Misinformation Effects Caused by Retroactive Brand Replacement in Photographs

Maria Victoria Hellenthal

Submitted to City, University of London for the degree of Doctor of Philosophy.

Department of Psychology

December 2016

Contents

List of figures and tables

List of figures

List of tables

Acknowledgements

I would like to express my sincere gratitude and thanks to my principal supervisor Professor Dr. Mark L. Howe, without whom this work would not have been possible. I would like to thank him for encouraging my research and for giving me the chance to grow as a researcher. His advice on my studies and his support have been most valuable and are greatly appreciated.

I would also like to thank my second supervisor Dr. Lauren M. Knott for her valuable support and insightful comments, which helped me to widen my research and approach it from various perspectives.

A very special thanks to my mother Mane Hellenthal. Words cannot express how grateful I am for her continuous support and for always believing in me when it was most needed. I also thank my partner Simon for his patience and encouragement and my grandfather Josef Hellenthal for his support.

Last, but certainly not least, I thank my grandmother Dr. Eva Hellenthal, who has always been my role model and who I miss dearly.

Declarations

Originality Statement

This thesis is submitted to City, University of London in support of my application for the degree of Doctor of Philosophy. It has been composed by myself and has not been submitted in any previous application for any degree.

Included paper and contribution of candidate

The present thesis includes one publication-based chapter (Experiment 5, Chapter 7).

Hellenthal, M. V., Howe, M. L., & Knott, L. M. (2016). It must be my favourite brand: Using retroactive brand replacements in doctored photographs to influence brand preferences. *Applied Cognitive Psychology.* In press.

80% contribution.

The candidate led the experimental design, experimental testing, data analysis, and manuscript preparation.

Abstract

By using a modified version of the misinformation paradigm, this thesis examined a new and ecologically realistic domain for the investigation of false memories: Brands retroactively replaced in photographs. The main research questions addressed in this work was whether retroactively replaced brands in doctored photographs could influence memories for previously experienced brands. Following from this, the question of whether false brand memories would have any attitudinal or behavioural consequences for falsely remembered brands was addressed. Five experiments were carried out that included four misinformation studies (Experiments 1, 3, 4, and 5) as well as one brand norming study (Experiment 2). Whereas all four misinformation studies examined the effects of a 'brand misinformation effect', Experiment 5 went one step further and examined the behavioural and attitudinal repercussions of false brand memories. In line with previous research, the results of all misinformation studies revealed reliable misinformation effects. These effects were found in more manufactured settings in which brands were experienced as brand placements in photographs (Experiments 1 and 3) but also in settings in which participants were misled on actual past autobiographical brand experiences (Experiments 4 and 5). Furthermore, the results of this thesis suggest that false brand memories could be accompanied by preference changes. That is, the data of Experiment 5 showed that false brand memories for 'less liked' competitor brands led to a positive shift in attitudes and behaviour towards these falsely remembered brands. These findings extend the applicability of the classical misinformation paradigm by showing reliable misinformation effects in a new and ecologically relevant context – retroactively changed brands in photographs. Second, these findings show the additional consequences of false memories for a new kind of stimuli that are real and competitive in nature and are associated with participants' personal preferences. The practical and theoretical implications of misinformation-induced false memories elicited by suggestive photographs are discussed.

Chapter 1: Introduction

Introduction

Increased advertising clutter in traditional mass media and technological advancement has led to the emergence of more innovative methods of advertising in recent years. One method that has become an indispensable part of the marketing mix for many companies is social media marketing. Aza Raskin, the former creative lead of Firefox, recently predicted that marketers might start to apply a new form of brand communication: Social network platforms could be used to replace existing brands in personal photos uploaded by their users. This retroactive product placement might create false memories for brands that were only suggested to the viewer (Raskin, 2010). Because, in marketing, consumers' individual experiences are considered to be key for future purchasing behaviour, in one form or another such a technique might indeed find its way into the marketer's toolbox. But could advertisers really use this method to direct how past experiences with a brand are remembered and even go so far as to change a brand preference?

Support for the effectiveness of retroactive product placement comes from more than four decades of extensive false memory research. Here, hundreds of studies have provided evidence that individuals create false recollections of events that never actually occurred (Gallo, 2010) or that they confuse incidents that happened prior to or after an actual event with the original event itself (Loftus, 2003; Roediger & Gallo, 2004). By using a variety of false memory paradigms, researchers have repeatedly and reliably triggered spontaneously generated false memories for non-presented materials (e.g. the Deese/Roediger–McDermott paradigm [DRM; Deese, 1959; Roediger & McDermott, 1995]), implanted rich false memories for entire events (Bernstein, Scoboria, & Arnold, 2015), or implanted explicitly suggested false event details (e.g. the misinformation paradigm; Loftus, 2005). Over the years, false memory effects have found applications in a number of areas, including the accuracy of eyewitness reports in legal settings (see, Loftus & Cahill, 2007, for a review). More recently, these effects have been extended to areas such as marketing and advertising (e.g. Braun-LaTour, LaTour, Pickrell, & Loftus, 2004; Braun, Ellis, & Loftus, 2002; Sherman, Follows, Mushore, Hampson-Jones, & Wright-Bevans, 2015). For example, by using a suggestive advertisement, Braun and Loftus (1998) misled participants on the colour of a previously seen chocolate bar wrapper, a finding the researchers called the ‘advertising misinformation effect’. Braun et al. (2002) showed that it is even possible to implant rich false memories for an impossible event (e.g. shaking hands with a Warner character such as Bugs Bunny in Disneyland as a child) by exposing participants to a misleading advertisement. Although relatively little research has been done in this area, the studies that have been conducted provide reason to believe that false memory effects could be triggered by everyday life situations such as exposure to advertising. However, the exposure to retroactive product replacement would directly mislead a person on a previously experienced brand and hence, trigger a ‘brand misinformation effect’.

In the psychological literature, the most widely used technique to induce misleading postevent information is the misinformation paradigm (Loftus, 2003; Loftus, Miller, & Burns, 1978). In this standard three-step paradigm, participants are typically exposed to events (e.g. a crime scene depicted in slide shows, videos, or staged by live actors), they then receive misleading information about the event in the form of a narrative or misleading questions (e.g. that a knife, not a gun, was used in the crime), and finally complete a memory test for what happened in the original event. The typical finding is that the misleading information is falsely reported as being part of the original event. This effect has been found in strictly controlled lab environments in which both the original event and the misinformation phase were manufactured (e.g. Loftus et al., 1978), but also in more ecologically natural settings in which participants were misled on actual past autobiographical events (e.g. Loftus, Levidow, & Duensing, 1992; Wylie et al., 2014). The nature of this phenomenon has been explained by various theories. One frequently used theory, source-monitoring, proposes that participants confuse the sources of information. More specifically, that they confuse the source of the misleading information with the source of the original event. Indeed, it is well known that information about an event can be better remembered than the information about its source (Johnson, Hashtroudi, & Lindsay, 1993).

Although the misinformation effect is well established in psychological literature, only a few studies exist that have used this paradigm to directly suggest contradicting brand information. In a more traditional misinformation study, Belli (1993; see also Frost, 2000, for a similar study) used brand items (e.g. versions of a soft drink, type of coffee, magazines) as critical objects in a slide show depicting a crime scene. When reading a narrative about the presence of these objects, some were replaced with misleading alternative brands (e.g. if they saw a Maxwell coffee jar in the slide show, this was replaced with Nescafe in the narrative). A second control narrative was used in which the object type (e.g. a coffee jar) was referred to but not the specific brand. In a final recognition test, participants recalled more misleading items in the misled narrative condition compared to the control narrative condition. However, consumer memory was not the focus of this study and other items types as brands (e.g. tools) were used as critical items as well. In a more recent study Holmes and Weaver (2010) used a modified version of the misinformation paradigm and asked participants to select various product brands for a fictitious ‘care package’. A postevent narrative included reference to the correct brand or a contradictory brand (i.e. a different competitor brand). The researchers found that participants falsely recognized misleading brand items from the postevent narrative as belonging to their original 'care package'. Hence, studies have shown that participants can be misled on previously experienced brands by suggesting contradicting brand information in a postevent narrative. However, how do these effects develop when misleading brand information is induced using doctored photographs?

In some studies, manipulated images have been used to implant misleading information (e.g. Nash & Wade, 2008; Wade, Garry, Read, & Lindsay, 2002). For instance, Nash, Wade, and Brewer (2009) demonstrated that the use of doctored videos could lead to the creation of memory illusions for recently self-performed actions (e.g. copying a simple action by a researcher). These effects were stronger when the participants saw doctored footage of themselves compared to when the erroneous actions in the video were carried out by the researcher or a complete stranger. In a perhaps more ecologically valid setting, Sacchhi, Agnoli, and Loftus (2007) investigated how doctored photographs of past public events changed memories for those events. Participants viewed original or misleading digitally doctored images depicting protests in Beijing and Rome as being more violent than they actually were. Viewing the doctored images influenced the way participants remembered the events (they remembered them to be more violent and negative, and they recalled more damage). Nash et al. (2009) proposed that it is underlying mechanisms, such as the illusion of familiarity as well as perceived credibility of such images, that are involved when participants falsely attribute details from doctored images to an original event. Hence, research has shown that doctored photographs can be a powerful tool to introduce misleading information. However, manipulated images have not been commonly used in the area of advertising to implant misleading information.

