

Illusions of Memory: A Literature Review

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Abstract

The purpose of this literature review was to examine various illusions of memory within a source-monitoring framework. Topics including familiarity, attribution theory, déjà vu, dual-process theory, fuzzy trace theory, facial recognition memory, the remember-know paradigm, memory reconstruction, and the misinformation effect were all discussed within this source-monitoring framework. Concerns regarding the reliability and potentially fallacious nature of memory in forensic contexts, such as eyewitness testimonies and police interrogations were also discussed. The author concluded that future research must focus on formulating objective techniques in an attempt to predict the truth or falsity of any particular memory, since high levels of confidence are not indicative of the truth of any matter. Until these objective techniques have been discovered, and in the absence of corroborative evidence, one must remain suspicious of the reliability and truthfulness of phenomena related to eyewitness testimonies and recovered memories.

Keywords: memory illusions, source-monitoring errors, familiarity, dual-process theory

Illusions of Memory: A Literature Review

One of the most perplexing questions in cognitive science is whether or not human memory is trustworthy. It has been discovered, through various studies, that memory is malleable, and confidence alone cannot determine the truth of any matter (Morgan, Southwick, Steffian, Hazlett, & Loftus, 2013). That is, claiming to remember an event does not necessarily mean that event has actually occurred. This is precisely the reason researchers must continue to study illusions of memory.

Certainly, at first glance these illusions may not seem that severe. However, upon closer inspection, researchers have learned, for example, that eyewitness testimonies are not nearly as reliable as one might think (Morgan et al., 2013). This means, of course, that some individuals may be serving unjust prison sentences due to the fallibility of eyewitness memory. Surely, only until the research community has a firm grasp on the likely conditions that create and foster these kinds of memory illusions, can one ever hope to mitigate the potentially devastating effects created by these types of illusions. The implications of these types of memory illusions can be quite serious, especially when one considers them within the context of eyewitness testimonies and therapist driven recovered memories.

However, the author of this literature review suggests that many of these memory illusions are best understood in the context of source confusion, or source-monitoring errors. Source confusion occurs when one is unable to remember how, when, and where a memory was acquired (Clancy, McNally, Schacter, Lenzenweger, & Pitman, 2002). Recollections of events can be confused and therefore produce distorted memories. For example, in a study conducted by Brown and Murphy (1989), the researchers investigated inadvertent plagiarism. Their results suggested that participants generated plagiarism responses even when the participants were explicitly

instructed to avoid such intrusions. In other words, participants assumed their ideas had been self-generated, but in reality, other participants in the experiment had actually generated those ideas. In this case, the participants could not recall the source of their ideas, which was an illustration of source confusion. Given this explanation of source-monitoring errors, the purpose of this literature review is to explain various illusions of memory as they relate to familiarity, attribution theory, Déjà vu, dual-process theory, fuzzy trace theory, facial recognition memory, the remember-know paradigm, memory reconstruction, and the misinformation effect within the source-monitoring framework.

Familiarity

Jacoby, Woloshyn, and Kelley (1989) investigated feelings of familiarity, the impact of divided attention on recognition judgments, and whether or not the unconscious affects decision-making. The researchers presented famous and non-famous names under full versus divided attention. Interestingly, their results suggested that divided attention reduced recognition memory, but had no effect on familiarity, which was measured via fame judgments. They concluded that conscious recollection was attention demanding, and was somehow separate from feelings of familiarity, since dividing attention decreased memory performance but did not affect familiarity judgments.

Greene (1999) sought to determine the role of familiarity in item recognition. In this study, participants studied a list of items in order to become familiar with them. Afterward, they were asked to study another list of items for an unspecified memory test. After the second study list, the participants were given a memory test and were told to provide positive responses to items that had occurred on the second study list. Greene's (1999) results indicated that recognition accuracy was lower for familiar stimuli compared to new or novel stimuli.

In other words, accuracy declined when familiarity was high, and since false alarm rates were affected more by familiarity, recognition rates were also compromised by familiarity. In all three experiments, hits and false alarm rates both increased as a function of familiarity, and this phenomenon was known as the concordant effect. The results from this study were in accordance with researchers who posited that recognition decisions must be largely steered by feelings of familiarity.

However, one must wonder whether the study conducted by Greene (1999) was actually set up to examine recognition memory, or whether the study inadvertently examined source memory. Certainly, if the illusion of memory in these experiments was simply the fact that participants falsely recognized items because of their heightened feelings of familiarity, then this type of memory illusion could be adequately explained as a source attribution error. For example, in this study, (Greene, 1999) the participants viewed one list of words, and then viewed a second list shortly after, but the memory test only tested their memory for words that appeared on the second list of study words. Furthermore, in this study, an error was defined as any word that appeared on the first study list; however, this type of error was actually a list discrimination error, and this resulted in source confusion errors.

Attribution Theory

In the attribution theory, when a person experiences familiarity without recall, he or she has a desire to know where that sense of familiarity is coming from. As a result, the person wishes to attribute that sense of familiarity to something in the world. Jacoby and Whitehouse (1989) examined the attribution theory and they suggested that an illusion of memory could be produced by unconscious perception. Jacoby generally constructed his studies around the concept of logical opposition in order to examine the differences between familiarity and recollection (Jacoby &

Whitehouse, 1989). Other researchers (Lindsay, 1990) have also used this same procedure in order to distinguish between true and false recollection. Jacoby's paradigm requires that participants be able to use recollection in order to discriminate between different lists, and therefore be able to identify the correct source of those items (Jacoby & Whitehouse, 1989). Therefore, if the participants make an error, the researcher can be sure that recollection was not involved, since correct responses would be based on recollection, and incorrect responses would be based on feelings of familiarity in the absence of recollection.

In one study, the researchers (Jacoby & Whitehouse, 1989) presented a long list of words to participants during the study phase. Afterward, the participants were given a test of recognition memory, whereby a context word was presented before most recognition test words. The participants judged whether the test words had been presented during the earlier study phase. The results indicated that when participants were unaware that a context word had been presented, the probability of false recognition increased. When participants were made aware of the presentation of a context word, the probability of false recognition decreased. The illusion of memory occurred when participants informed the researchers that a particular word had been presented in an earlier list, when in fact that word had not been presented in that list.

