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Individual differences in false memory from misinformation: Personality characteristics and their interactions with cognitive abilities

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ABSTRACT

This research investigated the associations among personality characteristics, cognitive abilities, and false memory induced by misinformation. Chinese college students ($N = 436$) participated in a misinformation study and received a battery of cognitive tasks and personality measures. Results showed that false memory was positively related to persistence, self-directedness, and active coping, but negatively related to depression, fear of negative evaluation, novelty seeking, negative coping, and cognitive abilities. Importantly, significant interaction effects were found between personality factors and cognitive abilities. Individuals with particular combinations of personality characteristics and cognitive abilities (i.e., low fear of negative evaluation, low harm avoidance, high cooperativeness, high reward dependence, and high self-directedness in combination with relatively low cognitive abilities) were more vulnerable to the misinformation effect.

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1. Introduction

Past research on false memories has primarily focused on the experimental conditions that can create different amounts and types of false memories (Loftus, 2005). Recently, this area of research has experienced a growing interest in individual differences in false memory (Eisen, Winograd, & Qin, 2002). Although not always consistent, accumulating evidence shows that individuals with certain personality and cognitive characteristics show greater propensity for experiencing false memories. In our recent study of cognitive factors in false memory (Zhu et al., submitted for publication), for example, we found that cognitive abilities were negatively associated with greater likelihood of having false memory. In this study, we extended our previous research to include personality factors in false memory.

The present study had both hypothesis-testing and exploratory components. A number of studies have linked personality and other individual characteristics to false memories. Few of them, however, have used the misinformation paradigm. Therefore, the first aim of the current study was to extend previous findings to misinformation false memory. We used a large sample and an extensive battery of measures of personality and related constructs. Given our previous findings on the importance of cognitive

factors in misinformation false memories, this study's second aim was to explore whether personality and cognitive abilities had interactive effects on misinformation false memory. In the following paragraphs, we first review previous literature on the personality factors in false memory that are most relevant to the current study, and then discuss the rationale for our exploratory examination of potential interactions between personality and cognitive abilities on false memory.

1.1. Personality factors and false memory

1.1.1. Dimensional personality traits

Several studies have correlated measures of dimensional personality traits with individual differences in false memory. Porter, Birt, Yuille, and Lehman (2000) found that subjects scoring low on extraversion were more susceptible to creating false childhood memories. Liebman et al. (2002) found that false memory from misinformation (labeled as suggestibility in that study) was positively associated with three subscales of the NEO Personality Inventory (values of the Openness dimension, and modesty and altruism of the Agreeableness dimension). Salthouse and Siedlecki (2007), however, did not find significant correlations between personality traits and false memory of words as measured by the Deese–Roediger–McDermott (DRM) method (i.e., lists of semantically related words can lead to false memories of seeing the critical “lure” words that were not presented, Roediger and McDermott (1995)).

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1.1.2. Dissociation

Dissociative experience, or the tendency to have disturbances of normal integration of awareness, thought, memory and personality (Carlson & Putnam, 1993), has weak to moderate associations with several kinds of false memories (Eisen & Lynn, 2001), including false childhood memories (Qin, Ogle, & Goodman, 2008), errors induced by misleading questions (Merckelbach, Muris, Rassin, & Horselenberg, 2000), and DRM false memory (Winograd, Peluso, & Glover, 1998). Some studies have not replicated this finding (e.g., Wilkinson & Hyman, 1998).

1.1.3. Depression

Most of the significant findings regarding the positive relation between depression and false memory came from special populations, such as subjects with PTSD or self-reported alien abduction (Clancy, McNally, Schacter, Lenzenweger, & Pitman, 2002; Zoellner, Foa, Brigidi, & Przeworski, 2000). Using a non-clinical sample, Salthouse and Siedlecki (2007), however, did not find a significant relation between DRM false memory and depression. Storbeck and Clore (2005) further found that negative mood was related to less DRM false memory.