So, exactly what are the consequences of false memories? Although much has been learned about the false memory phenomenon over its history, researchers typically do not study its 'after effects' (Laney, Morris, Bernstein, Wakefield, & Loftus, 2008). Yet, it is of particular interest for applied areas such as advertising to know about potential downstream effects of false memories. A few studies have shown that false memories for attributes of experienced brands can be linked to consumer judgments and choice. For instance, the study by Braun and Loftus (1998) showed that when the misleading colour information was linked to a positive message (e.g. greater safety), misled participants expressed more favourable feelings towards the brand and more willingness to buy the product relative to non-misled participants (see also Braun-LaTour, LaTour, & Loftus, 2006; Braun, 1999, for similar findings in different advertising contexts). More recently, several researchers found that implanted autobiographical memories could have attitudinal and behavioural effects downstream (e.g. Berkowitz, Laney, Morris, & Loftus, 2008; Bernstein et al., 2015; Laney et al., 2008). Rajagopal and Montgomery (2011) demonstrated this effect using high imagery advertisements for a fictitious brand that made some participants falsely believe that this product had been experienced in the past. Akin to brands that were actually experienced in the study, this 'false experience effect' led to more favourable feelings for the fictitious product. Hence, studies to date provide reason to assume that false memories, once created, may indeed lead to attitudinal and behavioural repercussions. So how would these effects develop in a retroactive product placement context? Research has yet to examine the consequences of false memories for misleading and competitive brands that directly challenge a consumer's original brand choice.

On a practical note, examining the potential effects of a futuristic advertising method such as retroactive brand placement is important because several developments suggest that the ability to implement this strategy might be closer than first thought. In times of TiVo (a recording system allowing consumers to skip TV commercials), Netflix, and ad blocker (an application that can remove or alter advertising content from websites or mobile applications), consumers can easily skip or entirely avoid advertisements, increasing the marketers need for more integrated advertising methods (Wright, Khanfar, Harrington, & Kizer, 2010). Already, marketers place their brands into myriad media channels (e.g. movies, TV soaps, reality shows, games, books, radio streams; Gould & Gupta, 2006; Gupta & Lord, 1998; Lee & Faber, 2007) and research suggests that brands placed in movies and games can have an influence on consumers' explicit and implicit memory (e.g. Brennan, Dubas, & Babin, 1999; d'Astous & Chartier, 2000; Gupta & Lord, 1998; Lee & Faber, 2007; Russell, 2002; Yang, Roskos-Ewoldsen, Dinu, & Arpan, 2006; Yang & Roskos-Ewoldsen, 2007). In addition, it seems to be more and more popular to use social media accounts of 'influencers' such as stars to promote brands and products on social network platforms, verbally (e.g. 'I just love this new bag from brand x'), or as product placements in personal photographs (e.g. an athlete drinking an energy drink of his sponsor; "5 Advantages of Influencers Product Placement on Instagram," 2016). On top of that, it was recently made public that new technologies, allowing retroactive brand integrations in music videos and movies, are already in place. For example, China's online video and TV distributor, Youku, recently announced that they would use digital product placement in its shows to allow product placement to be tailored to the audience of the programme. Thus, if you lived in America, your favourite TV actor would be holding a Coke can where as in China they would be holding Lipton iced tea ("New technology can turn TV shows into sophisticated adverts," 2015). As highlighted by Raskin (2010), social network platforms such as Facebook provide a unique venue to retroactively insert brands in personal photographs, potentially changing one's own brand memories and potentially one's future purchasing behaviour. Therefore, it is of considerable importance not only to advance our understanding of false memory production, but in a consumer context, to understand if and how we can 'override' consumers' brand memories and take a first step toward examining the effectiveness of retroactive brand placement.

By using a modified version of the misinformation paradigm, the experiments in this thesis took a first step and examined the effects of retroactively replaced brands in photographs on memory. Although there is some research about the advertising misinformation effect, there are still a number of questions that have to be addressed. One of these questions is whether (and how) retroactively replaced brands in personal photographs affect memories for previously experienced brands. Although previous studies might suggest that the answer to this question is yes, exploring the effects of retroactive brand replacement differs somewhat from past research. It is well established that manipulated photographs can be used to implant false information and that deceptive advertising can mislead on previously experienced products. However, research has yet to examine the effects of direct brand suggestions in doctored photographic materials. Hence, the current research serves as a conjunction between two areas of research. Whereas the examination of potential 'brand misinformation effects' in different settings forms the main contribution of this study, a second important question is addressed later on in this project. That is, if we form false memories about brand experiences, do these memory errors have any attitudinal (affecting brand preference) or behavioural (affecting brand purchasing) effects downstream? In regard to the consequences of false memories, previous studies either (1) focused on false memories for misleading brand attributes and the consequences for the original brand experience or (2) looked at implanted false memories for the experience of a fictitious brand. In contrast, this study explored the consequences of false memories for misleading and competitive brands that directly challenge a consumer's original brand choice. A positive finding would extend previous research to a personalised 'brand misinformation effect' that might reflect the competitive environment in supermarket shelves as well as participant's real brand choice behaviour.

On a subsidiary level, this thesis addressed several other research questions that were raised as part of the individual experiments reported and these will be specified in detail in the corresponding chapters. One question focused on the effect of delay between the different stages of the misinformation paradigm, a question that is important concerning the ecological validity of our paradigm. Here, researchers have shown that participants can be more vulnerable to misleading information the longer the delay between the original event and the misinformation phase (e.g. Loftus et al., 1978; Paz-Alonso & Goodman, 2008) as well as between the misinformation phase and the final memory test (e.g. Frost, 2000; Roediger, Jacoby, & McDermott, 1996). However, these effects have been explored by using misleading narratives and have yet to be explored in a doctored photograph context (but see Schacter, Koutstaal, Johnson, Gross, & Angell, 1997).

Another research question addressed in this thesis involves examining age differences in the vulnerability to suggestive brand information. More specifically, differences in false memory creation between younger and older adults were examined. From a marketing perspective, this question is important because as population ageing increases, there is a need to explore consumer behaviour of this important target group. Here, several studies provide reason to suggest that older adults are more vulnerable to misleading information than are younger adults (e.g. Cohen & Faulkner, 1989). One explanation for this suggests that older adults have more problems in monitoring the sources of their memories due to an age-related decline in cognitive abilities (e.g. Schacter et al., 1997). However, age-related differences have not been examined in an advertising misinformation context yet, a gap that will be addressed in this thesis.

Last, two subsidiary research questions were raised that aimed to better understand the processes involved in the misinformation paradigm. The first question was somewhat exploratory in nature and aimed to examine the involvement of encoding specific processes in the misinformation paradigm by using eye-tracking technology. The second question centred on the debate concerning whether false memories created in the misinformation paradigm are related in any way to false memories created in the DRM paradigm (e.g. Ost, Blank, Davies, & Jones, 2013; Zhu, Chen, Loftus, Lin, & Dong, 2013). However, because these questions were raised based on results obtained in previous studies in this thesis, they will be discussed in the respective chapters.

In the following chapters, I begin by laying the theoretical foundation for the experiments in this thesis. First, misinformation-based false memories are defined with reference to other false memory phenomena that are touched on in this work.

Next, I review theoretical accounts of the misinformation effect. Following this, findings of studies using photographs to implant misinformation are presented and the underlying mechanisms are discussed. Subsequently, the experiments carried out as part of this thesis are introduced, including methodological commonalities and differences between the experiments. Then each individual experiment is presented in detail. Finally, there is an overall discussion that reviews and integrates the findings of this project.

Chapter 2: Literature review

Literature review

The misinformation effect in light of other false memory phenomena

Although this work mainly focuses on memory distortions created in the misinformation paradigm, it is important to define the false memory term in the light of other ‘types’ of false memories that are touched on in this project. In general, false memories (sometimes also referred to as memory illusions or pseudo-memory; Zhu, Chen, Loftus, Lin, He, Li, Xue, et al., 2010), refer to recollections of events or details of events that were actually never experienced. They are also defined as being a memory distortion, in which individuals confuse incidents that happened prior to or after an actual event with the original event itself (Loftus, 2003; Roediger & Gallo, 2004). In comparison to true memories, which can be reconstructively remembered more or less as they actually occurred, memory illusions go beyond direct experience and include interpretations, interference, or actually contradict the experienced event (Reyna & Lloyd, 1997). But unlike lying, these non-experienced events are really believed to have happened (Zhu, et al., 2010). However, false memory phenomena are diverse and relate to a broad range of episodic memory distortions that have been observed in experimental settings, in psychotherapeutic environments, and in other real life settings (Reyna & Lloyd, 1997; Wade et al., 2007). According to Brainerd and Reyna (2005, p. 25) false memories ‘…are what we measure’ and to fully understand what is known about the phenomenon requires an understanding of the basic research paradigms that have been used to induce false memories.

The misinformation paradigm and the misinformation effect

The misinformation paradigm is used to implant false memories for what is often seen as ‘contradictory’ event details. As noted in the last chapter, in the standard three-step paradigm of a classical misinformation experiment, participants are first exposed to a forensically relevant event in form of a slide show, a video, or an event staged by actors (e.g. a crime scene). Subsequently participants receive misinformation about this event by being exposed to a narrative or suggestive questions including ‘hidden’ misleading details (e.g. suggesting that a knife not a gun was used in the crime). Finally participants complete a memory test for the original event to record the influence of misinformation on participant’s memory. A typical finding is that misled participants are more likely to report the misleading postevent information than control participants who were not exposed to the misleading information. For example, in one of the first studies using this paradigm, Loftus et al. (1978) exposed participants to a traffic accident scenario via picture slides. One slide depicted a critical event scene showing a car stopping at a ‘stop’ sign. After, some participants were asked a neutral question about the event including a ‘hidden’ contradicting detail such as ‘Did another car pass the red Datsun while it was stopped at the yield sign?’, when in fact a stop sign had appeared in the slides. Other participants (the control condition) received consistent (stop sign) or neutral (traffic sign) information. Last, in a final memory test, all participants were asked to discriminate between old/accurate slides and new slides containing the misinformation detail. Findings revealed that misled participants recognized the original event detail (the stop sign) less often and the misleading detail (the yield sign) more often relative to the control conditions.

