
Article:
Meyer, K.R. orcid.org/0000-0003-3250-0539, Blades, M. and Krähenbühl, S. (2023) The gestural misinformation effect in child interviews in Switzerland. Journal of Nonverbal Behavior, 47. pp. 99-114. ISSN 0191-5886

https://doi.org/10.1007/s10919-022-00419-0

Journal of Nonverbal Behavior (2023) 47:99–114
https://doi.org/10.1007/s10919-022-00419-0

ORIGINAL PAPER

The Gestural Misinformation Effect in Child Interviews in Switzerland

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Accepted: 20 August 2022 / Published online: 25 January 2023

Abstract

Gestures embody concepts in the form of universal representations. Researchers have highlighted that social communication often embodies nonverbal behavior. A forensic interviewer's nonverbal behavior, such as gesturing during an interview, could communicate misleading information and may cause inaccuracies in the interviewees' testimonies. The current study was conducted in Switzerland and included 108 child participants, in three age groups (a younger sample aged 6–9 years, n = 32) (a middle sample aged 10–11 years, n = 40) and an older sample aged 12–13 years, n = 36). Participants viewed a video and completed an interview about the video, individually, immediately after. During the questioning, the interviewer deliberately misled the interviewees with nonverbal gestures. The results showed that 95 children were misled by at least one gesture and that gestures led to a significant decrease in accuracy. Children also incorporated misleading gestures and reported false information; adding to existing evidence that misinformation can also be communicated through nonverbal gestures. Our findings demonstrate the negative influence of misleading gestures in child eyewitness interviews and provide more evidence for the robustness of the gestural misinformation effect, reported in previous research.

Keywords Child interviewing · Gestural misinformation effect · Gestures · Child eyewitness interviews

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Introduction

When people communicate, for example in talking to each other, they move their hands - they gesture. Gesturing is a cross-cultural and robust phenomenon, found across the world in all ages and cultures (Stevanovi & Salmon, 2005). Gesturing has also been found in people blind from birth (Iverson & Goldin-Meadow, 1998). Gestures may accompany speech or may substitute for it. The most prominent gestures to speakers and listeners are the forms that can substitute for speech (Alibali et al., 2001). Gestures are common in adult-child interactions and a recent study found that child interviewers made frequent use of iconic gestures when they interviewed children about a witnessed event, referring to clothing, accessories, body parts and actions (Meyer, 2019).

Situations can often be interpreted in a number of ways and information can be communicated through different channels (Leathers & Eaves, 2015). Information can be communicated with gestures and can further be influenced by interviewers' beliefs, attitudes, and prior knowledge (Almerigogna et al., 2008; Wright et al., 2009; Sondhi & Gupta, 2005; Wright et al., 2007). In child interviewing research, forensic investigations rely on children's abilities to appropriately recall information about the witnessed event during questioning (Bruck & Ceci, 1999, 2004; Finnilä et al., 2003; Goodman & Reed, 1986; Lehman et al., 2010). Exposure to verbal suggestive interviewing techniques can affect the accuracy of eyewitness testimonies (Okado & Stark, 2005; Roebers & Schneider, 2000). Suggestibility by interviewers is relevant to the police interviewing of both adults and children and can be a potential risk factor or vulnerability when obtaining witness statements of events (Gudjonsson et al., 2016; Roebers & Schneider, 2000; Volpini et al., 2016).

Suggestive verbal questions can be influential in affecting adults' recall (Roebers & Schneider, 2000) and children's recall in eyewitness interviews (Alexander et al., 2002; Bruck & Melnyck, 2004; Hritz et al., 2015; Lamb & Fauchier, 2001; Roebers & Schneider, 2000). Prior misinformation led to reduced accuracy of recognition. But the influence of gestures in investigative interviews has only been investigated in a handful of studies (Broaders & Goldin-Meadow, 2010; Gurney et al., 2013; Kirk et al., 2015).

