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Making memories: The gestural misinformation effect in children aged 11-16-years-old with intellectual/developmental difficulties.

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ABSTRACT

Background: In 2016, global records documented around 1 billion child abuse cases, with higher rates among children with Intellectual and Developmental Disabilities (IDD), and most recorded offenses not proceeding to court. Accurate eyewitness testimony is vital for the justice system. Yet, while children with IDD are known to be influenced by verbal misinformation, the effect of gestures on their testimony is still unknown.

Aims: The present study assessed the extent to which gesture can mislead children with IDD, alongside comparisons to prior research in typically developing (TD) children.

Method: A sample of children with moderate IDD aged 11–16 years (n = 21, *M*=12.95 years) were recruited from a UK school, and compared to TD 5–6-year-olds (n = 31, *M*=5.77 years) and 7–8-year-olds (*n* = 32, *M*=7.66 years) from previous published research. After watching a video participants underwent an interview containing 12 questions, some of which contained suggestive gestures.

Outcomes and Implications: Results demonstrated that in children with IDD, gesture observation significantly influenced responses given, with 18 of 21 children being misled at least once. Comparisons to TD children indicated no difference in suggestibility. This study is the first to examine how leading gestural information affects children with IDD, broadening previous research to a more representative sample for the justice system. Discussion centres on implications for police interview guidelines.

What this paper adds?

This study is the first inquiry into the GME on children with IDD, a population over-represented in the criminal justice system, and an unexplored area in the literature. The low percentage of crimes against children with IDD that proceed to court is, in part, attributed to challenges in presenting reliable evidence. By examining the impact of gestural information on this population, it contributes to a more comprehensive understanding of their vulnerability to misinformation. The findings hold particular significance for police interviews, offering crucial insights to improve the accuracy and reliability of testimony, and ultimately enhancing the fairness and effectiveness of legal proceedings involving children with IDD.

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Data Availability

The data that has been used is confidential.

1. Introduction

Children with diagnosed IDD are over-represented within the criminal justice system and at an increased risk of emotional, physical, and sexual abuse, compared to TD children (Fang et al., 2022). Compared to the general population, cases concerning children with IDD rarely go to court (Brown et al., 2017) in part due to the belief that their ability to testify reliably and accurately is compromised by both the child's age and their disability (Brown & Lewis, 2013; Gudjonsson & Henry, 2003). Non-verbal information, such as gestures involving the movement of the body to convey information, have been shown to corrupt witness evidence when gestural information is misleading in both TD adults (Gurney et al., 2016) and children aged from 2–13-years-old (Broaders & Goldin-Meadow, 2010; Johnstone, Blades, & Martin, 2023; Johnstone, Martin, & Blades, 2024; Kirk, Gurney, Edwards, & Dodimead, 2015; Meyer, Blades, & Krähenbühl, 2023). This is known as the Gestural Misinformation Effect (GME) (Kirk et al., 2015). For example, when children are asked if they remember what a person looked like, exposure to a misleading gesture that indicates "coat" may lead them to believe the person was wearing a coat. The ability of gesture to mislead children with IDD has not been examined despite evidence that children with IDD can be strongly misled by verbal misinformation (Morrison et al., 2019). The present study assesses the strength of the GME in children with IDD with the aim of informing current eyewitness interview practices. Comparisons are made to prior published work conducted by the authors (Johnstone et al., 2023) in TD children to help establish accuracy and suggestibility differences in eyewitness testimonies between TD children and those with IDD. The study also extends research into the reliability and accuracy of children with IDD as witnesses, and further assesses the ability of question centrality and gesture saliency to mediate the GME in a sample representative of children who are more likely to be the victims of crime (Fang et al., 2022).

1.1. Maltreatment and children with IDD

Around 1 billion child abuse offenses were recorded globally in 2016 (Hillis et al., 2016) with even higher rates recorded during the COVID-19 pandemic due to an escalation of family tension and a reduction in protective services (Bourgault et al., 2021; Romanou & Belton, 2020). In the UK, out of 250,000 offences recorded in 2019, only 4 % resulted in a charge or summons, with evidential difficulties accounting for half of all cases dropped (Office for National Statistics, 2020). Maltreated children often display language difficulties and low social skills (Lum et al., 2015, 2018), reduced intelligence and executive function (Su et al., 2019), memory impairments (Baugerud et al., 2016), compromised expressive and receptive language learning (Lum et al., 2015) and mental health problems (Geoffroy et al., 2016). Forensic transcripts of children recounting maltreatment have shown interview narratives to be vague and disordered (Westcott & Kynan, 2004) with nearly half of reports being sufficiently incoherent to impact interviewer comprehension.

Children with IDD are more than twice as likely to suffer physical, sexual, or emotional violence, or neglect, than their TD peers (Fang et al., 2022). Children with IDD are typically characterised by deficits in intellectual functioning, and a reduced ability to cope independently (World Health Organization, 2010). During interview, children with IDD can lack the required attention, verbal and working memory skills, and executive function ability to enable them to understand a listeners' prior knowledge of an event (Henry, 2010; Henry & Gudjonsson, 2007). Cognitive deficits lead to complications with relational information such as chronology and causal reasoning (Brown et al., 2018) and contextual information such as location, source, and time (Gaigg et al., 2008; Poirier et al., 2011). This not only affects an individual's ability to relate, comprehend, and interpret the world around them, but can compromise the clarity and organisation of narratives during interview (Brown et al., 2018), resulting in lower rates of open-ended questioning, and a less reliable interview approach (Agnew et al., 2006). Altogether it is apparent that children with IDD face significant challenges that may compromise the quality of interview evidence, in addition to a heightened vulnerability compared to TD children.

1.2. The misinformation effect

Leading questioning in eyewitness interviews can lead to false memory formation (Loftus, 2005). While often studied with verbal cues, misinformation can also arise from non-verbal sources like gestures. Gestures aid in the conceptualisation and schematisation of information (Kita et al., 2017); enhancing comprehension in cases of speech ambiguity (Dargue et al., 2019; Hostetter, 2011). Observing gestures can also improve memory above that of speech alone through exploitation of the listener's mirror-neuron system (Proverbio & Zani, 2022) and motor system (Ianì & Bucciarelli, 2017) to create stronger mental representations. Gesture comprehension and generation share a common neural system with speech (Yang et al., 2015) and has been shown to be used unconsciously during interviews, especially with younger children (Meyer, 2019).

