Running head: AGE, NEUROPSYCHOLOGICAL AND SOCIAL COGNITIVE MEASURES

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Age, Neuropsychological, and Social Cognitive Measures as Predictors of Individual Differences in Susceptibility to the Misinformation Effect

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Abstract

This study examined the relationship between age, neuropsychological performance (indexed by the Wisconsin Card Sorting Test, California Verbal Learning Test, the backward digit span and the verbal paired associates scale, VPA), social cognitive status (indexed by the Children's Social Desirability and the Gudjonsson Suggestibility Scale, GSS), and susceptibility to the misinformation effect (Loftus, Miller and Burns, 1978) in 65 children and adolescents. The predictors accounted for 17% to 22% of variation in the misinformation effect. In particular, participants with better VPA scores were more susceptible to the effect. In a secondary analysis involving interrogative suggestibility, better VPA scores correlated with lower suggestibility. These findings show that better associative memory can be correlated with either higher or lower suggestibility depending on the way in which participants are misled.

Age, Neuropsychological, and Social Cognitive Measures as Predictors of Individual Differences in Susceptibility to the Misinformation Effect

In the past three decades, a large number of studies have examined the circumstances in which eyewitnesses' memories can be contaminated and rendered unreliable. In a seminal paper, Loftus, Miller, and Burns (1978) examined the effect of misleading postevent information or misinformation. In their study, participants saw a series of slides, one of which depicted a red Datsun stopping in front of a Yield sign. After viewing the slides, participants read a description of what they saw. Part of the description contained misinformation, which stated the Datsun stopped in front of a Stop sign. At test, participants exposed to misinformation were more likely to report seeing a Stop sign than were participants not misinformed.

This effect has since been replicated using a variety of retrieval tests (for review, see Payne, Toglia, & Anastasi, 1994). The bulk of these studies focused on uncovering the processes responsible for this effect (e.g., Belli, 1993; Loftus & Hoffman, 1989; Zaragoza, McCloskey, & Jamis, 1987). Others examined the effect of misinformation on various populations, such as children (Ackil & Zaragoza, 1995; Ceci, Ross, & Toglia, 1987) and adults from different occupational backgrounds (Loftus, Levidow, & Duensing, 1992). Although findings from these studies have important implications for legal policy and forensic practice, little information is available on measures that will help identify individuals who are particularly susceptible to the effect. In this study, we examined the efficacy of age, neuropsychological, and socio-cognitive measures as predictors of susceptibility to the misinformation effect.

Predicting the Misinformation Effect

Being able to predict individual differences in susceptibility to the misinformation effect is important. Witnesses to crime are often questioned repeatedly or are shown statements of their descriptions of witnessed events before they give testimony in court. Unless conducted carefully, each of these events represents an opportunity for misinformation to be introduced. Findings from studies using Loftus et al's (1978) misinformation paradigm show that even if subsequent interviews are conducted in a non-leading manner, prior exposure to misinformation is likely to introduce errors into subsequent testimony. Yet, not all witnesses are equally susceptible to the influence of misinformation. Even in Loftus et al.'s (1978) study, a substantial number of participants were not affected by exposure to misinformation.

The bulk of previous studies on individual differences in suggestibility have focused on hypnotic suggestibility (e.g., Barnier & McConkey, 1999), interrogative suggestibility (in adults, e.g., Gudjonsson, 1987a; 1988; and in children, e.g. Geddie, Fradin, & Beer, 2000; McFarlane, Powell, & Dudgeon, 2002; Muir-Broaddus, King, Downey, & Petersen, 1998; Roebers & Schneider, 2001; Scullin & Ceci, 2001), false autobiographical memory (e.g., Hyman & Billings, 1998), or the effects of misleading questions (in both adults, e.g., Eisen

& Carlson, 1998; Eisen, Morgan, & Mickes, 2002; Hyman & Billings, 1998; and children, e.g., Weede Alexander et al., 2002).

Whether findings from these studies will generalise to the misinformation effect has not been studied directly. However, several methodological differences across the various paradigms suggest that findings may differ. For example, the types of suggestions to which participants are exposed are different. In the misinformation paradigm, suggestions are content specific. In the present study, for example, it was suggested to participants that they saw a blue washing basket instead of a white one. In the interrogative suggestibility paradigm, two types of suggestions are generally used: misleading questions and critical feedback. Although the misinformation effect has been shown to be sensitive to social demands (Ceci et al., 1987), the use of explicit feedback in interrogative paradigms is likely to render it more sensitive to participants' responses to interpersonal pressure (Gudjonsson, 1987b).

Another salient difference is the stage at which misleading information is administered. In the misinformation paradigm, it is administered between initial exposure to the witnessed event and the final retrieval test. In interrogative paradigms, suggestions are administered at test. A number of studies, beginning with Loftus et al's (1978) seminal study, have shown that the time at which misleading information is introduced is likely to influence its effect. Given these differences, there is likely to be variation in the relationship between different measures of suggestibility and measures of individual differences.

Only a small number of studies have directly examined issues regarding individual differences and the misinformation effect. In an earlier study, Ward and Loftus (1985) examined the role of Jungian personality types. Using the Myers Briggs Type Indicator (Myers, 1962) and the same misinformation procedure as that used in Loftus et al. (1978), they found participants rated as introverts-intuitive were more likely to accept both accurate and inaccurate postevent information than were those rated as extroverts-sensate. It was argued that the introverts were more likely to have lower confidence in their memory and were thus more likely to accept misinformation. The relationship between personality and susceptibility to the misinformation effect was revisited in a recent study by Liebman et al. (2002). Using the Revised NEO Personality Inventory (Costa & McCrae, 1992) and the Multidimensional Personality Questionnaire (Tellegen, 1982), they failed to find a reliable relationship between extroversion and susceptibility to the misinformation effect. Instead, several facets of the neuroticism domain were found to correlate to two measures of the misinformation effect.

Others have focused on the relationship between cognitive abilities and susceptibility to the misinformation effect. Dobson and Markham (1993), for example, examined imagery abilities. Similar to Ward and Loftus (1985), they used a traditional three stage misinformation paradigm in which participants saw a filmed event followed by descriptive statements of that event. Susceptibility to the misinformation effect was indexed by a source monitoring test. Participants with higher imagery abilities were more susceptible to the misinformation effect than were those with lower abilities. Dobson and Markham argued that participants with higher imagery abilities were more likely to form vivid images of the misleading information at encoding or at retrieval. Because these generated images had rich perceptual features, they were more likely to be mistaken as having been presented in the slides. Jaschinski and Wentura (2002) focused on the contribution of working memory capacity. Participants were asked to perform a dual task: simultaneously remembering a list of words and judging the accuracy of arithmetic statements. Participants who were more accurate on the dual task were less susceptible to the misinformation effect. They argued that participants with greater working memory capacity were better able to establish a more coherent image of the original event. This, in turn, allowed them to reject the misinformation.