1.1.4. Anxiety

In a study of patients with PTSD, Zoellner et al. (2000) found that DRM false recall was positively related to anxiety. Similarly, Gudjonsson (1988) found that social-evaluative anxiety (measured by the Fear of Negative Evaluation Scale) was positively associated with interrogative suggestibility (a form of susceptibility to false memory as induced by misleading questions). In contrast, Roberts (2002) found that when under stress (i.e., right before the final examinations), students with low anxiety were more likely to have false memory of words as pictures.

1.1.5. Coping strategies

Gudjonsson (2003) emphasized the importance of coping strategies in the suggestion process. Gudjonsson (1988) found that subjects who used avoidance coping had much higher suggestibility scores than those who used active coping. Howard and Hong (2002) found that emotion-focused copers scored significantly higher on suggestibility than did problem-focused copers.

As the above review shows, although several studies have examined the personality correlates of false memory induced by paradigms such as the DRM and misleading questions, but few have involved false memory induced by the misinformation paradigm (see Liebman et al., 2002, for an exception). This paradigm is commonly used to elicit false memory related to eyewitness inaccuracies. It involves three standard stages: experiencing an event, receiving misinformation, and being tested for memory of the original event (Loftus, 2005). False memory is created when subjects report information from the misinformation session as part of the original event. Given that false memories induced by different paradigms are only modestly related to one another and are likely to involve different cognitive processes (Qin et al., 2008), it is important to extend the current research to include personality correlates of misinformation false memory.

The current study examined the following correlates of misinformation false memory: dimensional personality factors (the Temperament and Character Inventory-Revised (TCI-R), which includes seven dimensions: harm avoidance, cooperativeness, reward dependence, self-directedness, persistence, novelty seeking, and self-transcendence), dissociation (the Dissociative Experiences Scale), depression (the Beck Depression Inventory-II), anxiety (the Beck Anxiety Inventory and the Brief Fear of Negative Evaluation Scale), and coping styles (the Brief COPE Inventory). Although previous findings were not always consistent, the preponderance of evidence led us to hypothesize that false memory from misinfor-

mation would be positively related to dissociation, depression, anxiety, and negative coping, and negatively related to active coping. In terms of dimensional personality scales, no study has used the TCI-R. Given the documented associations between dimensions of TCI-R and the NEO Personality Inventory (Cloninger, 1999), we hypothesized that false memory would be positively related to cooperativeness and reward dependence of TCI-R (based on Liebman et al.'s (2002) results on agreeableness of the NEO, which is positively related to the above two dimensions in TCI-R), and negatively to novelty seeking (based on Porter et al.'s, 2000 finding with extraversion). We did not advance specific hypotheses about other four TCI-R dimensions.

1.1.6. Interactions between personality and cognitive factors in false memory

In addition to personality factors, cognitive factors also contribute to individual differences in false memory. Many studies have documented various cognitive correlates of individual differences in false memory (Gudjonsson, 2003). In our recent study (Zhu et al., submitted for publication), we found that misinformation false memory was related to a battery of cognitive abilities, including intelligence, perception, memory, and face judgment.

In order to have a comprehensive understanding of individual differences in false memory, it is necessary to examine not only cognitive and personality factors separately and their additive effects, but also their interactions. Thus far, several studies have examined personality characteristics and cognitive abilities simultaneously as predictors of false memory (Liebman et al., 2002; Salthouse & Siedlecki, 2007), but none has examined potential interactions between personality and cognitive factors. Theoretically it is possible that certain combinations of cognitive and personality factors (e.g., low cognitive abilities and high reliance on others) may exacerbate susceptibility to misinformation, whereas certain personality factors (e.g., low trust in others) may mitigate low cognitive abilities' effects on false memory.