Evidence from the verbal misinformation literature shows certain groups are more suggestible to misinformation including younger children (Gudjonsson et al., 2016; Volpini et al., 2016) the elderly (Biondi et al., 2020) and those with cognitive deficits (Morrison et al., 2019) indicating a developmental role of cognition in suggestibility. In a review of the literature (Morrison et al., 2019), the more severe the cognitive impairment, the more suggestible children were, and the more likely they were to acquiesce to a leading question or change their response following negative feedback. Children with IDD show a disordered awareness and comprehension of gesture

due to issues with attention, imitation, language, and memorisation (Choi et al., 2022). While children with IDD may face gestural challenges, the often-seen use and exposure to sign language in schools could enhance gestural comprehension and attention. Currently, the differences in suggestibility between verbal and gestural information remain unclear, given the lack of research on gestural influences in children with IDD and their potentially varying abilities to engage with gestures. Building on Kirk et al.'s (2015) work on the GME, research suggests a robust misleading ability of gesture, with three-quarters of TD children aged 5–8-years (N = 63) and seven-eighths of TD children aged 6–13-years (N = 108) being misled by gesture at least once (Johnstone et al., 2023; Meyer et al., 2023). False memory was found to increase further for highly visible gestures, and questions about peripheral details, with children more likely to give an answer consistent with the gesture seen than any other response (Johnstone et al., 2023).

1.3. Police interviews

Current forensic interview methods, employing evidence-based techniques like free-recall, context reinstatement, and cognitive load questioning, are effective for TD populations. However, these methods inadequately address the developmental and social needs of individuals with IDD (Wyman et al., 2019), leading to less reliable interview techniques such as specific, leading, and forced choice questions (Brown et al., 2017; Cederborg & Lamb, 2008). While police interviewers are instructed to use neutral mannerisms and speech to avoid leading feedback (College of Policing, 2022), official guidelines overlook the potential influence of gestures on witness testimony. Neglecting to monitor gestures during interviews jeopardises the collection of reliable testimony and hinders case progression, particularly for children with IDD due to perceived differences in cognitive competence and accuracy (Brown & Lewis, 2013).

1.4. Aims and research questions

Building on previous work in TD children by the authors (Johnstone et al., 2023) this study evaluated the strength of the GME in a sample of children with IDD, a population frequently overrepresented in the justice system (Office for National Statistics, 2019). Comparisons with TD children from prior research using the same methodology and paradigm (Johnstone et al., 2023) were used to assess the accuracy and suggestibility of children with IDD in relation to TD children, including the consideration of chronological age, question centrality, gender, and gesture type. Practical limitations when testing children with IDD resulted in an older age group than initially expected. Due to the lack of research into the GME in children with IDD, and the lack of age effects expected, the age range was deemed to be acceptable for the aims of this study.

Based on research that shows significant memory deficits, reduced executive function, greater compliance/acquience, and disordered narrative abiites (Brown et al., 2018; Henry, 2010; Henry & Gudjonsson, 2007; Morrison et al., 2019) it was expected that children with IDD would be susceptible to the GME due to the reliance on gestural information for information; and that this will be greater in comparison to TD children aged 5–8-years old interviewed using the same methodology (Johnstone et al., 2023). Following from Johnstone et al's. (2023) previous work, it was anticipated that accurate gestures would result in more correct responses and that misleading gestures would lead to more incorrect answers due to the ability of gesture to cue the original memory (Lindsay & Johnson, 2000) and be used as a source of information (Dargue et al., 2019; Pezdek & Roe, 1995).

While younger children typically exhibit greater vulnerability to verbal misinformation (Bruck & Melnyk, 2004; Gudjonsson et al., 2016; Volpini et al., 2016) evidence suggests that semantically related items in misinformation paradigms may induce developmental reversals (Otgaar et al., 2018). Research on the GME to date indicates no age effects (Johnstone et al., 2023; Kirk et al., 2015; Meyer et al., 2023), suggesting a potential distinction in how modality (auditory or visual) influences misinformation encoding and/or retrieval, and as such, no age effects were anticipated. In line with Johnstone et al. (2023), salient gestures were anticipated to provide stronger visual cues, heightening mirror-neuron engagement (Proverbio & Zani, 2022) and motor system activation (Ianì & Bucciarelli, 2017), resulting in a more misleading influence. Durable memory traces linked to central events (Migueles & Garcia-Bajos, 1999; Sarwar et al., 2014) were hypothesised to protect against misleading gestures, leading to fewer incorrect answers. It was unclear whether an interaction between gender and the GME would be observed, with current GME research limited, and findings in the verbal misinformation literature yielding mixed results (Bruck & Melnyk, 2004; Gudjonsson et al., 2016; Klemfuss & Wang, 2017; Perez et al., 2022). Overall, the primary objective of this study was to investigate the potential of gestural information to lead children with IDD. The study placed importance on determining the specific effects of chronological age, gesture saliency, and question centrality, with the aim of applying findings to forensic interview practice.

2. Method

2.1. Participants

A power analysis was conducted with G Power for a repeated measures ANOVA (1 group, 3 measures), with a power of 0.80, a significance effect of $\alpha = 0.05$, and an effect size calculated from prior research of $\eta^2 = 0.15$ (f=0.42). This resulted in a suggested sample size of 11. A second power analysis using the same parameters for a 3×3 within-between ANOVA gave an additional sample estimate of 15. The calculated effect size was obtained from the average effect size from prior work using the same methodology, which resulted in an average of 1.12 misinformation details recorded per participant (Johnstone et al., 2023). This aligns with misinformation research which suggests that the smallest effect size of interest (SESOI) accepted is any effect size resulting in $p < 0.05$, or a raw mean difference of anything up to 1 misinformation detail (Riesthuis et al., 2022).

A sample of 21 school children were recruited from a Special Educational Needs school in the UK for children with moderate IDD.

Children ranged in age from 11–16-years-old ($M = 12.95$ $SD = 1.43$, 11 boys, 10 girls). Children were selected by teachers based on their ability to attend to the video and comprehend questions, resulting in the exclusion of younger children, and those deemed a safety risk for the researcher. This resulted in an older age range being used for analysis than anticipated. After consideration of the study aims, the lack of research in this area, and the hypothesised null effect of age, the authors deemed the age range to be acceptable. Children were recruited as a sample of convenience from a mix of backgrounds. Comparisons were made to prior published research by the authors (Johnstone et al., 2023) assessing TD 5–6-year-olds old ($n = 31$, 9 boys, 22 girls, $M = 5.77$ years $SD = 0.43$) and 7–8-year-olds old ($n = 32$, 19 boys, 13 girls, $M = 7.66$ years, $SD = 0.48$) using the same methodology, question sets, and video. Ethical approval for this study was given by The University of Sheffield.

