# No gesture too small: An investigation into the ability of gestural information to mislead eyewitness accounts by 5-8-year-olds.

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Abstract

The accuracy of eyewitness interviews has legal and clinical implications within the criminal justice system. Leading verbal suggestions have been shown to give rise to false memories and inaccurate testimonies in children, but only a small body of research exists regarding non-verbal communication. The present study examined whether 5-8-year-olds in the UK could be misled about their memory of an event through exposure to leading gestural information, which suggested an incorrect response, using a variety of question and gesture types. Results showed that leading gestures corrupted participants' memory, with the level of centrality (central details such as what and how, compared to peripheral descriptive detail) and saliency (how visible and expressive a gesture is) significantly affecting the level to which participants were misled, and even subtle gestures demonstrating a strong misleading influence. We discuss the implications of these findings for the guidelines governing eyewitness interviews.

*Keywords*: Gesture, Eyewitness, Misinformation, False Memory, Non-verbal communication, Children

# General Summary

In the UK, over 250,000 child abuse offences were recorded by the police in 2019. Of these, only 4% resulted in a charge or summons, with evidential difficulties accounting for half of all cases dropped. In child abuse cases, the child is often the only witness, so improving interview techniques for children is important to gain full and accurate testimony. Police interview guidelines currently include extensive procedures to prevent verbally leading, or misleading, a witness through questions which imply an answer, prior to the witness having provided information to that fact e.g. did you see the weapon? This introduction of post-event information to witnesses can often become embedded within the original memory, creating a false memory which the witness believes to be true. There are currently no guidelines for the use of non-verbal communication during interview, despite the ubiquitous use of gestures to convey meaning either as part of speech, or as a separate source of information. This study demonstrates that non-verbal communication, in the form of gestures, can mislead children into giving inaccurate testimony, in the same way as verbal misinformation. The type of question (central or peripheral to the event in question) and gesture (salient or subtle) was also examined, with peripheral events and salient gestures being the most likely to result in participants being misled. Importantly, findings showed that even subtle gestures relating to central events were able to mislead children, indicating that no level of gesture is safe to use during interview. Our results provide evidence that gestures can have a negative impact on children's testimony, and, for this reason, we suggest that police interview guidelines should be updated to avoid non-verbal leading of a witness, and to help increase the chance of child abuse offences reaching court.

# No gesture too small: An investigation into the ability of gestural information to mislead eyewitness accounts in 5-8-year-olds.

## Introduction

The degree to which children are susceptible to misleading information has important legal and forensic implications for eyewitness testimony (Klemfuss & Olaguez, 2020). To obtain the best evidence possible, police interview guidelines include recommendations to reduce the possibility of *verbally* leading a witness (Ministry of Justice, 2011). No such guidelines exist regarding *non-verbal* communication however, despite research which shows that gestural influence can be as misleading as verbal information (Broaders & Goldin-Meadow, 2010; Gurney, Ellis, & Vardon-Hynard, 2016; Gurney, Pine, & Wiseman, 2013; Kirk, Gurney, Edwards, & Dodimead, 2015). The present study addressed previous methodological limitations to assess the strength of the gestural misinformation effect, and extended previous findings by examining the effect of question centrality and gesture saliency, on the ability of gestures to mislead child witnesses, with the aim of meaningfully informing current eyewitness interview practises.

Gesture is closely linked to speech, whether for the benefit of the speaker through helping to conceptualise and schematise information (Kita, Alibali, & Chu, 2017) or for the listener by enhancing understanding when speech is unclear or difficult to articulate (Dargue, Sweller, & Jones, 2019; Hostetter, 2011). Speech and gesture are also most often unconsciously combined into a single unified memory event (Stark, Okado, & Loftus, 2010) suggesting that different modalities may be embedded within an original memory trace.

The ability of gesture to disrupt memory recall has been shown in adults (Gurney et al., 2016) and children (Kirk et al., 2015)., with the same ability to mislead as a verbal leading question, even after a 12 week delay (Broaders & Goldin-Meadow, 2010). Gestural information can also mislead in conditions which would usually protect children against verbal suggestibility such as higher verbal ability, older age, or increased memory trace strength (Kirk et al., 2015).

At present, research regarding the gestural misinformation effect in children is limited. Importantly, previous methodologies did not consider how different questions might bias an accurate or misleading condition, depending on the strength of the memory, and the ability of the gesture to cue the memory trace (Lindsay & Johnson, 2000); with scripts either not counterbalanced for occurring vs non-occurring events (Broaders & Goldin-Meadow, 2010), or between participant designs leading to groups being exposed to only one condition i.e. accurate or misleading, with no baseline control measure (Kirk et al., 2015).

In forensic contexts, information is classed as central or peripheral depending on its closeness to the 'plot' or forensic event in question, with central information defined as details related to the central characters and action, while peripheral information focuses on non-central characters, and events before or after (Ibabe & Sporer, 2004). Children typically show better integration and recall of action events than peripheral details (Migueles & Garcia-Bajos, 1999; Sarwar, Allwood, & Innes-Ker, 2014) potentially making some questions easier to answer and less vulnerable to misleading gesture effects, than other questions.

The type of gesture used has not been considered in previous research, despite evidence that salient gestures are attended to more by the listener (Chu, Meyer, Foulkes, & Kita, 2014).

Salient gestures may also be more influential due to increased mirror neuron engagement (Brainerd, Reyna, & Ceci, 2008; Wimmer & Howe, 2009) when a memory trace is weak, or when a question is ambiguous (Dargue et al., 2019; Pezdek & Roe, 1995).