By using the misinformation paradigm in one form or the other, hundreds of studies have found evidence for the existence of one or both manifestations of misinformation’s influence: (1) poorer memory performance for originally presented items (e.g. stop sign) in the misled condition compared to the control condition. Alternatively, or sometimes in addition (2) stronger endorsement rates of misinformation items (e.g. yield sign) in the misled relative to a baseline condition (e.g. false retrieval of novel but related items at test; Blank & Launay, 2014). Although the influence of misinformation on memory is undisputed, the magnitude of the misinformation effect has shown to depend on many factors centring on study design and type of memory test (Roediger et al., 1996).

Other 'types' of memory distortions and differentiation from the misinformation effect

Various other paradigms have been used that have elicited false memory phenomena (see Brainerd & Reyna, 2005 for an extensive review of these methods). Next to the misinformation paradigm, the DRM paradigm and the implanted false memory approach are two of the most established false memory paradigms in the cognitive literature (Pezdek & Lam, 2007). A crucial difference between the methods is how false memories are elicited in these paradigms. Whereas the DRM paradigm aims to elicit internally generated false memories for non-presented materials, the misinformation paradigm as well as the implanted false memory approach aim to induce false memories by means of explicit suggestion (Zhu et al., 2013). For instance, in a typical DRM study, participants are presented with lists of related words (e.g. table, sit, legs, couch) that are semantically associated with a non-presented critical lure word (e.g. chair). In a subsequent memory test, many participants falsely recall or recognize the critical lure word as part of the word list (Roediger & McDermott, 1995). In contrast, in the misinformation paradigm, participants are misled on existing memories and participants create false memories for misleading event details (Otgaar, Verschuere, Meijer, & van Oorsouw, 2012). The implanted false memory paradigm goes one step further and aims to induce false memories for entire events that did not happen. In a typical study, participants first receive narratives or photographs about supposedly experienced events (Loftus & Pickrell, 1995; Wade et al., 2002). After several suggestive interviews, participants typically report partial or full false memories for rich and complex events (e.g. that participants went on a hot air balloon ride in their childhood; Wade et al., 2002).

Myriad theories have been proposed to explain false memory phenomena created in these different paradigms. Examples are the source-monitoring framework, the activation-monitoring account, the fuzzy trace theory, the fluency-misattribution perspective, and the constructive memory framework (see the following chapters for a description of some of these theories and Gallo, 2010, and Steffens & Mecklenbräuker, 2007, for a full description of these and more concepts). Whereas some of these theories have been established to explain memory errors created in specific paradigms, others are used to explain false memory phenomena in a variety of tasks (Gallo, 2010). In this context researchers have questioned whether or not memory errors elicited by different paradigms are mediated by the same cognitive mechanisms and whether they are even related (Pezdek & Lam, 2007; Wade et al., 2007). For example, spontaneously generated false memories in the DRM paradigm are thought to be mainly caused by endogenous processes (i.e. that they are mainly driven by spreading activation in networks of memory traces (see Howe, Wimmer, Gagnon, & Plumpton, 2009; Otgaar, Howe, Brackmann, & Smeets, 2016). In contrast, paradigms using external influence to implant misleading information are believed to be driven by exogenous processes as well (Otgaar et al., 2016). That is, not only memory traces, but also social demands may play a role when participants misattribute misleading information to an original event or report entirely implanted events (Otgaar et al., 2016, 2012). Still, a common mechanism of internally and more externally generated false memories may lie in the formation of distorted memory traces, potentially being caused by source-monitoring difficulties in the paradigms (Ost et al., 2013; see Experiment 3 for more discussion on this matter).

Theoretical accounts of the misinformation effect

It is well established that human memory is a reconstruction of past events rather than a veridical representation of events as they actually happened. It is also known that the extent to which a person is misled by suggestive postevent details can influence the reports of originally experienced events (Hyman & Loftus, 1998). In order to specifically account for the suggestibility to misinformation phenomena, various theories have been proposed over the years. Whereas early-developed theories proposed the misinformation phenomenon to occur because misinformation alters the originally stored memory trace (memory impairment hypothesis; Loftus et al., 1978) or renders it difficult to retrieve (memory interference accounts; Bekerian & Bowers, 1983), later theories hold that the misinformation effect is a bias effect caused by misinformation acceptance (McCloskey & Zaragoza, 1985). Researchers have also proposed more integrative frameworks that are not constructive in nature to explain the suggestibility to misinformation. One theory that has been used to explain memory phenomena in a variety of tasks and that has been used most widely to explain the misinformation effect, is the source-monitoring framework (Lindsay & Johnson, 1989). Because of their importance for this research, the following sections will first provide an overview of the early hypotheses and their development before presenting the source-monitoring framework. Last, some alternative theories that can account for the misinformation effect will be briefly addressed.

Memory impairment and interference accounts

Early explanations of the misinformation effect were based on the consistent finding that misled participants performed less accurately than control participants on the final memory test. For instance, when a ‘stop sign’ was originally shown to participants that was later contradicted by a ‘yield sign’ in the misinformation phase, misled participants were less accurate about the stop sign relative to non-misinformed control participants. The original interpretation of this phenomenon was that misinformation, at encoding, might change the original event memory trace in some way (e.g. by partially overwriting the original memory trace). It was believed that in some extreme cases the original event information could even be entirely erased from memory (e.g. Loftus et al., 1978). When participants were later asked about the original event, they accessed an updated memory trace version containing the false information (yield sign) instead of the original detail. Other researchers soon challenged this notion by introducing a memory interference account. It was suggested that original event information as well as misinformation details might co-exist in memory. However, retrieval of the original event memory was believed to be blocked by the retrieval of the potentially stronger and more recently received misinformation trace. Hence, misinformation was thought to merely lead to impaired accessibility of intact memory traces for an original event (Bekerian & Bowers, 1983).

Most of these previous conclusions were questioned by McCloskey and Zaragoza (1985) who claimed that misinformation has no effect on the original event memory at all. They criticized the traditional memory testing procedure in which misled and control participants were required to distinguish between original items and misinformation items in two alternative forced choice-tests. They argued that misinformation effects recorded by these means might merely present a bias effect caused by misinformation acceptance in the misled condition. In order to provide evidence for this ‘non-impairment’ view, the researchers established equal conditions for the experimental as well as control condition and excluded misinformation items at test. Instead, all participants (misinformed and non-misinformed) were asked to discriminate between originally seen and completely novel test items (e.g. excluding the yield sign and discriminating between the stop sign and an intersection sign). The researchers argued that if misinformed participants would still perform worse than the control groups on originally seen items, a guessing bias in the misled condition could be dismissed as the driving force of the misinformation effect. However, in a series of six experiments the researchers did not reveal a misled-control difference for original event accuracy by using this procedure. McCloskey and Zaragoza (1985) concluded that neither memory impairment nor impairment of access could be implied from studies to date and proposed that guessing or social demands might account for previous findings instead.

However, despite these null-effects, researchers did not entirely rule out memory impairment as partly causing the misinformation effect. Several researchers showed that under certain conditions, memory impairment might play a role in the misinformation effect. For example, Belli (1989) proposed McCloskey and Zaragozas’ (1985) modified testing procedure as not being sensitive enough to tap into memory impairment processes. In one study Belli (1989) used a yes/no recognition task (e.g. did you see a hammer in the slides – yes or no?) instead of a forced choice test (discriminating between slides depicting the original and a novel detail). Results showed that misled groups reduced the yes-responses about the original event items even when the modified testing procedure was applied (see also Tversky & Tuchin, 1989, for similar findings). Belli, Windschitl, McCarthy, and Winfrey (1992) revealed the effect with longer retention intervals between original event and final test phase but not when shorter intervals were used. Hence, several studies were able to reveal a memory impairment effect, which provided support for the validity of previous research and memory impairment hypotheses (Belli et al., 1992).

The suggestibility account

The memory impairment debate brought forward alternative interpretations for the misinformation effect. One of these accounts focused on the incorporation of misleading information into a memory report (Ceci, Crotteau Huffman, Smith, & Loftus, 1994). For instance, consider the scenario in which misinformation (e.g. yield sign) is selected in the absence of other memories because the original event information (e.g. the stop sign) was never encoded in the first place or was simply forgotten. If participants choose the misleading detail with great conviction it might be that participants created a new memory for the postevent detail that was integrated into the original event memory trace. Hence, even if no memory impairment could have occurred, it might be that participants truly misremember that a misleading detail appeared in the original event (Loftus & Hoffman, 1989) - a process that some researchers consider to be equally important (e.g. Johnson, Hashtroudi, & Lindsay, 1993; Lindsay & Johnson, 1989).

However, researchers stressed the importance of distinguishing such memory-based misinformation acceptances from test errors caused by deliberation, recency bias, or pure guessing mechanisms (e.g. Blank, 1998). For example, from a deliberation perspective, participants may indeed know or suspect that the misleading information is inconsistent with their original memories. However, participants still falsely accept the misleading information because of task compliance or because they trust the misinformation source more (Belli, 1989; Lindsay, 1990). Recency biases may occur when both the original as well as the misleading information are principally available in memory, but the misleading item is selected nonetheless because of its recency advantage over the original information. Here, participants may simply rely on decision criteria such as familiarity or retrieval fluency instead of applying more systematic decision processes about the source of the information. Importantly, compared to deliberation processes, participants do not realise at test that they report information remembered from the misinformation phase only (Blank, 1998). Last, guessing might occur when participants remember neither the event detail (e.g. stop sign) nor the misinformation detail (e.g. yield sign) and randomly select the misleading item (yield sign) at test (Loftus & Hoffman, 1989).