2.2. Design

The initial experiment consisted of 3 conditions - no gesture, accurate and misleading- which were analysed using a repeated measures ANOVA for response type (correct, incorrect, DK/DR) with condition as the within participant variable. An example of a misleading/accurate gesture can be seen in Fig. 1. All children answered four questions from each condition, and the scripts were counterbalanced to vary gesture presence so that (for example) a question asked in script 1 with no gesture, was asked with an accurate gesture in script 2, and a misleading gesture in script 3. Incorrect responses were further analysed in relation to the misleading gesture given using a paired t-test to compare the significance of answers consistent/inconsistent with the misleading target word.

Comparisons to prior research on TD children using the same misinformation paradigm and methodology consisted of a 3×3 mixed measures ANOVA with condition (no gesture, accurate and misleading) as the within participant variable, and group (TD aged 5–6-years, TD aged 7–8-years, and IDD) as the between participant variable. Given that the original published study on TD children provided between group analysis regarding age, we decided to maintain the same age groups from the TD children for analysis within the current study. This approach was chosen to provide more detailed comparisons of any age effects observed, including whether children with IDD aligned more closely with younger or older TD children.

2.3. Materials

Following from previous work by the authors (Johnstone et al., 2023), participants viewed a 5-minute, dialogue-light video on an iPad, featuring a young girl's gymnastics examination and practice sessions. Participants' responses were recorded digitally. Three scripts were created, each with 12 questions, containing 4 no gesture questions, 4 accurate gesture conditions, and 4 misleading gesture conditions (appendix – table 1). A range of gestures were employed, encompassing 6 expressive and visible salient movements (e.g., full-arm gestures above the chest) and 6 discreet and subtle gestures (e.g., hand or finger motions below the chest) (Chu et al., 2014). Gestures were derived from a combination of iconic signs adapted from British/American Sign Language. Those not obtained directly from a sign language system were naturalistic movements that were deemed to be gestures used day-to-day and easily recognisable. Each script contained six central and six peripheral information-based questions. The proximity of each question to the main

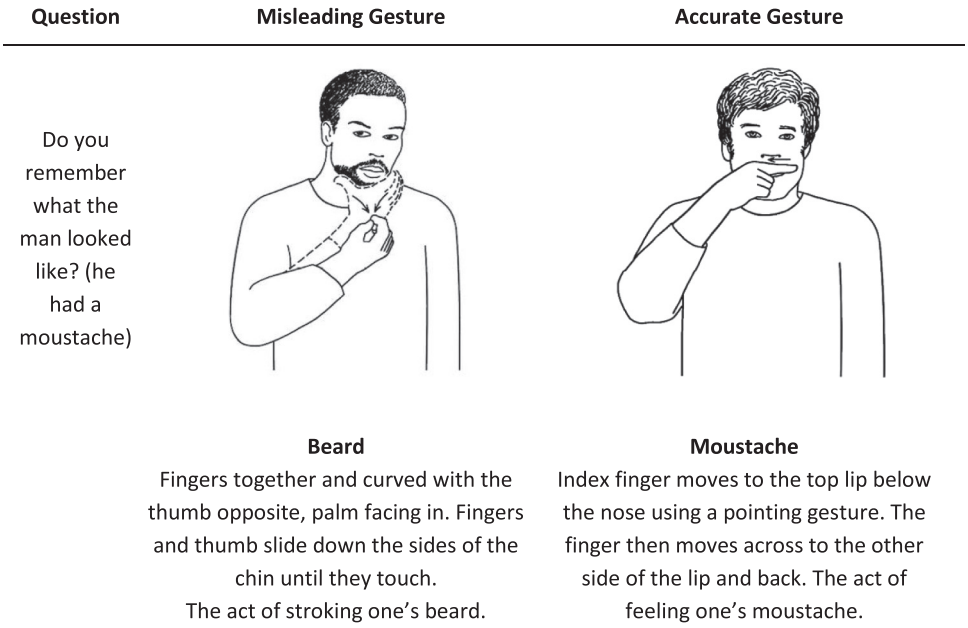

Fig. 1. An example of a misleading and accurate gesture in the context of the question asked. Adapted from Simplified Signs: A Manual Sign-Communication System for Special Populations, 2020, https://doi.org/10.11647/OBP.0220 CC by 4.0.

event determined its centrality. Central questions pertained to the primary character and the unfolding action sequence, while peripheral questions concerned events occurring before or after the central event or focused on other individuals in the video (Andrews & Lamb, 2019). Questions were divided equally by saliency and centrality resulting in three questions per category (central/salient, central/subtle, peripheral/salient, peripheral/subtle) within each script.

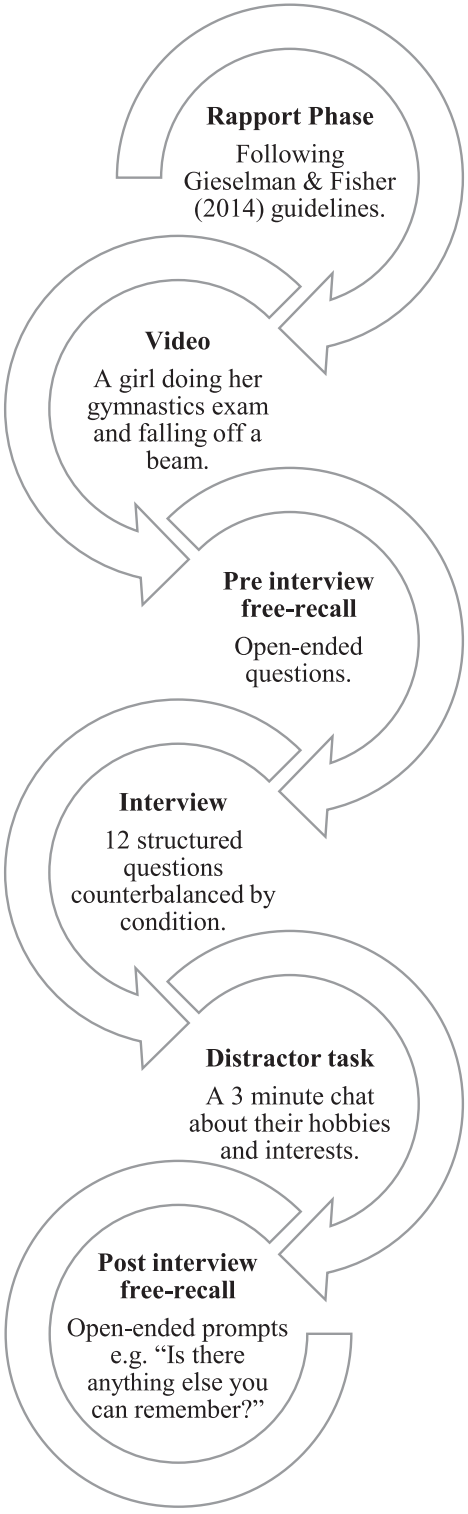

Fig. 2. The 6 stages of the interview procedure: Rapport, Video, Pre-interview free-recall, Interview, Distractor task, and Post-interview free-recall.