When children talk to others about memories and past experiences, they observe as well as engage in nonverbal behavior (Congdon et al., 2018). The nonverbal behavior can occur spontaneously or by instruction (Stevanovi & Salmon, 2005). Researchers have noted the importance of spontaneous and instructed nonverbal gestures in communication and educational settings in children (Alibali et al., 2001; Goldin-Meadow, 2002; Liwag & Stein, 1995; Kelly & Church, 1998; McNeill, 1992). Seeing gestures helps children to encode events, by facilitating their memory of the information communicated through the gesture (Aussems & Kita, 2019; So et al., 2012). Parents, as well as other adults, often gesture when they communicate with children and most of these gestures co-occur with their speech (Acredolo & Goodwyn, 1988) and gestures and accompanying words have been found to increase children's word recall, compared to speech alone (So et al., 2012). Although gestures have been recognized as important in educational research (Aussems & Kita, 2019; So et al., 2012), in forensic settings they have largely been ignored (Lamb & Fauchier, 2001; Roebers & Schneider, 2000).

In terms of suggestibility, as discussed above, the majority of forensic research focuses on the influential effect of specific/direct questions in investigative interviews and guidelines have been developed, which mostly make recommendations regarding the use of open-

ended questions in child interviews. Even though it is recommended that interviewers should mainly rely on open-ended and free recall questions (Brown & Lamb, 2015; Oxburgh et al., 2010; Saywitz et al., 2017), there is always the possibility that interviewers use accompanying gestures, which could, in turn, communicate information on their own, due to the natural instinct of individuals to move their hands and gesture (Church et al., 2004).

Gestures embody concepts in the form of universal representations (Church et al., 2004). Social communication often embodies nonverbal behavior (Krauss et al., 1996) and has led to a debate about whether gestures in general can singularly convey a large portion of the communicative load. It is still largely unknown if nonverbal suggestions, both accurate and misleading, can be as influential as those made verbally (Gurney et al., 2013) but recent research studies with children suggest that they can (Broaders & Goldin-Meadow, 2010; Kirk et al., 2015). The influence of accurate nonverbal gestures has been mainly investigated in educational research contexts, where children were fully able to understand the accompanying speech of the interaction (Vallotton et al., 2015). In such contexts, adults' gestures support children's learning in problem-solving tasks and adults adapt their gestures to a child's age and skill level (Goldin-Meadow & Singer, 2003).

When gesturing is used synonymously with speech, it helps the listener to comprehend and encode the information (Goldin-Meadow & Alibali, 2013). In educational settings, teachers can use gestures to be more effective in communication, assessment of children's knowledge and teaching of abstract concepts in both language and mathematics (Kelly et al., 2008). Further, when gestures accompany speech instructions in a non-native language, not spoken to by the children, the participants' learning increased two-fold (Church et al., 2004). Encouraging children to gesture can improve their understanding of educational concepts in mental representations (Brooks et al., 2018), and in cognition and learning (Broaders et al., 2007; Goldin-Meadow & Singer, 2003). A meta-analysis (Hostetter, 2011) showed that gestures provided an advantage to communication if used correctly, in a non-misleading way.

In suggestibility research, speech is the main source of suggestibility, when witnesses and victims misremember details of an event (Ackil & Zaragoza, 1995; Loftus & Hoffman, 1989; Roebers & Schneider, 2000). Researchers have also considered other forms of misleading influence, such as manipulated images and photographs (Wade et al., 2010), or nonverbal behavior in form of hand gestures or body postures (Davis & Bottoms, 2002). Misinformation can also be communicated through nonverbal gestures and corrupt individuals' eyewitness testimonies, leading to inaccuracies and false statements in an eyewitness's long-term recall of events, both in adults (Gurney et al., 2013) and in children (Broaders & Goldin-Meadow, 2010; Kirk et al., 2015).

The misinformation effect describes the event when misleading post-event information impairs or alters memory (Gurney et al., 2013; Lehman et al., 2010). The alteration or impairment of memory can refer to weakening or clouding, as well as a general failure of memory (Holliday et al., 2002). Researchers have identified several factors that can add to the impairment of memory. People can and do accept misinformation and adopt it as their own memory when they did not have an original memory in the first place (Ackil & Zaragoza, 1995; Hyman et al., 2019; Loftus, 2019). Further, misinformation can also impair an accessible original memory (Chan & LaPaglia, 2013). In real-life scenarios, leading or misleading suggestions are often presented alongside open prompts and accurate descriptions of the witnessed event (Lamb et al., 2011; Otgaar et al., 2019) by a person presumed

to be knowledgeable and credible, so child witnesses may be willing to accept them as true (Zajac & Brown, 2018).

