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Misinformation and Need for Cognition: How They Affect False Memories

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Abstract

The purpose of this study was to gain a better understanding of false memories and Need for Cognition (NFC). The relationship was examined using a typical misinformation paradigm where participants viewed a video clip which depicted a museum burglary and were later presented with an auditory narrative that contained misleading information about the video they previously saw. Half of the participants were exposed to warnings of misinformation. Additionally, the effect of question type (e.g., central, peripheral, and neutral) was taken into account. A main effect for NFC was found indicating that high NFC individuals had fewer false memories for the originally witnessed event than low NFC individuals. It was also found that memory for central details was better than for peripheral details. Furthermore, an interaction between warning and question type showed that when a warning was present, memory for the misleading peripheral details was stronger. Overall, the results demonstrate that there is a difference between high and low NFC individuals and the way memory is processed in the misinformation paradigm. Additionally, the results of this study reaffirm the notion that post-event information can hinder an eyewitness's memory for an original event.

Misinformation and Need for Cognition: How false memories are affected.

Eyewitnesses are called upon to testify in a court of law about crimes they have witnessed. Oftentimes, individuals cannot recall many of the details they witnessed and are at times susceptible to suggestion from other sources which can distort their original memory for the event. Over the past several years research articles have been published on what affects memory for originally witnessed events (Ayers & Reder, 1998; Loftus, Miller, & Burns, 1978; Loftus & Hoffman, 1989; Loftus, 2005; McCloskey & Zaragoza, 1985; Zhu, Chen, Loftus, Lin, & Dong, 2013).

Misinformation Paradigm

The misinformation effect occurs when participants experience false memories of details of a witnessed event after they have been exposed to misleading information (Loftus & Hoffman, 1989). The misinformation paradigm usually involves a three step process which includes the participant witnessing an event, receiving misleading post-event information, and concludes with a memory test (Zhu et al., 2013).

One of the first experiments testing this effect was conducted by Loftus, Miller and Burns (1978) where participants were presented with a series of 30 slides which involved a car hitting a pedestrian. The slides depicted a red Datsun traveling along an intersection where the participants saw either a stop sign or a yield sign. After viewing the traffic sign, the driver of the Datsun knocked down a pedestrian walking in the crosswalk. After viewing the slides, participants were asked questions pertaining to the accident they saw. The questions were designed in a way where half of the participants received information congruent with what they saw whereas the remaining half received misleading information. Specifically, participants in the experimental group were exposed to a stop sign but were later misled to believe they saw a yield

sign. Over half of the participants in this group incorrectly chose the yield sign, suggesting they experienced a false memory for the witnessed event (Loftus et al., 1978). It was first suggested that the misinformation effect occurred because of memory trace impairment (Loftus et al.). This impairment in memory means that there is distortion in the memory trace for the witnessed event likely caused by the post-event misinformation (Loftus & Hoffman, 1989). For example, according to the memory trace impairment, when an eyewitness views a crime and is later exposed to misinformation about what they saw, they are more likely to report the misinformation. More specifically, if an eyewitness views a thief take a calculator and a hammer but then speaks to another eyewitness who says she remembers the robber taking a calculator and a screwdriver, when questioned later, the first eyewitness might say he remembers a screwdriver and not a hammer (Loftus & Hoffman).

After Loftus' seminal work using the misinformation paradigm, there were conflicting results and several theories were examined for their ability to explain the varying results of the misinformation literature (Ayers & Reder, 1998). One theory is the blocking hypothesis which posits that when an individual is exposed to incorrect information it hinders access to the correct information (Bekerian & Bowers, 1983). More specifically, when an individual is asked to recall, memory traces for the misleading and original information exists and the more recent memory blocks access to the earlier trace (Ayers & Reder).

Other researchers claimed that the misinformation effect may be due to the fact that the information was not encoded the first time and therefore memory for the original event was not hindered by the misleading information that was given to participants (McCloskey & Zaragoza, 1985). To assess the Loftus claim that original event memory was distorted by exposing the participant to misinformation, researchers used a variation of Loftus' original misinformation

paradigm which depicted an office theft (McCloskey & Zaragoza). Participants were exposed to a slideshow where they witnessed a maintenance man stealing money from an office. Later they were asked what type of tool the maintenance man took out from the toolbox (a hammer was the originally witnessed tool and a wrench was the misleading information). Participants were then asked to complete either an "original" questionnaire of the witnessed event where they were given a forced choice between the originally seen item (hammer) and the misleading item (wrench) or a "modified" recognition questionnaire where the misleading item was not an option. Participants in the modified condition were instead asked to choose between the original item (hammer) and a newly introduced item (screwdriver).