2.4. Coding

In the analysis of free recall interviews, items of information (IOIs) were the unit of coding and were defined as any information provided by the child regarding the video content. For example, the statement "A girl called Molly was doing a gymnastics exam, she had blonde hair. Her mum was there." was coded as having 6 IOIs. These included details about the main character (1. Girl, 2. Molly, 3, Blonde), the activity (4. gymnastics), the video's storyline (5. an exam), and the presence of other people (6. Mum). IOIs were examined to distinguish correct and incorrect information in pre- and post-free recall interviews. New IOIs provided after structured questions were further assessed for correctness and their alignment with previously observed gestures. A trained researcher, who was not part of the study, coded a portion (40 %) of the data, establishing inter-rater reliability. High agreement was found for pre-interview free-recall (Kappa=0.71, $p < 0.001$) and post-interview free-recall (Kappa=0.87, $p < 0.001$). Responses to the 12 interview questions were categorised as correct, incorrect, or 'do not know/do not remember' (DK/DR). DK/DR responses encompassed non-verbal signals like head shaking ('no') or shoulder shrugging. Incorrect answers in questions involving misleading gestures were further coded as consistent or inconsistent with the gesture. Inter-rater reliability was assessed for 20 % of participants, demonstrating nearly complete concordance between raters (Kappa=0.99, $p < 0.001$).

2.5. Procedure

Children underwent individual testing sessions in a quiet area of the school setting, with the experimenter seated beside them. The study had six stages, beginning with a rapport-building phase, followed by watching the video, pre-interview free recall, structured interview questions, a distractor task, and concluding with post-interview free recall. This was in line with Johnstone et al. (2023) to facilitate comparison of results between TD and IDD children (see Fig. 2).

Following enhanced cognitive interview guidelines (Fisher & Geiselman, 2010; Geiselman & Fisher, 2014), the interviewer transferred perceived control to the child, stating, "I don't know what happened in that video, do you think you could help me by answering some questions?" Children were assured that it was okay if they didn't know or couldn't remember answers. In cases where children did not pay attention to, or missed gestures, the interviewer verbally redirected their focus, and the question was reiterated. Following video presentation, each child underwent an initial free recall assessment. They were asked if they could tell the interviewer, in as much detail as possible, what they saw on the video. Uniform open-ended prompts were employed to facilitate information retrieval, including questions such as "Can you remember anything else?", "Could you describe what happened next?", and "Can you tell me a bit about any other people you saw in the video?".

Following the initial free recall interview, each child was randomly assigned one of three scripts and asked 12 structured questions (see Table 1 in the supplementary materials) across three conditions: no gesture (Condition 1), accurate gestures (Condition 2) and misleading gestures (Condition 3). Gestures were presented live and face-to-face, and were standardised using the same props/clothes/movements to the best of our ability. No practise/fatigue effects were noticed during the testing phase which lasted approximately 30 min. In Condition 1 questions were presented without any accompanying gestures, with the experimenter keeping their hands stationary on the table. In Condition 2 questions were presented with accurate gestures aligning with the content of the video. In Condition 3 questions were presented with misleading gestures which contradicted the video's information. All gestures employed were defined as iconic (McNeill, 1992) and formed a meaningful representation of a concept visually, e.g., miming putting on a hat to represent 'hat' and conveyed accurate or plausible semantic information to the participant. Following structured questions, children engaged in a three-minute distractor task, during which they talked about their interests and hobbies. They then participated in a second free recall test employing the same open-ended prompts as in the initial recall test.

3. Results

Analysis of pre- and post-interview free-recall IOIs showed very little information collected and only one IOI was consistent with a

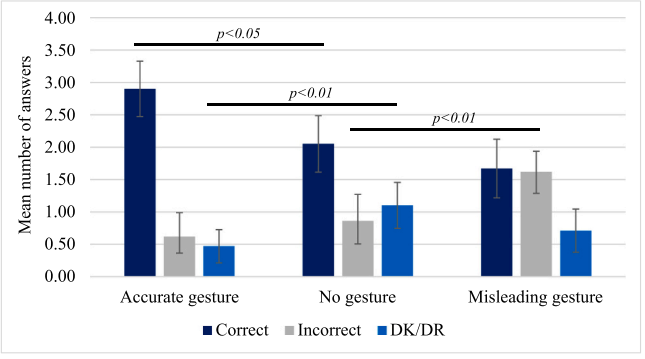

Fig. 3. Mean number of correct, incorrect, and DKDR responses (out of a maximum possible 4) for children with ID/LD aged 11–16 years, including 95 % confidence intervals and significance levels.

misleading gesture. As such, further investigation into this aspect of the GME was not pursued in this study. In cases where results deviated from normal distribution, non-parametric tests were conducted alongside parametric tests. In cases where both analyses agreed, parametric results were reported on the basis of all assumptions being met.

3.1. The GME in children with IDD

To determine whether children with IDD were misled by gestures, the mean number of questions that children answered correctly and incorrectly for each condition (accurate, no gesture and misleading) were examined (Fig. 3).

Results showed that compared to the control condition of no gesture, children with IDD gave a correct answer more often when the question was accompanied by an accurate gesture, and an incorrect answer more often when the question was accompanied by a misleading gesture. A repeated measures ANOVA for gesture condition (accurate, no gesture and misleading) showed a significant main effect for both correct answers $F(2,40)= 8.35$, $p < 0.001$, $\eta^2= 0.295$), incorrect answers $F(2,32)= 8.64$, $p < 0.001$, $\eta^2= 0.302$), and DKDR responses $F(2,40)= 3.74$, $p = 0.032$, $\eta^2= 0.158$). Planned comparison using Least Significant Difference (LSD) showed that an accurate gesture was more likely to elicit a correct answer than either the no gesture condition (MD=0.86, $p = 0.018$) or the misleading condition (MD=1.24, $p < 0.001$). Misleading gestures were also shown to be significantly more likely to produce an incorrect answer than either the accurate condition (MD=1.00, $p < 0.001$), or the no gesture condition (MD=0.76, $p = 0.002$). The control condition of no gesture was significantly more likely to produce a DKDR response than when a question was accompanied by an accurate gesture (MD=0.62, $p = 0.004$).

3.2. The ability of gesture to mislead the content of incorrect responses

Incorrect responses underwent additional analysis to determine the relationship of the response content to the given misleading gesture. Responses were categorised into three groups: consistent with the gesture, inconsistent with the gesture, or DKDR (Fig. 4). For instance, when a question such as "what was the judge on the right wearing?" was accompanied by a misleading gesture of a hat, a response of 'hat' was considered consistent, whereas a response of 'coat' was deemed inconsistent. All inconsistent answers were plausibly related to the question.