Children might be more prone to incorporate suggested information into their testimonies, compared to adults, because they feel pressured to concur with the person (often a police officer, researcher, or adult in general) who suggested it (Blasbalg et al., 2018). Children's inclination to report misinformation is linked to the perceived authority of the person who suggested it; they are more likely to incorporate and report misleading suggestions provided by adults, than by a seven-year-old child (Ceci et al., 1987). Nevertheless, children as well as adults, are prone to the misinformation effect, as the typical eyewitness status quo requires that eyewitnesses must discriminate between memories derived from similar sources, as the witnessed event and the suggested information both refer to the same set of events and they often occur in a brief timeframe (Ackil & Zaragoza, 1995).

The majority of studies in the area of children's eyewitness suggestibility are laboratory experiments on the misinformation effect. Based on an experimental paradigm, first developed and used by Loftus (1975) and Loftus and Palmer (1974) in adult studies, the most common methodology is to let children watch an event and then later present them with either leading or misleading information that contradicts certain aspects of the event. Until recently, misinformation studies have only employed verbal paradigms, for example with an experimenter reading a summary of a previously watched video to children, containing suggested information (Ackil & Zaragoza, 1995). The children are then asked to help the experimenters to decide which information was present (true) by answering a set of questions. Children's exposure to misleading information can lead them to claim that they have actually seen some of the suggested items, indicating that the children came to believe that they actually remembered seeing the event details, when in fact, they were only suggested to them (Ackil & Zaragoza, 1995). In order to assess whether children confuse misleading information given by the interviewer for their real memories, it is necessary to employ test procedures that more directly assess children's memories for the source of the memories they report. Ackil and Zaragoza (1995) did so by including a surprise test on children's memories for the source of the details, including yes/no questions about each of the test items, enquiring whether they remembered seeing the detail in the video and whether they remembered hearing them mentioned by the experimenter, who read a summary of the video. It was found that children were more likely to claim they remembered seeing the misleading information when they had been suggested to them than when the same information was new.

Corresponding to the general misinformation effect described above, a gestural misinformation effect has been found, where instead of misleading questions, misleading gestures are presented to eyewitnesses after witnessing an event, leading to inaccuracies in the reporting of an event by both children (Broaders & Goldin-Meadow, 2010; Kirk et al., 2015) and by adults (Gurney et al., 2013). In recent years, child-interviewing research has started to consider nonverbal behavior, both from the interviewees (Congdon et al., 2018; Katz et al., 2012) and interviewers (Broaders & Goldin-Meadow, 2010; Gurney et al., 2013; Kirk et al., 2015). These studies have highlighted the importance of nonverbal behavior and indicate that current child interviewing guidelines (Lamb et al., 2011; Ministry of Justice, 2011) have neglected an important aspect of interaction in interviews. To date, only a small number of studies have investigated the concept of a gestural misinformation effect, but all

of them have come to similar conclusions (Broaders and Goldin-Meadow, 2010; Gurney et al., 2013; Kirk et al., 2015).

Broaders and Goldin-Meadow (2010) examined how gestures by an interviewer add information during investigative interviews with child eyewitnesses between 5 and 6 years of age. The results showed that children communicated details that were conveyed by the gestures; thus, they incorporated the misleading, nonverbal information into their memory of the witnessed event. This effect of misleading gestures was found to be as strong as the effect of misleading questions. Children gave just as many false answers to open-ended questions, accompanied by misleading gestures, as when asked specific, misleading questions, therefore providing good evidence that children's eyewitness testimonies are vulnerable to nonverbal suggestion.

The effects of gestural misinformation on children's testimonies have also been shown in three separate experiments with adults (Gurney et al., 2013). In two experiments, adult participants watched footage of a crime scene, depicting a confrontation between two individuals and an office theft and were then interviewed via a video recording of an actor, dressed as a police officer. The videos were edited so that participants were asked the same questions in two conditions: the accurate condition, when the interviewer used an accurate gesture, and the misleading condition when the interviewer used a misleading gesture. Participants' memory was indeed distorted in the misleading gesture condition. Further, misleading gestures of details that were not shown in the video, could not only distort a memory, but also implant specific memories (for example, gesturing a piece of jewelry, a hat, or a beard that were completely absent from the video). The results again demonstrated a misleading gesture effect, with nearly a third of the participants reporting details which were conveyed by the gestures. Therefore, it was found that gestures can act as a form of misinformation and negatively affect eyewitnesses' responses, even when questioned over the video, without interacting with the interviewer; and even if the gestures included details that were absent in the video.

