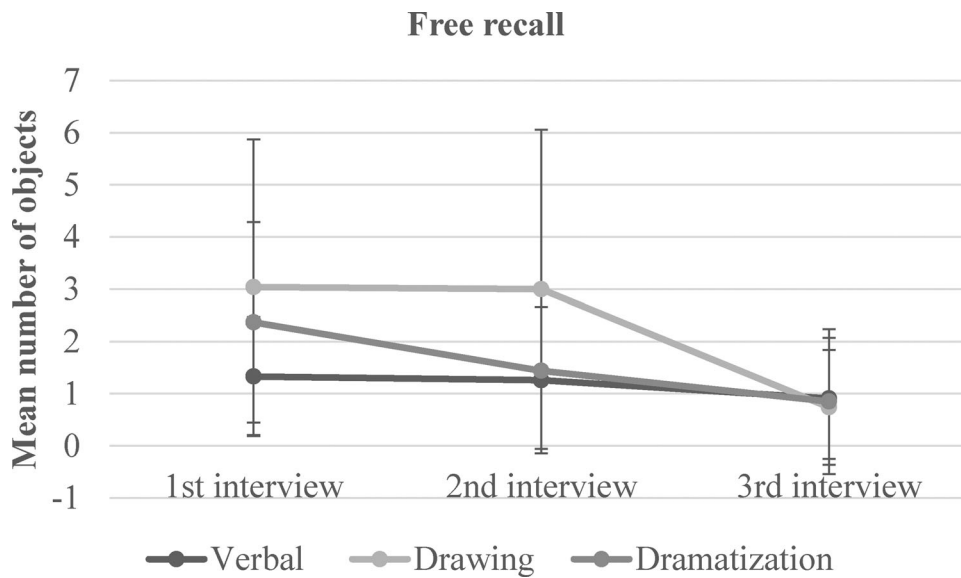


Figure 3. Mean number of objects (and error bars of standard deviation) reported in each condition of each interview in free recall.

As with previous work (Gross & Hayne, 1998), our findings showed that children who drew reported more objects within a two-week delay from the event. In line with the embodied cognition theory (Kiefer & Trumpp, 2012), drawing may have activated sensory and motoric neural pathways in the children's brains (through visualising the items they drew and engaging in motoric action) which enhanced their recall and provided two potential routes into memory stores. Children may also draw more objects because drawing objects is easier than drawing actions; indeed, objects are one of the first types of representational drawings children create (Eng, 1999; Golomb, 1974). It is possible that the aspects of planning during drawing production favour object representations. When executing a drawing, one needs to be specific about the size and spatial relationships of the elements being drawn (Golomb & Farmer, 1983), which may focus children on concrete elements such as objects to provide initial structure to the scene. Future work could note whether children draw objects first and graphically structure the remainder of the event around them. Additionally, the longer duration of the drawing interview relative to the other conditions may have affected memory recall by allowing children more time to search their memory and provide a structure for their reports (Butler et al., 1995; Pipe et al., 2002; Salmon, 2001).

Contrary to Gross and Hayne (1999), drawing did not benefit recall after six months. Children reported

fewer details about objects in the drawing compared to the verbal condition in free recall. These disparate findings may reflect children's overall inability to (freely) retrieve information from their memory after six months (Butler et al., 1995; Pipe et al., 2004). After such a long retention interval, children may have forgotten parts of the event (decay) (Nairne, 2002; Page & Norris, 1998) and may have required adult scaffolding (i.e. more focused questions such as "who said that?") to facilitate their memory (Larsson & Lamb, 2009). This is in line with Barlow et al. (2011), who found that drawing is more useful when combined with specific "wh" questions (e.g. who, what). It is however possible that the verbal interview benefited children more than the drawing interview; children in the verbal condition faced a simpler interview process to begin with, thus in subsequent interviews, they focused on remembering the actual event. On the contrary, children in the drawing condition were faced with a potentially more complex interview process involving both drawing and telling. Interference from the drawing activity may have affected their memory to a greater extent if children recalled the drawing event alongside the actual event, leading to greater decay compared to the verbal interview.