Out of the four misleading questions given to each participant, 18 out of the 21 participants were misled by at least one question (86 %) and gave a word consistent with the misleading gesture as a response. A paired sample t-test showed that children with IDD were significantly more likely to give an answer consistent with the misleading gesture, than inconsistent $t(20) = 2.43$, $p = 0.024$, *Cohen's d*= 0.53 indicating that participants were meaningfully misled by the gesture observed. Out of the 12 possible misleading questions, the misleading gesture that had the greatest effect overall was the hug vs high five gesture, with 71 % of children overall giving a response consistent with the misleading gesture. The least misleading gestures were red vs blue leotard and curly vs straight hair which did not elicit any answers consistent with the gesture observed (Fig. 5).

3.3. Suggestibility as a function of age

Following from research demonstrating that the act of 'binning' ages can cause a loss of power for detecting an effect (Bainter et al., 2020), and prior results which have shown no relation between age and the GME in between-participant groups (Johnstone et al., 2023) participant age was analysed as a continuous variable using age in years.

Overall, children with IDD gave more accurate information than inaccurate information during the structured interview, with an average of 7.02 correct details provided compared to 3.01 incorrect details. Age and correct answers ($r(21) = 0.21$, $p = 0.365$) and age and incorrect answers ($r(21) = 0.13$, $p = 0.567$) were both shown to have a weak non-significant positive correlation, indicating no developmental trend between accuracy and chronological age in children with IDD (Fig. 6).

Analysis of consistent, inconsistent and DKDR answers for misleading gestures (Fig. 7) showed weak non-significant negative correlations between age and consistent answers ($r(21) = -0.15$, $p = 0.531$) and age and inconsistent answers ($r(21) = -0.03$,

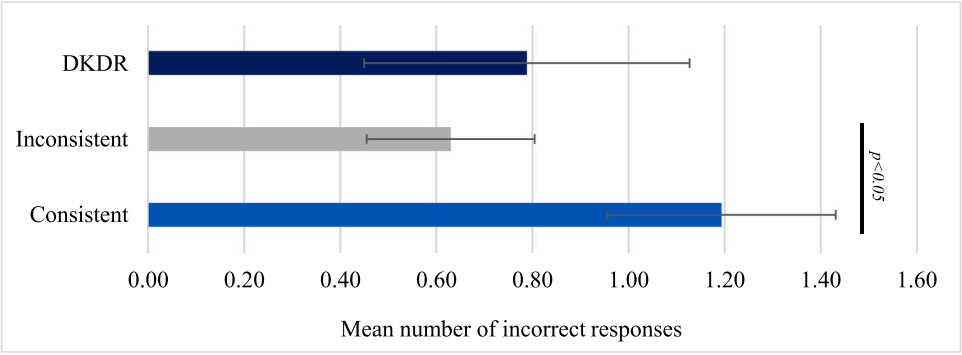

Fig. 4. Mean number of incorrect responses that were consistent/inconsistent with the misleading gesture given, including confidence intervals.

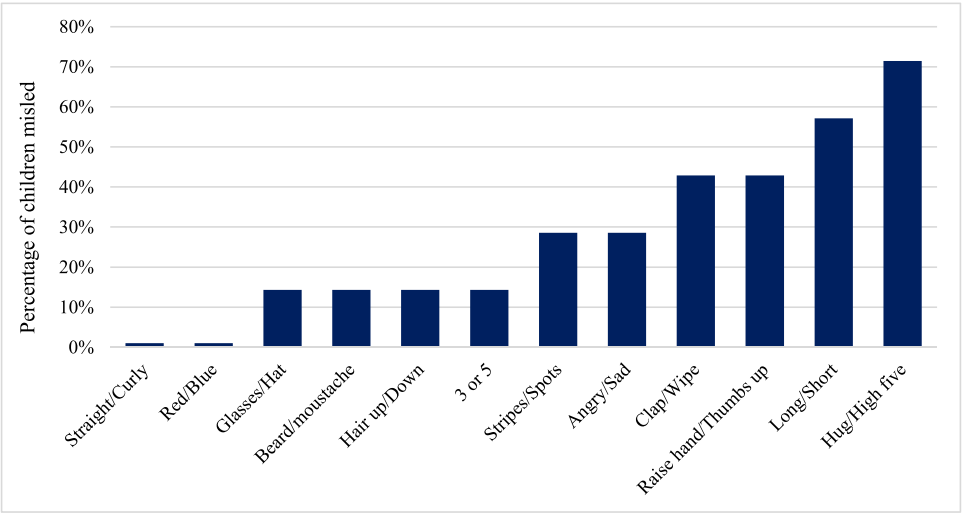

Fig. 5. The percentage of children misled by the 12 possible gestures.

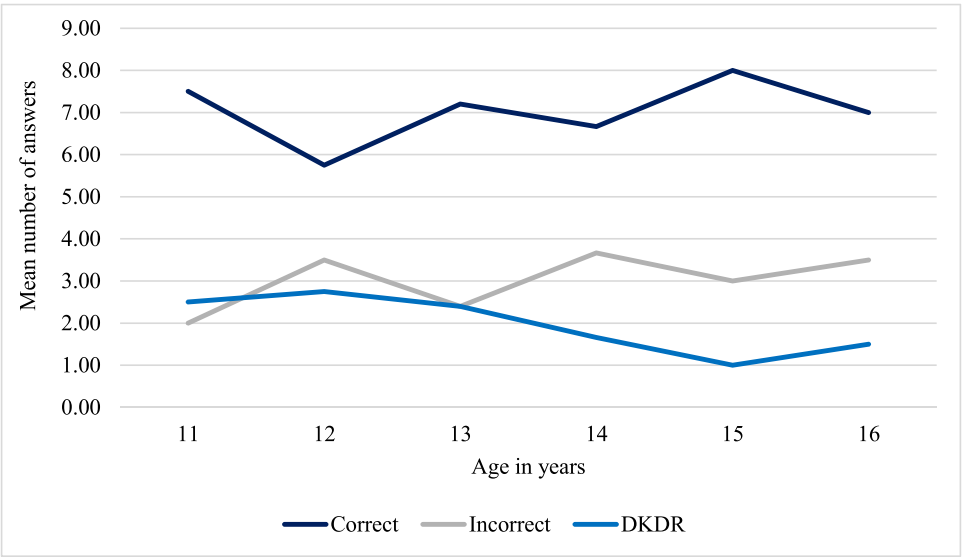

Fig. 6. Mean number of correct, incorrect and DKDR answers given by age in years during the structured interview.

$p = 0.905$) while a weak non-significant positive correlation was seen between age and DKDR answers ($r(21) = 0.21$, $p = 0.360$).