2. Method

2.1. Subjects

Subjects were 436 Chinese college students (mean age = 19.83 years, $SD = .96$; 57% female). Written informed consent was obtained from each subject. This study was approved by the IRB of Beijing Normal University, China.

2.2. False memory test

We used Okado and Stark's (2005) misinformation false memory materials. First, subjects saw picture slides depicting an event. Two events were selected from Okado and Stark (2005), each consisting of 50 digital color slides. One event was about a man breaking into a car and stealing things from it, and the other was about a girl's wallet being stolen by a seemingly nice man. Presentation order of the two events was randomized across subjects. Of the 50 slides, 12 were critical slides that would be inaccurately described in the next stage.

Second, after 30 min of filler tasks (to allow for sufficient memory decay), subjects read narrations of the two events that had been presented in picture slides. The narratives consisted of one sentence for each slide image describing the scene depicted in the slide. For each event, 50 sentences were presented, including 12 inaccurate descriptions (misinformation) and 38 accurate descriptions (i.e., consistent with the picture slides).

Third, after 10 min of a filler task (this short filler period was used to maximize the misinformation effect), subjects took the

recognition test and then a source monitoring test. For the recognition test, 18 questions were asked for each story regarding what was presented “in the picture slides”, 12 of which were critical questions (pertaining to critical slides) and 6 were control questions. Each question had three possible choices as answers. For the critical questions, choices included a detail presented in the picture (“original item”), a detail presented in the narrations with misinformation (“misinformation item”), and a new foil detail (“foil item”). The mean endorsement rate for misinformation items was called *overall false memory* (OFM).

Immediately after the recognition test, subjects took the source monitoring test. Subjects were asked from what presentation source they remembered the answers they indicated on the recognition test. Five options were given: “saw it in the picture only”, “read it in the narrations only”, “saw it in both and they were the same”, “saw it in both and they conflicted with each other”, and “guessed”. Misinformation items that were further endorsed on the source memory test as “saw it in the picture only” or “saw it in both and they were the same” were considered as “*robust false memories*” (RFM). It should be noted that OFM and RFM are not distinct types of false memory. RFM is the false memory when subjects used a stricter criterion (see Okado & Stark, 2005).

2.3. Personality tests

Temperament and Character Inventory-Revised (TCI-R) has seven dimensions: harm avoidance; cooperativeness; reward dependence; self-directedness; persistence; novelty seeking; self-transcendence (Cloninger, 1999). Subjects rated their agreement with 240 statements on a five-point scale (from 1 = *definitively false* to 5 = *definitively true*). Subscale α s ranged from .82 to .92.

Dissociative Experiences Scale (DES) is a self-report questionnaire designed to identify patients with dissociative psychopathology and to quantify dissociative experiences (Carlson & Putnam, 1993). Subjects responded to an 11-point scale, ranging from 0% (Never) to 100% (Always) in 10% increments. Cronbach α = .92.

Beck Depression Inventory-Second Edition (BDI-II) measures depressive symptoms and experiences with a 21-item self-report questionnaire (Beck, Steer, & Brown, 1996). Cronbach α = .80.

Beck Anxiety Inventory (BAI) is a 21-item self-report questionnaire measuring anxiety severity (Beck & Steer, 1990). Cronbach α = .88.

Brief Fear of Negative Evaluation (BFNE) includes 12 items measuring the degree to which people experience apprehension at the prospect of being evaluated negatively (Leary, 1983). Cronbach α = .90.

Brief COPE is an abbreviated version of the COPE inventory (Carver, 1997). Carver (personal communication) suggested that, to generate a higher-order structure of coping styles, a factor analysis should be run for the sample in which this scale is being used. In our data, we found three factors explaining 47% of variance: support (emotional support, instrumental support, venting), active coping (active coping, positive reframing, planning), and negative coping (denial, behavior disengagement, acceptance, self-blame). Cronbach for the three subscales were .85, .74, .51, respectively.