Gurney et al. (2013) Study 3 then considered whether these results would also apply to a live interview, with participants answering freely to an interviewer's questions, in a more naturalistic situation. Again, participants were more likely to give a response congruent to the gesture, than participants in the control group. Thus, the study demonstrated that gestures can also affect adult eyewitness testimonies in a live, face-to-face interview, even when interviewed immediately after watching a target video when memory trace is considered strong. This thereby adds support to the gestural misinformation effect, which has already been found in interviews with children (Broaders & Goldin-Meadow, 2010).

In another child study, Kirk, Gurney, Edwards and Dodimead (2015) tested the robustness of the gestural misinformation effect under conditions that would normally buffer children against verbal suggestibility, namely strength of memory trace, age, and verbal abilities. Participants included two age groups, one of them being much younger children than the children in Broaders and Goldin-Meadow's (2010) study, including age groups of 2–4 years and 6–9 years of age. The children watched a target video and were randomly allocated to either an accurate or misleading gesture condition and were interviewed immediately after (including a distractor task). The questions and gestures were similar to Gurney et al. (2013), with gestures describing accessories, body parts and actions. Younger children were misled more often, with 14 out of 15 being misled on at least one question, compared to 11 out of 14 in the older age group; however, all the children appeared to be equally vulnerable

to the misleading gestures. It was found that children's baseline accuracy of the event, as well as verbal language ability, did not protect children from being misled by the gestures. Children of all ages were vulnerable to the gestural misinformation effect and sometimes incorporated misleading information into their post-interview narrative of the event.

Broaders and Goldin-Meadow (2010) conducted interviews two weeks or three months after the witnessed event, so the misleading effect could be attributed to memory decay of the event, which facilitated the interference by the more recent misleading information (Holliday et al., 2002). According to memory interference theory, weaker memories are less resistant to suggestibility than stronger memories (Brown, 1958) and it may be possible that children's memory traces of the event had decayed during the delay between the event and the interview, in which case immediate interviewing might lessen the gestural misinformation effect. However subsequent research has provided evidence against this notion. Gurney et al. (2013) found that almost one-third of their adult participants still reported details conveyed by gestures (shown on video), even when interviewed immediately after the event when memory was still presumed to be strong. This was further supported by Kirk et al. (2015), who found a robust gestural misinformation effect in child interviews despite factors that normally buffer children from verbal suggestions, namely strength of memory trace, greater age, and greater language skills. In other words, children were misled by the gestures, even when interviewed immediately after the event and regardless of their age and verbal ability.

In line with research (Lamb & Fauchier, 2001; Roebers & Schneider, 2000) that has described the influential effect of specific/direct questions in forensic interviews, Broaders and Goldin-Meadow (2010) also showed that children produced more affirming responses to specific questions rather than open-ended questions. Thus, it has been found that misleading nonverbal gestures can influence the interviews in the same way and to the same extent, that misleading verbal questions do. Age differences have been found in verbal suggestibility, with pre-school children being the most vulnerable, but verbal suggestibility levels remain high throughout childhood (Bruck & Ceci, 2004; Bruck & Melnyk, 2004). However, there is a clear gap in the research, and the need to test nonverbal suggestibility in samples other than English-speaking children.

Memory skills develop gradually during the preschool years (Melinder et al., 2006) both concerning the ability to discriminate between external sources of information, for example, who said what (Lindsay et al., 1991), and the ability to discriminate between external and internal sources, for example distinguishing between what is imagined and what is said (Foley et al., 1983). In particular, if sources are similar (Lindsay et al., 1991) or if memory testing is delayed (Parker, 1995) young children perform less well than older children in responding to both verbal nonsuggestive and verbal suggestive questions. Hence, it is important to test the influence of misleading gestures in several age groups, to identify any age differences in vulnerability to suggestibility.