3.4. Centrality/saliency and the misinformation effect

To investigate how the strength of the GME might be influenced, the centrality of each question to the main plot/event, and the saliency of the accompanying gesture, was analysed (Table 2). Salient gestures were shown to mislead participants 43 % of the time in children with IDD, compared to subtle gestures which misled 12 % of the time, while central and peripheral questions misled 29 % and 26 % of the time respectively.

The saliency of the gesture used had a significant effect on the ability of the gesture to mislead, with salient gestures demonstrating greater influence than subtle gestures (*MD*=0.62) $t(20) = 3.28$, $p = 0.004$, *Cohen's d*= 0.72. The centrality of a question did not affect the ability of that question to mislead (*MD*=0.05) $t(20) = 0.22$, $p = 0.825$, *Cohen's d*= 0.05 (see Fig. 9).

3.5. Comparisons to TD children

The results from the current experiment were compared to those from previous research by the authors on TD children from a mainstream school, $N = 63$, M= 7 years 2 months, SD= 0.99, 35 girls and 28 boys (Johnstone et al., 2023). The same paradigm and

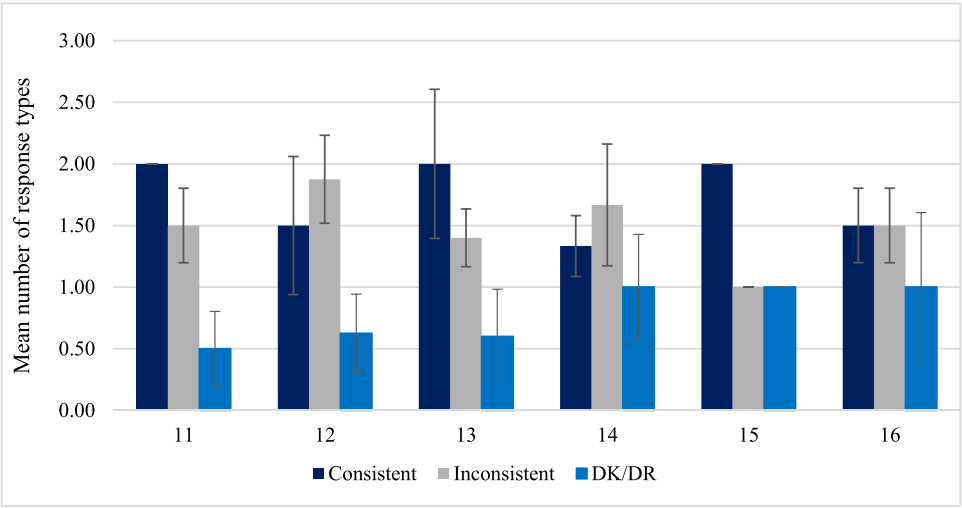

Fig. 7. Mean number of consistent/inconsistent/DKDR responses by age (years) out of the 4 misleading questions asked.

Table 2
The number of children misled by each question and gesture type. Each question was asked a total of 7 times, to 7 different children.

Question	Central/Peripheral	Salient/Subtle	Total misled	% misled
Hug/High five	Central	Salient	5	71 %
Long/Short	Peripheral	Salient	4	52 %
Clap/Wipe	Central	Salient	3	43 %
Raised hand/thumb	Peripheral	Salient	3	43 %
Stripes/Spots	Peripheral	Subtle	2	29 %
Angry/Sad	Central	Salient	2	29 %
Glasses/Hat	Peripheral	Salient	1	14 %
Beard/moustache	Peripheral	Subtle	1	14 %
Hair up/Down	Central	Subtle	1	14 %
3 or 5	Central	Subtle	1	14 %
Straight/Curly	Peripheral	Subtle	0	0 %
Red/Blue	Central	Subtle	0	0 %

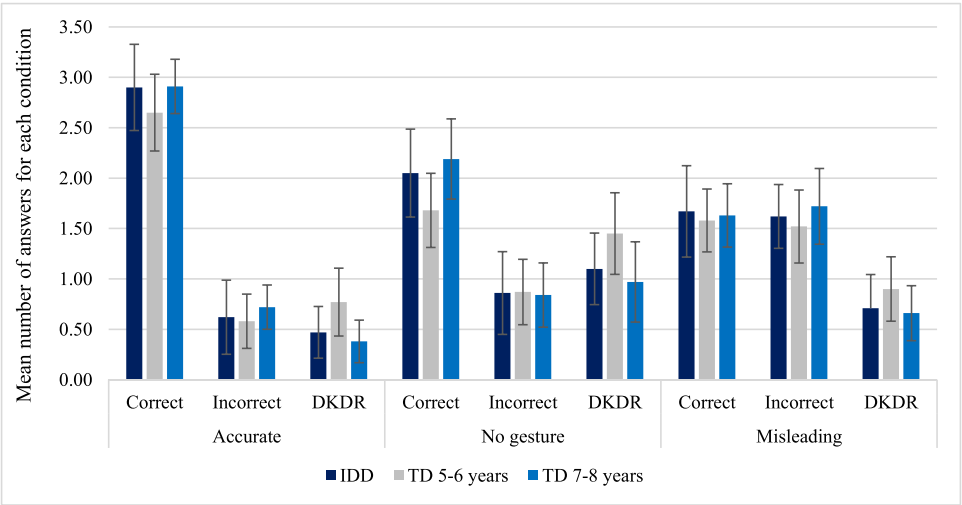

Fig. 8. The mean number of correct, incorrect and DKDR responses given by each group tested (TD 5–6-years, TD 7–8-years and IDD) for each condition (accurate/no gesture/misleading) including 95 % confidence intervals. Data for TD 5–6-years and TD 7–8-years was adapted from prior research by the authors (Johnstone et al., 2023).

methodology were used to ensure both studies were comparable and able to discern any differences in the GME in children with IDD and TD children (Figs. 8 and 9). Children with IDD aged 11–16-years-old in this sample performed at a similar level to TD children aged 7–8-years-old (Johnstone et al., 2023) in all conditions.

A 3 × 3 repeated measures ANOVA was conducted to examine the between participant groups (TD aged 5–6, TD aged 7–8, and IDD) with the within participant conditions (accurate gesture/no gesture/misleading gesture) for correct, incorrect and DKDR answers. A significant main effect of group (IDD or TD) was seen for DK/DR responses $F(1,80) = 139.29$, $p < 0.001$, $\eta^2 = 0.64$, but no interaction $F(4160) = 0.21$, $p = 0.935$, $\eta^2 = 0.005$. LSD pairwise comparisons showed the significant main group effect to only be due to the differences in mean between TD groups, and not due to differences with children with IDD. No group effect was seen for correct answers $F(2,80) = 1.87$, $p = 0.160$, $\eta^2 = 0.045$, or interaction between the two $F(4160) = 0.42$, $p = 0.796$, $\eta^2 = 0.010$, and no group effect for incorrect responses $F(2,80) = 0.17$, $p = 0.845$, $\eta^2 = 0.004$, or interaction $F(4160) = 0.10$, $p = 0.982$, $\eta^2 = 0.003$ was seen.