It is important to note that it is very difficult to study unconscious processing, such as an unconscious attribution process. This is because merely asking the participants what they did or did not see is not an adequate method of testing unconscious processes, since all unconscious processing is subliminal. Therefore, in order to study these kinds of effects, the researchers (Jacoby & Whitehouse, 1989) attempted to show that when participants were in the aware condition, they tended to act in a particular way, and when the participants were in the unaware or unconscious processing condition, they acted in an opposite way. Given that the aware and

unaware conditions showed a different pattern of results, this was evidence enough that opposing effects were occurring for the conscious and unconscious conditions, and both conditions seemed to be influencing processing in different ways. Ultimately, the researchers (Jacoby & Whitehouse, 1989) discovered that the probability of false recognition was augmented when participants were not aware of the source of that feeling of familiarity. Similarly, the probability of false recognition decreased when participants were made aware of the source of that feeling of familiarity.

Whittlesea, Jacoby, and Girard (1990) suggested that feelings of familiarity and perceptual quality depended on an unconscious attribution process. In this study (Whittlesea, et al., 1990), participants viewed a short list of words, whereby the participants were required to pronounce those words and then judge a target word. Whittlesea et al. (1990) suggested that a subjective experience, something akin to familiarity, relied on an unconscious attributive process. As a result, the researchers (Whittlesea et al., 1990) suggested that a memory illusion could be created if a participant misattributed a present experience to an experience that had occurred in the past.

An interesting difference between the studies conducted by Whittlesea et al. (1990) and Jacoby and Whitehouse's (1989), was that Whitehouse et al. (1990) incorporated perceptual fluency into their study. The idea behind perceptual fluency is that a prior experience of perception can be processed with greater ease when encountered another time. An item with high processing fluency may seem as if it has been encountered before, thus a participant may make the attribution that he or she has seen a particular item before, and thereby elicit a feeling of familiarity. The researchers (Whittlesea, et al., 1990) suggested that it was possible to produce an illusion of familiarity by manipulating the physical characteristics of an item and thereby change its perceptual fluency, without requiring any prior experience with that item. In manipulating

perceptual fluency of a study item, the researchers hypothesized that the feelings of familiarity used for recognition memory decisions would also be affected.

The researchers (Whittlesea, et al., 1990) found that the majority of participants did not notice the perceptual processing manipulation, and therefore the participants were more likely to report an item as being old if the item was presented in the condition that allowed for greater perceptual processing, compared to the condition that allowed for lesser perceptual processing. This result indicated that participants were indeed influenced by perceptual fluency when making recognition decisions, even though the participants were not consciously aware of that influence.

The researchers conducted a further experiment in an attempt to demonstrate that feelings of familiarity were related to unconscious attributions. They accomplished this task by showing that the familiarity effect disappeared when the participants were made aware of the perceptual fluency manipulation. The hypothesis was that participants generally do not notice differences in perceptual fluency, but the manipulation that allowed for greater perceptual processing due to greater fluency would feel more familiar because it was processed more easily. When participants were told about this processing manipulation, they would ascribe that sense of fluency to the manipulation and not to past experience, and thereby would be less likely to misattribute that ease of processing to familiarity.

In another study, Whittlesea (1993) examined how illusions of familiarity arose from unconscious attributions about the source of processing fluency. He found that attribution does not depend on perceptual fluency but can also be influenced by conceptual processing fluency. Whittlesea (1993) suggested that many feelings about the past, including feelings of familiarity, are controlled by a simple fluency heuristic. One important question is whether or not fluency must

always be familiarity, or whether fluency and familiarity are two distinct items that have overlapping qualities.

All of the studies in this section illustrate how familiarity might feel familiar to an individual, but that feeling of familiarity may not be the result of a true memory. Instead, that feeling of familiarity may simply be related to unconscious processes such as ease of processing or fluency. In other words, if something has certain characteristics, such that it is easily perceived, one might assume that thing is tied to a past experience and therefore elicits a feeling of familiarity; however, given the results of studies such as these, this is obviously not always the case. It may seem odd to suggest that both unconscious and automatic processes involve decision making, but that is precisely the reason it is so important to continue to examine such intriguing avenues of research.

The attribution theory presupposes that correct responses are based on recollection, and incorrect responses are based on feelings of familiarity. Furthermore, the attribution theory suggests that when participants feel a sense of familiarity, the participants desire to attribute that sense of familiarity to something, whether or not that something is the true cause of that feeling of familiarity. For example, rather than the participants attributing their feelings of familiarity to ease of processing, (Whittlesea, 1993), they attributed it to an incorrect past experience, and this resulted in an illusion of memory. However, this illusion of memory appears to be simply another illustration of source confusion, since the participants could not pinpoint the source of their feelings of familiarity, and as a result, they misattributed that feeling of familiarity to an incorrect source.

Déjà Vu

According to Cleary (2008), déjà vu experiences occur when one feels as if a current situation is somehow familiar, even though there is clear evidence that the current situation could not have been formerly experienced. Cleary (2008) suggested that déjà vu occurs when one feels a sense of familiarity without being able to identify or attribute the source of that familiarity. The question is, of course, what exactly is familiarity, if familiarity is indeed the basis for déjà vu experiences.

According to Cleary, (2008) familiarity based recognition occurs when a person matches the features or elements in one's present situation with the features or elements of a previously experienced situation that is stored in memory. Cleary (2008) suggested that the overlap between features in a current situation with the features of a previous situation stored in memory is what creates the feeling of familiarity. According to this hypothesis, when there is large overlap between features, this overlap can be either the source of correct recognition, or the source of familiarity-based memory illusions, such as déjà vu.

Cleary and colleagues (Cleary, Brown, Sawyer, Nomi, Ajoku, & Ryals, 2012), investigated the Gestalt familiarity hypothesis which suggested that déjà vu experiences occur when a configuration of elements in a scene is mapped onto a configuration that was seen before, but that previous scene does not appear in one's mind. In this particular study (Cleary et al., 2012), participants viewed configurally similar scenes, and then reported both familiarity ratings and déjà vu experiences. The participants scored the familiarity ratings and reports of déjà vu as being higher for the configurally similar scenes as compared to the novel scenes. These results supported a feature-matching approach to familiarity and déjà vu, since there was an augmented sense of familiarity produced by the increased match to an experience stored in memory, and this match is

what theoretically contributed to the high déjà vu rates. In other words, when there was a large match to a representation stored in memory, then familiarity and déjà vu rates both increased alongside each other.