In several recent reviews, a number of variables that might contribute to individual differences in children's suggestibility were identified (Bruck, Ceci, & Melnyk, 1997; Quas, Qin, Schaaf, & Goodman, 1997). Similar to the adult literature, most of the studies cited in these reviews did not index suggestibility in terms of susceptibility to the misinformation effect. Only a small number of studies have examined this issue directly. Ridley, Clifford, and Keogh (2002) focused on state anxiety and used a traditional misinformation design in which 9 to 10 year olds were shown a videotaped event followed by misleading questions and a final retrieval test. Children with higher state anxiety were less susceptible to the effects of misinformation than were children with lower anxiety. In a series of studies, Welch-Ross and her colleagues (Welch-Ross, 1999a; Welch-Ross, 1999b; Welch-Ross, Diecidue, & Miller, 1997) examined the relationship between 3 to 5 year olds' understanding of conflicting mental representations and susceptibility to the misinformation effect. They showed that performances on a number of theory of mind tasks were inversely related to misinformation acceptance. Furthermore, children who had better understanding of conflicting representations were more likely to discount misinformation from interviewers deemed less knowledgeable about the original event.

Measures of individual differences

This study examined the relationship between several measures of individual differences and susceptibility to the misinformation effect. Although formal models of the misinformation effect have been proposed (Ayers & Reder, 1998; Metcalfe, 1990), an earlier explanatory framework provides the best guide to potential predictors. Belli (1989) divided explanations of the misinformation effect into those that focus on the role of socially mediated processes versus those that focus on the memorability of the target memory trace. According to the first class of explanations, responses can be biased for one of two reasons (McCloskey & Zaragoza, 1985). First, some participants will have no memory of the original event, not because of exposure to misinformation, but because they failed to attend or encode the information in the first place. Because they have no alternative information to contradict the experimenter's suggestions, when they are exposed to misinformation, they are likely to accept it and to select it at test. Second, for participants who do remember the original event, some will acquiesce and will accept the misinformation as a more accurate or preferable version of the original event.

Previous studies show that both adults and children are affected by misinformation acceptance. Ceci, Ross, and Toglia (1987), for example, tested the effects of social demands on both children and adults. Misinformation was administered by either a child or an adult. The misinformation effect was attenuated when it was administered by a child. In a more recent study, Welch-Ross (1999a) extended this finding and showed that only preschoolers with better developed theories of mind were sensitive to the perceived expertise of experimenters. These children were only misled by experimenters perceived as knowledgeable. Children with less developed theories of mind were misled by both knowledgeable and naïve experimenters.

In the present study, propensity to be affected by socially mediated processes was measured by two indices. First, the Children's Social Desirability Scale (CSDS, Crandall, Crandall, & Katkovsky, 1965) was used as a general measure of participants' propensity to behave in a socially acceptable manner. Second, the shift and yield scales of the Gudjonsson Suggestibility Scale (GSS, Gudjonsson, 1987a) were used to measure participants' propensity to acquiesce. In the GSS, after listening to a story and answering the first set of leading and non-leading questions, participants are told they performed poorly and have to answer the same questions again. The shift scale measured changes in participants' responses across the two sets of questions. The yield scale measured participants' propensity to answer the two sets of questions in accordance to information embedded into the leading questions. Although procedures used in the misinformation paradigm are more subtle -- typically, misinformation is embedded into a narrative description or the subsidiary clauses of follow-up questions with no explicit instructions on their truth value -- the GSS seems to engage some of same socially mediated processes involved in the misinformation effect.

The second class of explanations refers to processes affecting the integrity, accessibility, or identifiability of the target memory trace. According to these explanations, exposure to misinformation results in the destruction (e.g., Loftus & Loftus, 1980) or in reduced accessibility to the target memory trace (e.g., Bekerian & Bowers, 1983). Lindsay and his colleagues (e.g., Lindsay & Johnson, 1989) showed that exposure to misinformation could also result in an elevation of source misattribution errors. In the present study, individual differences in susceptibility to such processes were measured by a battery of neuropsychological measures.

The use of neuropsychological measures was motivated by suggestions that age and individual differences in mnemonic abilities might be partially related to brain development. Schacter, Kagan, and Leichtman (1995), for example, argued that errors found in children's recollections bore close resemblance to errors made by adults with frontal lobe damage. Specifically, both groups exhibited similar errors in source attribution, confabulation, and false recognition.

They argued that this similarity suggested a link between mnemonic errors made by children and immature frontal functions.

In the last few years, a number of developmental studies have examined the relationship between one particular type of mnemonic error -- source misattribution -- and performance on a variety of neuropsychological tests. Using 10 to 14 year olds, Rybash and Colilla (1994) found performance on the Wisconsin Card Sorting Test (WCST, Heaton, 1981) predicted source memory errors. Similarly, Ruffman, Rustin, Garnham, and Parkin (2001) found performance on a Stroop test to be related to both false alarms -- and source memory. Further evidence, though based on a different population, came from Henkel, Johnson, and De Leonardis (1998). They examined older adults' abilities to remember source memory and found misattribution errors to be predicted by a battery of tests commonly used to measure frontal and medial temporal functions.

From a developmental perspective, evidence from both neuropsychology and neuroscience shows that the functional efficiency of the frontal lobes does not reach adult levels until the mid-adolescent years. Levin et al. (1991; see also Chelune & Baer, 1986; Rosselli & Ardila, 1993), for example, found significant improvement from childhood to adolescence on a number of tasks commonly used to measure frontal lobes functioning, e.g., Tower of London and Twenty Questions. Findings from functional magnetic resonance imaging studies are consistent with this finding. During performance of cognitive inhibition tasks, 8 year olds -- compared to adults -- were found to exhibit both different areas of cortical activation (Bunge, Dudukovic, Thomason, Vaidya, & Gabrieli, 2002) and different levels of prefrontal activation (Tamm, Menon, & Reiss, 2002). In sum, these findings suggest that children's frontal system is relatively inefficient.