Understanding how question and gesture type may protect against leading questioning is important to meaningfully inform future interview practise. Police interviewers are not told to monitor gestures during interviews, leaving evidence vulnerable to gestural information, leading to errors that may reduce the chances of a case proceeding to the prosecution service. To address some of the gaps in research, the present study assessed the strength of the gestural misinformation effect when questions were asked not only about central events and characters, but also about peripheral details. A variety of gestures were used to ensure a mix of gestures that were salient and highly visible (e.g. whole arm movements above chest), and gestures that were subtle and less obvious to the listener (e.g. hand or finger movement below chest) (Chu et al., 2014). In the present study all the questions were counterbalanced and subjected to appropriate control conditions (accurate, misleading, and no gesture) so that each child was exposed to each question type (central and peripheral) and each gesture condition (salient and subtle).

Previous researchers have shown that biological and cognitive changes in memory between 6-7 years of age promote better recall of events (Fritz, Howie, & Kleitman, 2010; Geurten & Willems, 2016; Ghetti, 2003). Based on this evidence, and research indicating that verbal suggestibility is a function of age, (Bruck & Ceci, 1999; Gudjonsson, Vagni, Maiorano, & Pajardi, 2016; Volpini, Melis, Petralia, & Rosenberg, 2016) it was hypothesised that the gestural misinformation effect will decrease with age. It was expected that *accurate* gestures would lead to more correct responses than *no gesture,* due to their ability to cue the original

memory (Lindsay & Johnson, 2000), and that misleading gestures would lead to more incorrect answers than *no gesture* due to the mismatch with the original memory (Willems, Özyürek, & Hagoort, 2006). Following Kirk et al (2015) and Broaders and Goldin-Meadow (2010), it was hypothesised that a significant portion of incorrect answers would be consistent with the misleading gesture due to source misattribution (Brubacher, Peterson, La Rooy, & Dickinson, 2019), and/or suggestive pressure (Bruck & Ceci, 1999; British Psychological Society, 2010). Although not previously tested, salient gestures were expected to provide stronger visual cues than subtle gestures, increasing mirror-neuron engagement (Brainerd et al., 2008; Wimmer & Howe, 2009) and resulting in more participants being misled. The stronger memory traces associated with central events over peripheral events (Migueles & Garcia-Bajos, 1999; Sarwar et al., 2014) were expected to protect against misleading gestures, resulting in less incorrect answers. In line with Kirk et al (2015) and Broaders and Goldin-Meadow (2010) post-interview free recall was expected to include more items of information (IOIs) than pre-interview free recall, including gestural information that participants had been exposed to during the interview.

## Method

### Participants

A total of 63 primary school children were recruited in two age groups, 5-6-year-olds (n=31, 9 male, 22 female) and 7-8-year-olds (n=32, 19 male, 13 female). Sixty-five children were initially recruited, but two had special needs which affected their ability to attend to the video and the questions, and these children were dropped from the study. This sample size was deemed reasonable due to comparisons with other previously published work and effect sizes. Children were recruited through a school in the UK as a sample of convenience and were predominantly of a white British background. All the children took part in each of the three

conditions (accurate gesture, no gesture, and misleading gesture). Ethical approval for this study was given by the University of Sheffield.

## Materials

The children were asked to watch a five-minute video of a young girl taking a gymnastics examination. The video showed the girl doing gymnastics on a beam and included scenes of her practising when she was younger. There was little dialogue in the video. The video was presented on an iPad. Audio recordings were taken of the children's responses to the experimental questions using a digital recorder.

## Procedure

Children were tested individually in a quiet area of the school and were seated next to the experimenter. The study was completed in five stages – watching the video, a pre-interview free recall, interview questions, a distractor task, and a post-interview free recall. All the children completed all stages. As per the enhanced cognitive interview guidelines (Fisher & Geiselman, 2010; Geiselman & Fisher, 2014) a rapport phase was included. Perceived control was handed from the interviewer to the child through statements such as 'I've forgotten most of that video so do you think you could help me by answering some questions?'. Children were reassured that it was alright if they did not remember, or did not know an answer, as per police interview guidelines (Geiselman & Fisher, 2014).

After the video children were interviewed individually by the experimenter. Each child was given the first free recall test and asked if they could tell the experimenter, in as much detail as possible, about the video that they had just watched. The same open-ended prompts were used to help elicit information from each child including 'Can you remember anything else?',

‘Do you know what happened next?’, and ‘Can you tell me a bit about any of the people in it?’.

After the first free recall interview, each child was asked 12 counterbalanced questions (supplementary materials - table 1) across each of the three conditions. Condition 1 – a question was asked with no gesture, so the experimenter kept her hands still on the table. Condition 2 – a question was asked with an accurate gesture, i.e. the experimenter gave a gesture consistent with the information in the video. Condition 3 – a question was asked with a misleading gesture, i.e. the experimenter gave a gesture inconsistent with information in the video. Iconic gestures, as defined by McNeill (1992) were chosen so as to convey semantic information to the participant.

To examine whether the centrality of the event affected the level to which participants could be misled by gesture, six questions were about the central character and/or action, and six questions were about peripheral details. The centrality of a question was determined based upon its closeness to the event in question, with central questions being about the main character and the action sequence of how and what happened, while peripheral questions focussed on events that took place before or after the main event, and other people in the video (Andrews & Lamb, 2019). Gestures were split evenly into subtle or salient gestures as defined in previous research (Chu et al., 2014). Salient gestures required whole arm movements above the chest, and subtle gestures required movement involving just the hand or fingers below the chest.