In regard to these concerns, several studies provide reason to believe that misinformation acceptances are more than caused just by deliberation and biases. For instance, researchers demonstrated misinformation false alarms associated with high degrees of confidence, something that would not be expected from mere guessing mechanisms (Donders, Sehooler, & Loftus, 1987 in Loftus & Hoffman, 1989; Tversky & Tuchin, 1989). Furthermore, researchers demonstrated misinformation false alarms at test that were associated with fast response times, speaking against the influence of deliberation processes (Donders, Sehooler, & Loftus, 1987 in Loftus & Hoffman, 1989). Additional support comes from studies that encourage more elaborate source judgments at test by using source-monitoring tasks (see below) and post-warnings about the about the misinformation. Findings show that awareness about the misinformation does not necessarily make participants immune to the misinformation effect (e.g. Eakin, Schreiber, & Sergent-Marshall, 2003; Wyler & Oswald, 2016). Hence, although guessing, social demands, and recency effects may play a role in producing the misinformation effect, in some cases participants may genuinely believe that a misleading item was indeed encountered during the original event (Loftus & Hoffman, 1989).

The source-monitoring framework

In order to explain the misinformation acceptance phenomenon, researchers developed more integrative theories. One of these theories is the source-monitoring framework (Lindsay & Johnson, 1989) an extension of the reality-monitoring model developed by Johnson and Raye (1981). Source-monitoring refers to processes involved when mental experiences, such as thoughts, images, and feelings are attributed to reality or imagination (Lindsay, 1990). According to the framework, memory errors are the result of misattributing the source of imagined, inferred, or suggested information to the original event experience (Frenda et al., 2013). The central idea is that these source confusions arise because retrieving the content of a memory trace and its source is underpinned by two separate cognitive processes. When information is retrieved from memory, it is believed that source information is not a fixed label attached to the memory trace. Instead, source attributions underlie separate, often non-deliberate decision-making processes in which the source is inferred from the integral qualitative characteristics of the memory trace (heuristic processing). In this rapid and non-reflective process, sources may sometimes be confused when individuals fail to access the characteristics of a memory effectively. Source decisions can be based on more extended reasoning as well (systematic processing), which may involve the search for the plausibility of an event and congruence with other beliefs (Johnson et al., 1993). However, although both heuristic and systematic processes can be integrated to produce a more accurate source judgment (Henkel & Carbuto, 2008), even conscious source deliberations may not always guarantee remembering the aspects relevant for identifying a source.

Generally, it is believed that source relevant information from an event memory fades more rapidly than memory for the content of the event. In misinformation terms the source-monitoring theory holds that at test, the misleading postevent detail is erroneously attributed to the original event because individuals confuse the sources of information either rapidly and automatically or after conscious deliberation (Johnson et al., 1993).

Researchers have suggested that the decision-making process about the source of a memory is influenced by two key variables that are in turn influenced by several other factors. One of these key variables is the extent to which a more systematic decision-making process and source deliberation are encouraged at the time of memory retrieval (Reyna & Lloyd, 1997). Although asking for participant's original event memory by means of classical recognition testing (e.g. 'what have you seen during the original event?') is in essence testing participants' source-monitoring abilities, researchers started to use more direct tests to examine the occurrence of source errors. For instance, instead of solely referring to the original event at test, researchers started to provide different source options as response alternatives (e.g. 'seen in original slide show only, misleading narrative only, or both event phases'?). Findings across these studies showed that such measures usually reduce and sometimes even eliminate the occurrence of source errors (e.g. Lindsay & Johnson, 1989; Zaragoza & Lane, 1994). The model explains these test differences by highlighting different judgment criteria applied in classical recognition and source-monitoring tasks. Thus, recognition tasks are thought to trigger more rapid and familiarity-based judgments in which source decisions are made in a rather non-deliberate process. As a result, participants behave more liberally in stating that a familiar item was seen in the slides. Source-monitoring tests, on the other hand, may trigger a more effortful and systematic based decision-making process for familiar items (Lindsay & Johnson, 1989).

The other important variable that is likely to influence the decision-making process about the source of a memory is whether the information accessed can be used to reliably discriminate between the original event and misinformation episode. The decision-making process involves evaluating the characteristics of memories such as vividness, perceptual detail, and familiarity. For instance, compared to imagined events, memories for veridical events are believed to contain richer sensory detail and more cues about the context in which these memories were acquired. However, when mental images have similar phenomenological qualities to memories for actual experiences, distinguishing between imagined and real experiences may be a demanding task (Johnson, Suengas, Foley, & Raye, 1988). Consequently, the likelihood of source confusions is expected to vary depending on the similarity between original event and misinformation episode (Zaragoza, Lane, Ackil, & Chambers, 1997). Given that in the misinformation paradigm the original event and misinformation episode refer to the same event (the originally experienced event), in most cases there should be a substantial overlap between the two sources of information, making them objectively similar (Mitchell, Johnson, & Mather, 2003).

The source-monitoring model posits that the source deliberation and discrimination ability processes are affected by various other factors. Examples are delay, source credibility, judgment biases, and current goals (Reyna & Lloyd, 1997). Although not all of these factors can be reviewed as part of this work, some factors such as the 'When question' (i.e. the time of exposure to misinformation and final test), will be pursued in succeeding chapters. Last, it should be noted that the decision processes about the source of a memory might also interact with previously described memory impairment and misinformation acceptance mechanisms. For example, participants may be more prone to source confusions when only the misleading detail instead of both the original detail and the misleading detail are remembered (due to memory impairment or non-encoding/forgetting of the original item). On the other hand, if both details are remembered, more effortful source deliberations may reduce the occurrence of misinformation false alarms (Lindsay, 1990). Hence, in contrast to theories mentioned above, the source-monitoring framework posits that both original event and misinformation experiences may indeed remain separate and intact; however, their sources might not be accessible (Johnson et al., 1993).

Summary and alternative accounts

In sum, researchers have proposed various theories as to why misinformation is sometimes falsely attributed to the original event. These include memory impairment hypotheses, memory blocking accounts, misinformation acceptance theories caused by biases, as well as the more integrative theories such as the source-monitoring account. Although these theories have been debated heavily in the past, nowadays there is a consensus that several factors can be involved when misinformation is falsely accepted (Ayers & Reder, 1998). Researchers agree that although processes such as guessing and social demands may contribute to the misinformation effect, genuine memory impairment as well as source confusions may play a role when misleading details are falsely attributed to the original event. However, the occurrence of the misinformation effect seems to depend on key variables such as the encouragement of source deliberation at test, as well as on the similarity between original event details and misleading information. These variables can in turn be influenced by other factors such as time delays, and source credibility.

It should be noted that other theories exist that can account for the suggestibility to misinformation that, compared to the source-monitoring framework, incorporate more detailed assumptions about the processes underlying the effect (Ayers & Reder, 1998; Steffens & Mecklenbräuker, 2007). For example, Fuzzy Trace Theory (FTT; Reyna & Brainerd, 1995) draws upon the concept of dual-opponent processes. It assumes (in misinformation terms) that individuals encode and store in parallel verbatim and gist representations for both the original detail and the misinformation detail and that these traces are held independently of one another. Whereas verbatim representations refer to surface-level aspects of event details and are believed to drive accurate memories, gist representations which are of schematic nature (fuzzy traces) present the meaning or theme of the event details and are said to drive false memory production (Steffens & Mecklenbräuker, 2007). According to the theory, verbatim representations are believed to be highly susceptible to interference and to decline rapidly over time. On the other hand, gist traces are more durable (Reyna & Lloyd, 1997). Hence, in a misinformation task, participants might falsely 'recognize' the misleading detail (the yield sign) because it triggers memory for the gist of the originally seen information (traffic sign; Reyna & Titcomb 1997).

Other theories derive from spreading activation models that propose false memories to arise because of spreading activation across meaning-connected information in memory (Howe et al., 2009; Henry Otgaar et al., 2016). For example, one of these theories, the Activation Monitoring Theory (AMT; Roediger, Watson, McDermott, & Gallo, 2001), suggests the operation of two opponent processes on accurate and inaccurate memories: activation of the presented stimuli and source monitoring during testing (Steffens & Mecklenbräuker, 2007). It is assumed that at encoding, processing of a concept results in a spreading activation to corresponding but non-presented concept nodes. Thus, in misinformation terms, encoding of the original event information may already activate the related misleading item prior to its presentation in the misinformation phase. At retrieval/test, participants must then distinguish between activation resulting from originally presented items (the stop sign) and misleading items (the yield sign). In this process, source monitoring-errors may occur (Steffens & Mecklenbräuker, 2007).

Ayers and Reder (1998) developed a spreading actication model (Source of Activation Confusion model; SAC) in order to specifically explain the various findings revealed by using the misinformation paradigm (Pickrell, McDonald, Bernstein, & Loftus, 2016). Based on similar grounds as AMT, the researchers argued that a concept's strength decays over time. Thus, weaker activation of the originally experienced concept and stronger activation for more recently experienced misinformation concept may lead to misattributing the source of an activated concept and hence to source-monitoring errors (Steffens & Mecklenbräuker, 2007). In this process participants may be aware of the high activation of the misleading concept ‘yield sign’ but may be unaware of the reason that it was activated (Pickrell et al., 2016). Another theory, the Associative-Activation Theory (AAT; Howe et al., 2009), is partly based on AMT (Otgaar, Peters, & Howe, 2012). However, although the model shares the underlying spreading activation assumptions of AMT, contrary to AMT (and also FTT), the model can be considered as a single process theory that focuses on false memory production through immediate and automatic spreading activation processes at encoding rather than at retrieval (Howe et al., 2009; Otgaar, Howe, Peters, Sauerland, & Raymaekers, 2013). Hence the theory predicts misinformation false memories to occur because the concept of the misleading detail was activated during the original event and reinstated at the time of misinformation presentation.