One possible implication of these findings is that brain maturity is at least partially responsible for age related differences in source memory and inhibitory control. Because exposure to misinformation is known to increase misattribution errors, by extension, it is likely that brain maturity is also related to susceptibility to the misinformation effect.

In the present study, the contributions of both frontal and medial temporal functions were examined. Although the literature has focused largely on frontal contributions, findings from functional imaging studies show that both frontal and medial temporal lobes are important for mnemonic functions. In a recent review, multiple sites within the frontal and medial temporal lobes were found to activate during semantic memory retrieval, episodic memory encoding, and episodic memory retrieval (Cabeza & Nyberg, 2000). Buckner (1999) argued that the two areas work interdependently in memory formation; the medial temporal area is responsible for the binding of information from multiple cortical areas, and the prefrontal area is necessary for higher level representation that results in the formation of explicit memory (cf. Squire & Knowlton, 1999).

Method

Participants and Design

The parents of 87 children and adolescents consented to their participation in the study. All participants were recruited from schools located in middle-class suburbs in the Gold Coast, Queensland, Australia. Because of school activities and unexpected absences, a number of participants -- 6 children and 16 adolescents – could not complete the whole battery of tests. The final sample contained 35 children (13 males, 22 females) with an average age of 8.5 years (range = 7.9 to 9.3 years, *SD* = .32), and 30 adolescents (16 males, 14 females) with an average age of 16.3 years (range = 15.2 to 17.8 years, *SD* = .67). Of these, 61 were Caucasians and 4 were East Asians.

A three stage misinformation paradigm was used. The type of postevent information administered to participants was manipulated on a within subject basis. All participants saw the slides followed by two types of questions: misleading and control questions that did not refer to the critical events. This was followed by recognition and source memory tests. All participants were also given a battery of neuropsychological and social cognitive tests.

Misinformation Stimuli

Slides. Eighty-four slides were used to depict a home burglary. Previous studies suggest that the misinformation effect is maximised when recognition accuracy for control items is at around 82% (Payne et al., 1994). In a pilot study conducted with 25 participants (approximately the same number of children and young adults), 14 of the 84 slides were found to be recalled by 65 to 85% of all participants. Of the 14 slides that were not sequentially contiguous, 10 were selected and designated as critical. Of the 10 critical slides, 5 were designated control and 5 were designated targeted. Information depicted in the targeted slides was subsequently followed by misinformation. Designation of control versus targeted was counterbalanced across participants.

Insert Table 1 about here

To control for the possibility that some exemplars were more easily remembered than others, two versions of each critical slide were prepared. Each version contained one of two exemplars from the same category. For example, a critical slide that depicted a video game console was filmed with either a Sony Playstation or a Nintendo. Each version was counterbalanced across participants. Exemplars used in the two versions are listed in Table 1. Together with the two versions of slides that counterbalanced for targeted versus control assignment, four slide series were prepared. For example, participants saw a key hidden under either a green or a black flowerpot. The flowerpot was designated as either a control or a targeted item.

Postevent information. Misinformation was introduced using misleading questions. Similar to the procedure used in Loftus, Miller, and Burns (1978), misinformation was incorporated into subsidiary clauses of questions directed at non-critical components of the target slides. Placement in a subsidiary clause discouraged participants from questioning the veracity of the misinformation. There were 16 questions. Of these, 10 pertained to the critical slides. 5 of these contained "contradictory" misinformation, the remainder contained neither consistent nor inconsistent information. One example of a misleading question is "The burglar used the key he found underneath the black flower pot to open the door. Which hand did he open the door with? Left hand or right hand". This question was administered to participants who had flowerpot assigned as a critical item to be targeted by misinformation. For those who had flowerpot assigned as a critical but control item, the question read "The burglar used the key he found to open the door. Which hand did he open the door with? Left hand or right hand".

The 6 remaining questions administered during the second stage of the misinformation procedure were distractors. Similar to Zaragoza and Lane (1994), 3 of these contained information not present in the original slides. For example, participants were asked, "At the bottom of the stairs, there was a basketball next to a pair of blue boxing gloves. Was there also a rugby ball?" In fact, there were no rugby balls in the slides. "Complementary" misinformation was included to improve the face validity of both the postevent questions and the source memory questions administered at the end of the misinformation procedure. As they were not the focus of this study, responses to these items were excluded from the data analyses.

Four versions of misleading questions were produced. The versions varied in a similar fashion to the slides: in terms of items that were subjected to misinformation, and in terms of the exemplars used. Altogether, there were 8 slides-postevent combinations.

Susceptibility to the misinformation effect. The extent to which participants were affected by exposure to misinformation was measured by their performances on a standard recognition test and a source memory test. The recognition test was modelled after the standard test used in Loftus, Miller, and Burns (1978). This was used in preference to the modified test (McCloskey & Zaragoza, 1985) because it allowed for the operation of socially mediated processes. The test contained 14 questions that referred to the slides. Five of these questions referred to information targeted by misinformation. Another five referred to control information. The remainders were distractors. For each question, participants were asked to select, from two alternatives provided (slides and postevent), the one depicted in the slides. All participants were given the same response alternatives.

The source memory test contained 30 questions. For each question, participants were asked to identify the source of a particular piece of information. Instructions for this test were adopted from Zaragoza and Lane (1994). Participants were told each question referred to information that originated from one of four sources: the slides, the postevent questions, both the slides and the questions, or neither. To avoid leading participants into assuming that there were equal number of stimuli from each source category, the number of questions per category was varied. Of the 30 questions, 5 were targeted items from the slides, 5 were control items from the slides, 5 were misleading information introduced in the postevent questions, 3 were complementary information introduced in the postevent questions, 5 referred to information presented in both the slides and questions and 7 were novel items.

Instruments

Neuropsychological measures. Tests used in this study were selected from a larger battery that had been found to predict source memory performance in Henkel et al. (1998). Similar to that study, the WCST (Heaton, 1993) and the backward digit span test (BDS) from the Children's Memory Scale (Cohen, 1997) were used to assess frontal lobe functions. The long delayed cued recall score from the California Verbal Learning Test (CVLT, Delis, Kramer, Kaplan, & Ober, 1994) and the verbal paired associates (VPA) task from the Children's Memory Scale were used to assess medial temporal function.