The decrease in the amount of information recalled after six months may also be linked to the nature of our event. Contrary to Gross and Hayne (1999) who utilised a long out-of-school activity,

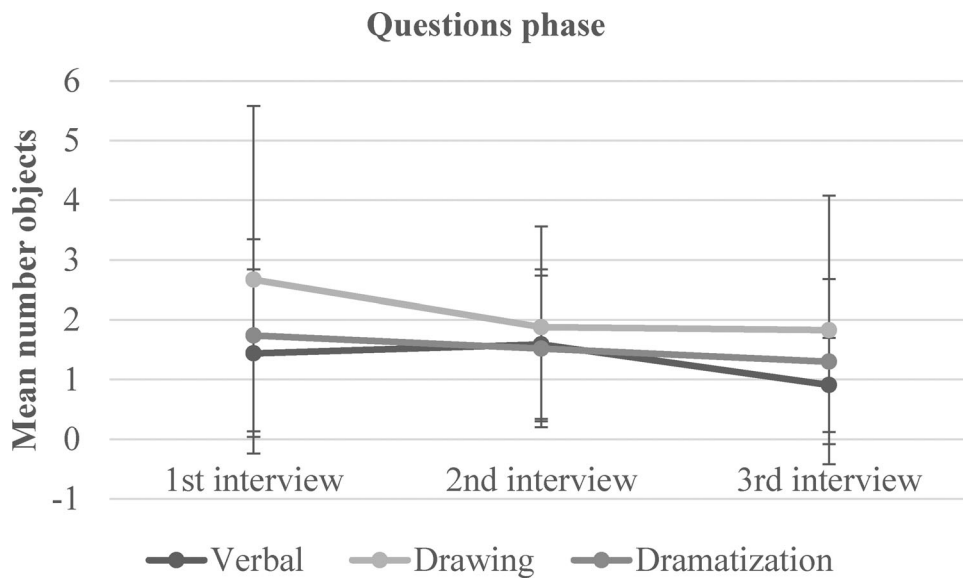


Figure 4. Mean number of objects (and error bars of standard deviation) reported in each condition of each interview in questions phase.

we used a short, novel event that took place in the children's school, a setting children are familiar with and are exposed to every day. Aspects of the event here may have been confused with other school activities (e.g. storybook reading in their classroom) and thus forgotten (Van Dyke, 2012). Our finding supports previous criticisms that drawing is only an effective retrieval cue for events that are distinct and novel compared to everyday, routine events (Jolley, 2010; Salmon & Pipe, 2000). Nonetheless, events that happen in a familiar environment are crucial, given that children may be witnesses of domestic abuse or bullying in school, and therefore are worth investigating further. Since only a handful of studies have investigated the effects of drawing on young children's recall (e.g. 3-to 4-year olds; see, Magnusson et al., 2020) more research is needed to produce more conclusive findings.

Unlike Wesson and Salmon's findings (2001), dramatisation did not facilitate children's recall. They found that drawing and reenactment were equally effective methods for eliciting more descriptions compared to a verbal-only interview. Two methodological differences may explain these disparate findings. Children in Wesson and Salmon's study were asked to make a corresponding facial expression of the emotion they had felt at the time of the experience and found that reenactment facilitated verbal recall. This parallels Liwag and Stein's method (1995) who also found an advantage when children "emotionally reinstated" personal past

experiences. In our study, the children passively watched an interaction between two other people, which may have not been encoded as efficiently as a self-performed task (Hornstein & Mulligan, 2001). Thus, the findings of this study may differ from prior work because here the children did not re-experience the event emotionally, and this study involved an observed rather than a personal event.

Contrary to our expectations, no interaction between the three-way effect between condition, delay and recall phase and children's internal characteristics emerged. Instead, we found that children with greater symbolic and language skills recalled more details, regardless of condition. It is possible that we did not have sufficient power across conditions to pick up more subtle interactions. Further analyses on the overall best model showed that symbolic ability had a significant effect on recall, with age not significantly contributing to the model. This finding is critical in that it indicates that the level of children's symbolic ability may actually facilitate recall, particularly for objects. This finding could be explained by the measure we used to assess symbolic skills. Success on the ToPP (Lewis & Boucher, 1998) requires children to think flexibly and refer to absent objects, which are also required when recounting a past event. It further suggests that children with more advanced symbolic skills may be able to provide more detailed testimonies, and interviewers can be flexible in the interview approach they adopt.