The 12 questions were counterbalanced to ensure each question was asked in each condition, resulting in three question sets that were alternated between the children. After answering the

questions, children were given a distractor task for three minutes, during which they talked about their favourite TV or film characters. Then the children were given a second free recall test and were again asked if they could tell the experimenter as much information as possible about the video that they had watched. The same open-ended prompts were used as in the first recall test.

Free recall interviews were coded by items of information (IOIs), which were defined as any information the child gave about the video. For example, a child who said, 'A girl was doing gymnastics when she was younger and got a bit older, and she kept trying, there were girls with blonde hair and orange hair, some had brown' was coded as having 7 IOIs due to information about the main character (1. girl), what she was doing (2. gymnastics), what happened in the video (3. she got older), the theme of the video (4. she kept trying), and what some of the people looked like (5. blonde hair, 6. orange hair, and 7. brown hair).

IOIs were analysed to determine which ones were correct and incorrect for pre- and post-free recall interviews, and then compared to see if participants gave new IOIs after the structured questions. New IOIs were coded correct or incorrect, and examined to see if any were consistent with the gestures to which participants had been exposed. Inter-rater reliability completed for 40% of participants showed good agreement between coders for the pre-interview free-recall Kappa=0.62, $p<0.001$, and for the post-interview free-recall, Kappa=0.86, $p<0.001$.

Responses to the 12 interview questions were coded as either correct, incorrect or no answer. Incorrect responses to questions with a misleading gesture were further categorised into responses consistent with the misleading gesture, or responses inconsistent with the

misleading gesture. Inter-rater reliability was completed for 20% of the participants, with analysis showing nearly complete agreement between raters, Kappa=0.99, $p<0.001$.

## Results

The mean number of questions that children answered correctly, incorrectly, or were not able to answer, for each condition are given in Figure 1.

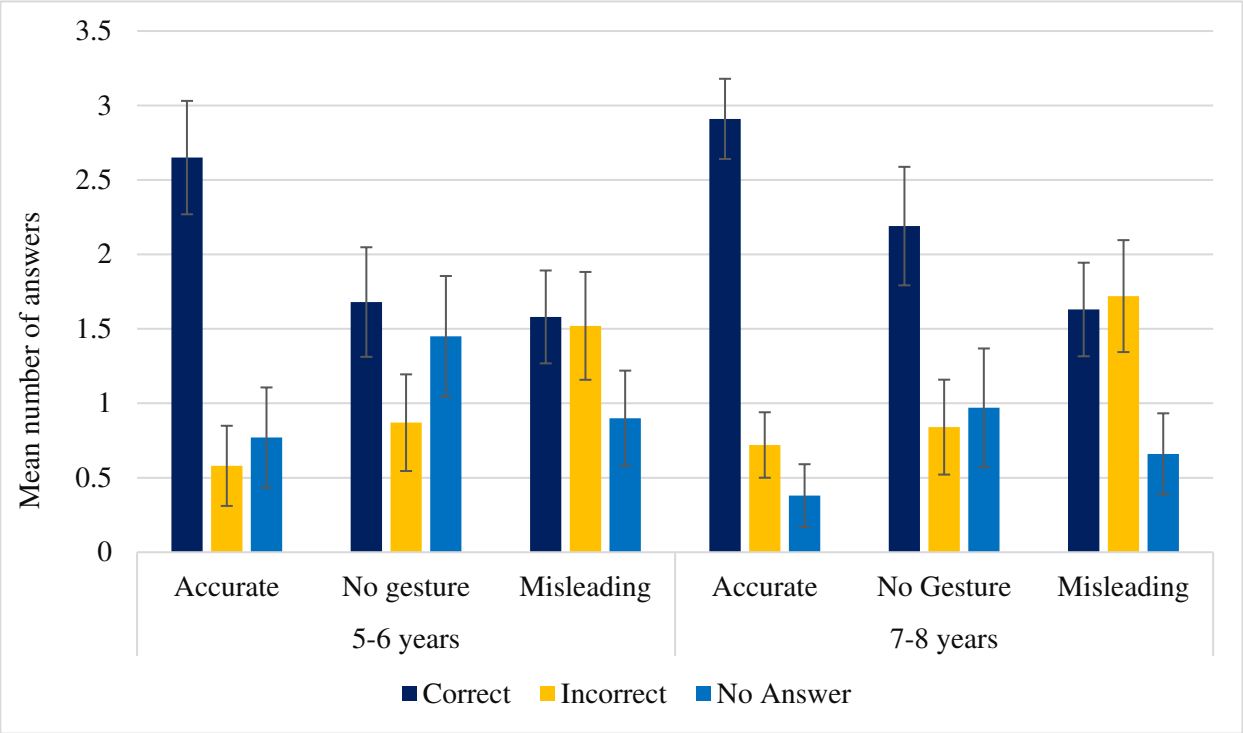


Figure 1. Mean number of correct, incorrect, and no answer responses (out of a maximum score of 4) for 5-6-year olds and 7-8-year olds, including 95% confidence intervals.