Generally, spreading activation theories and also FTT are more established in the area of spontaneously generated false memories (e.g. elicited in the DRM paradigm) and are less commonly used to describe false memories elicited in the misinformation paradigm (Ayers & Reder, 1998; but see Otgaar et al., 2016; Reyna, 2000). However, under certain conditions the theories may provide explanation for the misinformation false memories. For example, when false information is not actively suggested but merely retroactively presented and if this false information preserves the meaning of originally presented stimuli (Otgaar et al., 2016). Similar to the source-monitoring framework, FFT, AMT, SAC, and AAT are not constructive in nature and do not posit the impairment of original event information. For example, the same individual who accepted the misleading detail (the yield sign), based on gist reliance or spreading activation could also accept the original detail (the stop sign), based on accessing the verbatim memory trace or activation of the original concept (Ayers & Reder, 1998; Reyna, 2000).

Researchers have debated which of the above mentioned theories can better explain false memories in general (e.g. Steffens & Mecklenbräuker, 2007) and whether the source-monitoring account, AAT/AMT, or FFT, is more suitable to explain the empirical findings in the misinformation paradigm (e.g. Lindsay & Johnson, 2000; Reyna, 2000; Reyna & Lloyd, 1997). Generally, this research does not posit that one theory is better than the other in explaining the misinformation effect and where possible, empirical findings will be interpreted from a variety of angles. However, due to its prevalence in the misinformation literature most findings will be explained in the light of the source-monitoring framework as well as the earlier proposed theories (memory impairment and suggestibility accounts).

Doctored photographs as suggestive postevent misinformation

Although researchers have traditionally used false narratives to implant information, several studies exist that have used suggestive images. For example, Schacter et al. (1997) examined the effects of interpolated photographs on participant's memory for a previously seen videotape. They found that older participants were particularly prone to falsely attributing the new photo scenes (i.e. the additive misinformation) to the earlier watched videotape even when they were explicitly warned that some of the photo scenes were new. Although the researchers found this effect only for older but not younger adults, their findings provided the first evidence that suggestive postevent photos could lead to memory distortions (see Experiment 4 for a more detailed discussion about the age related differences in source-monitoring abilities). Later studies specifically examined the effects of doctored images on participants' memories. For example Wade et al. (2002) exposed participants to a manipulated childhood photo depicting participants on a hot air balloon ride when in fact participants had never experienced such an event. After several interviews about the false event including imagination-based tasks, a substantial number of participants (50%) falsely recalled autobiographical experiences of the suggested event. Hence, the researchers showed that doctored images could lead to implanting entirely fictitious autobiographical childhood events (see also Garry & Wade, 2005). As demonstrated earlier, manipulated images have also been found to effectively induce false memories when participants were misled on more recent experiences (Nash & Wade, 2008; Nash, et al., 2009).

Although false memory rates elicited by photographs have not always been higher compared to false memory rates elicited in false narrative studies (see Garry & Wade, 2005), judging from previous research it seems reasonable to conclude that photographs are perceived as compelling evidence that a depicted event really occurred. But what are the mechanisms responsible for these effects? From a source-monitoring perspective researchers proposed that heuristic as well as more systematic judgments contribute to this phenomenon. For instance, regarding the latter factor, it is generally believed that relatively plausible events are more likely to be falsely remembered and than relatively implausible events. This assumption is based on false narrative studies that were not always successful in implanting less plausible events (Hyman & Loftus, 1998; but see Otgaar, Candel, Merckelbach, & Wade, 2009). For example Pezdek et al. (1997) were not able to implant the false memory that participants had received an enema as a child. However, research has also shown that information from a presumably credible source can influence the perceived plausibility of misleading information (Mazzoni, Loftus, & Kirsch, 2001). In this regard, photographs might be perceived as authoritative evidence that an event really occurred and as a result doctored images may skew participants' plausibility judgments (Otgaar, Candel, Merckelbach, & Wade, 2009; Wade et al., 2002).

Regarding more heuristic judgements, researchers argued that photographs can provide a 'cognitive springboard' to generate thoughts, feelings, and images in association with the suggested event. As a result, the pictorially suggested event and actually experienced events may contain enough similar features in order for participants to claim that the suggested event is remembered (Wade et al., 2002). It follows that viewing doctored photographs can lead to source misattributions when the source of the mnemonic experience is misremembered. For instance, the vivid representation produced by being exposed to an image may not be remembered as having been a photograph but falsely remembered as having been one's actual and original experience of an event (Henkel & Carbuto, 2008).

The more recent study by Nash et al. (2009) specifically examined the question of why doctored images lead to source misattributions for suggested events. In their study, the researchers filmed participants while they were observing and copying simple actions performed by a researcher. After two days, participants saw a doctored video about the events in which some additional actions were included that were neither observed nor performed originally. In a between-participant design, participants saw the misleading video in such as way that it either depicted the participant and the researcher, the researcher only, or a stranger performing the actions. In a final memory and belief questionnaire participants were tested for old, misleading, as well as entirely new control actions. In line with the researchers' predictions, the first important finding was that participants in all three video conditions rated the misleading actions higher on the memory and belief scales than the control actions. Hence, data provided evidence that the doctored videos led to memory and belief distortions, an effect the researchers named the 'doctored-evidence effect'. Because the effect occurred independently of how misinformation was presented (i.e. who appeared in the photos), the researchers concluded that familiarity processes might be one driving force for these distortions. The explanation proposed suggests that the rush of familiarity typically associated with veridical memories, might have cause source-misattributions when the same feelings of familiarity were experienced for the suggested events. More specifically, when the suggested image came to mind and was accompanied by a rush of familiarity, it is possible that the image was misattributed to genuine recollection. The second important finding of that study was that memory distortions were stronger when participants were misled by a video depicting the researcher and themselves, compared to when the researcher only, or a stranger had presented the new actions. Hence, seeing oneself in the videos when the new actions were performed seemed to be perceived as more evidential that these actions were indeed originally performed. The researchers concluded that credibility might be a second factor contributing to memory distortions caused by images and that this credibility might led participants to lower their source-monitoring criteria when judgements were made (Nash, et al., 2009; see also Mazzoni & Kirsch, 2002).

In sum, several studies provide evidence that photographs are a powerful tool to implant misleading information. These effects have been shown in a variety of settings such as by using interpolated photographs that misled on more manufactured original experience, but also by using doctored images that implanted entire childhood memories, or that misled on self-experienced events. These phenomena can be explained by applying the source-monitoring framework that suggests several cognitive mechanisms potentially responsible for the 'doctored-evidence' effect (Nash et al., 2009). For example, Nash et al. (2009) provided evidence that doctored images may create an illusion of familiarity and also increase the perceived credibility of misleading information that may subsequently lead to an increase in source-confusions.

Experiments in this thesis

So far, I have presented the motivation for this research, defined the false memory term, and discussed the original misinformation paradigm including the nature of the misinformation effect. In addition, the possible underlying mechanisms of the 'doctored evidence effect' were discussed. Returning to retroactive product replacement, recall the main research questions of this thesis. The first was whether retroactively replaced brands in personal photographs affect memories for previously experienced brands. Following from this, the second question addressed later in this project centred on the consequences of false brand memories. More specifically, if we form false memories about brand experiences, do these memory errors have any attitudinal (affecting brand preference) or behavioural (affecting brand purchasing) effects downstream? In order to provide answers to these questions, five experiments were carried out. These five experiments included four misinformation studies (Experiment 1, 3, 4 and 5) as well as one brand norming study (Experiment 2). Whereas all four misinformation studies examined the effects of retroactively replaced brands in photographs on participants' original brand memories, Experiment 5, went one step further and looked at the attitudinal and behavioural consequences of false brand memories. Data collected in Experiment 2, the brand norming study, served to provide a pool of normed brands that could be used for stimuli selection in Experiments 3-5 and to gather information about the role of brand awareness factors in the misinformation effect.

Commonalities and differences between misinformation experiments

Methods. All misinformation experiments reported in this thesis had in common that they used a modified version of the misinformation paradigm in which participants were misled via doctored photographs on an original brand experience. More specifically, in all experiments, participants were exposed to brand stimuli during an original event, received contradicting brand misinformation embedded in a doctored photo at a later stage, and subsequently completed a final surprise memory test for the original event. However, the original event (i.e. how brands were originally experienced), the degree of personalization of study stimuli (in both original event as well as misinformation phase), as well as participant's awareness about the brand nature of the tasks differed across experiments.

Similar to the traditional misinformation paradigm procedure, Experiments 1 and 3 examined the effect of retroactive brand replacements in a manufactured and rather impersonalized setting. More specifically, the original event and misinformation phase were experienced as photographs that included brand placements and that were embedded into a fictitious Facebook account. It was not mentioned to participants that the brands appearing in the photos were of interest for the experiment. These methods were chosen because first, Experiments 1 and 3 served as proof of concept studies in which impersonalized study materials reduced the complexity of these studies. Second, the studies specifically aimed to examine a brand misinformation effect in a typical 'product placement setting' that would be comparable to integrated brand placements in movies and game shows. The results of these studies would not only provide information about how brands in photographs would be generally remembered but also whether a reliable misinformation effect could be replicated in an incidental learning task focusing on brand placement. Hence, the 'product placement nature' of study materials was the focus in these studies.

In contrast, Experiments 4 and 5 examined the effects of retroactive brand replacements in settings in which in which participants were misled on actual pasts with brands (brands were rated in Experiment 4 and even personally selected in Experiment 5). In addition, the photographs that were used to mislead participants during the misinformation phase were photos taken during the study and even depicted participants themselves in Experiment 5. Hence participants were tested in more personalized settings in these studies. Another important difference between

Experiments 1 and 3 and Experiments 4 and 5 is that participant's attention was directed to the brands in the latter studies. More precisely, although the tasks were incidental in these Experiments as well (i.e. participants were not aware that their memory for the brands would be tested at a later stage) brands were consciously experienced during the experimental stages of the task. Hence, in these studies it was not the product placement question that was in focus but rather how a brand misinformation effect would develop under more personalized circumstances.