Results across six experiments showed that when the participants were in the modified condition, they correctly identified the item that was originally presented as often as those participates who did not receive any misinformation. This suggests that exposure to misinformation does not erase memory for the originally witnessed event or make it inaccessible. Memory for the original event was only skewed when the suggested misleading item was an option on the recall test. Therefore, McCloskey and Zaragoza (1985) suggest that the misinformation effect occurs because the misled participants have a tendency to fill the gap where they failed to encode the original event or item that was shown to them.

These studies demonstrate that not all information is remembered equally. Researchers have been investigating how question type can affect memory. For example, information can be classified two ways; central information which includes details that are highly relevant to the event or peripheral information which is irrelevant information to the main focus of the event (Luna & Migueles, 2009). A recent study which investigated central and peripheral information after viewing a crime demonstrated that memory errors are more likely to occur for peripheral

details (Luna & Migueles). In this study participants were exposed to a video of a bank robbery and then exposed to misinformation concerning central and peripheral details of the robbery that they witnessed. The next day participants were asked to complete a recognition task. Results indicate that central information was better remembered. This can be explained by the attentional narrowing hypothesis which states that humans have a limited attentional capacity (Easterbrook, 1959). This may occur because central information is more distinctive when presented which may cause individuals to focus their attention more on the central information than the peripheral information (Heuer & Reisberg, 1992).

Susceptibility to the misinformation effect is another important factor that has been investigated. Previous findings have demonstrated that young children and elderly adults are more likely to produce false memories from the misinformation effect when compared to young adults (Ceci & Bruck, 1993; Karpel, Hoyer, & Toglia, 2001). Studies have found that 3-to 4-year old children tend to be more susceptible to post-event suggestion than 5-to12-year olds (Ceci, Ross & Toglia, 1987; Sutherland & Hayne, 2001). These results suggest that children are more vulnerable to suggestion because they lack the awareness needed to protect their memory from misleading information. Specifically, they lack the metamnemonic awareness needed to shield their memory from suggestion (Ceci, et al.). Also, children may lack the awareness of the need to be vigilant about information that maybe incongruent (Ceci, et al.,; Schneider, 1984). Prestige is also an influencing factor for children, meaning that children are still susceptible, though less so, to misinformation even when the information is not provided by adults or authority figures who possess prestige (Ceci, et al.).

Recent studies have used warnings and participant involvement in the misinformation paradigm and explored how these factors may influence the misinformation effect. For example,

in Szpitalak and Polczyk's (2013) first study participants were told they were partaking in research pertaining to a planned reform of Polish universities. They were told the reform would consist of the students taking a comprehensive exam which was a prerequisite for graduation. Half of the participants were told they would be affected by the reform which would be implemented within the next two years; this was the high involvement group. The second half of participants were told the reform would take effect starting in 2018, therefore they were not affected; this was the low involvement group. Additionally, participants were given a warning that read, "While answering the questions you should rely only on what you remember from the recording. The text you've just read contained a few details that were inconsistent with the recording. Therefore when answering the questions, use only the information from the recording" (Szpitalak & Polczyk , p. 107). Results from this study demonstrated that those participants who were misled and received a warning prior to completing the memory task performed better than those who did not receive the warning. Additionally, the low involvement misled condition performed worse regardless of whether they received a warning.

These researchers conducted a second experiment which only took participant involvement into account; involvement was manipulated the same way as in study 1 (Szpitalak & Polczyk, 2013). The findings demonstrate that participants who had high involvement in the issue were less susceptible to the misinformation effect. This suggests that the low involvement participants have worse memory because they are viewing the event less closely and therefore have weaker memory for the witnessed event. These results are in accordance with study 1 which shows that involved participants should be more resistant to misinformation because they should have better memory for the original event (Szpitalak & Polczyk).