However, it seems plausible that the researchers did not actually elicit déjà vu at all and merely produced strong feelings of familiarity without identification. This is especially important to consider, since the researchers did not distinguish between feelings of familiarity and déjà vu in the self-reports. Not to mention, there may have been strong demand characteristics, such that the participants felt as if they were required to report déjà vu experiences even if they did not really have such an experience.

One implication of both of these studies (Cleary, 2008; Cleary, et al., 2012) is the idea that déjà vu is really just an augmented sense of familiarity without source identification. One may try to discount this suggestion by positing the view that recognition without source identification is a very common occurrence, especially when tested in the laboratory, as compared to relatively uncommon déjà vu experiences. One would think that if déjà vu was solely based on a strong sense familiarity, then people would experience déjà vu very often, but déjà vu experiences do not seem to occur nearly that frequently.

Perhaps, déjà vu is more related to attribution, such that if a person attributes his or her feelings to déjà vu more frequently than others, he or she may experience déjà vu more frequently simply in virtue of that attribution. Nevertheless, future researchers must consider different methods for studying déjà vu, preferably outside the realm of familiarity, or, at the very least, they must do a better job distinguishing between feelings of familiarity and déjà vu experiences. Until that point, it seems logical to suggest that déjà vu experiences may in fact be strong feelings of

familiarity without source identification, and this is ultimately just another form of source confusion.

Dual-Process Theory

The dual-process theory for recognition memory suggests that item recognition can arise from one of two ways: either through the recollection of important details of an earlier event from when the item was originally presented, or through a sense of familiarity with either the test item or with the current situation (Cleary, 2008; Kostic & Cleary, 2009). Many researchers consider recollection to be a slow controlled process, and familiarity is seen as an automatic and fast process within the dual-process framework (Jones & Jacoby, 2001).

By utilizing the dual-process framework, Kostic and Cleary (2009) examined the recognition without identification effect for segments of songs. In this study, participants listened to segments of popular songs and were tested for memory recognition. For a recognition without identification effect to occur, participants were required to recognize a song as being familiar during the test phase, without recollecting specific details about the song that were responsible for that feeling of familiarity. The researchers found a recognition without identification effect for song segments when rhythm information or tonal information was removed, and when tempo was not exact. The fact that song recognition without identification effect occurred, suggests that familiarity was driving this effect, and not recollection.

In the design of this experiment, the test items were partitioned into different components as a means of determining which of the various components were responsible for the feelings of familiarity that were elicited in the song segments. For example, the researchers (Kostic & Cleary, 2009) manipulated rhythm information by itself, and then tonal information by itself within the different song segments as a way of determining if one elicited more familiarity than the other. It

is worth mentioning that the recognition without identification effect can still occur even with low identification rates, since the effect is based on feelings of familiarity without identification.

In a different type of study, Jones and Jacoby (2001) examined feature and conjunction errors in recognition memory through the dual-process framework. Participants were required to either respond very quickly while under a time pressure, or they were given ample time to respond. The researchers also manipulated divided and full attention. Interestingly, the time pressure condition increased the probability of committing feature and conjunction errors. This increase in errors was not found for participants who were given more time to respond.

The researchers (Jones & Jacoby, 2001) discovered that dividing attention during the study phase or test phase decreased recognition for old words but did not affect feature and conjunction errors. Furthermore, divided attention decreased recollection, so participants were less likely to discriminate old items from new items in the divided attention condition. However, this was not the case for familiarity. Instead, there was no change in discrimination of feature and conjunction words from new words, so only old-new discrimination was affected by the divided attention condition.

The researchers (Jones & Jacoby, 2001) hypothesized that when participants were required to complete a time pressured task, they did not have enough time to complete a recollection process, and this forced them to rely entirely on familiarity. Conversely, when participants were permitted more time to complete their task, they were able to conduct a memory search, which allowed them time to recollect details, and the familiarity effect vanished as a response to this added time. Ultimately, the researchers concluded that familiarity must be an underlying feature since it was possible to mitigate conjunction errors through recollection, so feature and conjunction errors had to have been based on familiarity without recollection.

The researchers (Jones & Jacoby, 2001) concluded that a dual-process model must exist for recognition memory because the results of this study suggested that familiarity and recollection were characterized by different retrieval rates. Certainly, given the fact that recollection could be used as a means of mitigating feature and conjunction errors, it seems as if feature and conjunction errors must be based on familiarity in the absence of recollection. A single process model would not be able to account for this pattern of results, especially given the effects on feature and conjunction errors for the short response group as compared to the long response group.

The dual-process theory is an intriguing framework because it seems to explain a wide range of results. However, this ability can also be considered a drawback, since it is very difficult to test the dual-process theory simply because it explains the majority of results by pointing to a second process, even when the details surrounding that second process are relatively unknown. For example, the dual-process theory explains the mirror effect by suggesting that the higher hit rate and lower false alarm rate for low frequency words is due to the greater recollection of low frequency words because low frequency words are more distinctive (Diana, Reder, Arndt, & Park, 2006). In the end, it is very difficult to think of an experimental design that would adequately test the dual-process theory, and that fact seems disconcerting.

Nevertheless, illusions of memory in the dual-process framework, at least in terms of the above studies, (Kostic & Cleary, 2009; Cleary, 2008; Jones & Jacoby, 2001) were based on recognition without identification. In other words, some participants in these studies were able to voice whether or not a test item seemed familiar to them, but they could not recall the exact details of the test item. For example, Jones and Jacoby (2001) found that in the divided attention condition, participants relied solely on familiarity because they did not have enough time to complete a recollection process, and this reliance on familiarity increased feature and conjunction

errors. A conjunction error occurred when the study primes (e.g., *checklist* and *needlepoint*) were similar to an item on a recognition test (e.g., *checkpoint*), and the familiarity produced by the elements in the study primes impelled the participant to respond old when the participant should have responded new (Jones & Jacoby, 2001). For these errors to have occurred, it seems likely that when the participants were given a recognition test, they confused the source of familiarity created by the study primes as being words that had occurred on the study list, when in reality, those words had not actually been presented. In other words, the participants committed a source-monitoring error.