2.4. Cognitive tests

As mentioned earlier, our previous study (Zhu et al., submitted for publication) showed that, misinformation false memory was negatively related to multiple measures of cognitive factors. Principal component analysis revealed a main first component with 6 of the 11 cognitive measures, whose loadings were larger than .40 (Raven's Advanced Progressive Matrices, Wechsler Adult Intelligence Verbal Scale, Wechsler Adult Intelligence Performance Scale, Motor-Free Visual Perception Test, Changing Blindness, and Tone

Discrimination). (Separate analyses by gender showed the same pattern of results for males and females.) They were all tests of intelligence and perceptual abilities. In this paper, we focused on the potential interactions between the main index of cognitive abilities (composite Z scores of these six cognitive indices) and personality characteristics.

3. Results

3.1. Relations between personality characteristics and false memory

Table 1 shows the descriptive statistics and bivariate correlations between scores on personality characteristics and misinformation false memory. Overall false memory (OFM, i.e., the mean endorsement rate for misinformation items) was .32 ($SD = .18$), and robust false memory (RFM, i.e., misinformation items that were further confirmed on the source memory test) was .12 ($SD = .09$). This rate of false memory inducement is consistent with previous research (Okado & Stark, 2005). The means and standard deviations of the personality measures were similar to those obtained in previous studies of non-clinical samples (TCI-R: Cloninger, 1999; DES: Ray & Faith, 1995; BDI-II: Storch, Roberti, & Roth, 2004; BAI: Joiner, 1996). The only exception was the mean for fear of negative evaluation, which appeared to be higher in our sample than the mean ($M = 35.7$) in the study by Leary (1983).

Among the subscales of the TCI-R, novelty seeking was negatively correlated with both OFM and RFM, whereas self-directedness and persistence were positively correlated with RFM. Among other individual factors, RFM were modestly negatively related to depression, fear of negative evaluation, and negative coping, but positively related to active coping. After correcting for multiple comparisons, all correlations at the level of $p < .01$ remained significant.

Another approach to examine relations between personality characteristics and false memories is the extreme groups comparison. Following the procedure of previous studies (e.g., Pozzulo, Crescini, Lemieux, & Tawfik, 2007), we selected two extreme groups: the “high” and “low” groups whose scores were $\pm 1 SD$ of the means of personality characteristics. Although forming

Table 1

Mean and SD of individual factors and their bivariate correlations with false memories.

	<i>M (SD)</i>	<i>Correlations</i>	
		<i>Overall false memory</i>	<i>Robust false memory</i>
<i>Personality characteristics</i>			
<i>Temperament and Character Inventory-Revised</i>			
Harm avoidance	93.53(16.22)	-.02	-.08
Cooperativeness	127.22(13.67)	.01	.06
Reward dependence	100.13(12.48)	-.03	-.04
Self-directedness	127.75(16.74)	.03	.15**
Persistence	116.61(16.86)	.09	.19***
Novelty seeking	102.57(12.61)	-.11*	-.11*
Self-transcendence	76.04(12.88)	.01	.06
Dissociative experiences	23.40(12.95)	.02	-.00
Beck Depression Inventory	10.81(6.64)	-.03	-.12*
Beck Anxiety Inventory	10.49(7.95)	-.00	-.05
Fear of negative evaluation	42.25(9.49)	-.07	-.11*
<i>Brief COPE</i>			
Support	2.82(.76)	-.09	-.07
Active coping	3.15(.54)	.04	.16***
Negative coping	1.98(.45)	-.03	-.14**
<i>Cognitive abilities</i>		-.40***	-.24***

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2
Comparisons between extreme groups.