Temperament also influenced verbal recall: shy children reported fewer details than less shy children. Their verbal performance may have been worse because the social demands of the interview evoked feelings of distress and inhibition, not because they forgot the information. Such children may need more time to get acquainted with interviewers, build rapport with them, and adjust to the demands of the interview. Shy children may offer brief descriptions of an event because they feel uncomfortable in unfamiliar settings than in the presence of familiar individuals (Asendorpf & Meier, 1993). This suggests that building rapport with shy children is vital for the interview process (Roebers & Schneider, 2001). Manipulating rapport-building strategies is a fruitful area (Saywitz et al., 2015).

Finally, there were no differences among age, condition, sociability, and delay in accuracy scores. Although not a significant difference, the accuracy rate in the questions phase dropped after six months (to approximately 60%). This is in line with previous work, which suggests that more direct prompts in interviews with children are related to higher levels of inaccuracy (Larsson & Lamb, 2009; Melnyk et al., 2006). As children reported fewer details in the drawing condition after six months in response to free recall prompts and young children require more specific questions to retrieve information from their memory (Poole & Lamb, 1998), it is important to investigate further the interaction between different nonverbal methods and different types of questions.

Our study has several limitations. First, we did not control for children's initial drawing skills in this study in line with similar studies (e.g. Jack et al., 2015; Salmon et al., 2003). Future research should take this into account when investigating the effects of drawing in children's recall to look at the relation between representational quality and usefulness of drawing as a memory aid, particularly if the same drawing is introduced at different time intervals. Second, the event involved a child-friendly argument between two friends over who would read a storybook to the children. Ideally, a real forensic event would provide an ecologically valid scenario, however, for ethical reasons, it was not possible to stage a truly traumatic event for young children. An experienced event may be better recalled than an observed one (Murachver et al., 1996), and a longer event may have given the children more to report on. However, children are

often witnesses, but not participants, in criminal situations (e.g. domestic abuse, Underwood, 2003) and such events are often brief. Third, real-life interviews may be conducted in unfamiliar locations, use several interviewers, and follow formal interview protocols (e.g. Brown et al., 2013). Our interviews did not follow these guidelines and procedures, therefore, caution should be taken regarding our findings' application. Fourth, our sample size decreased substantially by the third interview, which reduced our power to detect effects in later interviews. Given that children are usually interviewed after long delays, more research is needed on their recall, especially in relation to drawing. Future researchers should plan for substantial participant drop-out over a long-range time frame. Finally, we did not take measures to limit possible suggestibility (Ceci & Bruck, 1993) or declarative contagion of the children (e.g. asking children to avoid practicing or talking to other children about the event from the first to the second and third interview). Future research should take this into account given that children's memory is more malleable than adults and thus more prone to mistakes (Loftus & Davies, 1984).

Nonetheless, our study adds to an increasing amount of research regarding young children's eye-witness memory and the nonverbal cues that enhance their reports. It shows that drawing while narrating has a positive effect on children's verbal recall, particularly about objects, within a short time frame. Future research should try to tease apart precisely what aspects of drawing help children report more information. Our study further highlights that children's internal characteristics may play an important part in forensic interviews. Children's symbolic ability and shyness may influence their verbal recall, irrespective of the interview method utilised. From an applied perspective, an understanding of children's individual characteristics may help interviewers determine which interview method is more appropriate for each individual child.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data that support the findings of this study are openly available in OSFHome at <http://doi.org/10.17605/OSF.IO/6D2R8>.