Whether tasks used in this study should be classified using cortical labels -- frontal and medial temporal -- or working memory labels -- e.g., executive function and storage -- is controversial. As Anderson (2001) pointed out, in the context of neuropsychological assessment, the two sets of labels have been used interchangeably. In this study, we followed the classification used in two previous studies (Glisky, Polster, & Routhieaux, 1995; Henkel et al., 1998) on which the present selection of tests was based. In both studies, factor analysis showed that the tests loaded on two analytic factors. One further point regarding the various tests is that they are not pure measures of frontal or medial temporal functions. Performance of these tasks is likely to draw on wider cortical areas. However, findings from functional neural imaging studies have shown that both the WCST and the BDS tasks preferentially activate various areas in the frontal cortex (e.g., Fletcher & Henson, 2001; Konishi et al., 1999; Monchi, Petrides, Petre, Worsley, & Dagher, 2001; Tsukiura et al., 2001). Regarding the CVLT and VPA, the data are more ambiguous with findings from lesion and imaging studies suggesting the involvement of both medial temporal and frontal structures (e.g., Baldo, Delis, Kramer, & Shimamura, 2002; Johnson, Saykin, Flashman, McAllister, & Sparling, 2001).

The computerised version of the WCST was used. It contained 4 stimulus cards and 128 response cards. Each card varied in form (crosses, circles, triangles, or stars), colour (red, blue, yellow, or green), and number of figures (one, two, three, or four). Participants were asked to match each response card with one of four stimulus cards. Minimal instructions were given on the basis upon which matching was to be performed. The underlying matching rule changed, without notice, after a number of successful matches were made. In contrast to the "categories completed" measure used by Henkel et al. (1998), percentage perseverative error was used to give a more fine graded measure of frontal functions. Perseverative errors measure children's propensity to respond in accordance to a sorting strategy that was previously correct. It gives an indication of mental flexibility. In contrast to categories completed, which has a range of 6, percentage perseverative error is computed based on a maximum range of 127.

For the BDS, participants were asked to remember lists of numbers in reverse order. Immediately after presentation of each list, they were asked to recall the list in reverse. The number of items contained in each list increased across trials, from 2 to 7. Two lists of each length were used. Any errors resulted in a zero score on that list. In the data analysis, a total accuracy score was used.

In the CVLT, participants were asked to remember two different lists of 15 everyday objects. The objects were exemplars from three semantic categories. In the first stage, participants were administered five study-test trials on the first list followed by one study-test trial on the second list. The second stage consisted of long delayed retrieval tests. These were administered 20 minutes after the termination of the first stage. In the long delayed cued recall test, the three semantic categories were given as retrieval cues and participants were asked to remember studied exemplars from each of the three categories.

In the VPA, participants were read eight meaningless stimulus-response word associates. This was followed by an immediate recall test in which participants were given the stimulus terms and were asked to remember the response terms. Participants had up to six opportunities to reach a criterion of one errorless recall. Feedback on accuracy was given after each response. The VPA score was based on participants' total accuracy on all eight word associates across the first three trials.

Social cognitive measures. The Children's Social Desirability Scale (CSDS, Crandall et al., 1965) was used to measure the extent to which individual differences in social desirability contributed to differences in susceptibility to the misinformation effect. The scale was a paper and pencil test in which participants were asked to give true-or-false answers to 48 self-referenced propositions. One sample question was "Sometimes I do things I've been told not to do". On the CSDS, higher scores denote heightened social desirability.

A parallel form of the Gudjonsson Suggestibility Scale (for details, see Gudjonsson, 1987a) was used to measure participants' propensity to yield to social pressure and to accept information contained in leading questions. In this test, participants were read a short story followed by a set of 20 questions on what they had read; 15 of these questions were suggestive. Regardless of accuracy, participants were told they performed poorly and had to answer the questions again. Participants' responses to the first and second sets of suggestive questions provided a "yield" index: a measure of their propensity to agree with misleading information. The number of changes in responses between the two sets of questions provided a "shift" index.

Procedure

All neuropsychological tests were administered individually as per standardised procedures. Apart from the WCST, which was administered using a computer, all other tests were administered manually. The CSDS was administered to children in small groups of two or three. For the children, each question was read aloud and further explanations were provided when needed.

All tests were administered over two separate days. On the first day, participants were administered the WCST, BDS, VPA, and the slides from the misinformation procedure. The target slides were shown to small groups of participants (from one to five) using a computer screen with a 35cm viewable area. The slides were displayed in either portrait or landscape mode and were 20cm by 13cm in size. Participants were situated no more than 120 cm away from the screen. Each slide was shown for four seconds. Participants were told the experimenters were interested in people's memory of events. They were asked to watch the slides carefully and were told questions would be asked about the slides the following day. The whole slide show lasted five and a half minutes.

Approximately 24 hours later, participants were administered the postevent questions. Each participant was interviewed in small groups of two to three. Participants were asked to think about what they saw the previous day and to answer all questions. For the children, the experimenter assisted by reading the questions. This was followed by a 10 minute distracter task. For the children, the task was a game that did not have an overt memory component. The adolescents were asked to read and rate some comics. The retrieval tests were conducted immediately after the distracter task. Participants were asked to complete a standard recognition test and a source memory test. For all participants, the standard recognition test was administered prior to the source memory test. This was followed by the CVLT, CSDS, and the GSS. To minimise fatigue, children were given more rest in between tests. Because of unexpected school activities, a small number of participants had to leave prior to the end of the testing sessions. These participants were asked to finish the test they were taking and to come back on a subsequent day to finish the rest.

Results

Scoring

Two types of data were derived from the misinformation procedure: recognition and source memory. The recognition data were generated from five questions referring to control items and five questions referring to information targeted by misinformation. A response was accurate if participants selected information presented in the slides. For the regression analyses, a recognition misinformation effect score was obtained by subtracting the accuracy score for misleading items from that of control items.

The source memory data were generated from responses to five control items that had not been presented in the experiment and five "misleading" items that were presented in the postevent questions. Total misattributions were used. A misattribution was defined as assigning a misleading or control stimuli as having originated from either (a) the slides or (b) both the slides and the postevent questions. For the regression analyses, a source memory misinformation effect score was computed by subtracting the number of misattributed control stimuli from the number of misattributed misleading items.