Some of the misinformation studies examined the effects of additional study manipulations on memory performance in the misinformation paradigm that will be specified in the respective chapters. For instance, Experiment 1 examined the effects of a delay between misinformation phase and final memory test and included a font at test manipulation (i.e. at test, stimuli were either shown as the brand's correct logo or in normal text font). Experiment 3 examined a time delay between original event phase and misinformation phase. Furthermore, the experiment measured an additional variable, which was visual fixation duration on the brands using eye-tracking technology. Last, Experiment 4 examined the effects of age in the misinformation effects and tested younger as well as older participants.

Designs and final memory tests. Besides experiment-specific wordings, the format of the final memory tests was identical for all misinformation studies. Participants were first administered a recognition test for the original event in which they were tested for original items (originally experienced brands), misleading items (contradicting brands in the photos that only appeared during the misinformation phase), as well as on non-presented but related foil items. Rather than including a non-misled control condition in a between-participants design, our studies applied a within design in which participants were misled on some original items (misled item condition) but not on others (control item condition). The latter items served as baselines (this will be specified in later chapters). Whereas some researchers use forced-choice recognition tests to analyse the uptake of misinformation (e.g. Okado & Stark, 2005), we[1] used yes/no recognition tests similar to Underwood and Pezdek (1998), in which each of the three item types (the original, the misleading, and the foil item) were tested separately (see also Frost, Ingraham, & Wilson, 2002; Tversky & Tuchin, 1989). Researchers acknowledge that both procedures are valuable, but that they each pose different demands on participants (Wright & Loftus, 1998). The forced-choice procedure suggests that only one response alternative is true. In contrast, the yes/no method suggests that all alternatives, neither, or either could be correct, a method that has shown to be more sensitive to tap memory processes elicited in the misinformation paradigm (e.g. Belli, 1989; Tversky & Tuchin, 1989).

In order to record more information about the characteristics of participants' yes-responses from the recognition test, yes-responses were accompanied by Remember, Know, and Guess judgments. This measure (originally Remember/Know paradigm; Tulving, 1985) was included in order to capture the distinct psychological experiences that accompanied participants' memory performance. In this context, remembering is defined as the true state of conscious recollection in which details are perceived as more vivid and with more sensory detail, possibly because these memories are re-experienced at retrieval. Knowing, on the other hand, is defined as a feeling of familiarity that arises in the absence of recollection. It occurs when participants believe that an item appeared during the original event but they do not explicitly remember its presence (Tulving, 1985). We added a 'Guess' option to

[1] Using the plural form 'we' in this thesis is merely stylistic and refers to the candidate solely in most cases. One exception can be found in Chapter 7 (Experiment 5), a publication based chapter, in which other researchers contributed to approximately 20 per cent of the published manuscript.

separate responses based on familiarity processes from simple guess responses (e.g. Dewhurst & Anderson, 1999). Generally, only a few studies have used the Remember/Know paradigm in the standard misinformation paradigm (but see Frost, 2000; Holmes & Weaver, 2010; Roediger et al., 1996) and most studies have used false narratives to implant misleading information. Findings across these false narrative studies suggest a trend that misinformation false memories for contradicting misinformation (as supposed to additive misinformation) are associated with higher scores of know compared to remember responses. Because veridical memories have shown the reversed pattern (in short delay conditions between the experimental stages), findings suggest that misinformation false memories are perceived as having different subjective qualities compared to veridical memories (Frost, 2000). However, how will these effects develop in a paradigm that uses photographs to mislead on original information?

Similar to previous research (Okado & Stark, 2005; Zhu et al., 2012; Zhu, Chen, Loftus, Lin, He, Li, Moyzis, et al., 2010; Zhu, Chen, Loftus, Lin, He, Li, Xue, et al., 2010) participants' yes-responses from the recognition test were then followed up in a source-monitoring task. In this test participants were asked to reconsider the sources of their recognition test answers by offering participants several source options. This approach was chosen to complement potentially more rapid and familiarity-based judgments in the recognition test (heuristic source judgments) with a measure of participant's more effortful and systematic based decision-making process for familiar items. Hence, the recognition task was used as a more liberal measure and the source-monitoring task as a more conservative measure to analyse the uptake of misinformation. The source options provided at test were chosen in line with Okado and Stark (2005). In comparison to earlier studies, which typically provided the following four options for an answer: original event only, postevent information only, both, and neither (e.g. Lindsay & Johnson, 1989), Okado and Stark (2005) replaced the ‘neither’ option with a ‘guessed’ option and added an additional ‘items conflicted across phases’ choice. A guess option is important as participants may simply guess even when provided with concrete source options at test. For instance, participants may be unsure about the actual source of remembered information and feel obliged to commit to an option if ‘guessing’ is not allowed (Blank, 1998). Similarly, the ‘conflicted’ optioned provides an escape in cases in which a conflict across phases is noticed, but in which exact source-attributions are not possible.

Main predictions

In line with previous research we expected that participants in all misinformation studies would be misled by the retroactively replaced brands in the photographs. We predicted that participants would create source confusions and falsely attribute the misleading brands from the photos to the original brand experience. In addition, we believed that the participant’s original brand placement memory would be impaired as a result of the manipulation and hence, lower hit rates for originally experienced brands would be obtained in the misled relative to the control item condition. We expected to see these trends for participants’ overall memory performance in the recognition test as well as potentially in their more refined memory performance measured as remember responses and source-monitoring judgements. In Experiment 5, we expected that participants’ false memories for the misleading brands would be associated with attitudinal and behavioural consequences for the falsely remembered brands.

Chapter 3: Experiment 1 - A proof of concept study - the effects of retroactive product replacement on placement memory

Experiment 1 - A proof of concept study - the effects of retroactive product replacement on placement memory

As demonstrated in previous chapters, numerous studies exist that support the likely effectiveness of retroactive product replacement. Hundreds of studies provide evidence to suggest that presenting contradictory misinformation can affect memory reports of a previously experienced event (Belli, Lindsay, Gales, & McCarthy, 1994; Loftus, 1977). Indeed, we have seen this effect in the world of consumer behaviour and advertising. However, studies directly challenging an original brand experience by suggesting a direct competitor brand (i.e. that specifically examine the occurrence of a 'brand misinformation effect') are rare (but see Belli, 1989; Holmes & Weaver, 2010). We have also reviewed studies that show the effectiveness of manipulated images to implant misleading information (Nash & Wade, 2008; Wade et al., 2002). However, to our knowledge, in advertising, doctored photographs have not yet been used to suggest false brand information.

Experiment 1 was carried out to address these gaps and to examine for the first time whether retroactively changed brands embedded in photographs have the potential to create a reliable 'brand misinformation effect'. To address this question we used a modified version of the misinformation paradigm in which we misled participants via manipulated photographs on brand placements that had been experienced during a previous encounter with these photographs. More specifically, participants were unknowingly exposed to misleading brand information by watching what they believed were the same photographs depicting the same events. However, some of the original brand placements within each photograph were replaced by a competitor brand the second time. Because the experimental design aimed to reflect a situation in which a social network user browses a person's Facebook photos twice and is incidentally exposed to original and misleading brand placements in this process, we did not use the classical misinformation paradigm procedure. That is instead of having the original event phase presented in pictorial form and the misinformation phase as a written narrative, both phases were presented pictorially.

Although not used as often, similar techniques have been employed before and do elicit reliable misinformation effects (Manning & Loftus, 1996; Okado & Stark, 2005). For example, in the study by Okado and Stark (2005), participants were exposed to eight vignettes that depicted a crime scene (original event phase). In these slides, 12 critical event details were manipulated when participants viewed the vignettes a second time (misinformation phase). Two days later, participants took a three-alternative forced-choice recognition test for the original event exposure, in which participants had to discriminate between original event items, misleading items, as well as foil items. Following the recognition test, a source-monitoring test was completed that required participants to indicate which source the recognition test answers were remembered: (1) saw in the first set of presentations, (2) saw in the second set of presentations, (3) saw in both sets of presentations, (4) items conflicted between original event and misinformation stage, and (5) guessed. Results showed that in the recognition test about 30% of the misleading items were falsely attributed to the original exposure to the vignettes. Of these, about 50% of the items were robustly endorsed in the subsequent source-monitoring task (i.e. options (1) or (3) were chosen).

Although we did not expect any extreme deviations from previous findings, several study-specific factors might influence our results. The first factor was the exclusive use of brand items as study stimuli. As demonstrated in previous chapters, previous misinformation studies have found reliable misinformation effects by partially (e.g. Belli, 1989) or entirely (Holmes & Weaver, 2010) using brand stimuli in the conventional misinformation procedure (i.e. in a procedure using the standard three step paradigm in which misinformation is presented in narrative form). However, studies exist that provide reasons to assume that the use of brand specific stimuli can lead to unusual results in established false memory paradigms. For example, Sherman and Moran (2011) examined false memories for non-presented brand names in the DRM paradigm. Here, participants were presented with lists of associated brand names and were subsequently confronted with a memory test for presented as well as non-presented brands. Consistent with previous research, the study produced a high and reliable false alarm rate for the obvious missing critical lure brand (e.g. for the non-presented brand TESCO, when the brands Morrisons, Sainsbury's, Asda, Waitrose, Somerfield, Aldi, Safeway, Co-op, Iceland and Lidl had appeared in a list). However, unlike previous studies, data also revealed an unusually high false alarm rate for weakly related, non-presented control brands (see also Sherman, 2013). This finding suggests that false memories for brands were not only 'reserved' for the obvious lure brand but that they also occurred for more loosely associated brands, although at a lower rates. The explanation proposed suggests that there might be strong semantic connections between brands of a category considering that brands often occur in their competitive environment (e.g. in the same supermarket shelves; Sherman & Moran, 2011).