References

- Asendorpf, J. B., & Meier, G. H. (1993). Personality effects on children's speech in everyday life: Sociability-mediated exposure and shyness-mediated reactivity to social situations. *Journal of Personality and Social Psychology*, 64(6), 1072–1082. <https://doi.org/10.1037/0022-3514.64.6.1072>
- Baker-Ward, L., Gordon, B. N., Ornstein, P. A., Larus, D. M., & Clubb, P. A. (1993). Young children's long term retention of a pediatric examination. *Child Development*, 64(5), 1519–1533. <https://doi.org/10.1111/j.1467-8624.1993.tb02968.x>
- Barlow, M. C., Jolley, R. P., & Hallam, L. J. (2011). Drawing as memory aids: Optimising the drawing method to facilitate young children's recall. *Applied Cognitive Psychology*, 25(3), 480–487. <https://doi.org/10.1002/acp.1716>
- Bates, J. L., Ricciardelli, L. A., & Clarke, V. A. (1999). The effects of participation and presentation media on the eyewitness memory of children. *Australian Journal of Psychology*, 51(2), 71–76. <https://doi.org/10.1080/00049539908255338>
- Baugerud, G. A., Magnussen, S., & Melinder, A. (2014). High accuracy but low consistency in children's long-term recall of a real-life stressful event. *Journal of Experimental Child Psychology*, 126, 357–368. <https://doi.org/10.1016/j.jecp.2014.05.009>
- Bodén, L. (2021). On, to, with, for, by: Ethics and children in research. *Children's Geographies*. <https://doi.org/10.1080/14733285.2021.1891405>
- Boland, A. M., Haden, C. A., & Ornstein, P. A. (2003). Boosting children's memory by training mothers in the use of an elaborative conversational style as an event unfolds. *Journal of Cognition and Development*, 4(1), 39–65. <https://doi.org/10.1080/15248372.2003.9669682>
- Bolker, B. M., Brooks, M. E., Clark, C. J., Geange, S. W., Poulsen, J. R., Stevens, M. H. H., & White, J. S. S. (2009). Generalized linear mixed models: A practical guide for ecology and evolution. *Trends in Ecology & Evolution*, 24(3), 127–135. <https://doi.org/10.1016/j.tree.2008.10.008>
- Brown, A. D., Lamb, M. E., Lewis, C., Pipe, M.-E., Orbach, Y., & Wolfman, M. (2013). The NICHD investigative interview protocol: An analogue study. *Journal of Experimental Psychology: Applied*, 19(4), 367–382. <https://doi.org/10.1037/a0035143>
- Bruck, M., Melnyk, L., & Ceci, S. J. (2000). Draw it again Sam: The effect of drawing on children's suggestibility and source monitoring ability. *Journal of Experimental Child Psychology*, 77(3), 169–196. <https://doi.org/10.1006/jecp.1999.2560>
- Buchanan, H., & Niven, N. (2002). Validation of a facial image scale to assess child dental anxiety. *International Journal of Pediatric Dentistry*, 12(1), 47–52. <https://doi.org/10.1046/j.0960-7439.2001.00322.x>
- Burgwyn-Bailes, E., Baker-Ward, L., Gordon, B. N., & Ornstein, P. A. (2001). Children's memory for emergency medical treatment after one year: The impact of individual difference variables on recall and suggestibility. *Applied Cognitive Psychology*, 15(7), 525–548. <https://doi.org/10.1002/acp.833>
- Buss, A. H., & Plomin, R. (1984). *Temperament. Early developing personality traits*. Erlbaum.
- Butler, S., Gross, J., & Hayne, H. (1995). The effect of drawing on memory performance in young children. *Developmental Psychology*, 31(4), 597–608. <https://doi.org/10.1037/0012-1649.31.4.597>
- Cassel, W. S., & Bjorklund, D. F. (1995). Developmental patterns of eyewitness memory and suggestibility: An ecologically based short-term longitudinal study. *Law and Human Behavior*, 19(5), 507–532. <https://doi.org/10.1007/BF01499341>
- Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin*, 113(3), 403–439. <https://doi.org/10.1037/0033-2909.113.3.403>
- Chae, Y., & Ceci, S. J. (2005). Individual differences in children's recall and suggestibility: The effect of intelligence, temperament, and self-perceptions. *Applied Cognitive Psychology*, 19(4), 383–407. <https://doi.org/10.1002/acp.1094>
- Clift, S., Stagnitti, K., & DeMello, L. (1998). A validation study of the test of pretend play using correlational and classificational analyses. *Child Language Teaching and Therapy*, 14(2), 199–209. <https://doi.org/10.1191/026565998675895190>
- Colonesi, C., Engelhard, I. M., & Bögers, S. M. (2010). Development in children's attribution of embarrassment and the relationship with theory of mind and shyness. *Cognition and Emotion*, 24(3), 514–521. <https://doi.org/10.1080/02699930902847151>
- Cook, S. W., Yip, T. K., & Goldin-Meadow, S. (2010). Gestures make memories last. *Journal of Memory and Language*, 63(4), 465–475. <https://doi.org/10.1016/j.jml.2010.07.002>
- Cox, M. V. (1992). *Children's drawings*. Penguin.
- Dando, C. J. (2013). Drawing to remember: External support of older adults' eyewitness performance. *PLoS One*, 8(7), e69936. <https://doi.org/10.1371/journal.pone.0069937>
- Davison, L. E., & Thomas, G. V. (2001). Effects of drawing on children's item recall. *Journal of Experimental Child Psychology*, 78(2), 155–177. <https://doi.org/10.1006/jecp.2000.2567>