Preliminary analyses

Tests for outliers on the predictor variables showed that two participants had WCST scores that were more than three standard deviations above the mean. To attenuate their effect on the distribution while preserving their values as extreme scores, the raw data points were set to three standard deviations above the mean. Tests for normality showed that the WCST score exhibited a strong positive skew. Both the CVLT and the GSS shift scores exhibited skews that were more moderate. To reduce skewness, the WCST and the GSS shift scores were transformed using a logarithmic and a square root transformation respectively. Transformation on the CVLT score resulted in a poorer distribution; the variable was left unchanged.

Because of technical difficulties and unexpected absences from school, there were differences in the frequency with which various slides-postevent questions combinations were used. Analyses conducted on the effects of slide and postevent versions showed that some versions were associated with a stronger recognition based misinformation effect, $F(3, 61) = 2.82$, $p = .05$, $\eta^2 = .12$, and $F(3, 61) = 2.98$, $p = .04$, $\eta^2 = .13$ respectively. Versions did not have a reliable effect on the source memory based data. To account for these effects, both slide and narrative versions were included as control variables in all analyses involving recognition data. All inferential tests were evaluated at an α level of .05.

Tests for misinformation and age related effects. Both the recognition accuracy and misattribution scores revealed reliable misinformation effects. One way repeated measures analysis of variance showed that items targeted by misinformation were less likely to be recognised accurately (*M* = 2.3, *SD* = 1.1) than were control items (*M* = 2.8, *SD* = 1.1), $F(1, 58) = 11.89$, $p < .01$, $\eta^2 = .17$. Similarly, misinformation was more likely to be misattributed as being part of the slides (*M* = 2.9, *SD* = 1.3) than were novel items, (*M* = 2.3, *SD* = 1.3), $F(1, 64) = 9.09$, $p < .01$, $\eta^2 = .12$.

To examine age related effects, accuracy scores from the recognition test and misattribution scores from the source memory test were analysed using 2 (item type: targeted vs. control) X 2 (age: children v adolescents) mixed model analyses of variance. The recognition data revealed no age related effects. The misattribution data showed a small but reliable age effect, $F(1, 63) = 4.17$, $p = .05$, $\eta^2 = .06$. The adolescents were less likely to commit misattribution errors (*M* = 2.4, *SD* = .99) than were the children, (*M* = 2.9, *SD* = .94). Notably, the interaction involving item type and age did not attain significance. Thus, both the recognition and source memory data revealed no age related differences in susceptibility to the misinformation effect.

All the neuropsychological and social cognitive measures revealed age related differences, $F(1, 63) > 10.44$, $ps < .01$, $\eta^2 > .14$. As expected, children obtained poorer scores than did the adolescents on all neuropsychological measures. They committed more perseverative errors and demonstrated smaller spans on the other measures. On the social cognitive measures, children obtained higher social desirability scores and were more likely to acquiesce than were the adolescents. Means and standard deviations can be found in Table 2.

Insert Table 2 about here

Relationship between susceptibility to misinformation, neuropsychological and social cognitive performances

Correlational findings. Pearson correlations showed that the recognition based misinformation score was not correlated reliably to any of the neuropsychological or social cognitive measures. The source memory based score was correlated reliably with performance on the VPA (r = .26). Participants with better associative memories were more susceptible to the misinformation effect. Intercorrelations between the various scores can be found in Table 3.

Insert Table 3 about here

The recognition and source memory based measures were positively correlated. Participants whose recognition accuracy was more severely affected by exposure to misinformation were also more likely to be similarly affected in terms of source misattributions. Intercorrelations between most of the neuropsychological measures were statistically reliable. Correlations between the two frontal measures (WCST, BDS) were reliable; so were correlations between the two medial temporal measures (CVLT, VPA). However, the frontal measures were also correlated with the medial temporal measures. Performance on the BDS was correlated with both medial temporal measures and performance on the WCST was correlated with performance on the VPA. These findings are consistent with suggestions that these tests do not uniquely measure functions in just one brain region (Phillips, 1997).

The social cognitive measures were correlated positively. Participants with higher CSDS were also likely to have higher GSS shift and yield scores. In relation to the neuropsychological measures, the CSDS correlated negatively with the VPA. The GSS shift score was correlated negatively with both the BDS and the CVLT. The GSS yield score was correlated negatively with the CVLT and the VPA. Both sets of correlations showed that participants with a stronger tendency towards socially desirable behaviour or acquiescence were likely to have poorer neuropsychological performances.

Regression findings. Because of the large number of predictor measures, separate principal components analyses were used to reduce the data. Three factor scores were computed, each combined information from tests used in each of three domains: frontal, medial temporal, and social cognitive. The frontal factor score (eigenvalue 1.41) captured 70% of the total variance from the WCST and BDS. The medial temporal and social cognitive factor scores (eigenvalue 1.27 and 1.58 respectively) captured 63% and 53% of the total variance from their respective component scores.

To examine the unique contributions of age and the three factor scores, standard regression analyses were conducted for the recognition and source memory based misinformation effect scores. In addition, hierarchical regression analyses were conducted to examine whether age provided information in addition to those provided by the factor scores. In these analyses, the factor scores were entered first as a single block, followed by age.

From an applied perspective, the age of a witness is likely to be one of the most salient features. Additional measures will only be of interest if they afford information that cannot be gathered from knowing age alone. For this reason, an additional set of hierarchical regression analyses were conducted with age entered first, followed by the factor scores entered in a single block. A final set of analyses examined whether the relationships between susceptibility to the misinformation effect and the predictors were qualified by age. Interaction terms involving age and the three factor scores were computed and were entered as additional predictors.

Standard regression analysis conducted on the recognition based misinformation effect score showed that age, the three factor scores, and the control variables accounted for 22% ($R^2_{adjusted}$ = .14) of variation, $F(6, 58) = 2.71$, $p = .02$. Inspection of the regression coefficients showed that only the medial temporal score predicted uniquely to the recognition based misinformation effect. It accounted for 6.5% of variation in the recognition data. Participants with higher medial temporal scores were more susceptible to the misinformation effects and had higher recognition based misinformation scores. A summary of the regression coefficients can be found in Table 4.

Insert Table 4 about here

Results from the hierarchical analyses showed that when the three factor scores and the control variables were entered into the equation, they alone accounted for 20% of variation in the recognition data, $F(5, 59) = 2.93$, $p = .02$. Addition of age did not provide a reliable improvement in the amount of variation explained. When age was entered first, it accounted for less than 1% of variation, $F(1,63) = .48$, $p > .05$. Addition of the factor scores and control variables provided a reliable improvement to the model ($\Delta R^2 = 21$), $F(5, 58) = 3.14$, $p = .01$. Addition of the interaction terms provided a small but unreliable improvement ($\Delta R^2 = .02$) to a model containing age and the other predictor measures.