Fuzzy Trace Theory

Fuzzy trace theory is another version of the dual-process theory, however the fuzzy trace theory distinguishes between verbatim and gist traces. Verbatim traces are similar to recollection in the dual-process theory because verbatim traces occur when a person remembers test items word for word. Likewise, gist traces occur when a person remembers the general, overall meaning of test items, which is similar to feelings of familiarity within the dual-process framework (Payne, Elie, Blackwell, & Neuschatz, 1996)

Fuzzy trace theory was partially built on evidence provided by Bransford and Franks (1971). Bransford and Franks (1971) investigated memory for wholistic semantic ideas. The researchers hypothesized that participants could attain complete ideas from an experience with only partial ideas. Furthermore, they claimed that the participants would proclaim to have heard the sentences that contained the complete ideas, even when they could not have actually heard those complete ideas during the study phase.

In this study, (Bransford & Franks, 1971) the participants were shown different sentences and were then given a recognition test. The sentences were manipulated so that they contained

varying degrees of prepositional content. The pattern of results indicated that the participants called entirely new sentences old with the same confidence level as actual old sentences. In other words, the participants could not discriminate new sentences that were consistent with the ideas assimilated during the encoding phase from sentences that they had heard during the actual acquisition task. Consequently, the participants remembered the meaning of the sentences, and not the literal verbatim details of the sentences.

Bransford and Franks (1971) discovered that when participants lost the verbatim information for word memory, they tended to remember the gist or conceptual meaning of those sentences instead. It appears that when participants were provided with sentences that had varying amounts of propositional information, they tended to combine information that was related to those sentences. That information seemed to be stored in memory in a meaningful way, and that meaning was retained even when the verbatim information was lost.

Bransford and Franks (1971) discovered that participants were completely unable to distinguish old from new sentences, so this study illustrated an illusion of memory simply because the participants recalled sentences they had not seen previously. Yet, at the same time, the participants also remembered the gist information. Therefore, it is possible that the researchers unfairly tested verbatim memory, since they had only presented information piece by piece with sentences that contained varying degrees of prepositional content.

In other words, it seems likely that the participants were required to put the various sentences together in order to fully understand the meanings of those sentences. This matters, of course, because meaning is not based on verbatim information. Rather, meaning is based on gist information. Furthermore, the researchers seemed to only be focusing on reading comprehension, which again, required the participants to comprehend meanings of sentences, and not verbatim

information. If this were the case, then it seems likely that the participants constructed meaning out of their experiences and therefore they remembered the meanings that they had generated themselves.

This pattern of results was similar to a study conducted by Roediger and McDermott (1995). The participants in that study (Roediger & McDermott, 1995) claimed to have remembered critical words even though those words had not been presented on the study list. Perhaps in each case, the associations between the sentences in Bransford and Franks (1971) study, and the associations between the words in Roediger and McDermott's (1995) study, both produced an illusion of memory that was unsurprising, given the type of experimental design that was implemented.

In another study, Payne and colleagues (1996) investigated false memories within the fuzzy trace theory framework. These researchers sought to examine both the accuracy of participants' memories, and any phenomenological characteristics that might have been created by the false memories. Participants were required to study a list of words that were related to a critical non-presented word, and afterward they either completed a recall test or they solved a math problem. The participants were told to give Remember-Know judgments for items that were identified as old on a memory recognition test that was given to them 24 hours after the recall test.

The pattern of results indicated that participants called critical non-presented items old almost as equally often as studied items. The false alarm rate was higher for critical non-presented items compared to distractor items. In a further experiment, the researchers (Payne et al., 1996) found an advantage for forced recall compared to free recall. The false recall effect increased over repeated tests, and false memories depended on gist information because the repeated tests provided more opportunities for gist information.

The researchers (Payne, et al., 1996) discovered that participants had falsely recalled critical items; additionally, the participants were quite confident that the critical item had appeared on the study list, even when the critical item had not actually been presented. The researchers concluded that false memories could be consistently produced through a standard list learning procedure, and that the fuzzy trace theory seemed to adequately explain their results. That is, the fuzzy trace theory predicted that participants would create a gist representation, and this representation was consulted when participants were recalling a critical non-presented item, and systematic errors were created as a result of this process. However, by accessing the verbatim representations, rather than the gist representations, participants were able to accurately recall study items.

Most perplexingly, Payne et al. (1996) found evidence that indicated participants believed their false memories were just as real as their memories for true events. This finding is incredibly important for forensic matters, particularly in regards to eyewitness testimonies. One obvious reason for this concern is the implication that a high level of confidence is not indicative of the truth of any matter. For example, an eyewitness may be highly confident when informing the jury about an event that he or she believes really occurred. However, that eyewitness may have simply recalled a false-memory without being aware of doing so, since true and false memories, at least according to this study, feel phenomenologically similar, if not the same.

Given that the fuzzy trace theory predicts similar results as the dual-process theory, it should be sufficient to simply mention that the participants in these studies appeared to have also made source-monitoring errors. For example, Bransford and Franks (1971) found evidence that suggested participants were unable to distinguish old from new sentences, but at the same time, the participants had remembered gist information. In dual-process terms, gist information is akin to

feelings of familiarity. In both the dual-process and fuzzy trace frameworks, participants made memory errors because they had incorrectly assumed test items that contained a sense of familiarity, or gist information, had occurred on the study list, which resulted in a source-monitoring error.

Facial Recognition Memory

Jones and Bartlett (2009) sought to determine how feature and configural information was retrieved in facial recognition memory. The researchers investigated whether feature and configural information could be retrieved from memory through a recollection or familiarity process, or through a combination of both. In this particular study (Jones & Bartlett, 2009), participants could avoid a recognition error to conjunction lure faces or feature lure faces by recalling a studied configuration for either case. The researchers compared a dual-process model to a single process model, and their results for old responses indicated that participants were not able to use recollection to retrieve configural information in order to mitigate recognition errors for conjunction and feature lure faces. Given that the participants could not use a recollection process to mitigate recognition errors, the researchers posited a single process framework based on the strength of familiarity in order to account for this pattern of results.