- Eng, H. (1999). *The psychology of children's drawings: From the first stroke to the coloured drawing* (H. Stafford Hatfield, Trans.). Routledge. (Original work published 1931).
- Engelkamp, J., & Jahn, P. (2003). Lexical, conceptual and motor information in memory for action phrases: A multi-system account. *Acta Psychologica*, 113(2), 147–165. [https://doi.org/10.1016/S0001-6918\(03\)00030-1](https://doi.org/10.1016/S0001-6918(03)00030-1)
- Engelkamp, J., Seiler, K. H., & Zimmer, H. D. (2004). Memory for actions: Item and relational information in categorized lists. *Psychological Research*, 69(1), 1–10. <https://doi.org/10.1007/s00426-003-0160-7>
- Engelkamp, J., & Zimmer, H. D. (1994). *Human memory: A multimodal approach*. Hogrefe & Huber Publishers.
- Gardner, E., Gross, J., & Hayne, H. (2020). The effect of drawing and socioeconomic status on children's reports of a past experience. *Journal of Experimental Psychology: Applied*, 26(3), 397–410. <https://doi.org/10.1037/xap0000264>
- Goldin-Meadow, S. (2011). Learning through gesture. *Wiley Interdisciplinary Reviews. Cognitive Science*, 2(6), 595–607. <https://doi.org/10.1002/wcs.132>
- Golomb, C. (1974). *Young children's sculpture and drawing: A study in representational development*. Harvard University Press.
- Golomb, C., & Farmer, D. (1983). Children's graphic planning strategies and early principles of spatial organization in drawing. *Studies in Art Education*, 24(2), 86–100. <https://doi.org/10.2307/1319564>
- Gordon, B. N., Ornstein, P. A., Nida, R. E., Follmer, A., Crenshaw, M. C., & Albert, G. (1993). Does the use of dolls facilitate children's memory of visits to the doctor? *Applied Cognitive Psychology*, 7(6), 459–474. <https://doi.org/10.1002/acp.2350070602>
- Gross, J., & Hayne, H. (1998). Drawing facilitates children's verbal reports of emotionally laden events. *Journal of Experimental Psychology: Applied*, 4(2), 163–174. <https://doi.org/10.1002/acp.706>
- Gross, J., & Hayne, H. (1999). Drawing facilitates children's verbal reports after long delays. *Journal of Experimental Psychology: Applied*, 5(3), 265–283. <https://doi.org/10.1037/1076-898X.5.3.265>
- Gross, J., Hayne, H., & Drury, T. (2009). Drawing facilitates children's reports of factual and narrative information: Implications for educational contexts. *Applied Cognitive Psychology*, 23(7), 953–971. <https://doi.org/10.1002/acp.1518>
- Gross, J., Hayne, H., & Poole, A. (2006). The use of drawing in interviews with children: A potential pitfall. In J. R. Marrow (Ed.), *Focus on child psychology* (pp. 119–144). Nova Publishers.
- Gupta, P., & MacWhinney, B. (1997). Vocabulary acquisition and verbal short-term memory: Computational and neural bases. *Brain and Language*, 59(2), 267–333. <https://doi.org/10.1006/brln.1997.1819>
- Hammond, N. R., & Fivush, R. (1991). Memories of Mickey Mouse: Young children recount their trip to Disney World. *Cognitive Development*, 6(4), 433–448. [https://doi.org/10.1016/0885-2014\(91\)90048-I](https://doi.org/10.1016/0885-2014(91)90048-I)