A 3x2 factorial ANOVA was conducted to test the effect of condition (no gesture, accurate gesture, or misleading gesture) and age (5-6 years and 7-8 years) on correct responses. A significant main effect of gesture type for correct responses was found, $F(2,122)=28.27$, $p<0.001$, $\eta^2=0.32$. Planned LSD comparisons revealed that accurate gestures were significantly more likely to elicit a correct response compared to both the no gesture condition (Mean Difference (MD)=0.84, $p<0.001$) and the misleading gesture condition

(MD=1.17, p<0.001). A misleading gesture was significantly less likely to elicit a correct response compared to the no gesture condition (MD=0.33, p=0.042). No main effect of age was found for correct responses F(1, 61)=2.76, p=0.102, $\eta^2$=0.043, and there was no interaction between age and gesture for correct responses F(2,122)=1.05, p=0.353, $\eta^2$=0.017.

A second 3x2 factorial ANOVA was conducted to test the effect of condition (no gesture, accurate gesture, or misleading gesture) and age (5-6 years and 7-8 years) on incorrect responses. Results showed a significant main effect of gesture type on incorrect answers F(2,122)=23.16, p<0.001, $\eta^2$=0.275, with misleading gestures significantly more likely to produce an incorrect answer when compared to both the control condition (MD = 0.76, p<0.001) and the accurate condition (MD =0.97, p<0.001), while no effect was seen on the number of incorrect answers between accurate and no gesture conditions (MD=0.21, p=0.139). No main effect of age was found for incorrect responses F(1, 61)=0.49, p=0.485, $\eta^2$=0.008, and there was no interaction between age and gesture for incorrect responses F(2,122)=0.31, p=0.731, $\eta^2$=0.005.

Incorrect responses were further analysed to examine whether the incorrect response was consistent with the misleading gesture given, inconsistent with the gesture given, or whether children were unable to answer (Figure 2). For example, when being asked ‘what was the judge on the right wearing?’ followed by the misleading gesture of hat, a response of ‘hat’ would be classed as a consistent response, but a response of ‘coat’ would be classed as an inconsistent response. If the child didn’t answer or said they didn’t know, this was coded as ‘no answer’.

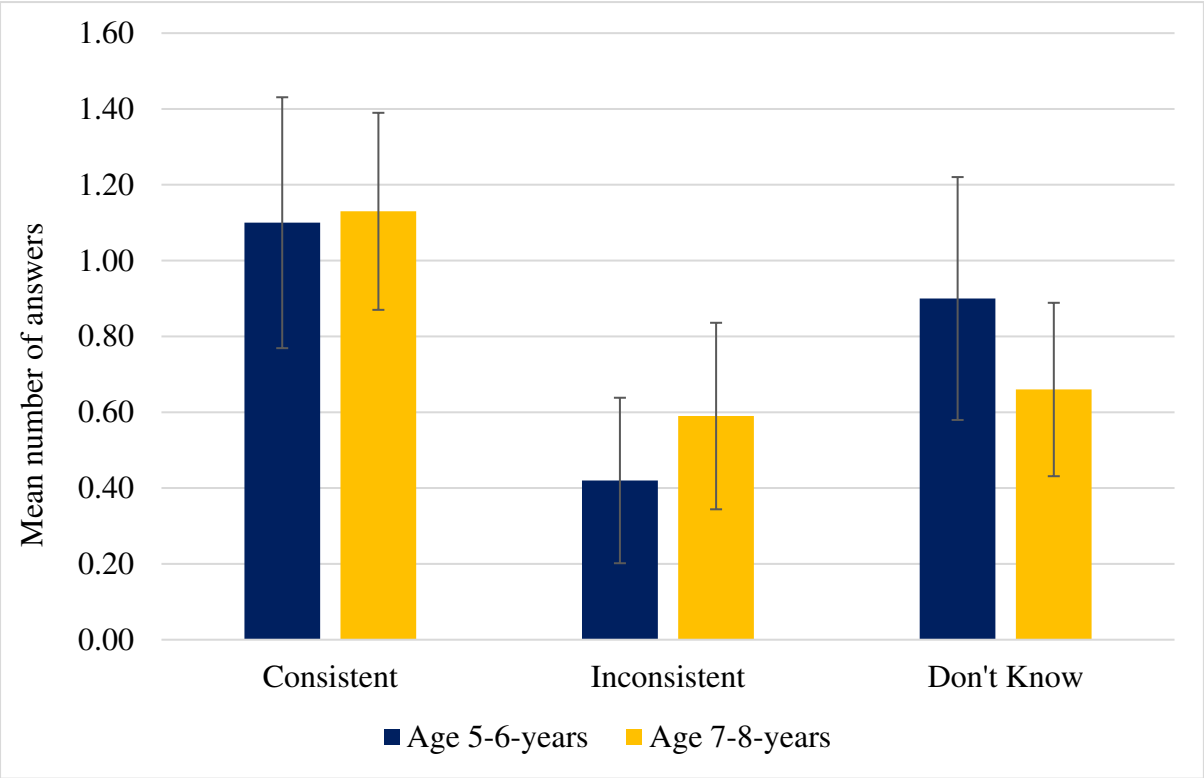


Figure 2. Mean number of incorrect responses that were consistent or inconsistent with the misleading gesture given, or not answered, including 95% confidence intervals.

A significant main effect of response type $F(1.8,110.7)=7.11$, $p=0.002$, $\eta^2=0.104$ was found, with incorrect answers *consistent* with the misleading gesture produced more often (MD=0.60, $p<0.001$) than incorrect answers *inconsistent* with gestures. No difference was seen between inconsistent and no answer responses (MD=0.27, p=0.085) or between consistent and no answer responses (MD=0.33, p=0.075).