Previous research has found mixed results on the efficacy of warnings. Post-event warnings have been shown to reduce an individual's susceptibility to misinformation (Blank, 1998; Echterhoff, Hirst & Hussy, 2005; Greene, Flynn, & Loftus, 1982); whereas other studies have resulted in post-event warnings being ineffective (Zaragoza & Lane, 1994). This can depend largely on the participant's capability to monitor the source of information, their ability to discriminate between sources of information or the placement of the warning (Lindsay & Johnson, 1989; Lindsay, 1990; Szpitalak & Polczyk, 2013). Additionally, in their investigations, researchers timed participants when reading the post-event information and noted that the participants who received a warning took longer when reading compared to those who received no warning (Greene, et al.). This suggests that the warned participants read the information more closely which led them to have less false memories.

False Memory Theories

Several explanations for false memories in the misinformation paradigm have been offered. For example, false memories may reflect retroactive interference. Specifically, individuals may have a more difficult time recalling the information that they were originally presented with because of the interference from the post-event information (Zhu et al., 2013). Other explanations include memory theories such as the source monitoring framework, the fuzzy trace theory and the activation monitoring theory.

The Source Monitoring Framework

The Source Monitoring Framework (SMF) explains the mental processes involved in making attributions about the origins of one's memories or the source of those memories. The Source Monitoring Framework also explains the process by which individuals can identify the source of their recollections (Johnson, Hashtroudi & Lindsay, 1993; Lindsay & Johnson, 1997).

Source monitoring attributions occur unconsciously and rapidly. Because of the rapidity in decision making, there are memory errors in the source of the memory that is being recalled (Johnson et al., 1993). For example, a person may remember a story about a dog that was told at work but they may not remember who told the story thus losing the source information. Additionally, the SMF allows an individual to differentiate between memories that were actually experienced from those that were imagined.

According to the SMF, false memories occur when a participant attributes thoughts, images and feelings from the original source to the source of misinformation (Lindsay & Johnson, 1997). This can occur because there is an overlap between the event that was originally witnessed and the post-event information; this makes it easy for a participant in a misinformation study to produce false memories (Zaragoza & Lane, 1994). For example, in Loftus et al, (1978) study, participants were exposed to a yield sign and then received misinformation that they saw a stop sign, the overlap of a traffic sign makes it easier to accept misinformation. False memories may also be influenced by factors such as accessibility, plausibility and consistency (Lindsay & Johnson). For example, if a participant is attempting to discriminate a false memory from a true memory, the plausibility of the memory for the event will come to mind.

Fuzzy Trace Theory

Fuzzy Trace Theory (FTT) is another theory that has been developed to help explain the relationship between false memories and memory task paradigms. The FTT states that there are two parallel processes that occur when an individual encodes memory: verbatim traces and gist traces (Reyna & Brainerd, 1995). Verbatim trace refers to the representation of details of an experienced event and gist trace involves incorporating new experienced events and information and connecting it to commonalities in past experiences. For example, if an individual attends a

sporting event and notices that other people are drinking Coke, Sprite, and Dr. Pepper, the individual will likely "remember" that they saw someone drinking Pepsi when asked after the game. Therefore, when an individual remembers seeing the different types of soft drinks (Coke, Sprite, Dr. Pepper) that were present, they are accessing the verbatim trace. When an individual remembers seeing a Pepsi soft drink, which was not originally present, they are accessing the gist trace by incorporating information from past experiences into their new memory for the event.

True memories can be supported by the gist or verbatim trace while false memories can be supported by the gist trace and the verbatim trace can be used to suppress them. The FTT theory suggests that verbatim traces tend to become more inaccessible in a shorter period of time due to decay (Brainerd & Reyna, 2002); this implies that if an individual is not questioned shortly after an experienced event , they will be more likely to rely on the gist trace, which may cause a higher rate of false memories. Additionally, this implies that false memories could last longer than true memories (Toglia, Neuschatz, & Goodwin, 1999). This can be explained by FTT because verbatim trace memory tends to decay at a faster rate than gist trace memory (Wright & Loftus, 1998). Furthermore, when individuals originally witness an event, they create verbatim trace memory with some gist trace memory for the event.