A standard regression analysis conducted on the source memory based misinformation effect score showed that the predictors accounted for 17% ($R^2_{adjusted} = 11$) of variation, $F(4, 60) = 3.0$, $p = .02$. Inspection of the regression coefficients showed that both the medial temporal factor score and age provided reliable contributions. The medial temporal score accounted for 15% of variation in the misattribution data. Participants with higher medial temporal scores were more susceptible to the misinformation effect and obtained a higher source memory based misinformation effect score. The effect of age accounted for 5% of variation in the misattribution data. The hierarchical analyses showed that only when individual differences indexed by the three factor scores were controlled did age attain significance. When age was entered into the regression model first and by itself, it failed to predict the misinformation effect.

Regarding the three factor scores, they provided reliable improvement to the regression model ($\Delta R^2 = .17$) when they were entered into the model after age had been entered, $F(3, 60) = 3.88$, $p = .01$. By themselves, their contribution ($R^2 = .11$) was marginally reliable, $F(3, 61) = 2.52$, $p = .07$. Similar to findings from the standard regression analysis, only the medial temporal score provided unique and reliable contribution. Addition of age related interaction terms to the model provided little improvement ($\Delta R^2 = .02$).

Interrogative suggestibility

Although not a primary focus of this paper, the relationships between interrogative suggestibility and the various predictor measures were also examined. Interrogative suggestibility can be defined as participants' propensity to accede to or incorporate suggestions in an interview context. Gudjonsson and his colleagues have conducted a large number of studies to examine the effects of contextual and individual differences on interrogative suggestibility (for a review, see Gudjonsson, Hannesdottir, Petursson, & Bjornsson, 2003). However, only a small number of studies have examined whether interrogative suggestibility are related to mnemonic or neuropsychological variables in children and adolescents (Danielsdottir, Sigurgeirsdottir, Einarsdottir, & Haraldsson, 1993; Gudjonsson, 1992).

In the present study, interrogative suggestibility was measured using the GSS. In the analyses presented earlier, the GSS shift and yield indices were used as predictors. For the present analyses, the full scale GSS (shift + yield score from the first set of questions) score was used. The full scale score has a range of 35, with higher scores denoting increasing susceptibility to interrogative suggestions.

A Pearson correlation showed the full scale GSS score was correlated reliably with performances on the CVLT, VPA, and CSDS. Both the CVLT and VPA showed participants with better associative memory were less susceptible to the effect of interrogative suggestibility. Participants more sensitive to social demands were more susceptible to the effect of interrogative suggestibility. Performance on the GSS was not reliably related to either the recognition or source memory based misinformation effect scores (see Table 3).

To examine the extent to which age, the neuropsychological and the social cognitive measures predicted interrogative suggestibility, a series of standard and hierarchical regression analyses similar to those used for the misinformation effect scores were conducted. The two neuropsychological factor scores computed for the earlier analyses were used as predictors. Because the social cognitive factor score was generated with the GSS shift and yield indices as two of its components, the CSDS raw score was used in its place.

The standard regression showed that the predictors accounted for a large amount of variation ($R^2 = .35$, $R^2_{adjusted} = .31$) in the GSS, $F(4, 60) = 8.19$, $p < .05$. Inspection of the regression coefficients revealed that age alone provided reliable prediction and accounted uniquely for 16% of variation. This finding showed that the adolescents were less susceptible to interrogative suggestions than were the children.

When the neuropsychological factor scores and the CSDS were entered into the regression model first, they accounted for 20% ($R^2_{adjusted} = .16$) of variation, $F(3, 61) = 4.94$, $p < .01$. Inclusion of age improved the regression model and accounted for an additional 16% of variation. When age was entered into the regression model first, it accounted for 34% of variation, $F(1, 63) = 32.48$, $p < .01$. Inclusion of the neuropsychological factor scores and CSDS in this hierarchical model did not provide reliable improvement ($\Delta R^2 = .01$). Addition of interaction terms also failed to provide reliable improvement ($\Delta R^2 = .04$).

Discussion

Performances of both the children and adolescents were affected by misinformation. In the recognition test, critical information targeted by misinformation was less likely to be recognised accurately than was information not targeted. In the source memory test, misinformation was more likely to be identified as having been seen in the slides than was novel information. Age and the neuropsychological and social cognitive predictors provided reliable prediction to both the recognition and source memory based misinformation effect. According to Cohen's convention (1992), the amount of variation explained by the predictors equates to a medium to large effect size.

Predicting the misinformation effect

Analyses conducted with both the recognition and source memory based misinformation scores showed that the medial temporal factor score alone provided a reliable and unique contribution to the respective regression models. Participants with better memories -- as measured by the medial temporal factor score -- were more likely to select the misinformation in the recognition test and to misattribute the misinformation in the source memory test. These findings are consistent with the adult literature. In a meta-analysis conducted by Payne, Toglia, and Anastasi (1994), studies with higher recognition accuracy in the control condition were more likely to report reliable misinformation effects. One contribution of the present findings is that a similar relationship applies on the individual differences level.

In contrast to the medial temporal score, the unique contribution of the frontal score was small and unreliable. Why was the medial temporal score more strongly related to both recognition and source based misinformation effect than was the frontal measure? The medial temporal region is thought to be involved in binding different features of information into complex and coherent memory. In contrast, the frontal region is involved in retrieval processes that involve deliberation, e.g., resolving conflicts between sources of information. According to the source memory framework (Johnson, Hashtroudi, & Lindsay, 1993), source monitoring decisions can be relatively automatic or controlled. Automatic decisions tend to be based on the qualitative characteristics (e.g., vividness and other perceptual detail) of remembered information. Controlled decisions are deliberative and are affected by a variety of factors, such as vividness of memory, presence of supporting evidence, and consequences of decisions. Although controlled processes are affected by both mnemonic and socio-motivational variables, Johnson et al. (1993) argued they rely fundamentally on the quality of the to-be-remembered information.