- Hope, L., Blocksidge, D., Gabbert, F., Sauer, J. D., Lewinski, W., Mirashi, A., & Atuk, E. (2016). Memory and the operational witness: Police officer recall of firearms encounters as a function of active response role. *Law and Human Behaviour*, 40(1), 23–35. <https://doi.org/10.1037/lhb0000159>
- Hornstein, S. L., & Mulligan, N. W. (2001). Memory of action events: The role of objects in memory of self- and other-performed tasks. *The American Journal of Psychology*, 114(2), 199–217. <https://doi.org/10.2307/1423515>
- Iordanou, C., Allen, M., & Warmelink, L. (2021). Drawing in eyewitness testimony: What is the content of children's drawings and how does it differ from their verbal reports? *Empirical Studies of the Arts*, 40(2), 245–258. <https://doi.org/10.1177/02762374211047971>
- Iverson, M. J., & Goldin-Meadow, S. (2005). Gesture paves the way to language development. *Psychological Science*, 16(5), 367–371. <https://doi.org/10.1111/j.0956-7976.2005.01542.x>
- Jack, F., Martyn, E., & Zajac, R. (2015). Getting the picture: Effects of sketch plans and photographs on children's, adolescents' and adults' eyewitness recall. *Applied Cognitive Psychology*, 29(5), 723–734. <https://doi.org/10.1002/acp.3156>
- Jolley, R. P. (2010). *Children & pictures: Drawing and understanding*. Willey-Blackwell.
- Kagan, J., Reznick, J. S., & Snidman, N. (1987). The physiology and psychology of behavioral inhibition in children. *Child Development*, 58(6), 1459–1473. <https://doi.org/10.2307/1130685>
- Katz, C., & Hershkowitz, I. (2010). The effects of drawing on children's accounts of sexual abuse. *Child Maltreatment*, 15(2), 171–179. <https://doi.org/10.1177/1077559509351742>
- Kiefer, M., & Trumpp, N. M. (2012). Embodiment theory and education: The foundations of cognition in perception and action. *Trends in Neuroscience and Education*, 1(1), 15–20. <https://doi.org/10.1016/j.tine.2012.07.002>
- Lamb, M. E., Sternberg, K. J., Orbach, Y., Esplin, P. W., Stewart, H., & Mitchell, S. (2003). Age differences in young children's responses to open ended initiations in the course of forensic interviews. *Journal of Consulting and Clinical Psychology*, 71(5), 926–934. <https://doi.org/10.1037/0022-006X.71.5.926>
- La Rooy, D., Katz, C., Malloy, L. C., & Lamb, M. E. (2010). Do we need to rethink guidance on repeated interviews?. *Psychology, Public Policy and Law*, 16(4), 373–392. <https://doi.org/10.1037/a0019909>
- La Rooy, D., Pipe, M.-E., & Murray, J. E. (2005). Reminiscence and hypernesia in children's eyewitness memory. *Journal of Experimental Child Psychology*, 90(3), 235–254. <https://doi.org/10.1016/j.jecp.2004.11.002>
- Larsson, A. S., & Lamb, M. E. (2009). Making the most of information-gathering interviews with children. *Infant and Child Development*, 18(1), 1–16. <https://doi.org/10.1002/icd.573>
- Lev-Wiesel, R., & Liraz, R. (2007). Drawing vs. Narratives: Drawing as a tool to encourage visualization in children whose fathers are drug abusers. *Clinical Child Psychology and Psychiatry*, 12(1), 65–75. <https://doi.org/10.1177/1359104507071056>
- Lewis, V., & Boucher, J. (1998). *The test of pretend play*. Harcourt Brace.