Recollection rejection or recall-to-reject is one way of countering the creation of false memories (Brainerd, Wright, Reyna & Mojardin, 2001; Brainerd et al., 2003; Gallo, 2004). This process allows participants to reject the acceptance of similar items that are presented in recognition tests by recollecting what they have been previously exposed to (Odegard & Lampinen, 2005). In accordance to FTT, this process involves editing a false memory that is consistent with the gist trace of the previously presented information. When an individual accesses the gist, they may also access the verbatim trace which will help avoid the false

memory. For example, as previously explained, if an individual attends a sporting event and is served soft drinks such as Coke, Sprite, and Dr.Pepper, when later asked if Pepsi was served at the event, the individual may say that they know Pepsi was not served because they remember seeing Coke. Therefore, the individual in this scenario recalls all the soft drinks that were present and is able to reject information about those drinks that were not.

The Activation Monitoring Theory

The Activation Monitoring Theory is an expansion of the Source Monitoring framework (Roediger & McDermott, 2000). According to this theory, monitoring consists of the editing that helps a person identify the source of information (Gallo, 2010). An explanation for false memories using this theory is false memories occur as a result of a lack of monitoring the source of the activation during encoding (Gallo & Roediger, 2002; Roediger, Watson, McDermott & Gallo, 2001). In the misinformation paradigm, the misinformation effect also depends on the availability and strength of the presented items (Ayers & Redder, 1998). Additionally, prior exposure to the original item and the activation of associated concepts affects memory.

In sum, SMF, FTT and the activation monitoring framework are the most commonly used theories to help explain false memories in the misinformation paradigm in the literature. According to the SMF, false memory creation can be attributed to the overlap between the original event and the post-event misinformation. Additionally SMF posits that false memories are also created due to the fact that source memory is more easily forgotten than content memory. The FTT suggests that within the misinformation paradigm, delays between the original event and the post-event misinformation could result in higher acceptance of misinformation. Within the activation monitoring theory, research suggests that false memories acceptance is based on the strength and availability of the originally presented item.

Individual Differences

Recently, research has focused on factors that influence an individual's susceptibility to accept and avoid false memories. According to results from several studies, individuals differ in their susceptibility to create false memories in the misinformation paradigm. It is important to investigate why and when certain individuals are more susceptible to false memories because it can help to explain the nature of false memories.

A recent study using the misinformation paradigm found that there was a relationship between intelligence and false memories (Zhu et al., 2010). Researchers in this study used the Wechsler Adult Intelligence Scale (WAIS) and Raven's APM to test intelligence and found that individuals who scored higher on these tests were less likely to incorporate the post-event information into their memory. Furthermore, among an aging population, low scores on the mental arithmetic subtest from WAIS-R were found to be related to higher acceptance of false memories in other false memory paradigms (Meade & Roediger, 2006).

Another individual difference that has been found to be related to acceptance of misinformation is working memory capacity (Owen, McMillan, Laird, & Bullmore, 2005; Xue, Dong, Jin, & Chen, 2004; Zhu et al., 2010). Results demonstrate that working memory and false memories were significantly related because the misinformation questionnaire is a task that requires a great deal of memory capacity from the participant. Therefore, when the participant is actively attempting to process the post-event false information, the original information needs to be remembered and manipulated in working memory over a short period of time. Interestingly, acceptance of false memories was not correlated with general memory which could indicate that high acceptance of false memories is more than just poor memory (Zhu et al.).

Need for Cognition

Need for Cognition (NFC) is defined as how much an individual enjoys in thoughtful and meaningful thinking. This concept was first conceptualized by Cohen in 1955 and was defined as "a need to understand and make reasonable the experiential world" (p. 291). This concept was further developed in 1982 by Cacioppo and Petty who defined NFC as an "individual difference in people's tendency to engage in and enjoy effortful cognitive activity (p. 118)**.**

NFC is scored on a continuum. If an individual scores high on NFC, that individual enjoys the process of thinking and enjoys engaging in activities that promote thinking such as complex problems (Cacioppo & Petty, 1982). This individual tends to expend more cognitive resources in reasoning and solving complex problems; there is a tendency to explore new information in their environments (Cacioppo, Petty, Feinstein, & Jarvis, 1996). If an individual scores low on NFC, this individual prefers to engage in tasks that do not require much thought (Cacioppo & Petty). Furthermore, the low NFC individual has a lack of motivation for complex thinking (Cacioppo et al.).