In a study conducted by Reder et al. (2013), the researchers also investigated facial recognition memory. However, in this study, the researchers hypothesized that faces that are known to the participants beforehand are easier to bind to context, compared to faces that are not known to the participants and therefore do not have a long-term memory representation. Participants were required to view faces superimposed on different backgrounds and were then given a facial recognition test. The researchers discovered that facial recognition memory for famous faces was better when the background was reinstated compared to when the background

was not reinstated. Additionally, this reinstatement effect differed depending on how many faces were seen with a given background, such that famous faces presented with a high-fan background produced a lower reinstatement effect and therefore generated the least amount of remember responses. Ultimately, the researchers concluded that it is easier to associate context to faces that have a long-term memory representation, e.g., famous faces, than faces that do not have this long-term memory representation, e.g., unknown faces.

It is interesting to note that Reder, et al. (2013) included an incidental study phase by asking the participants how likely it was that the presented faces would visit the different locations featured in the background photos. Interestingly, all of the backgrounds consisted of impressive locations such as the Eiffel Tower or the Colosseum, and given that the participants were viewing both famous faces and unknown faces, participants may have recalled the famous faces more often simply because it made further sense that a celebrity would actually visit such impressive monuments in real life. It would be difficult to convince oneself that unknown faces (e.g., strangers) would visit such impressive places.

Given this difference, perhaps the pattern of results differed between the famous and unknown faces simply because the participants were not engaged in the same type of mental processes for both kinds of faces. Furthermore, it is also possible that both types of faces differed in typicality such that the attractiveness levels and other related dimensions varied strongly enough that facial recognition memory was influenced, given the fact that more typical faces are harder to remember in comparison to atypical faces.

Ultimately, Reder et al. (2013) concluded that facial recognition memory for famous faces was better when backgrounds were reinstated, as compared to when backgrounds were not reinstated. Furthermore, memory errors may have occurred because participants were confused

about the source of their feelings of familiarity. Perhaps it was easier to attribute the feeling of familiarity to the correct source when backgrounds were reinstated, and therefore memory was better in that condition. Conversely, perhaps it was more difficult to attribute the feeling of familiarity to the correct source when the background had changed, and as a result, memory errors occurred. In other words, it is conceivable that when the background was not reinstated, the participants experienced source confusion about where exactly their feelings of familiarity were coming from, and as a result, those participants committed more memory errors.

Remember-Know Paradigm

In the Remember Know paradigm, participants are required to make recognition decisions based on recollection or familiarity. If an item is judged as being old, the participant must choose between a remember response, which is defined as a recollection of specific details of prior experience, or a know response, which is defined as an absence of recollection of specific details (Hockley, 2008). Hockley (2008) was interested in testing recognition memory via the Remember-Know paradigm, specifically through a manipulation of global context.

Hockley (2008) manipulated this global context by presenting words against differing background colours, real-world photographs, or changing the location of the word. After manipulating the global context, participants were asked to make recognition decisions via the Remember-Know procedure. The pattern of results indicated that the hit and false alarm rates were greater for items that were presented in an old study context compared to a new context. Different-old contexts, which were contexts that contained new but similar elements to old contexts, elicited a similar pattern of results to the old study contexts.

Hockley (2008) also investigated the effect of similarity between old and new items on a recognition memory test. If participants only encoded non-specific representations of photographs,

then a new context that was similar to an old context should produce a similar effect on recognition as an old context. Hockley (2008) replicated the context effect, so that there was a higher hit rate and false alarm rate when items were tested in an old context compared to a new context.

Hockley's (2008) pattern of results seemed to dispute the dual-process theory of global context effects. A new model, called the familiarity-based global matching model of context effects was proposed. This model predicted that old contexts and new contexts that had matching elements to the old contexts would create feelings of familiarity, which would combine with the familiarity associated with the test probe. In other words, the old and new items tested in the old and different-old contexts would have a higher overall level of familiarity than items tested in a novel context, and this caused the hits and false alarm rates to increase.

As a final caveat, in Hockley's (2008) study, if a participant was shown a picture of a beach during the study phase, then shown a picture of a similar but different beach during the test phase, and assuming the participant made a remember judgment, this response would be scored as a false alarm because the pictures were not exact matches. Although it is common sense, it must be noted that the majority of human beings do not have perfect photographic memories. It seems odd to require participants to remember exact pictures rather than the mere fact that both pictures contained beaches. In other words, must pictures always be exact matches, or can the participants' remember responses be regarded as hits merely because the pictures looked similar enough? Although this question has yet to be fully addressed, it is certainly worthy of future research, since the answer to this question will ultimately impact how researchers determine the hits versus false alarm rates within this particular experimental procedure.

Other researchers have also investigated Remember-Know judgments, but they were interested in studying false recognition using a list learning paradigm, namely, the Deese–

Roediger–McDermott (DRM) paradigm (Roediger and McDermott, 1995). In this paradigm, participants viewed a list of words and then completed a memory recognition test. Afterward, the participants were told to rate each word with a level of confidence on whether or not that word had appeared on the study list. The researchers incorporated critical words that were highly related to items on the study list, unrelated to words on the study list, or only weakly related to items on the study list. For example, if the list of words included *nap*, *slumber*, and *rest* the closely related critical word would have been *sleep*.

The results indicated that recognition rates for studied words was almost identical to the hit rate for the critical non-studied words, and participants were highly confident that the non-presented critical words had actually been studied over half of the time (Roediger & McDermott, 1995). Quite interestingly, false recognition of critical non-studied words were often accompanied with remember judgments even though those words had not been presented during the study phase. However, by utilizing recollection, participants were also able to increase their recognition memory accuracy. Consequently, false memory effects appeared in both recall and recognition memory tests, and participants claimed to have remembered the majority of the falsely recognized items as if they had been consciously recollected, even though those items had not been presented at study.

In a study conducted by Garry, Manning, Loftus, and Sherman (1996), the researchers investigated imagination inflation. Their results suggested that some participants were convinced that a false memory had occurred, when in fact that memory had only been imagined. It is interesting to note that the DRM procedure seems to be related to imagination inflation, such that in both cases, the presented items were all highly associated with each other, and this high association confused the participants' internal processes with an external reality.