The current study fills in the gaps in research and takes the existing studies one step further. The main strength of this research lies within the sample used: it includes children of higher age groups than those considered by previous research, to investigate whether age buffers children against gestural misinformation effects. Thus, the current study tested the influence of misleading gestures in immediate interviewing conditions and broadened the results to other (non-English-speaking) individuals. A mixed measures design, with a within-subject factor of condition (speech-plus-gesture, speech-alone) and a between-sub-

jects factor of age-group (young, middle, old) was employed to investigate any effect of the misleading gestures on the recollection for a video previously shown to the children.

The research questions this study addressed were the following: Can misleading gestures influence children's recall and reduce accuracy scores of the event? We expected significant differences between the conditions, with children incorporating misleading gestured information into their narratives of the event and lower scores in the speech-plus-gesture condition. Further, we anticipated that in the gestures condition, children would provide significantly more answers that correspond with the misleading gestures compared to the speech-only condition. To address the influence of age on children's abilities to answer correctly, we expected no significant interaction effect between age groups and gesture conditions. We anticipated younger children to score lower than older children in both the speech-plus-gesture condition and the speech-only condition. Finally, we hypothesized that children would produce more 'don't know' responses in the gesture condition.

Method

Pilot Study

In suggestibility research, a video target is the most commonly used target event in child studies (Bruck & Melnyk, 2004). To assess whether the video and gestures were appropriate, and to rehearse and practice the gestures for the main study, a pilot study was conducted with German speakers. Twelve adult proficient German speakers in England were interviewed about the footage of a crime scene. Several different misleading gestures were presented to evaluate which gestures felt the most natural and had the strongest communicative value in relation to the target video. Since non-native German speakers might react differently to gestures than native German speakers their responses were not analyzed. However, these preliminary interviews provided practice in utilizing the gestures and led to the choice of gestures used in the current study.

Participants

Interviews were conducted with a total of 108 children, of whom 32 were between 6 and 9 years old (youngest age group), 40 children were between 10 and 11 years (middle group), and 36 children were between 12 and 13 years (oldest group). The children's first language was German. The children were tested in different schools in Switzerland. The mean age of the children (64 male, 44 female) was 10.28 years (SD = 1.88) years.

Procedure

Children watched a video in their classrooms. Each child was asked the same 16 questions during each scripted interview. The questions were asked in *speech-alone* versus *speech-plus-gesture* for a total of eight experimental questions (Table 1). Two scripts were used and counter-balanced so that a question asked in speech-alone in one script was asked in speech-plus-gesture in the other. The interviewer was also the person delivering the gestures while asking the questions.

Table 1 Misleading Gestures presented in the interview, the accompanying questions, and correct answers

Question	Misleading Gesture	Correct answer
1. What did the man wear?	'Gloves' gesture	Jacket, trousers, shirt (no gloves)
2. What was the woman, sitting on the ground doing?	'Drinking' gesture	Eating
3. Before the man and the boy played football, where did the man softly punch the boy?	Punching 'arm' gesture	Chest
4. Where did the man stroke the boy?	Stroke over 'cheek'	Hair
5. Where did the man pinch the boy?	Pinching 'chin' gesture	Cheek
6. What was the mothers' friend's hairstyle?	Sweeping hand along jawline gesture (indicating short hair)	Long, curly
7. Did the mother wear jewelry?	'Necklace' gesture (gesturing 'v' down chest)	No
8. Before he played football, what did the man do with his jacket?	'Throwing away' gesture	Folded it up and placed it on the grass

Each child received a random order of four misleading gesture questions (speech-plus-gesture condition) and four speech-only questions (neutral condition), to limit potential order effects. The eight experimental condition questions were placed between eight general filler questions (Appendix A), containing no gestures, which stayed the same for all children. The filler questions were not of interest to the experimenter and therefore not analyzed. Their purpose was to distract from the experimental questions, especially the *speech-plus-gesture* questions, which may otherwise make it too obvious what we were interested in.

The gestures in a specific question reinforced or elaborated on the information conveyed in speech; the additional, misleading information conveyed in gesture effectively turned an open-ended or direct question into a specific question.

Children watched the video in a group. They were instructed to watch the video carefully, as it was shown on a projector screen in their classroom, in dimmed lighting to provide an environment, suitable for concentration and focus. They were informed beforehand that they would be questioned about the video. The children were advised not to talk with each other about the content until the experiment was finished and everyone had taken part. This was further reassured by a teacher, who supervised the children between the event and the interviews. Children seemed unaware of the gestures and did not comment on them, and the experimenter saw no evidence of collusion throughout the procedure.