Out of the 4 misleading questions given to each participant, 70% of the 5-6-year-olds and 75% of the 7-8-year-olds were misled by at least one question (Figure 3). Out of the 12 possible misleading questions, the misleading gesture that had the greatest effect overall was the hug vs high five gesture, with 66% of children overall giving a response consistent with the misleading gesture. The least misleading gesture was the gesture denoting how many

children sat on the bench at the end of the video, with no children from either age group responding with 'three' as was suggested by the gesture.

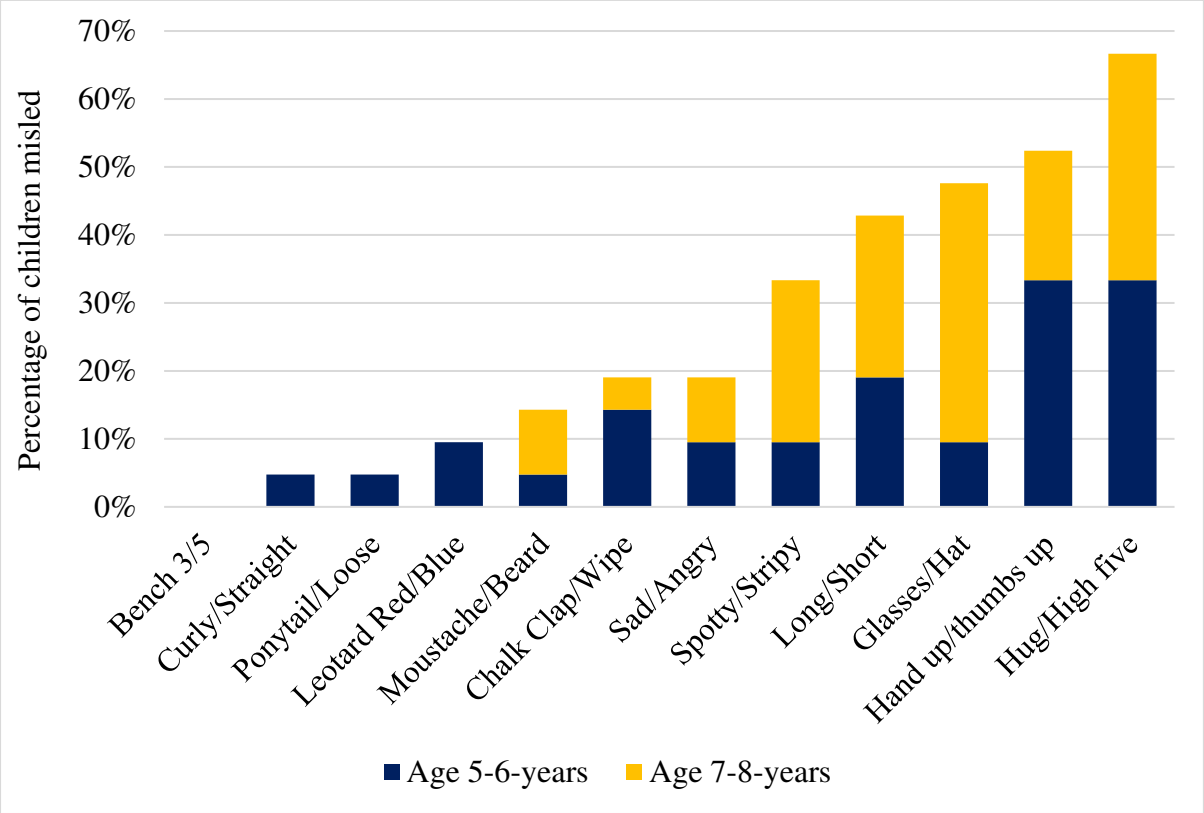


Figure 3. The combined percentage of children misled by the 12 possible gestures over the whole sample (n=63). Each misleading question was asked 21 times in total and was answered by 21 different children.

To further examine the capability of gestural information to affect memory, five 2 x 2 factorial ANOVAs were conducted to test the effect of age on pre- and post-free recall responses in relation to the number of words spoken, the number and proportion of correct items of information (IOI), and the number and proportion of incorrect IOIs (Table 2).

Table 2. Mean and standard deviations of free recall answers pre- and post-interview, for each age group.

| | Year 1 (n=31) | | Year 3 (n=32) | |
|---|---|---|---|---|
| | Pre-interview | Post-interview | Pre-interview | Post-interview |
| Total number of words | 41.32(45.41) | 31.80(34.04) | 47.56(50.82) | 46.94(43.93) |
| Correct IOIs | 4.81(3.62) | 4.81(4.50) | 6.28(3.42) | 7.81(7.09) |
| Incorrect IOIs | 0.52(1.81) | 0.55(0.89) | 0.13(0.34) | 0.94(1.70) |
| Proportion correct IOIs | 0.82(0.31) | 0.65(0.39) | 0.86(0.27) | 0.74(0.36) |
| Proportion incorrect IOIs | 0.05(0.12) | 0.08(0.13) | 0.02 (0.05) | 0.10(0.16) |

A main effect of age was seen for the number of correct IOIs ($F(1,61)=4.59$, $p=0.036$, $\eta^2=0.070$) with older children recalling 1.47 more correct IOIs pre-interview, and 3.00 more correct IOIs post- interview, than the younger sample. The *proportion* of correct and incorrect IOIs were examined to understand how much of the information given as a whole was correct/incorrect in comparison to other IOIs given by that participant. A significant change was seen pre- and post-interview for the *proportion* of correct IOIs ($F(1,61)=7.11$, $p=0.010$, $\eta^2=0.104$) and the *proportion* of incorrect IOIs ($F(1,61)=6.83$, $p=0.011$, $\eta^2=0.101$) with more IOIs for each seen post-interview.