	Overall false memory			Robust false memory		
	Low group	High group	<i>t</i>	Low group	High group	<i>t</i>
	M(SD)	M(SD)		M(SD)	M(SD)	
<i>Personality characteristics</i>						
Temperament and Character Inventory-Revised						
Harm avoidance	.34(.20)	.27(.14)	2.19*	.14(.09)	.10(.06)	2.75**
Cooperativeness	.29(.18)	.33(.20)	-.99	.11(.09)	.13(.11)	-1.37
Reward dependence	.31(.18)	.30(.19)	.21	.12(.08)	.12(.09)	.04
Self-directedness	.30(.17)	.33(.19)	-.97	.10(.08)	.14(.09)	-2.89**
Persistence	.31(.17)	.33(.18)	-.91	.11(.08)	.15(.10)	-2.23*
Novelty seeking	.32(.17)	.29(.18)	.87	.13(.08)	.10(.09)	1.27
Self-transcendence	.30(.18)	.32(.19)	-.54	.11(.07)	.13(.09)	-1.89
Dissociative experiences	.31(.18)	.32(.19)	-.37	.12(.08)	.13(.11)	-.65
Beck Depression Inventory	.32(.18)	.30(.18)	.53	.14(.08)	.11(.08)	2.26*
Beck Anxiety Inventory	.33(.19)	.31(.18)	.76	.15(.12)	.11(.09)	2.09*
Fear of negative evaluation	.36(.19)	.30(.17)	1.72	.15(.09)	.11(.09)	2.05*
Brief COPE						
Support	.33(.17)	.30(.17)	1.16	.12(.10)	.11(.09)	1.09
Active coping	.31(.16)	.33(.19)	-.77	.11(.06)	.15(.10)	-2.27*
Negative coping	.33(.18)	.31(.16)	.80	.14(.10)	.10(.08)	2.80**
Cognitive abilities	.41(.19)	.21(.14)	7.16***	.15(.11)	.09(.08)	3.42***

Note: low groups ($N = 56-87$), high groups ($N = 64-91$).

* $p < .05$.

** $p < .01$.

*** $p < .001$.

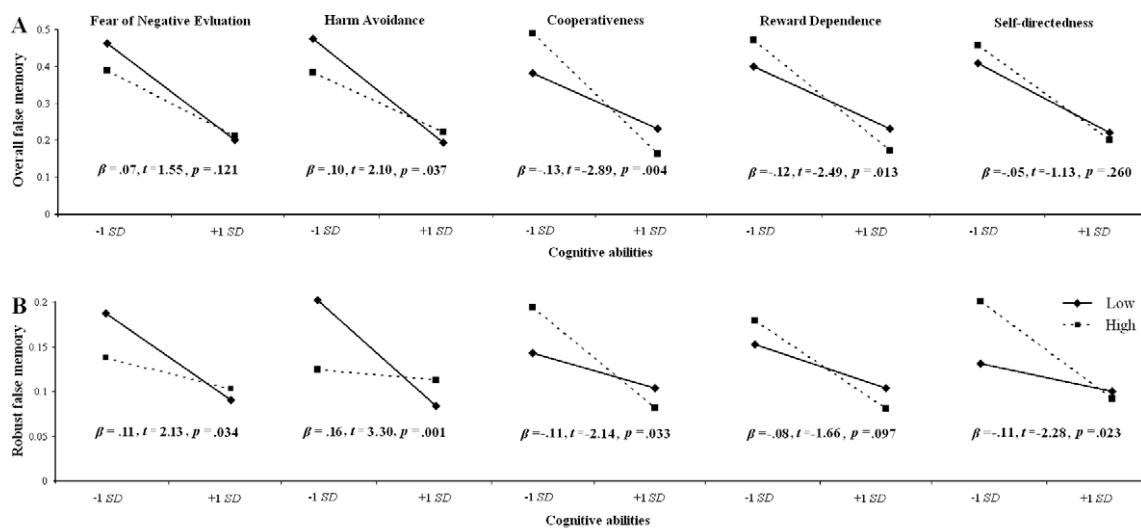


Fig. 1. Plots of regression lines for the interactions between cognitive abilities and personality characteristics. Also shown in each plot are the β , t , p values for the interaction variable in the regression analyses. Lines for low and high represent 1 SD below or above the mean of personality characteristics.