To examine the difference in strength of the GME between TD children aged 5–6-years and 7–8-years, and children with IDD aged 11–16-years, a 3 × 2 factorial ANOVA was completed to assess the effect of group (IDD, TD 5–6 years, and TD 7–8 years) on incorrect answers given after a misleading gesture (consistent or inconsistent). A significant main effect of type of incorrect answer was seen $F(1, 80) = 23.79$, $p < 0.001$, $\eta^2 = 0.229$, but no main effect of group $F(1,80) = 0.19$, $p = 0.826$, $\eta^2 = 0.005$, indicating that moderate IDD did not affect how susceptible the children were to the GME.

A 3 × 2 repeated measures ANOVA for the within participant condition of saliency (salient vs subtle gestures) and the between participant condition of group (IDD, TD 5–6-years and TD 7–8-years) showed a significant main effect for saliency $F(1,80) = 39.14$, $p < 0.001$, $\eta^2 = 0.39$ but no significant difference between groups $F(1,80) = 0.01$, $p = 0.989$, $\eta^2 = 0.00$, or interaction $F(2,80) = 0.01$, $p = 0.994$, $\eta^2 = 0.00$. Examination of the within participant condition of centrality (central vs peripheral) for all groups (IDD, TD 5–6-years and TD 7–8-years) showed no difference for condition $F(1,80) = 1.78$, $p = 0.186$, $\eta^2 = 0.02$, interaction $F(2,80) = 1.71$, $p = 0.187$, $\eta^2 = 0.04$, or group effect $F(1,80) = 0.01$, $p = 0.989$, $\eta^2 = 0.00$.

3.6. Gender and the GME

Following from Johnstone et al's. (2023) exploratory analysis which showed boys were misled by gesture significantly more than girls, T-tests were completed to see if a similar effect could be seen in children with IDD. An independent T-test showed no significant difference in answers consistent with the misleading gesture given between boys and girls (*MD*=0.18), $t(19) = 0.58$, $p = 0.566$, *Cohen's d*= 0.26. To compare accuracy between boys and girls, the total number of correct and incorrect information gathered during interviews was examined. Independent t-tests showed no differences between boys and girls in the quantity of correct (*MD*=0.15), $t(19) = 0.19$, $p = 0.855$, *Cohen's d*= 0.08, or incorrect information (*MD*=0.18), $t(19) = 0.25$, $p = 0.807$, *Cohen's d*= 0.11.

4. Discussion

This study examined the ability of gestural information to lead children with moderate IDD. Consideration was taken into how the centrality of a question, or the saliency of a gesture, might impact the gestural misinformation effect. Strengths of the study included its robust methodology, its comparisons to previous work on TD children, and its contribution to current gaps within the misinformation and IDD literature. Results were compared with prior work using the same misinformation paradigm and methodology in TD children (Johnstone et al., 2023). Consistent with our hypothesis, misleading gestures affected the recall of past events in children with

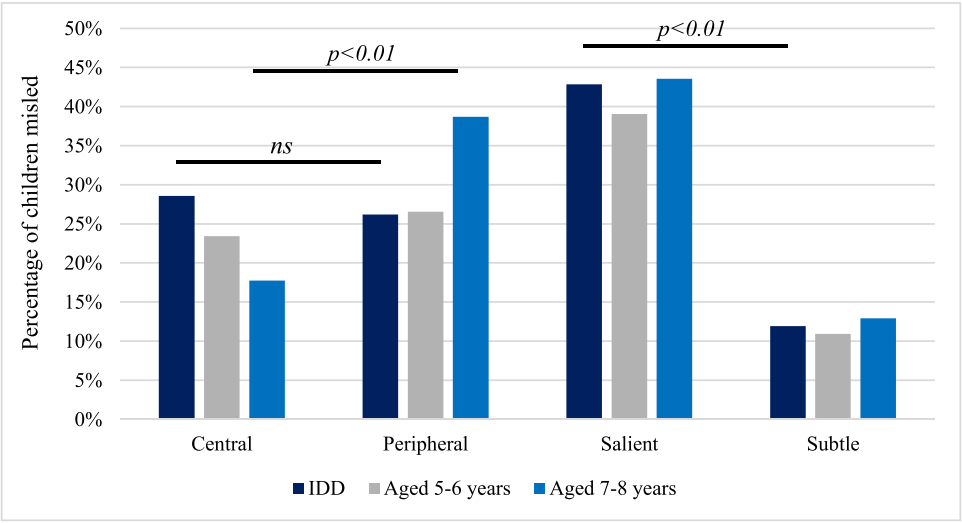

Fig. 9. The percentage of answers consistent with the misleading gesture for central/peripheral events and salient/subtle gestures. Results from Johnstone et al. (2023) for TD children aged 5–6-years and 7–8-years is included for comparison.

moderate IDD. In contrast to research indicating age-related verbal suggestibility in TD individuals (Bruck & Ceci, 1999; Gudjonsson et al., 2016; Volpini et al., 2016) children with IDD exhibited no reduction in suggestibility with age, aligning with previous findings in gestural studies (Johnstone et al., 2023; Kirk et al., 2015; Meyer, 2019). As anticipated the saliency of a gesture significantly affected the ability of that question to mislead, with salient gestures eliciting the misleading target word more often than subtle gestures. The centrality of a question however did not impact its misleading potential, with both central and peripheral questions equally misleading children with IDD. In comparison to TD children aged 5–6-years and 7–8-years, no difference in suggestibility was seen, however, the lack of controls for mental/chronological age or assessment of IQ/narrative ability in this study limits discussion of this point. Exploratory gender analysis showed no difference between boys and girls in the quantity of correct or incorrect information, or in their ability to be misled by gesture, contrasting with previous research (Johnstone et al., 2023). The observed gender differences may be partially attributable to the age of the sample taken compared to previous results, with more time developmentally available for boys to potentially 'catch up' with girls. Alternatively, prior gender differences may be due to individual differences in the sample taken. Further research into gender and the GME is necessary to draw definitive conclusions.