For example, in Roediger and McDermott's (1995) study, it was possible that the participants simply remembered exactly what they had been thinking about, and not necessarily a full fledged illusion of memory. As an illustration: although the researchers did not present the critical words at study, the collection of associate words may have forced the participants to construct meaning out of their experience. As a result, perhaps the participants remembered the meanings they had generated internally, and if this did occur, then it is not surprising that the participants assumed the critical word was on the study list. In other words, perhaps this is just a feature of highly associated words and should not necessarily be considered an illusion of memory.

Nevertheless, assuming the results from Hockley's (2008) and Roediger and McDermott's (1995) studies are accurate, in both studies the participants claimed to have remembered an item that they could not have actually remembered. For example, in Hockley's (2008) study, the participants could not have remembered the item because that item was either similar – but not identical to – an old context, or the item contained the wrong combination of elements. Similarly, in Roediger and McDermott's (1995) study, participants claimed to have remembered the critical word even though that word had not been presented on the study list. It seems plausible then, that these remember judgments may not reflect events that have actually occurred. Therefore, this pattern of results suggests that remember responses must be interpreted as a measure of confidence. One should not assume that remember judgments are always based on a true recollection of an event that really occurred in the past. On the contrary, it is quite possible that the feeling of remembering is itself an illusion of memory. As a result, it may be the case that the feeling of remembering should simply be interpreted as another kind of confidence judgment and not necessarily a true recollection of past events.

On the one hand, this pattern of results seems to indicate that illusions of memory do reliably occur. After all, the participants in Roediger and McDermott's (1995) study claimed to have remembered the critical word, even though that word had not been presented during the study phase. However, one must wonder whether the researchers were actually tapping into false memory. Certainly, it is quite possible that in Roediger and McDermott's (1995) study, the participants struggled with an illusion of memory simply because the experimental materials were closely related. It seems logical to suggest that the participants experienced source confusion at test due to the highly associated study items.

If the purpose of memory is to remember every single detail of an event, then yes, the participants probably experienced an illusion of memory, since the participants falsely remembered test items that had not actually occurred on the study list. However, if the purpose of memory is for a human being to be able to function as fluently as possible, as a means of preserving vital resources and saving time, then perhaps it is duplicitous to conclude that Roediger and McDermott's (1995) participants experienced a memory illusion. Instead, it seems more apt to presume that the participants were merely experiencing source confusion, and given the experimental method at hand, this is definitely not surprising.

Memory Reconstruction

Bartlett (1935) first suggested that remembering is a reconstructive process. That is, to the extent in which a person reconstructs a memory, more and more details will be altered on each reconstruction. Furthermore, given that memory is a reconstructive process, Bartlett argued that recall becomes more distorted with the passage of time.

In a study conducted by Castel, McCabe, Roediger, and Heitman (2007), the researchers were interested in examining which organizational processes benefit memory performance in

experts. That is, whether expertise leads to encoding context in such a way that expertise increases intrusions during recall. One plausible explanation for the benefits and costs of expertise on memory may be due to the way in which this knowledge is organized in a schema, such that incoming information is incorporated with an existing schema and is therefore easily accessed later. While expertise enhances access to domain-relevant information, this kind of enhanced activation can also lead to an increase in memory errors (Castel, et al., 2007).

In this study, participants contained either expert knowledge of American football, or the participants contained non-expert knowledge of American football. Both types of participants were required to study a list of familiar animal names, and some of those names were the same names as football teams. The researchers hypothesized that the animal names would be processed differently, depending on the expertise level of the participants. The researchers discovered that the participants with expert knowledge recalled more animal names, but also falsely recalled more of the non-presented animal names associated with the football teams, compared to the non-expertise participants. In other words, expertise created a benefit for better recall of studied items, but expertise also resulted in more intrusions.

In another study (Dooling & Christiaansen, 1977), the researchers investigated how prior knowledge informs and potentially causes complications for later knowledge. In this study, the theme of a narrative passage was manipulated in order to evaluate the constructive processes in remembering. The researchers (Dooling & Christiaansen, 1977) found that with the passage of time, participants had increased difficulty in retrieving narrative-specific episodes, and as a result, the participants compensated by utilizing the related information from within their semantic memory. These results are consistent with Bartlett's (1935) suggestion that remembering is a constructive process, and recall becomes more distorted with the passage of time.

The experimental conditions in the previously mentioned study (Dooling & Christiannsen, 1977) were designed in such a way that the researchers could examine schematic knowledge and reconstructive memory. For example, the participants were provided with a famous name (e.g., Hitler or Helen Keller) before reading their narrative passage and subsequent recall test, or they were provided with the famous name after they had read the passage but before they completed the recollection test. In another condition, participants were provided with the famous name after they had read the narrative passage and they were then given a delayed recall test. In the first instance, because the participants were given the famous name before reading the narrative passage, the participants were able to utilize that name as their schema for interpreting the passage. In the second case, the name provided a retrieval cue. However, in the last case, when the participants were provided with the name after they had already read the paragraph and then completed the delayed recall test, the famous name did not aid recall.

It is worth noting that personal characteristics are important for this paradigm, such that the researchers (Dooling & Christiannsen, 1977) must be certain that the participants are actually knowledgeable about the selected famous persons. Certainly, if the participants did not know who Adolf Hitler or Helen Keller were, the participants were going to have difficulty recalling information related to those famous names regardless of the experimental manipulation. In other words, it seems as if some schematic information must already be present in order for participants to have an awareness of the different elements in the narrative, and this allows them to refit those events into a different perspective or schema.

In a similar study conducted by Owens, Bower, and Black (1979) the researchers investigated how motives served as a schema for determining the meanings of actions. The researchers were interested in determining how participants' ideas about a character's motivations

would affect the interpretation of certain text statements. Participants were required to read and remember certain boring activities of a character, and then the participants were assigned to one of two conditions: participants were either made aware of a situation the character in question was worried about, or the participants were made unaware of the situation. The results indicated that during recall, participants seemed to reconstruct the motives, thoughts, and attributions that they had imagined the characters as having experienced. One major finding was that the participants strove to integrate the different goals and episodes into a coherent whole, and the most unrelated episode tended to be forgotten because the participants could not tie it to the whole.