No effect of condition (pre- and post-interview) was seen for the number of words spoken ($F(1,61)=0.78$, $p=0.382$, $\eta^2=0.013$), the number of incorrect IOIs ($F(1,61)=3.01$, $p=0.088$, $\eta^2=0.047$), or the number of correct IOIs ($F(1,61)=1.37$, $p=0.246$, $\eta^2=0.022$). There were no age effects for the number of words spoken ($F(1,61)=1.27$, $p=0.264$, $\eta^2=0.02$), the number of incorrect IOIs ($F(1,61)=0.00$, $p=0.997$, $\eta^2=0.00$), the proportion of correct IOIs

($F(1,61)=1.03$, $p=0.313$, $\eta^2=0.017$), or the proportion of incorrect IOIs ($F(1,61)=0.05$, $p=0.817$, $\eta^2=0.001$).

To establish whether question centrality or gesture saliency affected the strength of the gestural misinformation effect, each question was examined for its level of centrality to the event in question, and for the saliency of the gesture used (Table 3). Peripheral details ($M=0.65$) were significantly more likely to elicit the suggested word than central events ($M=0.41$), $t(62)=1.99$, $p=0.050$. Of the top five misleading questions, 4 out of 5 questions asked about peripheral details, while central events showed a more varied response (see Table 3). Salient gestures ($M=0.83$) were significantly more likely to elicit the misleading suggested word than gestures which were more subtle ($M=0.23$), $t(62)=5.45$, $p<0.001$. The top four misleading questions were those accompanied by salient gestures, with the most misleading question containing the largest whole arm movement above the chest, and were thus the most salient, while the five least misleading questions all contained more subtle naturalistic gestures (see Table 3).

Table 3. The number of children misled by each question and gesture type. Each question was asked a total of 21 times, to 21 different children.

| Question | % number of children misled | | Central/Peripheral | Salient/Subtle | Total misled out of 21 | % total misled (n=21) |
|---|---|---|---|---|---|---|
| | Age 5-6 | Age 7-8 | | | | |
| Hug/High five | 64% | 70% | Central | Salient | 14 | 67% |
| Raise hand/Thumbs up | 64% | 40% | Peripheral | Salient | 11 | 52% |
| Glasses/Hat | 20% | 73% | Peripheral | Salient | 10 | 48% |
| Long/Short | 40% | 45% | Peripheral | Salient | 9 | 43% |
| Stripes/Spots | 20% | 45% | Peripheral | Subtle | 7 | 33% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Angry/Sad | 20% | 18% | Central | Salient | 4 | 19% |
| Clap/Wipe | 30% | 9% | Central | Salient | 4 | 19% |
| Beard/moustache | 10% | 18% | Peripheral | Subtle | 3 | 14% |
| Red/Blue | 18% | 10% | Central | Subtle | 3 | 14% |
| Hair up/Down | 9% | 0 | Central | Subtle | 1 | 5% |
| Straight/Curly | 10% | 0 | Peripheral | Subtle | 1 | 5% |
| 3 or 5 | 0 | 0 | Central | Subtle | 0 | 0% |

To assess if the condition a question was asked in (accurate, no gesture, or misleading) affected the ability of children to give an answer, the number of questions unanswered in each condition and age group was examined (Figure 4). A significant main effect of condition was found $F(2,122)=9.98$, $p<0.001$, $\eta^2=0.14$, with planned comparisons showing that questions accompanied by no gesture were significantly more likely to elicit no answer than either an accurate gesture ($MD=0.64$, $p<0.001$) or a misleading gesture ($MD=0.43$, $p=0.007$).