One explanation for the frontal and medial temporal findings is that both children and adolescents had poor recollection of both the original and postevent misleading information. Because deliberative processes rely on the quality of the to-be-remembered information, not having a clear recollection of the original and postevent information reduces opportunity for deliberation, generally believed to be a frontal or executive function. Data from the control condition are consistent with this explanation. Despite pilot findings to the contrary, on average, participants provided correct responses for only 56% of control items. If this interpretation is correct, it may also explain the low correlation between the social cognitive and misinformation effect measures. The literature shows that processes related to social desirability are important components of the misinformation effect (e.g., Ceci et al., 1987). According to McCloskey & Zaragoza (1985), such processes can influence performance on the misinformation task by biasing the responses of participants who can remember the postevent information, but not the slides. However, if participants cannot remember either the postevent information or the slides, such processes should have little effect on their performances.

An alternative explanation is that the misinformation findings are affected by individual differences in frontal functions, but they are not functions captured by tests used in this study. Recent studies have shown that the frontal region is involved in the execution of a large number of higher cognitive and executive function tasks (for recent reviews, see Stuss & Alexander, 2000; Stuss & Levine, 2002). It can be argued that the WCST and the BDS captured only the mental flexibility and working memory aspects of frontal functions. Other aspects of frontal functions, e.g., inhibition and memory updating (Miyake et al., 2000), may provide better prediction to the misinformation effect. However, given Henkel et al.'s (1998) findings, which showed that a frontal composite score (consisting of both the WCST and BDS) predicted source attribution ability, the efficacy of these measures requires further investigation. Henkel et al. showed that the relationship between their frontal and source attribution scores was mediated by retention interval. It attained significance only when a two-day interval was used. In contrast, when a 15-min interval was used, only the medial temporal score attained significance. In the present study, a one-day interval was used. One avenue for further work is to examine whether frontal measures play a more prominent role when participants are likely to have clear memories of both the original and misinformation, but poor source identification cues for differentiating them.

One point to note is that although the medial temporal score provided unique contribution to the prediction of the recognition based misinformation effect, the bivariate correlation between the two variables was of marginal reliability ($r = .24$, $p = .058$). This discrepancy suggests that though the other variables in the regression model failed to provide reliable and unique contributions, their inclusion in the model bolstered the effect of the medial temporal score.

Predicting interrogative suggestibility

Although not a primary focus of this paper, data obtained from the GSS were analysed to examine whether the relationship between suggestibility and the various measures of individual differences differed depending on how suggestibility was measured. The findings differed in several respects. First, a reliable age related difference was found on the GSS. Adolescents obtained lower scores; they were less susceptible to interrogative suggestibility than were the children. The data also revealed several reliable bivariate correlations: the GSS full score was correlated with performances on (a) the CSDS, participants with higher social desirability scores were more suggestible, (b) the CVLT, participants who remembered more items in the delayed cued recall test were less suggestible, and (c) the VPA, participants with better recollection were less suggestible. These findings are consistent with previous studies conducted with children (Danielsdottir et al., 1993), adolescents (Gudjonsson, 1992), and adults (Gudjonsson, 1987c), all of which showed a negative correlation between memory and interrogative suggestibility.

The regression findings suggest that the contributions of the neuropsychological and social desirability measures are subsumed by their correlation with age. In both the standard regression analysis and the hierarchical analysis in which age was given priority, the neuropsychological and social desirability measures failed to account for additional variation in the GSS score. One interpretation of these findings is that maturation based changes result in changes in neuropsychological and social cognitive performance. These, in turn, result in lower interrogative suggestibility. Because neither the neuropsychological nor the social cognitive measures accounted for additional variance once age was entered, it is probable that maturation is the primary causal agent. Considered from an applied perspective, these findings suggest that once the age of a person is known, social desirability and neuropsychological data do not provide additional information on that person's interrogative suggestibility.

Memory and suggestibility

A finding of interest is the difference in relationship between medial temporal functions and the two measures of suggestibility. In particular, for the misinformation effect, participants with higher scores on the VPA were more susceptible. For the GSS, the relationship is in reverse: higher scores on the VPA were associated with lower interrogative suggestibility. These findings are of forensic importance. They suggest that better mnemonic function can be associated with either higher or lower suggestibility depending on the way in which participants are misled. Because both findings are consistent with the literature, it seems reasonable to assume they are not artefacts of the stimuli or procedure used in this study.

The processes responsible for the different pattern of correlation across the two paradigms are unclear. As mentioned in the introduction, there are several methodological differences across the two paradigms. Although these differences are likely to affect suggestibility, it is unclear how they can reverse the polarity of the correlation between mnemonic ability and suggestibility. One difference is that misleading information is introduced at different times across the two paradigms. An earlier study conducted by Loftus, Miller, and Burns (1978) examined the issue of timing and found a stronger misinformation effect when suggestions were administered closer to the retrieval test than when it was administered immediately after the target event. Other studies manipulated the overall retention interval between exposure to the target event and the retrieval test and found longer intervals to be associated with larger misinformation effects (for review, see Payne et al., 1994). In both of these studies, the magnitude of the misinformation effect varied because of manipulation that presumably influenced the retention of either the target or postevent information. In both studies, it was argued that a direct relationship existed between memory and suggestibility. In contrast, findings from the present study suggest that this relationship is mediated by other variables such that better mnemonic abilities do not always predict lower suggestibility.

An alternative explanation is that the positive correlation between mnemonic ability and susceptibility to misinformation is an artefact of the misinformation paradigm. In the majority of misinformation studies (including the present study), the final recognition test involved a two to four item forced choice task. Given the probability of guessing correctly is 25% to 50%, it has been argued that the magnitude of the misinformation effect is reduced when participants are evaluated on such tests (see Chandler, 1989 for detailed arguments). Because of this reduction in effect size, only participants who have a good recollection of the target event can demonstrate a misinformation effect. This reduction in effect size may be sufficiently large to distort an underlying negative correlation between memory and suggestibility. Given the available data, it is difficult to speculate beyond the explanations offered here. Because of the potential forensic applications, it merits further investigation.

Is age the best predictor?

Regarding whether age is the best predictor of suggestibility in children and adolescents, the present findings suggest it depends on which measure of suggestibility is used. Both recognition and source memory based misinformation measures showed age alone did not predict suggestibility. In contrast, data from the GSS showed age to be the best predictor.