In the previously mentioned studies, (Castel et al., 2007; Dooling & Christiannsen, 1977; Owens et al., 1979) the participants utilized a particular schema in order to organize the experimental material. For example, Castel et al. (2007) found that participants who had expert knowledge about American football better recalled items because those participants used a schema to organize all of the material related to American football teams. However, this schema also resulted in more error intrusions because the participants' prior knowledge intruded on their most recent knowledge in the experiment. One must wonder then, if the primary purpose of memory is to remember every little or potentially insignificant detail of one's experiences, then this method of organizing information via a schematic seems very unsatisfactory. However, if the purpose of memory is for human beings to be able to function fluently in different types of situations, the schematic method of organizing information is quite necessary. Perhaps the participants in this study (Castel et al., 2007) did not make grave memory errors in the grand scheme of things, given that this error fundamentally demonstrated an organizational schema that fit the experimental material presented to the participants.

Misinformation Effect

The misinformation effect occurs when a person erroneously recalls details of a past event after being exposed to false information about that event. This effect appears to operate outside of one's awareness, such that the person truly believes to have seen details they simply could not have seen (Morgan, Southwick, Steffian, Hazlett, & Loftus, 2013). The misinformation effect has been shown to occur in a variety of circumstances. For example, in one study, participants were presented with altered photographs of themselves, and they were made to falsely believe that as a child, they had been on a hot air balloon ride (Wade, Garry, Read, & Lindsay, 2002). In another study, participants viewed a videotaped robbery, and they were made to believe erroneous details they had not originally seen on the videotape, which generated a misinformation effect (Pickel, 2004).

In one of the earlier misinformation studies, Loftus, Miller, and Burns (1978) were interested in studying how information that was supplied after an event influenced memory for that event. In this study (Loftus et al., 1978), participants were exposed to consistent, misleading, or irrelevant information, and the researchers discovered that misleading information produced a larger misinformation impact if that information was introduced just before a recognition test rather than immediately after the initial event. Ultimately, the researchers concluded that information that a participant is exposed to after an event, whether or not that information is consistent or misleading, is integrated into the participant's memory of that event.

The question of course, is whether or not subsequent information alters the original memory, or if both the original memory and the new information compete with one another. This study (Loftus, et al., 1978) seems to indicate that when a person integrates information from more than one source into memory, the person is then able to use that information to reconstruct a

memory that was not actually experienced. A further question is simply this: how fragile need the original memory be, in order to get these effects of misinformation? Even if the memory was encoded, it could not have survived a long delay, since Loftus, et al. (1978) discovered that the participants in this study performed at chance levels after only a week-long delay.

At this point, one might be concerned about these kinds of memory illusions within the context of eyewitness testimonies, since these results suggest memory is incredibly malleable and majorly unreliable. One must wonder, too, how widespread these effects really are. It is interesting to note, that the study conducted by Loftus, et al. (1978) contained a large number of participants, namely 1,242 of them. Within the sciences, it is easier to obtain a significant effect when a study has a large number of participants, since the larger the sample size, the higher the power. If an effect is quite small, a very large sample size is required in order to find the effect reliably across experiments. Given this, one may take comfort in the fact that in this particular study (Loftus, et al., 1978), a large sample size was required in order to obtain a significant misinformation effect. This implies, at least for this specific study, that perhaps the effect is not as widespread as one might think, or at the very least, perhaps there are ways to mitigate this misinformation effect, since the effect required such a large number of participants in order to reach statistical significance.

Conclusion

Many researchers have demonstrated that illusions of memory can occur in various contexts and experimental procedures. For example, when studying effects of familiarity on recognition memory, Greene (1999) determined that false alarm rates were affected more by familiarity, and the illusion of memory in this case was the fact that participants falsely recognized test items because of the heightened sense of familiarity. Whittlesea, (1993) and Whittlesea, et al.

(1990) suggested that feelings of familiarity may not be the result of a true memory, and could very well be the result of ease of processing or fluency. Similarly, illusions of déjà vu may occur due to strong feelings of familiarity without source identification (Cleary, 2008; Cleary et al., 2012). In both the dual-process framework and the fuzzy trace theory, illusions of memory seem to be based on recognition without identification, so participants become confused by the source of familiarity, or gist information, that was created by the study primes. In terms of illusions of memory in facial recognition memory, Reder et al. (2013) concluded that facial recognition memory for famous faces was better when backgrounds were reinstated, and memory errors seemed to occur because the participants were confused about the source of their feelings of familiarity. In the Remember-Know paradigm, Roediger and McDermott (1995) discovered an illusion of memory when participants claimed to have remembered falsely recognized items as if they had been consciously recollected.

In studies conducted by Dooling and Christiannsen (1977), Castel et al. (2007), and Owens et al. (1979), participants utilized a specific schema in order to organize the experimental material, and this schema resulted in memory intrusions because the participants' prior knowledge intruded on their most recent knowledge created by the experiment. Lastly, in terms of the misinformation effect, Loftus et al. (1978) discovered that when participants were exposed to either misleading or consistent information directly after an event, that information was integrated into the memory of the event, and as a result, there was a statistically significant possibility that a misinformation effect would occur.

As mentioned in the introduction, many of the illusions of memory discussed in this literature review can be best understood within the context of source-monitoring errors or source confusions. This source confusion framework is not intended to detract from the potential severity

of the previously discussed research findings. Rather, the framework is meant to illustrate that not all of the findings in this collection of studies are clear-cut illusions of memory.

This is because much of the past research involving word lists and other related materials where illusions of memory have occurred, are vastly different from the richer autobiographical memories that are necessary for forensic contexts, such as eyewitness testimonies and police interrogations (Bernstein & Loftus, 2009). For example, in the DRM procedure, participants are presented with highly associated items. As a result of this association, it is not surprising that recognition rates for studied words are nearly identical to the hit rate for the critical non-studied, yet highly associated words, and therefore participants commit source attribution errors.

Although these studies illustrate that illusions of memory can occur in various experimental procedures, it is important to remember that many of the results from these studies can be explained by source confusion or source-monitoring errors. Due to this conclusion, it is important to differentiate between memory processes that are vital to survival, like the mind's ability to function fluently in order to preserve vital resources, and memory processes that incite disconcertment. For example, it is not alarming that participants in Roediger and McDermott's (1995) study claimed to have remembered critical words that were not presented during the study phase, since those words were highly associated, so the participants likely reconstructed the meaning of those critical words out of their experience. Alternatively, Loftus discovered that memory is malleable and unreliable, and therefore one must be cautious about the reliability of eyewitness testimony (Bernstein & Loftus, 2009; Garry, et al., 1996; Loftus et al., 1978; Morgan, et al., 2013). In other words, on the one hand, memory reconstructive processes are important for organizing mental material, but on the other hand, these same processes seem to give rise to disconcerting memory illusions, as seen, for example, via the misinformation effect.