Researchers have previously investigated NFC, message processing, and persuasion (Cacioppo, Petty & Morris, 1983). In this study, Cacioppo and colleagues asked participants to evaluate either a strong or weak argument that was in support of a recommendation for students to complete a comprehensive exam. Participants were then questioned on factors such as message evaluation, cognitive effort, recall and NFC. Results demonstrated that high NFC had a tendency to recall more message arguments regardless of the strength of the argument they evaluated. The results attained from this study demonstrate that there is a difference between individuals and their need to elaborate and develop information from materials that are presented

to them. This can alter memory because high NFC individuals have a tendency to elaborate information they are presented with and this may cause memory errors.

Need for Cognition and False Memories

A study was conducted which investigated NFC in a false memory test known as the DRM paradigm (Graham, 2007). In this paradigm participants are given a series of words that all relate to a critical non-presented item (e.g., bed, rest, awake, for the critical lure sleep). In Graham's study (2007), participants were given a series of words that all relate to a critical non-present item (e.g., bed, rest, awake) critical items that were related to the studied items but not presented (e.g., sleep), and unrelated items (e.g., file, load, honor) and concluded with a NFC questionnaire. The results from this study demonstrated that those individuals who scored high in NFC had a greater rate of false memories for the critical words. One possible explanation for this result is that individuals who are high in NFC have a tendency to have a more elaborative thinking process which can cause participants to incorporate more information into their gist memory. This may lead them to believe they studied the critical items (Cacioppo et al., 1996; Graham, 2007; Kardash & Noel, 2000).

To further develop these results a study was conducted to explore the relationship between the rates of false recall and NFC (Leding, 2011). In the first experiment participants were given DRM lists and one attempt to recall the items. The results did not yield any significant differences between high or low NFC individuals in false recall. However, in experiment two the participants were given three successive recall tasks; the results show that high NFC individuals demonstrated an increase in false recall and low NFC individuals showed no increase.

Additionally a recent study using the memory conjunction paradigm explored the effects of NFC and recollection rejection responses (Leding, 2013). Participants were first exposed to a word list (e.g., jailbird, witchcraft, blackboard), the features of these words were then recombined to make lure words (e.g., blackbird, spacecraft). The lures typically produce false memories; however, participants can reject the lures because of their verbatim trace memory for the studied word (e.g., participants will reject blackbird because they remember studying blackboard). Results demonstrated that NFC did not have an effect on the participant's rate of false memories. However, participants who were high in NFC had higher rates of recollection rejection responses when the lures were rejected. That is, participants who were high in NFC were better able to explain why they rejected which item they thought was a new item.

This overall suggests that NFC affects the way individuals process information. For example, in DRM paradigms participants who have high NFC tend to rely more on the gist of the word lists that are presented because they are more likely to engage in deeper processing (Toglia et al., 1999). In other paradigms such as the memory conjunction paradigm, participants rely more on their verbatim trace which can lead to participants using recollection rejection to edit their memories (Brainerd et al., 2002). This memory editing strategy allows participants who are high in NFC to use their verbatim trace memory to reject new items by engaging in effortful thought processes (Leding, 2013).

NFC and Misinformation Paradigm

One area that has not been explored is research on false memories is the misinformation paradigm and NFC. Need for Cognition has been demonstrated to be an individual difference variable that will affect the way that information is processed in false memory paradigms (Graham, 2007). Previous studies have demonstrated that high NFC individuals had a tendency

to elaborate their semantic memories for the information that was presented using the DRM paradigm which can at times lead to an increase in false memories. However, these results cannot be generalized to other false memory paradigms because different memory paradigms such as the memory conjunction paradigm and the DRM paradigm, cause individuals to have a different reliance on gist trace memory and verbatim trace memory (Brainerd, Reyna, & Zember, 2011; Leding, 2013).