- Lewis, V., Boucher, J., Lupton, L., & Watson, S. (2000). Relationships between symbolic play, functional play, verbal and non-verbal ability in young children. *International Journal of Language and Communication Disorders*, 35(1), 117–127. <https://doi.org/10.1080/136828200247287>
- Liwag, M. D., & Stein, N. L. (1995). Children's memory for emotional events: The importance of emotion-related retrieval cues. *Journal of Experimental Child Psychology*, 60(1), 2–31. <https://doi.org/10.1006/jecp>
- Llanes-Coromina, J., Vilà-Giménez, I., Kushch, O., Borràs-Comes, J., & Prieto, P. (2018). Beat gestures help preschoolers recall and comprehend discourse information. *Journal of Experimental Child Psychology*, 172, 168–188. <https://doi.org/10.1016/j.jecp.2018.02.004>
- Loftus, E. F., & Davies, G. M. (1984). Distortions in the memory of children. *Journal of Social Issues*, 40(2), 51–67. <https://doi.org/10.1111/j.1540-4560.1984.tb01093.x>
- Macleod, E., Gross, J., & Hayne, H. (2013). The clinical and forensic value of information that children report while drawing. *Applied Cognitive Psychology*, 27, 564–573. <https://doi.org/10.1002/acp.2936>
- Macleod, E., Gross, J., & Hayne, H. (2016). Drawing conclusions: The effect of instruction on children's confabulation and fantasy errors. *Memory*, 24(1), 21–31. <https://doi.org/10.1080/09658211.2014.982656>
- Magnusson, M., Ernberg, E., Landström, S., Joleby, M., Akehurst, L., Korkman, J., & Ask, K. (2020). The effects of drawing on preschoolers' statements about experienced and non-experienced events. *Applied Cognitive Psychology*, 35(2), 497–507. <https://doi.org/10.1002/acp.3772>
- Masi, G., Mucci, M., Favilla, L., Brovedani, P., Millepiedi, S., & Perugi, G. (2003). Temperament in adolescents with anxiety and depressive disorders and in their families. *Child Psychiatry and Human Development*, 33(3), 245–259. <https://doi.org/10.1023/A:1021408714741>
- Mattison, M. L. A., Dando, C. J., & Ormerod, T. C. (2015). Sketching to remember: Episodic free recall task support for child witnesses and victims with autism spectrum disorder. *Journal of Autism Developmental Disorder*, 45(6), 1751–1765. <https://doi.org/10.1007/s10803-014-2335-z>
- McGuigan, F., & Salmon, K. (2004). The time to talk: The influence of adult-child talk on children's event memory. *Child Development*, 75(3), 669–686. <https://doi.org/10.1111/j.1467-8624.2004.00700.x>
- Melnyk, L., Crossman, A. M., & Scullin, M. H. (2006). The suggestibility of children's memory. In M. P. Toglia, J. D. Read, D. F. Ross, & R. C. L. Lindsay (Eds.), *Handbook of eyewitness psychology, Vol 1: Memory for events* (pp. 395–421). Lawrence Erlbaum Associates.
- Meltzoff, A. N. (1995). Understanding the intentions of others: Re-enactment of intended acts by 18-month-old children. *Developmental Psychology*, 31(5), 838–850. <https://doi.org/10.1037/0012-1649.31.5.838>
- Murachver, T., Pipe, M. E., Gordon, R., Owens, J., & Fivush, R. (1996). Do, show, and tell: Children's event memories acquired through direct experience, observation, and stories. *Child Development*, 67(6), 3029–3044. <https://doi.org/10.2307/1131765>
- Nairne, J. S. (2002). Remembering over the short term: The case against the standard model. *Annual Review of Psychology*, 53(1), 53–81. <https://doi.org/10.1146/annurev.psych.53.100901.135131>
- Page, M. P. A., & Norris, D. (1998). The primacy model: A new model of immediate serial recall. *Psychological Review*, 105(4), 761–781. <https://doi.org/10.1037/0033-295X.105.4.761-781>
- Patterson, T. G., & Hayne, H. (2011). Does drawing facilitate older children's reports of emotionally laden events? *Applied Cognitive Psychology*, 25(1), 119–126. <https://doi.org/10.1002/acp.1650>
- Ping, R. M., & Goldin-Meadow, S. (2008). Hands in the air: Using ungrounded iconic gestures to teach children conservation of quantity. *Developmental Psychology*, 44(5), 1277–1287. <https://doi.org/10.1037/0012-1649.44.5.1277>
- Pipe, M.-E., Lamb, M. E., Orbach, Y., & Esplin, P. W. (2004). Recent research on children's testimony about experienced and witnessed events. *Developmental Review*, 24(4), 440–468. <https://doi.org/10.1016/j.dr.2004.08.006>
- Pipe, M.-E., & Salmon, K. (2008). Dolls, drawing, body diagrams, and other props. Role of props in investigative interviews. In K. Kuehnle, & M. Connell (Eds.), *The evaluation of child sexual abuse allegations: A comprehensive guide to assessment and testimony* (pp. 365–395). Wiley.
- Pipe, M.-E., Salmon, K., & Priestley, G. (2002). Enhancing children's accounts: How useful are non-verbal techniques. In H. L. Westcott, G. M. Davies, & R. H. C. Bull (Eds.), *Children's testimony: A handbook of psychological research and forensic practice* (pp. 161–174). Wiley.
- Poole, D. A., & Lamb, M. E. (1998). *Investigative interviews of children: A guide for helping professionals*. American Psychological Association.
- Raes, F., Verstraeten, K., Bijttebier, P., Vasey, M. W., & Dalgleish, T. (2010). Inhibitory control mediates the relationship between depressed mood and overgeneral memory recall in children. *Journal of Clinical Child and Adolescent Psychology*, 39(2), 276–281. <https://doi.org/10.1080/15374410903532684>
- Riggins, T. (2014). Longitudinal investigation of source memory reveals different developmental trajectories for item memory and binding. *Developmental Psychology*, 50(2), 449–459. <https://doi.org/10.1037/a0033622>
- Riggins, T., & Rollins, L. (2015). Developmental differences in memory during early childhood: Insights from event-related potentials. *Child Development*, 86(3), 889–902. <https://doi.org/10.1111/cdev.12351>
- Roebbers, C. M., & Schneider, W. (2001). Individual differences in children's eyewitness recall: The influence of intelligence and shyness. *Applied Developmental Science*, 5(1), 9–20. https://doi.org/10.1207/S1532480XADS0501_2
- Salmon, K. (2001). Remembering and reporting by children: The influence of cues and props. *Clinical Psychology Review*, 21(2), 267–300. [https://doi.org/10.1016/S0272-7358\(99\)00048-3](https://doi.org/10.1016/S0272-7358(99)00048-3)
- Salmon, K., & Pipe, M.-E. (2000). Recalling an event one year later: The impact of props, drawing and a prior interview. *Applied Cognitive Psychology*, 14(2), 99–120.