Immediately after watching the video, children were individually interviewed one by one, by the same experimenter in a quiet area of the school. Children's answers were written down by the experimenter after each response was given. Due to the same experimenter conducting all interviews, there were different time intervals between watching the video and being questioned, which ranged from 10 to 120 min. The experimenter rehearsed the gestures multiple times and presented the same hand movements to each child. For example, for the stroking 'cheek' gesture, the movement included a sweeping motion of the back of the right hand over the interviewer's right cheek and in the 'drinking' gesture, the right hand was moving an imaginary glass to the lips in a tilting motion of 90 degrees.

The children were seated at a table diagonally, at a 120-degree angle, indirectly facing the experimenter. This seating arrangement was chosen to reflect the recommendations by

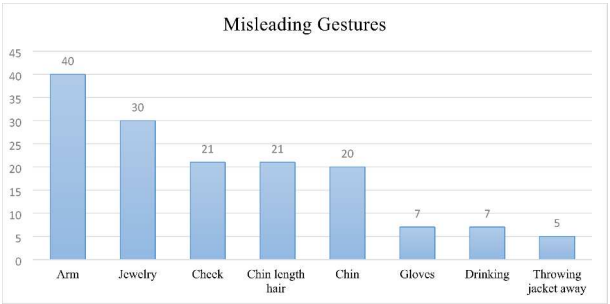

Fig. 1 Number of times children were misled by individual gestures

the Achieving Best Evidence Guidelines (Ministry of Justice, 2011) to promote a relaxed atmosphere and avoid the implication of a confrontation.

For a full list of experimental questions and the accompanying misleading gestures and correct answers see Table 1. Children were thanked and received either a vintage postage stamp (younger children) or a chocolate stick (older children) for their participation.

Children's responses to the questions during the interview were coded as affirming the gestural misinformation effect when they included the specific target the question was designed to elicit. Their responses were coded as either correct, incorrect affirming or 'don't know'. Children's incorrect responses to either the speech-alone or speech-plus-gesture question were coded to identify responses that were congruent with a misleading gesture. Responses to the speech-alone question thus provided a baseline for how likely children were to mention information (e.g., 'gloves') when nothing in the question hinted at this particular response. Therefore, there was no ambiguity in determining the gestural misinformation affirming questions. No inter-rater reliability check was employed, due to the schools' requirements to only allow the main researcher to collect and access the data. However, the main researcher coded the written down responses into categories and then re-coded all the answers twice.

Materials

A video was shown on a classroom projector to groups of children in their classrooms. The video lasted 2 min and was an extract from a German family TV movie ('Mama und der Millionär) released in 2005, that featured a mother, her son (age 8 years) and her female friend having a picnic in the park, involving the mother's blind date with a man and a game of football between said man and the son.

The children were asked if they had seen the movie before and all children responded that they had not.

Results

Of the total sample of 108 children, 95 children were misled by at least one gesture (88% of all participants). To investigate whether some gestures were more misleading than others, a score was made of the number of times that children were misled by each gesture (see Fig. 1).

Table 2 Mean and (SD) scores of correct, incorrect and 'Don't know' (DK) responses in both conditions, between age groups

	Speech-plus-gesture condition			Speech-alone condition		
	Correct	Incorrect	DK	Correct	Incorrect	DK
Youngest (6–9)	2.31 (1.00)	1.37 (0.91)	0.32 (0.51)	2.63 (1.18)	1.28 (1.25)	0.09 (0.30)
Middle (10–11)	2.10 (0.93)	1.60 (0.93)	0.30 (0.46)	2.68 (0.92)	1.05 (0.96)	0.27 (0.51)
Oldest (12–13)	2.67 (0.86)	0.97 (0.77)	0.36 (0.54)	2.97 (0.74)	0.83 (0.65)	0.20 (0.59)

Total number of answers = 4.00.

Figure 1. The number of times children were misled by individual gestures during questioning.