The second factor is the peripheral product placement nature of our stimuli (i.e. the typically subtle nature in which brand placements are integrated into scenes). In this regard, it is well established that the encoding conditions of target items can influence the occurrence or strength of misinformation specific memory processes (Belli et al., 1992). For example, studies that have used one version or the other of

McCloskey and Zaragozas' (1985) 'crime scene slides', in which target items were presented in a rather peripheral manner (e.g. a mug on a cluttered desk), have typically achieved hit rates for original slide items of about 36% to 46% (for original items on which participants were misled on). In contrast, Belli et al., (1992) achieved hit rates of 67% for details that were centrally placed into the slides. Another study specifically investigated the effects of centrally versus peripherally presented target items in the misinformation paradigm (Wright & Stroud, 1998). The researchers did not only obtain lower hit rates for more subtly depicted items but they also showed that the peripheral stimuli were associated with higher false alarm rates for the misleading information compared to more centrally placed items.

Another area of research that is informative in this context can be found in the area of marketing. Here, studies on product placement effectiveness exist that have focused on the question of how a product, once embedded in a scene, has an influence on brand memory. Results have been somewhat inconclusive, most likely because of a number of factors that influence memory for brands placed in movies or game scenes (La Ferle & Edwards, 2006; Law & Braun, 2000). These factors include exposure time (Brennan et al., 1999), placement prominence (Gupta & Lord, 1998; Lee & Faber, 2007), placement modality (visual or verbal reference) (Russell, 2002), the degree of brand integration in a scene (Yang et al., 2006), as well as whether a placement is referred to by a leading character or not (d'Astous & Chartier, 2000). Nevertheless, findings across these studies point to the fact that brands placed in movies, TV shows, and computer games can have an influence on consumers' explicit and implicit memory (e.g. Brennan et al., 1999; d'Astous & Chartier, 2000; Gupta & Lord, 1998; Lee & Faber, 2007; Russell, 2002; Yang et al., 2006; Yang & Roskos-Ewoldsen, 2007). However, research that examines false memories in the context of brand placements is rare. In one study dealing with implicit and explicit memory for brand names in computer games, Yang et al. (2006) measured false alarm rates for non-presented product placements as part of an incidental learning task. In the study, participants were asked to play a computer game that included product placements. In a subsequent recognition test that was administered after a short delay, participants correctly recognized about 47% of the presented product placements. However, about 29% of the non-presented competitor brands were falsely recognized.

Returning to retroactive product placements in photographs, it is important to know if consumers encode brand stimuli in snapshot photographs depicting everyday life scenes in the first place - a factor important for further false memory production. Watching photos may differ from watching movies, playing video games or slide shows depicting a crime scene. For example, rather than focusing on a storyline or a concrete task at hand, photographs often enable individuals to indulge in reminiscence or to build impressions. Here, the snapshot nature of photos might potentially let individuals pay more attention to details in order to extract information from the photo. However, in other ways watching photos may be similar to these other media. When watching photographs, analogous to movies, games, or slide shows, the characters, the storyline/occasion of the picture, as well as locations are in focus rather than the surrounding details. As a result, the likelihood of encoding and remembering brand information from these media may be comparable. Research has yet to examine if and how the encoding of retroactive brand placements in every day live photographs will influence the outcome of participants' true and false memories created in the misinformation paradigm.

It is well established that the strength of the misinformation effect depends on the retention intervals between the experimental stages of the misinformation paradigm. For instance, the results of several studies suggest that the effect of misleading information is stronger with longer retention intervals between the misinformation phase and the final memory test (Frost et al., 2002; Underwood & Pezdek, 1998). An important role in this context may be the perceived similarity between the memory details for misinformation items and the original items. Whereas over a short passage of time it may be more obvious that memory for (often verbally provided) misinformation does not have the perceptual features of the (often pictorially experienced) original detail, with longer retention intervals, this association may fade. Consequently the original detail may be perceived as more comparable to the misinformation detail (Frost et al., 2002).

Such time manipulations have been shown to influence phenomenological experience (Remember/Know judgements) of false memory retrieval in the misinformation paradigm as well. For example, Roediger et al. (1996) exposed participants to a slide show depicting a crime scene. Subsequently, participants read a narrative containing contradicting misinformation. In a recall test that was carried out two days later, misleading information was more likely to be judged as known than remembered. By using the same paradigm but administering the final recall test either immediately or one week after, Frost (2000) revealed similar findings. Here, contradictory misinformation was associated with higher scores of know responses compared to remember responses in both the immediate as well as the delay condition. For original items, on which participants were misled, remember judgments exceeded know judgments in the immediate condition. However, this was not true for the one-week delay condition. Here, the proportion of remember judgments decreased with longer retention intervals and both remember and know judgments were made equally often (see also Roediger et al., 1996). The explanation proposed suggested that the verbally presented misleading information does contain fewer episodic and perceptual details than does memory for the pictorially presented original event. Hence, know judgments exceed the remember judgments for the misleading details. Original items on the other hand, may lose some of their episodic and perceptual details over time. As a result, the amount of remember judgments decreases.

Although previous research examined the effects of longer time delays such as 48 hours or 1-week between the misinformation phase and the final test, we opted for an immediate and a 1-day delay condition. The delay condition would not only offer an ecologically valid interval between exposure to misleading information and subsequent memory retrieval, but it would also allow us to investigate whether proportions of Remember, Know, and Guess judgements would be affected after a shorter time delay. However, we did not include any predictions regarding the effect of time delay on memory performance. The reasoning here is that many theoretical explanations are based on the different modalities of the pictorial original event detail and the verbally presented misinformation detail (i.e. differences in perceived similarity between the critical details). The pictorial modality of both stages of our paradigm might reveal a different outcome because the amount of perceptual details might be very similar from the outset.

Previous research has examined the effects of font manipulations on true and false memories by using list-learning paradigms. Here, the so called ‘picture-superiority effect’ is well established with better memory for items that were presented in pictorial form compared to items that were presented in simple font

(Israel & Schacter, 1997). Researchers have also found that participants' false memory production can be affected in this context. For example, Israel and Schacter (1997) manipulated the study font at encoding as well as the type of font at test in the DRM paradigm. Participants were first exposed to lists of semantic associates in auditory form. Whereas these auditory words were accompanied by matching pictures in one condition, in another condition they were accompanied by a written version of that word. In the final memory task, test items were either presented in both auditory and pictorial formats or solely in auditory form. Results revealed that reinstating the visual information at test not only led to an increase in hits for the list items but it also led to a reduction of false alarms for the missing critical lure item. Hence, the study suggests that visually reinstating the study stimuli at test is relevant when making true as well as false recognition judgments (see also Schacter, Israel, & Racine, 1999). Schacter et al. (1999) argued that these effects are likely to reflect distinctiveness heuristic processes. More specifically, because participants in the pictorial testing condition were provided with more distinctive cues, they may have demanded more detailed recollections to support a yes-response on the recognition test.

One study exists that has examined the effect of a brand font manipulation on memory in the DRM paradigm. Sherman and Moran (2011) exposed participants to lists of associated brands in either brand-specific logo form or simple Times New Roman font. The font type of items in a subsequent Remember, Know, Guess recognition test were then either reinstated or not. Results showed that only participant's remember responses were affected in this design. Here, seeing the brand logos at encoding led to an overall increase in remember responses for all items types. However, and more importantly for our study, the font manipulation at test only led to an increase in remember responses for original list items and the manipulation had little effect on participants' false recognition of non-presented items. The explanation proposed suggests that it might have been participants' familiarity with seeing pairings of fonts and brand names (due to everyday exposure) that might have produced this null effect.

So how would these effects develop for misleading brands in the misinformation paradigm? The nature of our study required brand insertions in their brand-specific font because text placements in photographs would have been problematic and somewhat against the purpose of this study. Hence, we only manipulated font type at test. Because we used an incidental brand learning task, we were specifically interested to see whether brand-specific font at test, and hence the visual reinstatement of brand icons, would aid participants' true brand placement memories. In addition, we wanted to examine how these effects would develop for externally generated false memories created in the misinformation paradigm compared to non-presented, related items.

With these ideas in mind this proof of concept study examined for the first time whether retroactively replaced brands in photographs could change memories for originally seen brand placements. We invited participants to the lab under the auspices of examining how individuals process information when they are looking over a Facebook account of another Facebook user. Facebook was chosen for this research because of the large number of active users and the high familiarity with the platform among younger adults. We first exposed participants to photographs embedded into a fictitious Facebook account. Each photograph contained theme specific brand placements. Half of these brands were replaced by a competitor brand when participants saw the pictures a second time. Either immediately or after a delay of one day, participants completed a recognition test followed by a source-monitoring task in which test items were either seen in pictorial form or simple font.

It was predicted that participants would create source confusions and falsely attribute the misleading brands to the original photo exposure. In addition, we believed that that participant's original brand placement memory would be impaired as a result of the manipulation and hence, there should be lower hit rates for originally seen brands in the misled relative to the control item condition. We expected to see these trends in participants' overall recognition scores, as well as in their remember responses and more refined 'robust' memory performance in the source-monitoring task. We did not make any concrete predictions concerning how the time delay and font at test manipulations would influence these effects.

Method and Measurement

Participants

Sixty students and staff members aged 18 – 38 (*M* = 25.12 years, *SD* = 5.2; 30% male) of City, University of London participated in the experiment for course credit or remuneration.