Even if one accepts the assumption that illusions of memory are reducible to source-monitoring errors, this conclusion does not negate the fact that memory illusions are still worthy of future investigation. Certainly, Bernstein and Loftus (2009) were interested in determining whether or not it is possible to predict the truth or falsity of a memory. This endeavor is crucial for forensic contexts, including eyewitness testimonies, recovered memories, and police interrogation techniques. Perhaps, with improved imaging instruments, behavioral measures, and analysis procedures, one day it will be possible to predict whether or not a memory is true or false. At this time, however, there does not appear to be any objective method for determining the truth or falsity of a particular memory. As a result, one must be constantly aware of the potentiality for false memories, and given this real possibility, society must come to realize that memory is reconstructive and malleable; to the extent that memory is unreliable and potentially fallacious, corroborative evidence is absolutely essential to maintaining a democratic system that is based on authentic justice and grounded in reality.

References

- Bartlett, F. C. (1935). Remembering. *Scientia, Bologna*, 57, 221-226.
- Bernstein, D.M. & Loftus, E.F. (2009). How to tell if a particular memory is true or false. *Perspectives on Psychological Science*, 4, 370-374.
- Bransford, J.D., & Franks, J.J. (1971). The abstraction of linguistic ideas. *Cognitive Psychology*, 2, 331- 350.
- Brown, A.S., & Murphy, D.R. (1989). Cryptomnesia: Delineating inadvertent plagiarism. *Journal of Experimental Psychology: learning, Memory, and Cognition*, 15, 432-442.
- Diana, R.A., Reder, L.M., Arndt, J., & Park, H. (2006). Models of recognition: A review of arguments in favor of a dual-process account. *Psychonomic Bulletin & Review*, 1, 1-21.
- Castel, A. D., McCabe, D. P., Roediger, Henry L., I.,II, & Heitman, J. L. (2007). The dark side of expertise: Domain-specific memory errors. *Psychological Science*, 18(1), 3-5.
- Clancy, S.A., McNally, R.J., Pitman, R.K., Schacter, D.L., & Lenzenweger, M.F. (2002). Memory distortion in people reporting abduction by aliens. *Journal of Abnormal Psychology*, 111, 455- 461.
- Cleary, A. M. (2008). Recognition memory, familiarity, and déjà vu experiences. *Current Directions in Psychological Science*, 17, 353–357.
- Cleary, M., Brown, A.S., Sawyer, B.D., Nomi, J.S., Ajoku, A.C., & Ryals, A.J. (2012). Familiarity from the configuration of objects in 3-dimensional space and its relation to déjà vu: A virtual reality investigation. *Consciousness and Cognition*, 21, 969–975.
- Dooling, D.J., & Christiaansen, R.E. (1977). Episodic and semantic aspects of memory for prose. *Journal of Experimental Psychology: Human Learning and Memory*, 3, 428-436.

Garry, M., Manning, C.G., Loftus, E.F., & Sherman, S.J. (1996). Imagination inflation:

Imagining a childhood event inflates confidence that it occurred. *Psychonomic Bulletin and Review*, 3, 208-214.

Greene, R.L. (1999). The role of familiarity in item recognition. *Psychonomic Bulletin and Review*, 6, 309-312.

Hockley, W.E. (2008). The effects of environmental context on recognition memory and claims of remembering. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34, 1412-1429.

Jacoby, L. L., & Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General*, 118, 126-135.

Jacoby, L. L., Woloshyn, V., & Kelley, C. M. (1989). Becoming famous without being recognized: Unconscious influences of memory produced by dividing attention. *Journal of Experimental Psychology: General*, 118, 115-125.

Jones, T.C., & Bartlett, J.C. When false recognition is out of control: The case of facial conjunctions. *Memory & Cognition*, 37, 143-157.

Jones, T.C., & Jacoby, L.L. (2001). Feature and conjunction errors in recognition memory: Evidence for dual-process theory. *Journal of Memory and Language*, 45, 82-102.

Kostic, B., & Cleary, A.M. (2009). Song recognition without identification: When people cannot "name that tune" but can recognize it as familiar. *Journal of Experimental Psychology: General*, 138, 146-159.

Lindsay, D.S. (1990). Misleading suggestions can impair eyewitnesses' ability to remember event details. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 16, 1077-1083.

Loftus, E.F., Miller, D.G., & Burns, H.J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology: Human Learning and Memory*, 4, 19-31.

Morgan, C.A. III, Southwick, S., Steffian, G., Hazlett, G.A., & Loftus, E.F. (2013).

Misinformation can influence memory for recently experienced, highly stressful events. *International Journal of Law and Psychiatry*, 36, 11-17.

Owens, J., Bower, G.H., & Black, J.B. (1979). The "soap-opera" effect in story recall. *Memory & Cognition*, 7, 185-191.

Payne D.G., Elie C.J., Blackwell J.M., & Neuschatz, J.S. (1996). Memory illusions: Recalling, recognizing, and recollecting events that never occurred. *Journal of Memory and Language*, 35, 261-285.

Pickel, K.L. (2004). When a lie becomes the truth: The effects of self-generated misinformation on eyewitness memory. *Memory*, 12, 14-26.

Reder, L. M., Victoria, L. W., Manelis, A., Oates, J. M., Dutcher, J. M., Bates, J. T., . . . Gyulai, F. (2013) Why it is easier to remember a face we already know than one we don't: Preexisting memory representations facilitate memory formation. *Psychological Science*, 24, 363-372.

Roediger, H.L., III, & McDermott, K.B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21, 803-814.

Wade, K.A., Garry, M., Read, J.D., & Lindsay, D.S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin & Review*, 2002, 9, 597-603

Whittlesea, B.W.A. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 6, 1235-1253.

Whittlesea, B.W.A., Jacoby, L.L., & Girard, K.A. (1990). Illusions of immediate memory: Evidence of an attributional basis for feelings of familiarity and perceptual quality. *Journal of Memory and Language*, 29, 716-732.

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