Each gesture misled at least five of the children (see Fig. 1). The gestures that had greatest influence were the 'arm' and 'jewelry' gestures. The gestures 'cheek', 'chin length hair' and 'chin' each misled the children in about 20 interviews, and the gestures 'gloves', 'drinking' and 'throwing away jacket' misled the children the least.

A 2×3 mixed measures ANOVA, with a within-subject factor of condition (speech-plus-gesture, speech-alone) and a between-subjects factor of age-group (young, middle, old) was conducted to investigate any effect of gesture condition on the correct answers between age groups. The dependent variable was the children's accuracy scores in answering the experimental questions.

Correct and incorrect scores were summed with a value between 0 and 4 for each participant. Mean scores are presented in Table 2.

There was a main effect of condition, ($F(1,105) = 8.71$, $p = .004$, $\eta\rho^2 = 0.077$), children provided more correct answers in the speech-alone condition (2.76, SD = 0.96), than children in the speech-plus-gesture condition M = 2.35, SD = 0.95). The misleading gestures reduced the accuracy of children's responses.

In the gesture condition, 68 children (63%) gave gestural misinformation affirming answers, which matched the misleading gestures. In the speech-alone condition, 29 children (27%) gave wrong answers that resembled the misleading information, meaning that they provided answers that included the specific target by chance, without being presented with the misleading gestures. Hence, the gesture condition elicited more than twice as many incorrect affirming responses, which may have been prompted by the gesture.

There was a main effect of age group ($F(1,105) = 4.87$, $p = .009$, $\eta\rho^2 = 0.085$) on children's ability to answer questions correctly overall; a post-hoc LSD test showed that the oldest age group (M = 2.67, SD = 0.86) made fewer errors than the younger groups (M = 2.10, SD = 0.93), ($p = .004$); (M = 2.31, SD = 1.00) ($p = .02$), who did not differ ($p = .59$).

There was no interaction between age groups and gesture condition for correct scores ($F(1,105) = 0.46$, $p = .633$, $\eta\rho^2 = 0.009$). Accuracy scores were negatively affected for all children in the gesture condition.

There was no difference in the number of 'don't know' responses in the speech-plus-gesture condition (M = 0.31, SD = 0.50), and in the speech-alone condition (M = 0.20, SD = 0.49), ($F(1, 165) = 3.41$, $p = .67$, $\eta\rho^2 = 0.03$).

Discussion

The study demonstrated the negative influence of misleading gestures in child eyewitness interviews and provided further evidence for the robustness of the gestural misinformation effect, reported in previous research (Broaders and Goldin-Meadow, 2010; Gurney et al., 2013; Kirk et al., 2015). The gestural misinformation effect was tested in a questioning condition when memory is still presumed to be strong, compared to delays between stimulus and interview of 1–2 weeks. Overall, the children's susceptibility to suggestibility was high. Children in all three age groups were misled by gestures accompanying the questions. The children provided fewer correct responses in the speech-plus-gesture condition than in speech-alone condition, thus showing that misleading gestures negatively affected children's accuracy in the interviews. In some cases, children replicated the gestures when giving their responses, which implied that they had already incorporated the gestures into their memory.

Several similarities were noted between the current results and those of earlier experiments (Gurney et al., 2013), namely that the 'gloves' gesture was not particularly effective, but that the 'chin-length hair' and 'jewelry' gestures yielded more misled responses, which indicates a parity between these findings. These findings help strengthen the reassurance in the reliability of the methodology and effect.

There were significant differences between the three age groups in children's ability to provide correct responses overall, with the older group providing more correct responses than the middle and young group. However, no effect of age was found in the speech-plus-gesture condition alone. All children were affected by the misleading gestures, irrespective of their age. This supports Kirk et al. (2015) who found no age differences in nonverbal influence in children between the ages of 2–4 years and 7–9 years. In the present study the youngest group was in the same age range (6–9 years) as Kirk et al.'s older age group, but the other two other groups in the present study were older. The current study's findings suggest that the gestural misinformation effect can be found in children of all ages and that age does not buffer children against it.

As research on verbal suggestibility has reported that memory improves with age (Holliday et al., 2002) and older children are superior in regard to suggestive questioning compared to younger children (Goodman et al., 2001; Goodman et al., 1991), the results of the current study suggest that gestures embody an independent influence on suggestibility, regardless of age. Findings of adult studies also seem to support this notion, demonstrating a clear gestural misinformation effect, even in adults (Gurney et al., 2013).