Current Study

The current study was designed to investigate false memories using the misinformation paradigm while testing an individual's NFC. Another variable that was explored in the study is warnings of misinformation. It is predicted that low NFC individuals will be more likely to experience false memories than high NFC individuals because the misinformation paradigm does not lead participants to rely on the gist trace of memory. Additionally, it is hypothesized that memory for the peripheral items will be worse than central items overall regardless of NFC or warning. Also, participants who are warned will have lower levels of false memories than participants who are not warned. Specifically, it is predicted that participants who are high in NFC will have fewer false memories when the warning is present. By incorporating NFC into the misinformation paradigm it will allow researchers to better understand the relationship between the misinformation effect and how memory is being processed in individuals depending on their NFC. In sum, the purpose of this experiment was to test four hypotheses: Overall for question type, memory for the central items would be better than for the peripheral items. Next, when NFC is split, high NFC individuals would have fewer false memories regardless of question type. For warnings, when the warning of misinformation is present, participants would have fewer

false memories overall. Specifically, the presence of the warnings would be more beneficial for high NFC individuals.

Method

Participants

One hundred and three participants were tested in this study (82 women, 21 men); the mean age was 23.17 (*SD* = 6.03). Participants were undergraduate students from the University of North Florida and were recruited through the psychology department's online recruitment system. Participants received course extra credit for their participation.

Materials and Measures

Participants viewed a 10 minute clip from the film *The Pink Panther* which has been previously used in misinformation studies (Wilford, Chan, & Tuhn, 2014). The video clip depicts a burglary occurring in a museum. The burglar is dressed in all black and attempts to steal a large diamond. The experiment also consisted of a 10 minute distractor task which featured 100 anagrams where the participants unscrambled the existing word to create a new one (e.g., saves = vases). Four auditory narratives of the crime were used; they explained what occurred in the video that was previously viewed by the participant and were the same with the exception of six misleading pieces of information.

For counterbalancing purposes, each narrative contained three misleading central details (e.g., a glove was put in place of the stolen diamond) and three misleading peripheral details (e.g., the color of the hats the guards wore). There were additional control items which consisted of three central details and three peripheral details and contained no misinformation. Additionally, the specific piece of misinformation given was also counterbalanced. For example,

two narratives contained misinformation about the color of a wall (i.e., grey or beige), while the remaining two received the correct wall color (i.e., white).

A 24-item questionnaire was used to test the memory of the participants and consisted of six central items, six peripheral items, and twelve neutral items (Wilford et al., 2014). Each questionnaire included the same questions with the same responses in the same order; the only difference among the questions was the responses to the six misinformation questions; three for central details and three for peripheral details. For example, participants were asked, “As the burglar entered the roof of the museum in the video, the entrance was of a particular shape. What shape was it? ”, the correct response was “octagonal” however some participants were exposed to the misleading responses of either “circular” or “square”.

An 18-item NFC scale created by Cacioppo, Petty, and Kao (1984) was used to measure the extent to which an individual prefers engaging in effortful cognitive tasks. Items on this scale were assessed on a 5-point Likert scale with 1 indicating "extremely uncharacteristic" and 5 indicating "extremely characteristic". The scale includes items such as: “I would prefer complex to simple problems”; and “I like to have the responsibility of handling a situation that requires a lot of thinking”. Previous research has reported Cronbach alphas greater than .85 (Cacioppo, et al., 1996; Graham, 2007). The reliability of the scale for this experiment was .89.

Procedure

Participants entered the lab individually or in groups of up to four. They read and signed an informed consent form that briefly explained what would be taking place in the study. Participants were told they would be watching a short video clip, listening to a narrative and then taking a memory test. Once the form was signed, participants wore headphones and watched the short 10 minute video of a museum burglary.

Participants then completed the 10 minute distractor task. Following the distractor task participants listened to a narrative of the crime they witnessed. After the narrative, half of the participants were presented with a warning which read "While answering the questions you should rely only on what you remember from the video clip. The narrative you just heard contained a few details that were inconsistent with the video clip. Therefore when answering the questions, use only the information from the video clip" (Szpitalak & Polczyk, 2010, p. 107). The other half of the participants were given instructions to simply answer the questions that were presented in the questionnaire. Participants then answered a series of questions related to the crime and narrative. Participants then completed the NFC questionnaire as well as demographic information. To conclude the study, participants were debriefed with a brief explanation about the study.

Results

The focus of this study was to determine if the individual difference variable NFC as well and the use of warnings about misinformation would affect false memory rates using a misinformation paradigm. To test these factors a 2 (NFC: high, low) x 2 (warning: present, absent) x 2 (question type: central items, peripheral items) mixed-factors analysis of variance (ANOVA) was conducted on the rate of false memories. Warning and NFC were between-subjects variables and question type was a within-subjects variable.