- [https://doi.org/10.1002/\(SICI\)1099-0720\(200003/04\)14:2<99::AID-ACP639>3.0.CO;2-5](https://doi.org/10.1002/(SICI)1099-0720(200003/04)14:2<99::AID-ACP639>3.0.CO;2-5)
- Salmon, K., Roncolato, W., & Gleitzman, M. (2003). Children's reports of emotionally laden events: Adapting the interview to the child. *Applied Cognitive Psychology*, 17(1), 65–79. <https://doi.org/10.1002/acp.845>
- Saywitz, K. J., Larson, R. P., Hobbs, S. D., & Wells, C. R. (2015). Developing rapport with children in forensic interviews: Systematic review of experimental research. *Behavioral Sciences & the Law*, 33(4), 372–389. <https://doi.org/10.1002/bsl.2186>
- Saywitz, K. J., Lyon, T. D., & Goodman, G. S. (2017). When interviewing children: A review and update. In J. Conte, & B. Klika (Eds.), *APSAC handbook on child maltreatment* (pp. 310–329). Sage.
- Stevanoni, E., & Salmon, K. (2005). Giving memory a hand: Instructing children to gesture enhances their event recall. *Journal of Nonverbal Behavior*, 29(4), 217–233. <https://doi.org/10.1007/s10919-005-7721-y>
- Strange, D., Garry, M., & Sutherland, R. (2003). Drawing out children's false memories. *Applied Cognitive Psychology*, 17(5), 607–619. <https://doi.org/10.1002/acp.911>
- Sutcliffe Cleveland, E., & Morris, A. (2014). Autonomy support and structure enhance children's memory and motivation to reminisce: A parental training study. *Journal of Cognition and Development*, 15(3), 414–436. <https://doi.org/10.1080/15248372.2012.742901>
- Tsaroni-Georgiadi, G. (2014). *Ena phoveesmeno elephanta-kee* [A scared little elephant]. Savvalas.
- Underwood, M. K. (2003). *Social aggression among girls*. Guilford.
- VanderWeele, T. J., & Mathur, B. M. (2019). Some desirable properties of the Bonferroni correction: Is the Bonferroni correction really so bad? *American Journal of Epidemiology*, 617–618. <https://doi.org/10.1093/aje/kwy250>
- Van Dyke, J. A. (2012). The role of memory in language and communication. In E. Peach, & L. Shapiro (Eds.), *Cognition and acquired language disorders: A process-oriented approach* (pp. 94–120). Mosby Elsevier.
- Wesson, M., & Salmon, K. (2001). Drawing and showing: Helping children to report emotionally laden, events. *Applied Cognitive Psychology*, 15(3), 301–320. <https://doi.org/10.1002/acp.706>
- Willems, R. M., & Hagoort, P. (2007). Neural evidence for the interplay between language, gesture, and action: A review. *Brain and Language*, 101(3), 278–289. <https://doi.org/10.1016/j.bandl.2007.03.004>
- Woolford, J., Patterson, T., Macleod, E., Hobbs, L., & Hayne, H. (2015). Drawing helps children to talk about their presenting problems during a mental health assessment. *Clinical Child Psychology and Psychiatry*, 20(1), 68–83. <https://doi.org/10.1177/1359104513496261>
- Zimmerman, I. L., Steiner, G. V., & Pond, R. E. (2002). *Preschool language scale, fourth edition*. The Psychological Corporation.