Age effects may not apply in gestural misinformation. The lack of age differences in the speech-plus-gesture condition within the present study contrasts to reports of age differences as a factor of the oral misinformation effect (Goodman & Reed, 1986; Holliday et al., 2002; Lehman et al., 2010), as older children usually outperform younger children. The difference between the present study and previous ones was the use of gestures as the influence on suggestibility.

However, the age groups of those studies centered on much younger, pre-school children than the participants in the present study. Higher immediate suggestibility effects have been found in younger children (in three age groups between 7 and 9, 10–12 and 13–16 years of age) (Gudjonsson et al., 2016). Similar trajectories of developmental trends have been found in pre-school children, of correct answers in response to suggestive questions, in 3-

and 6-year-old children (Melinder et al., 2006). In a study involving misleading questions to test suggestibility (Alexander et al., 2002), the authors suggested that age alone does not account for all the variance in children's memory; and that there are a variety of potential factors, for example individual differences in cognitive inhibition. Such factors might indicate that this is the case for the nonverbal misinformation effect as well. Also, the lack of age differences in the gestural misinformation effect might be linked to the removal of language ability as a factor. Since children of all ages are able to understand gestures, they might affect them similarly.

The false information conveyed by the interviewer's gestures sometimes influenced children's memory of the event, and emerged in children's verbal responses to the questions, demonstrating that children were susceptible to nonverbal influence. Gestures embody an important channel for communication in children (Congdon et al., 2018; Leathers & Eaves, 2015). Since children's verbal abilities are still developing, gestures provide children with a way to interact with others, and as Hostetter (2011) found, children benefit from combined speech/gesture communication and are highly sensitive to information conveyed by such communication. In educational settings, gestures support children's learning (Church et al., 2004; Goldin-Meadow & Singer, 2003) and encouraging children to gesture supports mental representations (Brooks et al., 2018). Also, accurate gestures have been found to facilitate children's verbal recall (Kirk et al., 2015). Thus, encoding communicative information within a nonverbal paradigm might intensify the encoding of a false memory. The results of the present study demonstrate the potential risk of misleading gestures in real forensic investigations.

There is a clear lack of studies investigating differences between English speakers and other countries and languages in nonverbal suggestibility research. To our knowledge, no previous study has been conducted on the gestural misinformation effect outside the UK. The current study is the first ever to test the influence of misleading gestures in another country, broadening the results to other non-English speaking individuals. Children's sensitivity to gesture communication led to their suggestibility because the misleading gestures elicited contaminated memory for the event in a non-UK sample. Future research might consider other cultures and languages to establish whether the gestural misinformation effect is universal.

In summary, children were misled by the information conveyed by the misleading gestures, which resulted in less accurate responses to the questions. Considering the combined recent and current findings that support a gestural misinformation effect in children of various ages (Broaders and Goldin-Meadow, 2010; Kirk et al., 2015) the concept of speech as the main source of influence in misremembering (Ackil & Zaragoza, 1995; Loftus & Hoffman, 1989; Roebers & Schneider, 2000) may need to be re-evaluated when nonverbal behavior is present (Davis & Bottoms, 2002), as is the case when interviewers use gestures during child interviews.

Our results suggested that misleading gestures play an important role in children's eyewitness testimony and should be explored further. We can assume that children are vulnerable to misleading gestures, even when their memory of the event is still strong. Moreover, the developmental changes associated with qualitative differences in children's testimonies might not apply to nonverbal suggestions.

Authors' Contributions All authors listed have made substantial, direct, and intellectual contributions to the work, and approved it for publication. KM and MB designed the study; KM analyzed and interpreted the data and drafted the manuscript. MB and SK critically reviewed the manuscript.

Funding This work was supported by a grant to the Department of Psychology from the University of Sheffield.

Data Availability The data and material used in the study are available, if requested.

Declarations

Conflicts of Interest/Competing Interests Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethics Approval This study received ethical approval from the ethics committee in the Department of Psychology, University of Sheffield.

Consent to Participate Participants gave written consent to participate in the study. Further, both parents of the participants and the head of school gave written consent for the children to take part.

Consent for Publication All authors gave consent for the study to be published.

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