In line with other research (Cacioppo & Petty, 1982; Graham, 2007), NFC scores were divided using a median split resulting in low (N=49) and high (N=50) NFC groups. Scores ranged from 32 to 85 with a median score of 65. As was done in Graham (2007), data from the four participants whose score fell on the median were not included in the analysis. Proportions of the misinformation items were used to calculate the number of false memories. When

participants did not respond to items, for example, if a participant answered two of the three responses, the score was adjusted accordingly. See Table 1 for means and standard deviations. Proportions were also used for control and neutral items to calculate the number of true memories.

There was a significant main effect for question type, $F(1, 95) = 65.17$, $MSE = .04$, $p = < .001$, $\eta_p^2 = .41$, with fewer false memories for the central items than for the peripheral items. There was also a significant main effect for the split between high NFC and low NFC $F(1, 95) = 4.34$, $MSE = .06$, $p = .040$, $\eta_p^2 = .04$, indicating that high NFC individuals had fewer false memories than the low NFC individuals. There was a significant interaction between question type and warning $F(1, 95) = 4.41$, $MSE = .04$, $p = .038$, $\eta_p^2 = .04$. This shows that the warning of misinformation was only beneficial for the peripheral items. Thus there was a higher rate of false memories for peripheral items when there was an absence of warning; however the main effect of warning was not significant. None of the other interactions were significant.

The analysis conducted on the proportion of correct control items was a 2 (NFC: high, low) x 2 (warning: yes, no) x 2 (question type: central items, peripheral items) mixed-factors ANOVA. See Table 2 for means and standard deviations. The main effect of question type was significant $F(1, 95) = 90.21$, $MSE = .05$, $p = < .001$, $\eta_p^2 = .49$. This result suggests that participants had more true memories for the control central items than for the peripheral items. There were no other significant main effects or interactions.

For the neutral items, a 2 (NFC: high, low) x 2 (warning: yes, no) between-subjects ANOVA was conducted on the proportion of correct neutral items**.** See Table 3 for means and standard deviations. There was a significant main effect for warning, $F(1, 95) = 6.33$, $MSE = .01$, $p = .014$, $\eta_p^2 = .06$, indicating that when participants were warned, they had more correct

responses. The main effect for NFC was not significant for the neutral items. However, the interaction between warning and NFC was significant $F(1, 95) = 10.77$, $MSE = .01$, $p = .001$, $\eta_p^2 = .10$. Specifically, for low NFC individuals, the warning did not have an effect. However, for high NFC the warnings made participants more conservative in their responses leading them to have fewer correct neutral items.

Discussion

The purpose of this study was to gain a better understanding of the relationship between NFC and false memories using the misinformation paradigm. In the current study it was found that participants had a higher rate of misinformation acceptance for peripheral than central items. This led participants to have fewer false memories regardless of NFC for the central information. For the control items, participants had more true memories for the central details than for the peripheral details. This suggests that when the participants were not exposed to misleading details, they had more correct responses for the central items than for the peripheral items. There was also a main effect for NFC suggesting that high NFC individuals had fewer false memories. Additionally, warnings proved to be beneficial for peripheral details. For the neutral items, high NFC individuals had fewer true memories when a warning was present indicating that warnings made high NFC individuals more conservative in their responses to the detriment of the original memories. It is speculated that this may have occurred due to the warnings causing an alerted suspicion to misinformation therefore leading the participants to think even neutral information contained misinformation.

When considering central and peripheral details, the results provide evidence that memory for the central details was better than for the peripheral details because they had fewer false memories and better true memories on the control items. These results support findings

from previous studies indicating that individuals have a better memory capacity for elements that are central in an event (Luna & Migueles, 2009). It is stipulated that memory for peripheral information is not as deeply processed because peripheral details are not as important or informative (Luna & Migueles). Central information is more salient, therefore individuals are more reluctant to accept false information (Burke, Heuer, & Reisberg, 1992; Easterbrook, 1959; Luna & Migueles).

One way that has been thought to prevent misinformation from tainting true memories is the use of warnings. The current study found warnings to be beneficial for certain factors. First, when comparing the proportions of false memories for central and peripheral items, warnings were effective for the peripheral details, because participants had fewer false memories for the peripheral details when the warning was present. Based on this finding, it can be assumed that participants paid closer attention to the central items in both the video clip and narrative, causing them to have stronger memory traces for these items. Stronger memory can then lead individuals to discriminate the misleading information without the presence of a warning.