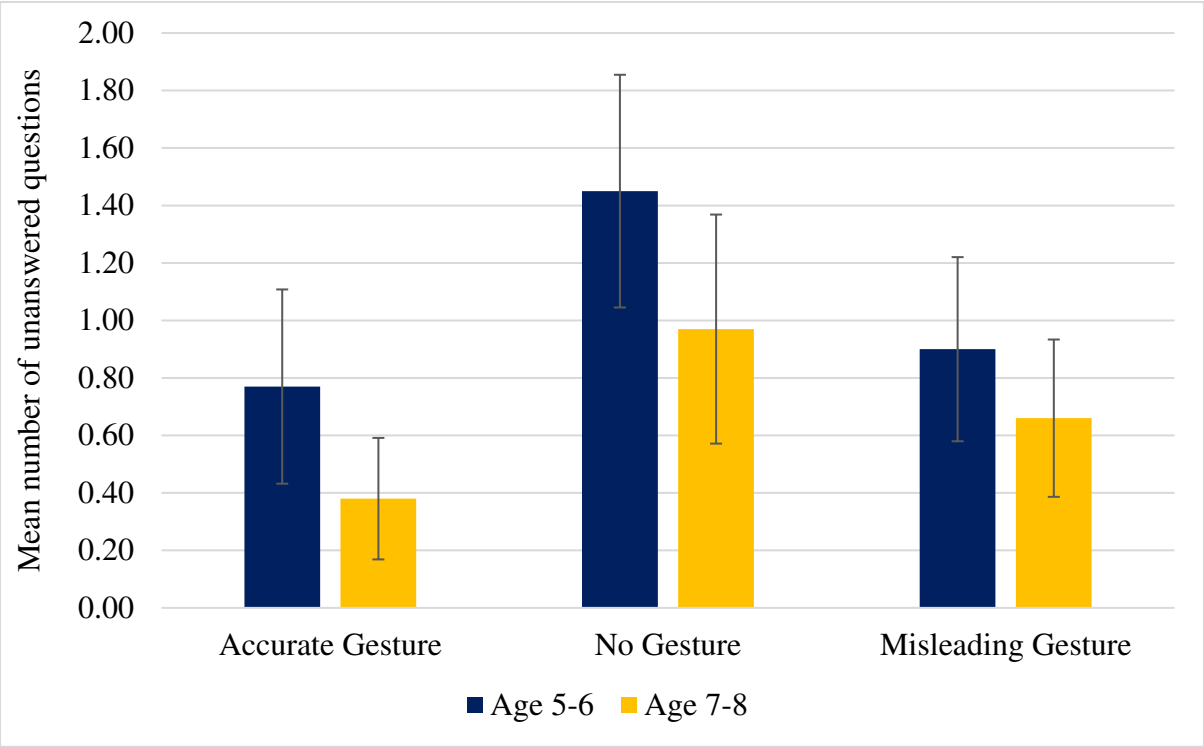


Figure 4. The mean number of unanswered questions for each condition and age group, including confidence intervals.

The five questions most likely to elicit no answer were all questions regarding peripheral details, and the five questions least likely to elicit no answer were all central details. Questions classed as peripheral accounted for 77% of all unanswered questions, compared to 23% for central events. The spread of unanswered questions with regards to saliency was more varied, with 54% of questions not answered when gestures were subtle, compared to 46% when gestures were salient. No discernible pattern could be seen in the effect of gesture saliency on unanswered questions.

Examining the effect of age on a gesture's ability to mislead showed no main effect of age for correct responses $F(1, 61)=2.76$, $p=0.102$, $\eta^2=0.043$, incorrect responses $F(1, 61)=0.49$, $p=0.485$, $\eta^2=0.008$, or incorrect answers consistent with the misleading gesture $F(1,61)=0.04$,

P=0.845, $\eta^2$=0.001, indicating that the ability of gestural information to mislead was not related to the age of the participants.

There were no age differences between erroneous answers consistent with the suggested word for central t(61)=0.95, p=0.347, Cohen's d=0.24; or for peripheral events t(61)=1.19, p=0.240, Cohen's d=0.30; or salient t(61)=0.21, p=0.836, Cohen's d=0.05; or subtle gestures t(61)=0.21, p=0.839, Cohen's d=0.05, indicating a lack of developmental change. A significant age difference was seen between groups for no answer responses, with younger children providing no answer more often than older children F(1,61)=4.95, p=0.030, $\eta^2$=0.08, but there was no interaction between age and condition F(2,122) = 0.34, p=0.713, $\eta^2$=0.01.

Given the difference in gender in the two groups, an exploratory analysis was conducted to look at the effect gender may play on gestural information's ability to mislead, and if this may have affected the lack of age effects seen (Figure 5). A t-test showed that boys were significantly more likely to give an answer consistent with the misleading gesture than were girls t(61)=2.42, p=0.019, indicating that the larger proportion of boys in the older group may have affected the findings.

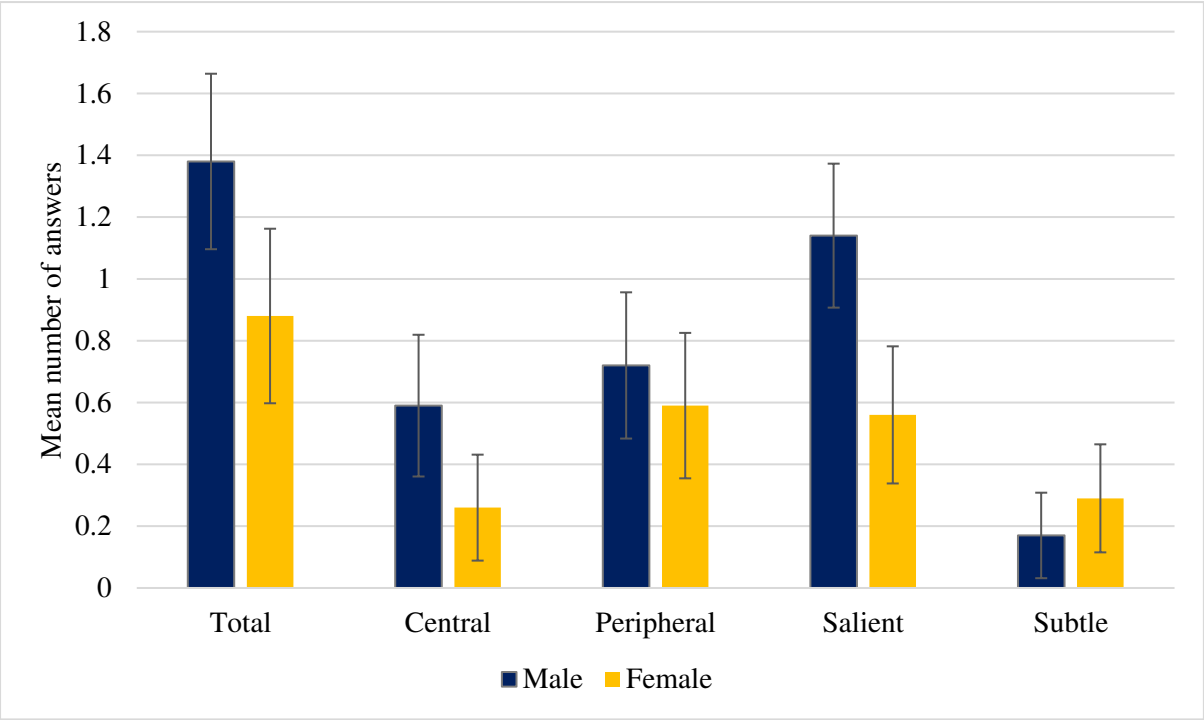


Figure 5. The mean number of answers consistent with the misleading gesture given, including confidence intervals.