Kirk et al. (2015) suggested that gestures alongside speech amplify the false memory effect due to stronger misinformation encoding, with Johnstone et al. (2023) demonstrating a strong misleading ability of even subtle gestures. The results from the current study find further support for the GME with 18 out of 21 children with IDD being misled by gesture at least once and salient gestures misleading nearly half of the time. This is in line with results from Johnstone et al. (2023) and previous 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 a question is ambiguous (Dargue et al., 2019; Pezdek & Roe, 1995). When a gesture is more salient, mirror neuron engagement may also be higher (Proverbio & Zani, 2022) increasing associative activation and false memory formation (Brainerd et al., 2008; Wimmer & Howe, 2009). For children with IDD, who are heavily represented within the justice system, the finding that gestures can strongly mislead during interview settings is critical. Susceptibility to gestural misinformation, in addition to communication challenges, highlights a vulnerability within this demographic that is currently not addressed in police interview training, or scientific literature to date.

In line with findings from Johnstone et al. (2023), interview responses were more likely to be consistent with the gesture observed than any other answer; signifying that no level of gesture is without risk. Despite expectations that children with IDD might be more reliant on gesture due to significant memory deficits, diminished executive function, and greater compliance/acquience (Henry, 2010; Henry & Gudjonsson, 2007; Morrison et al., 2019) this was not observed in the sample examined. It may be that reduced gesture perception due to issues with attention and a committal of these to memory in children with IDD (Choi et al., 2022) affected gesture accessibility regardless of reliance. Alternatively, results may be indicative of a closeness in mental age/IQ/narrative ability between the groups, which was not measured due to practical sampling limitations and ethics/time constraints, and would be worthy of further investigation. The fact that children with IDD were much older than the TD children tested introduced variables beyond the scope of this study, leaving findings unclear as to whether children with IDD aged 5–8-years-old would be misled in the same way as their chronological age matched peers. In contrast to work in TD children (Migueles & Garcia-Bajos, 1999; Sarwar et al., 2014) no link was seen between the centrality of information and suggestibility in children with IDD. Challenges in processing relational/contextual information, creating a coherent memory narrative, and issues with attention may partly explain why both central and peripheral details were equally susceptible to the GME in this population (Brown et al., 2018; Gaigg et al., 2008; Poirier et al., 2011). It is important to note that current police guidelines overlook semantic information conveyed through gestures, despite documented gesture use in interviews (Meyer, 2019) and the growing research base into the GME. Addressing issues from leading gestures is vital, not only for police interviews, but also for social workers, parents, and healthcare workers (for example) who interact with children with IDD, and can introduce leading information well before formal interviews. Awareness of the robust leading effect of gestural information helps ensure the minimisation of its use, helping to safeguard children with IDD's rights and leading to fairer judicial outcomes.

The lack of age effects seen contributes to a growing body of work demonstrating differences between verbal and gestural misinformation. Despite evidence showing the same neurological network activation for speech and gesture (Ianì & Bucciarelli, 2017; Yang et al., 2015), and the idea that similarities in processing would result in similar age-related suggestibility effects, current GME research shows no statistically significant differences between age groups. For children with IDD, differences may also be attributed to cognitive deficits which impact their ability to understand and organise information effectively, resulting in disorder narratives and recall, and indicating mental age to potentially be a better predictor of gestural suggestibility than chronological age (Brown et al., 2018; Gaigg et al., 2008; Henry, 2010; Henry & Gudjonsson, 2007). Conversely, the direct activation of children's mirror-neuron system (Proverbio & Zani, 2022) and/or motor system (Ianì & Bucciarelli, 2017; Wakefield et al., 2013) by gesture may indicate a more robust system not mediated by mental/chronological age at all.

An examination of IOIs recalled pre- and post-interview showed only one IOI consistent with the misleading gesture given recalled post- interview, supporting results from Johnstone et al. (2023), but contrary to other findings (Broaders & Goldin-Meadow, 2010; Kirk et al., 2015). This may be due to differences in study design, with previous studies exposing participants to much higher rates of misleading gestural information. Alternatively, working memory/language deficits, or verbal understanding, may have contributed to these findings in children with IDD, with reduced encoding and information retrieval when there is a delay between gesture exposure and recall (Choi et al., 2022; Henry, 2010; Henry & Gudjonsson, 2007).

Our results do not support the idea that children with IDD are more susceptible to the GME compared to TD children due to increased compliance/acquience (Morrison et al., 2019) or a greater dependence on gestures as an information source due to memory impairments (Baugerud et al., 2016). Sampling challenges, including non-random sample acquisition, potential teacher bias, safety constraints, and the school's decision not to include younger children, resulted in an unbalanced study design with regards to

participant numbers/ages, and may have affected our findings in this area. The children tested were not assessed for their mental age/IQ/narrative ability due to ethical restrictions and time constraints, and were chronologically much older than the TD children tested previously. As such, the lack of differences seen may be due to a closeness in mental age between groups which may have affected the original recall of the video due to similar cognitive and behavioural ability (Morrison et al., 2019) or due to individual differences in IQ (Bruck & Melnyk, 2004; Henry & Gudjonsson, 2003) and narrative ability (Kulkofsky & Klemfuss, 2008). Future work should aim to address these issues to assess age effects more thoroughly, including younger and older groups of children with IDD, and comparisons with TD children matched by cognitive abilities.

5. Conclusion

In conclusion, this study provides support for the gestural misinformation effect and extends previous research into a significant new sample group more representative of children who are typically found in the justice system. The importance of assessing gesture use with children with IDD cannot be overstated. Maltreated children show many of the same memory (Baugerud et al., 2016), cognitive deficits (Su et al., 2019), and social/language impairments (Lum et al., 2018) as children with IDD and it is important these are recognised in relation to gesture usage during police interview. The current study is the first of its kind to examine the misleading effect of gestural information in children with IDD and challenges the notion that children with disabilities are unreliable witnesses (Brown & Lewis, 2013; Gudjonsson & Henry, 2003; Henry & Gudjonsson, 2003). It is advised that police interview guidelines are reviewed with the aim of putting preventative measures in place regarding leading gestural information. For police interviews with children with moderate IDD, investigators should be mindful that no level of gesture use is safe, and that this applies equally across age groups, to help gather the most accurate and reliable evidence possible.

Ethics approval

Ethics approval was obtained from The University of Sheffield, Department of Psychology Research Ethics Committee.

Consent to participate

Written informed consent was obtained from the parents/legal guardians, and verbal consent was given by participants prior to beginning the interview.

Consent for publication

Parents signed informed consent forms for publication.

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CRediT authorship contribution statement

Kirsty L Johnstone: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Mark Blades:** Writing – review & editing, Supervision, Conceptualization. **Chris Martin:** Writing – review & editing.

Declaration of Competing Interest

None.

Data Availability

The data that has been used is confidential.

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Open practices statement

The datasets generated during and/or analysed during the current study are not publicly available due to ethical restrictions at the time of collection but are available from the corresponding author on reasonable request.

None of the experiments were pre-registered.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ridd.2024.104828.

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