One caveat to this conclusion is that the present data revealed no age related differences in susceptibility to the misinformation effect. Although there was a difference in the overall number of misattributions made by the two age groups, they did not differ on either the recognition or source memory based misinformation scores. This is despite reliable age differences in neuropsychological performances and on the social cognitive measures. Given these findings, the regression results related to the misinformation effect should be interpreted as being relevant to individual, but not age differences in suggestibility. Furthermore, though reliable, the magnitude of the misinformation effect was quite small. To examine age related differences, one possible avenue for future study is to replicate the study using a younger sample and include a wider range of age groups. Repeated administration of the target slides may also improve control performance.

Summary

The findings showed that a combination of neuropsychological and social cognitive measures provided reliable prediction to susceptibility to the misinformation effect. Of the various neuropsychological measures included as predictors, only the medial temporal measure provided unique and reliable contribution to the regression model. The data also showed a difference in findings across two suggestibility paradigms. For the misinformation effect, better associative memory was related to heightened susceptibility. For interrogative suggestibility, participants with better mnemonic abilities were less suggestible.

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Table 1

Critical items and response alternatives

Critical items	Response alternatives	
Pot colour	Black	Green
Pillow type	Triangular	Square
Washing basket colour	Blue	White
Game console type	Sony Playstation	Nintendo 64
Drink colour	White	Colourless
Money storage	Right pocket	Left pocket
Boxing gloves colour	Blue	Red
Jewellery	Watch	Necklace
Beverage	Lipton Tea	Nescafe
Shoes	White high heels	Brown boots

Table 2

Means and standard deviations of misinformation, neuropsychological, and social cognitive measures by age

	Mean (standard deviation)	
Measures (range)	Children	Adolescents
Recognition accuracy		
Control (5)	2.8 (1.1)	2.8 (1.2)
Targeted (5)	2.2 (1.1)	2.4 (1.2)
Source misattribution		
Control (5)	2.5 (1.3)	2.1 (1.3)
Misleading (5)	3.2 (1.3)	2.6 (1.2)
WCST (127)	18.5 (10.9)	9.8 (4.0)
BDS (12)	5.0 (1.7)	6.4 (2.0)
CVLT (15)	10.6 (2.5)	12.5 (1.4)
VPA (24)	16.0 (3.6)	20.1 (3.4)
CSD (48)	24.4 (8.6)	16.0 (6.8)
GSS - shift (20)	6.2 (3.2)	3.5 (1.8)
GSS - yield (30)	16.4 (4.8)	11 (6.1)
GSS full scale (35)	14.1 (4.2)	8.3 (3.8)

Table 3

Intercorrelations between the misinformation, neuropsychological, and social cognitive measures

Measures	1	2	3	3a	3b	4	4a	4b	5	5a	5b	5c	6
1. Recognition[a]	--	.40**	.19	-.15	.16	.24	.18	.20	.02	-.06	.09	.05	.08
2. Source[b]		--	-.02	-.04	-.07	.28*	.18	.26*	-.03	-.04	.16	-.19	-.05
3. Frontal			--	-.84**	.84**	.44**	.32**	.37**	-.30*	-.28*	-.22	-.15	-.25*
3a. WCST				--	-.41**	-.36**	-.22	-.35**	.21	.24	.12	.10	.19
3b. BDS					--	.38**	.32**	.28*	-.30*	-.23	-.25*	-.14	-.24
4. Medial temporal						--	.80**	.80**	-.48**	-.40**	-.26*	-.37**	-.39**
4a. CVLT							--	.27*	-.37*	-.21	-.34**	-.25*	-.36**
4b. VPA								--	-.40**	-.42**	-.07	-.34**	-.26*
5. Social cognitive									--	.75**	.70**	.69**	.84**
5a. CSDS										--	.30*	.28*	.34*
5b. GSS shift											--	.24	.74**
5c. GSS yield												--	.78**
6. GSS full													--

Note. Correlation ratios are based on transformed scores. GSS = Gudjonsson Suggestibility Scale; CSDS = Children's social desirability scale; BDS = backward digit span; WCST = Wisconsin card sorting test; CVLT = California verbal testing test; VPA = Verbal paired associates scale. Where transformations were applied to correct for skewness, correlation ratios were based on transformed scores.

[a]The recognition score was a measure of susceptibility to the misinformation effect and was computed by subtracting the number of correct responses for the misled items from the control items. [b]The source misattribution score was also a measure of susceptibility to the misinformation effect and was computed by subtracting the number of novel items misattributed to the slides from the number of misleading items that were misattributed.

*$p < .05$. **$p < .01$

Table 4

Summary of Regression Analyses for Variables Predicting to Suggestibility

	B			*SE B*			β		
Variables	Recogn	Source	GSS-F	Recogn	Source	GSS-F	Recogn	Source	GSS-F
Standard									
Frontal	.29	-.10	.44	.25	.23	.61	.17	-.06	.09
Medial temporal	.57	.81	-.39	.26	.25	.65	.34*	.49**	-.08
Social cognitive[a]	.04	-.05	.04	.26	.25	.07	.02	-.03	.07
Age	-.90	-1.19	-5.4	.73	.58	1.4	-.27	-.36*	-.55**
Slide show version	-.01	--	--	.24	--	--	-.01	--	--
Postevent version	.35	--	--	.21	--	--	.25	--	--
Hierarchical Age last[b]									
Frontal	.17	-.26	-.37	.23	.22	.64	.10	-.16	-.08

Medial temporal	.45	.66	-1.3	.24	.24	.66	.26	.40**	-.27*
Social cognitive[a]	.17	.20	.12	.23	.23	.07	.10	.12	.21
Slide show version	.12	--	--	.22	--	--	.08	--	--
Postevent version	.41	--	--	.20	--	--	.29*	--	--
Hierarchical Age first[b]	-.29	-.28	-5.7	.42	.41	1.0	-.09	-.08	-.58**
With interaction terms[c]									
Frontal x age	.40	-.14	-.86	.49	.48	1.2	.15	-.05	-.11
Medial temporal x age	-.06	-.07	-.20	.07	.07	.18	-.41	-.52	-.48
Social cognitive[a] x age	-.18	-.003	.16	.53	.52	.14	-.07	-.001	.29

Note. Recogn = recognition based misinformation score; source = source memory based misinformation score, GSS-F= Gudjonsson Suggestibility (Full) Scale.

[a] For regression involving recognition and source memory based misinformation scores, social cognitive referred to the social cognitive factor score. For GSS-F, it referred to the CSDS. [b] For all hierarchical regression, coefficients for the full model are the same as those for the standard regression. [c] The first step of this analysis was the same as the standard regression. Only the interaction coefficients are presented here.

*p < .05. **p < .01

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