Differences in the way participants processed the presented information could account for the NFC results obtained in this study. As previously mentioned, for the central and peripheral details, high NFC individuals had fewer false memories. Based on these results and previous findings, it can be assumed that participants used the memory editing strategy recollection rejection or recall-to-reject (Gallo, 2004; Leding, 2013). The use of recollection rejection allows participants to discriminate between what is false information and what is true. This strategy is supported by FTT which suggests that participants are able to use their verbatim trace for their true memory and are able to reject information that does not align (Brainerd & Reyna, 2002; Brainerd, Wright, Reyna, & Mojardin, 2003). For example, participants in previous

studies were able to reject the lures because of their verbatim trace memory for the studied word (e.g., participants will reject blackbird because they remember studying blackboard). This strategy could be especially helpful for high NFC individuals because they are more likely to deeply process and elaborate upon information presented during the recognition portion and can reject false information (Leding). In regards to the current study, it is speculated that high NFC participants performed better in the questionnaire because they were able to rely more on their verbatim trace rather than the gist trace. The verbatim trace allows individuals to recollect the video clip and narrative and reject any incongruent post-event misinformation.

These results may suggest that memory is processed differently in various false memory paradigms. For example, utilizing the DRM paradigm, (Desse, 1959; Roediger & McDermott, 1995), high NFC participants experienced more false recognition and false recall than low NFC participants (Graham, 2007; Leding, 2011). These findings are likely the result of the natural motivation for effortful information processing of high NFC individuals which leads to more elaborative thoughts and semantic connections. Due to familiarity and semantic connections of critical items, the high NFC participants were more likely to rely on the gist trace which led to more false memories (Leding, 2013). For example, if participants were presented with words such as: bed, rest and awake, they were more likely to believe the critical word sleep was presented.

In sum, paradigms such as the DRM produce more false memories for high NFC individuals because of the reliance on the gist trace. Conversely, in the misinformation paradigm, high NFC individuals likely utilize the verbatim trace which leads to fewer false memories. Taken together, these results provide may provide indirect evidence for the theory that not all false memories are created equally and differ among paradigms (Brainerd et al., 2011; Leding,

2013). However further studies should focus on directly comparing false memory paradigms and the way memory is processed in these paradigms Need for Cognition has not previously been studied in the misinformation paradigm, therefore these results provide new information to better understand the nature of false memories.

Conclusion

These results contribute to the existing body of eyewitness memory research. Post event information could hinder the effectiveness of an eyewitness's memory which has serious implications in the legal context. Even though witnesses are usually questioned about memory for central information, peripheral information is important as well and even a small incongruent post event detail can be incorporated into memory and can alter testimonies (Luna & Migueles, 2009). Additionally, high NFC individuals may make better eyewitnesses because they are more likely to have a stronger memory for important events and are less likely to accept suggested misinformation. Future research could focus on replicating these results and should consider using different materials. It would be interesting to see if other researchers obtain similar results with variations of the misinformation paradigm.

Table 1

Mean Levels of Proportions for Central and Peripheral Misinformation Items

	Central Items	Peripheral Items
Low NFC		
Warning	.10 (.23)	.28 (.24)
No Warning	.10 (.16)	.42 (.32)
High NFC		
Warning	.08 (.17)	.23 (.21)
No Warning	.03 (.09)	.28 (.29)

Note. Standard deviations are presented in parentheses.

Table 2

Mean Levels of Proportions for Correct Control Central and Peripheral Items

	Central Items	Peripheral Items
Low NFC		
Warning	.91 (.18)	.64 (.28)
No Warning	.91 (.18)	.60 (.31)
High NFC		
Warning	.88 (.21)	.62 (.34)
No Warning	.99 (.07)	.64 (.22)

Note. Standard deviations are presented in parentheses.

Table 3

Mean Levels of Proportions for Correct Neutral Items

	Warning	No Warning
Low NFC	.39 (.08)	.38 (.07)
High NFC	.35 (.10)	.46 (.09)

Note. Standard deviations are presented in parentheses.

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