extreme groups reduces statistical power, it is a useful method for detecting associations that might have been missed by correlational analyses. As Table 2 shows, the extreme group analysis confirmed the significant associations between RFM and the following personality characteristics: self-directedness, persistence, depression, fear of negative evaluations, active and negative coping. However, the modest correlations between novelty seeking and false memory were not confirmed by the extreme groups analysis. Interestingly, the extreme groups analysis revealed significant associations between harm avoidance and both OFM and RFM and between anxiety and RFM, that were not found in the correlational analysis. Those with low harm avoidance had significantly more false memory than did those with high harm avoidance. Further explorations revealed that this difference was missed by correlational analyses because false memory was low only when harm

avoidance was at the high end. Similarly, participants with low BAI had significantly more RFM than did those with high BAI.

3.2. Interaction effects of personality and cognitive factors

For the exploratory component of this study, multiple regression was used to investigate interaction effects of cognitive abilities and personality characteristics on misinformation false memories. The scores of OFM and RFM were the dependent variables, and three independent variables were the composite Z score of cognitive abilities, Z score of one of the personality characteristics, and their interaction term.

Twenty-eight analyses (14 personality characteristics \times 1 composite score of cognitive abilities \times 2 dependent variables) were run. Seven of the interaction terms were significant. The

following personality factors consistently showed no interactive effects with cognitive abilities: persistence, self-transcendence, novelty seeking, DES, depression, BAI, and the three coping variables. In other words, the effects of these personality factors, when they existed, were additive to the effects of cognitive factors. The remaining five personality factors (fear of negative evaluations, harm avoidance, cooperativeness, reward dependence, and self-directedness) showed significant interaction effects on OFM or RFM. As can be seen in Fig. 1, subjects with low FNE and relatively low cognitive abilities had the most RFM. (It should be noted that we used the term “relatively low” for cognitive abilities because these subjects were all college students.) Similarly, the combination of low harm avoidance and relatively low cognitive abilities led to the most OFM and RFM. In contrast, cooperativeness, reward dependence, and self-directedness had the opposite pattern of interactions with cognitive abilities. Subjects with high cooperativeness, reward dependence, and self-directedness in combination with relatively low cognitive abilities had the most false memory.

Finally, to gauge the overall power of individual characteristics (the personality and cognitive factors and their interactions) in predicting false memory, we ran a regression analysis including factors that showed significant bivariate correlations. Results showed that 24% of the variance for OFM and 17% for RFM were accounted for by these factors.

4. Discussion

Previous studies have examined the associations between false memory induced by various paradigms (i.e., DRM, suggestibility) and personality traits (e.g., the NEO Personality Inventory). Our study extended this line of research by using another commonly used personality inventory with seven dimensions (TCI-R) and a false memory paradigm that is widely used in false memory research but rarely examined in terms of its relations to personality. Our results showed that six of the seven dimensions of TCI-R (except for self-transcendence) had some relationship to misinformation false memory.

First, extreme values of harm avoidance were related to false memories; participants with low harm avoidance were more likely to have false memory. Furthermore, interaction effects from the exploratory component of the study showed that subjects with low harm avoidance and relatively low cognitive abilities were most likely to have false memory. Cloninger (1998) suggested that “individuals low in harm avoidance have little anticipatory anxiety or fear about danger; consequently, they are optimistic risk-takers or even reckless if they are not mature in character”. In other words, these subjects might have been less worried about or saw little harm in whether they separated or mixed up their true memories with their false memories. The combination of that attitude with low cognitive abilities (i.e., less able to clearly remember the details from the slides vis-à-vis the narrations) resulted in their susceptibility to misinformation. Moreover, low harm avoidance is related to low anxiety, fears, and neuroticism (Sen, Burmeister, & Ghosh, 2004). Cross-validating our results, we found that subjects who scored low in the two anxiety measures (BAI and FNE) had more false memory, especially when they had lower cognitive abilities.