## Discussion

This study examined the capacity of gestural information to mislead, with consideration of how the centrality of a question, or the saliency of a gesture, might impact the gestural misinformation effect. In line with our hypothesis, results showed that misleading gestures were able to corrupt recall of a past event in children between the ages of 5 and 8 years, supporting Kirk et al (2015) and Broaders and Goldin-Meadows (2010). Contrary to our prediction, and despite research that indicates verbal suggestibility is a function of age (Bruck & Ceci, 1999; Gudjonsson et al., 2016; Volpini et al., 2016) no age differences were seen between the two age groups, supporting Kirk et al (2015). As anticipated, the centrality of a question affected the ability of that question to mislead, with peripheral details showing more susceptibility to gestural misinformation than did central events. Similarly, the saliency of a gesture also affected the incorporation of misinformation, with salient gestures eliciting the

misleading suggested word more often than subtle gestures. These findings show that the gestural misinformation effect is a robust phenomenon, mediated by question centrality and gesture saliency; and demonstrating the forensic importance of these factors for the first time.

Our results show that even subtle gestures can lead a child witness during questioning, with more salient gestures misleading children on more than a third of occasions. This is in line with research showing that salient gestures are attended to more by a listener (Chu et al., 2014), making them more obvious as a source of information when a memory trace is weak, or when a question is ambiguous (Dargue et al., 2019; Pezdek & Roe, 1995). When gesture is more salient, mirror neuron engagement may also be higher, increasing associative activation and false memory formation (Brainerd et al., 2008; Wimmer & Howe, 2009). Central information was shown to protect against gestural misinformation, with the better integration, improved recall, and stronger memory trace associated with central events (Sarwar et al., 2014) reducing the ability of the gesture to mislead, compared to peripheral details. These findings highlight that question centrality and gesture saliency are important considerations during eyewitness interviews.

Further support for the idea that gesture acts as a source of information when a memory trace is weak, or when a question is ambiguous, can be seen in the increased number of questions answered when a gesture was present. This was especially the case for younger children, indicating that the cognitive immaturity of this group, in comparison to older children (Fritz et al., 2010; Geurten & Willems, 2016; Ghetti, 2003) affected their recollection of the video when no additional information was present. This can also be seen in younger children's reduced accuracy for correct answers when compared to the older children, within the control condition. Despite this, no developmental trend was seen with regards to suggestibility, as

suggested by Kirk et al (2015). There is however a wide body of reliable research demonstrating greater suggestibility to *verbal* misinformation in younger children (Bruck & Ceci, 1999; British Psychological Society, 2010). Auditory and visual information are most often self-reported as originating from the same source despite being from different modalities (Stark et al., 2010), indicating a processing similarity such that similar age-related suggestibility effects might be expected. Our findings indicate that the susceptibility of children to gestural misinformation may be more resistant to protective cognitive and social developmental advancements, than is verbal misinformation. In the case of this study, given the discrepancy in gender make-up of the two groups tested, and exploratory results which showed males to be misled more than females, it is unclear whether the lack of age effects seen was a real phenomenon, or was an artefact due to the uneven distribution of gender between the age groups.

An examination of IOIs recalled post-interview showed no information consistent with the misleading gesture given, contrary to previous findings (Broaders & Goldin-Meadow, 2010; Kirk et al., 2015). This may be due to differences in study design. Although Kirk et al (2015) found that one third of children included gestural misinformation during post-interview recall, most of the children were a younger age (three-year-olds) than the children in the present study. Between participant designs, with each child assigned to either accurate or misleading conditions and no baseline control, may also have reduced the ability of prior studies to discern whether gestural misinformation would have been present regardless of the gesture used, or was specifically linked to the misleading gesture given. Although previous research showed three-quarters of children affirm at least one untrue suggestion during free recall, this was compiled from data collapsed across 4 interview sessions, increasing the chances of this finding (Broaders and Goldin-Meadow, 2010). The focus of the present study

to ensure a format more relevant to real life interviews, including low saliency gestures and a reduced number of misleading gestures during interview, may have reduced the power of the study to find a misleading gesture effect during free recall compared to previous studies.

In conclusion, the results from this study support the gestural misinformation effect, with improvements in methodology strengthening the body of work in this area. This study also extends previous findings by demonstrating the importance of question centrality and gesture saliency. The findings have implications for guidelines regarding investigative interviews with children. Interview guidelines need to be updated to include instructions about the impact of gestural information, to help secure the best evidence possible, and improve the chances of a fair outcome. Investigators should be aware that even subtle gestures may mislead child eyewitnesses, and that evidence regarding peripheral details is vulnerable and prone to disruption. Unlike verbal misinformation, the gestural misinformation effect does not appear to reduce with age-related advances in cognitive development and social skills for the ages tested, indicating that care should be taken when interviewing children of all ages. In summary, it is advisable that police interview guidelines are revised to include warnings that gestural information can mislead witnesses, and that appropriate prevention measures are accordingly put in place.

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