Second, cooperativeness, reward dependence, and self-directedness had consistent associations with false memory. Subjects high in the above three dimensions but low in cognitive abilities were more likely to have more false memory. Cooperativeness means identification with and acceptance of other people; and reward dependence means likelihood to be influenced by other people (Cloninger, 1998). Therefore, it appears that when subjects had some difficulty (i.e., low cognitive abilities) separating true from

false memories, those high in cooperativeness and reward dependence were more likely to incorporate post-event information and more susceptible to misinformation. There is no easy explanation for the finding about self-directedness. However, Quas, Qin, Schaaf, and Goodman (1997) suggested that individuals with overly positive perceptions of their ability to remember information (related to high self-directedness, Cloninger, 1999) may rely on suggestions rather than to appear as though they have poor memory. In our study, this tendency appeared stronger for subjects with poor cognitive abilities.

Finally, persistence was positively related to RFM, but not OFM. One interpretation is that subjects high in persistence were more likely to reaffirm their false memory during the source monitoring test (i.e., RFM). Novelty seeking was modestly and negatively related to both OFM and RFM. This association, however, was not confirmed by the extreme group analysis and not significant after correcting for multiple comparisons.

Taken together, it appears that all significant interactions with cognitive abilities were found for personality dimensions that were inter-personal in nature (cooperativeness, reward dependence, harm avoidance, self-directedness, and fear of negative evaluation). The intra-psycho dimensions (novelty seeking, persistence, self-transcendence) had either only main effects or no effects. In other words, subjects who were relatively low in cognitive abilities were more likely to be subject to the influence of inter-personal aspects of their personality traits in the misinformation paradigm. These findings, however, may be specific to the misinformation paradigm because other paradigms such as the DRM are less likely to involve inter-personal interactions during the experiment.

The notion that different types of false memory can involve different personality processes was further supported by our results on other individual characteristics. We found that false memory was positively related to active coping, but negatively related to negative coping. Our results differed from Gudjonsson (1988), who found that active copers had less interrogative suggestibility than negative copers. We speculate that active copers (and those low in fear of negative evaluation) may be more (or even overly) confident about their answers (even when they were based on misinformation), resulting in more RFM; but at the same time they are less likely to submit themselves to the pressure of interrogative tactics used in interrogative suggestibility research. Similarly, some previous studies found that dissociation was positively related to false memory (see Section 1), but this was not replicated in our study. One explanation is that different paradigms might have relied on different levels of encouraging imagination and/or visualization (Qin et al., 2008). Finally, we found that depression was negatively related to RFM, which was consistent with the finding by Storbeck and Clore (2005), but differed from others, especially those involving clinical populations.

In summary, this study expanded the literature on personality characteristics involved in false memory by focusing on misinformation false memory. Results showed that personality correlates of misinformation false memory were generally different from those found for other types of false memory, disconfirming our original hypothesis based on the previous research of the latter. Instead, it appears the inter-personal aspects of personality characteristics are especially relevant to misinformation false memory when subjects have relatively low cognitive abilities. It should be noted, however, most of the effects of personality factors were modest in magnitude, as have been found in all other studies of personality correlates of false memory. However, the combination of personality and cognitive factors (both additive and interactive effects) can explain a significant amount of the variance of false memory.

Finally, future research should address several limitations of the current study. First, factors such as the order of presentation of the

pictures vs. narrations, the time intervals (short vs. long interval before recognition test), the use of recall vs. recognition tests, and types of events (traumatic vs. positive) should be considered. Second, future studies should test if our results can be applied to real-life situations (e.g., during a police investigation, whether an eyewitness with low cognitive ability and high cooperativeness is likely to be influenced by post-event misinformation from media or other sources).

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