Stimuli

Brand selection. To select the brand stimuli for this study we first identified a range of brand categories that would be relevant for our target sample 'University students and staff in early adulthood' (e.g. product categories typically found in University supermarkets or categories in the consumer electronic sector relevant for this age group). To reduce the occurrence of semantic intrusions in the study (e.g. that the exposure to one brand would trigger memories for a related brand where not wanted) we did our best to choose brand categories that were differentiated thematically. Next, we listed relevant brands belonging to these categories by using

UK relevant online resources. For example, we entered the term ‘fizzy drink’ into the ASDA UK grocery online shop website and added all relevant brands of that category. Crosschecks with other Internet sites (e.g. Tesco.co.uk) were used to assure that all relevant brands of a category were identified. We then searched for the three most popular brands for each category that were likely to present the brand leaders of their category. To do this, we used the search engine Google and the amount of ‘Google results’ that were counted by the tool when a brand name was entered. By restricting search results to UK registered websites, the three brands with the highest amount of hits/results per category were selected. We considered the number of times a brand appeared on the web to be a good proxy for its position in the market and hence, consumer awareness of these brands. In the end, we included the three most popular brands of 24 product categories as actual study stimuli (the specific brand categories and brands used in this study can be found in Appendix A). We confirmed that all brands were either internationally known or advertised in the UK.

Study stimuli. To present the brand stimuli to participants we created a fictitious Facebook account in the form of a screenshot-presentation in offline-mode. The account was a typical Facebook timeline showing the basic information about a male City, University of London student in his twenties. Twelve pictures were embedded into the Facebook account showing the account owner and/or groups of friends in different social situations (e.g. friends having a picnic).[2] Photos were mainly selected based on their ability to thematically ‘host’ brand placements of the chosen brand categories. Two out of 24 brand categories were assigned to each of the 12 photos (e.g. a chips brand and grocery shop brand in the picnic scene). It should be

[2] The content for the fictitious Facebook account including all photos were obtained from different Facebook account owners (e.g. family members or friends of the researcher) who all provided full consent that the photos could be used for this study.

noted that some brands from our brand selection process described earlier had to be omitted in this process. For example, some brands were not suitable as product placement because their brand font was too small to be recognizable in a picture. In these cases, the next brand in line was chosen. Next, three versions of each photo were created that embedded one of the three chosen brand examples of a brand category (e.g. one of the chips brands: Doritos, Kettle, or Walkers and one of the grocery shop brands: Asda, Tesco, or Morrisons; see Appendix B for examples of these photo versions). Because each photo depicted two brands of two different brand categories, two specific brands of these categories were paired for the study (e.g. photo version 1: Doritos and Asda). In this process, we did our best to balance brand strength between the paired brands of different categories to avoid effects driven by particularly strong or weak photographs. More specifically, we paired the strongest brand, i.e. the brand with the highest amount of Google hits (potentially the brand leader of a category) with a less strong brand of another category, i.e. the brand third in line regarding the amount of Google hits. During the original event, participants were exposed to one out of three versions of each of these 12 pictures and hence, to one out of three brands for each of the 24 brand categories.

To induce misinformation, participants were later misled on one category brand per photo. More specifically, misleading information was provided for 12 out of 24 brands by replacing these items with contradicting/misleading brands during a second exposure to the pictures (misled item condition). For the remaining 12 brands that were originally shown, consistent information was provided (i.e. participants were not misled on these items – control item condition). The remaining items of a brand category that were not used in the photos served as foil items in the final memory test.[3]

Assignment of the brands to the three item types (original item, misleading item, and foil item) and to the condition (misled item condition and control item condition) was counterbalanced across participants. Further, each of the competitor brands of a category served equally often as misleading/contradicting brand during the misinformation phase. To do this this, twelve different conditions in which participants were exposed to different brand combinations (slide show combinations) were created for counterbalancing purposes. We also randomized the order in which participants were exposed to the single photos.

Procedure

Original event. Figure 1 shows the design of this study. Participants were tested individually in this study in a laboratory of City, University of London. In order to reduce the risks of demand characteristics, participants were informed that the purpose of the study was to examine how information is processed when a Facebook user looks over the Facebook account of another user. They were not told that they would later complete a memory test for brand information.

---

[3] To illustrate, consider the following scenario in the picnic scene, in which participants saw the chips brand and a grocery shop brand: Participants may have been misled on the chips brand (misled item condition). If the chips brand Doritos was seen during the first exposure to the photos (original item in the misled item condition), Kettle may have been used to mislead participants during the second exposure to the pictures (misleading item in the misled item condition). The remaining non-presented brand Walkers was used as foil item in the test (foil item in the misled item condition). Participants may have not been misled on the grocery shop brand (control item condition) and hence, the brand Asda may have appeared in a consistent manner during both exposures to the pictures (original item in the control item condition). Last, the remaining non-presented brands Tesco and Morrisons (foil items in the control item condition) were the foils in the memory test. Please note that the misleading item is not applicable in the control item condition since participants were not misled on the originally seen brand in that condition.

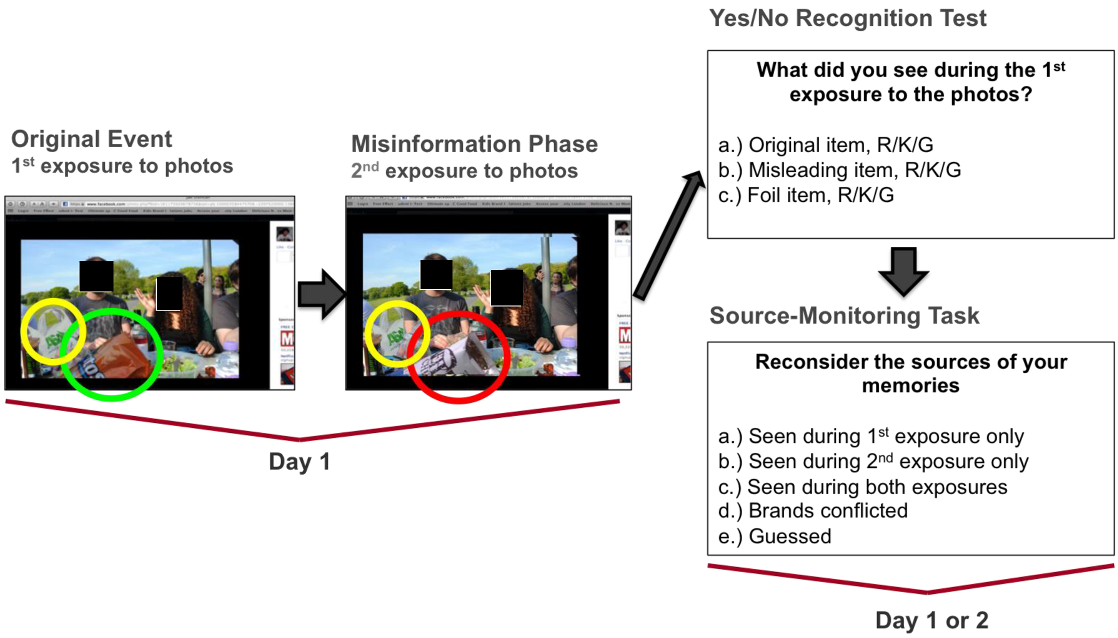


Figure 1. Study design

First, participants were shown the Facebook profile and were instructed to imagine that a fictitious acquaintance just added them as a friend on Facebook and that they should now gain their first impression by looking over the Facebook timeline of that person. Next, participants were instructed to click on ‘Photos’ and look at the personal pictures uploaded by their fictitious acquaintance. To stop participants from simply looking passively at the pictures, participants were asked to imagine that they were familiar with some of the account owner’s friends seen in the pictures. In addition, they were asked to imagine that they were part of the events shown, even if they were of course not seen in the pictures. By letting participants imagine who could have been present in the scenes, what could have been talked about, as well as where the events might have taken place, we hoped participants engaged with the scenes. Importantly, at no point was reference made to any of the brand placements. To ensure that all participants engaged for the same time period with the pictures, photos changed automatically and participants were exposed to each photo for 12 seconds.[4] After exposure to the study stimuli, participants completed some unrelated filler activities consisting of simple math tasks and logic-based number puzzles such as Sudoku for 30 minutes.

Misinformation phase. After 30 minutes, all participants were asked to look at the Facebook profile and the same photos again. The simple instruction was given that participants should indulge in reminiscence by viewing what they believed were the same photographs depicting the same events than seen earlier. This time however, participants saw the photos that were manipulated such that one brand per picture was replaced with a different brand of the same category, while the other brand did not change during the process. Each individual picture was again shown for 12 seconds. After, half of the participants were dismissed whereas the other half continued their unrelated filler activities (simple math tasks) for ten minutes.

Final memory test. The final memory tests were carried out either immediately (i.e. after a delay of ten minutes) by half of the participants (N = 30) or after 24 - 26 hours by the other half of the participants (N = 30). First, participants were given a recognition test that recorded their overall memories for the original event. Here, participants were explicitly told that the test strictly referred to the first exposure to the photographs. To further affirm this instruction, the word 'first' was underlined and typed in capital letters and red ink for each of the trials. Brand items appeared on the screen one at a time and participants were instructed to click 'yes' for brands that were seen during the first exposure to the photos and to click 'no' if they

[4] The exposure time to study stimuli in classical misinformation studies ranges from three to seven seconds per slide for long series of colour slides (about 80 slides; e.g. Ackil & Zaragoza, 1995; Belli, 1989; Frost, 2000) but has also been one minute for one single colour slide depicting an original event (e.g. Blank, 1998). For this study an exposure time of 12 seconds per slide was considered appropriate in order to let participants engage with the scenes and to provide the chance to encode the rather peripherally placed brand details without using an unnatural photo viewing behaviour.

were not. Only if ‘yes’ was clicked were participants asked to make a Remember, Know, or Guess judgment. Participants were asked to press ‘remember’ when they were able to consciously recollect and mentally relive the appearance of that item in the first presentation of the picture. They were asked to consider whether they could visually re-experience the item as well as its position in the photo. Participants were asked to press ‘know’ when the judgment was based on a feeling of familiarity, described as a sensation that the item was seen in one of the photos but could not be visually re-experienced in the setting of the picture. Finally, they were to press ‘guess’ when they could neither recollect nor recognize the item on the basis of familiarity, but if they could not definitely reject.

Following the recognition test, a final source-monitoring task was carried out to measure what is referred to as participants’ *robust* memory performance. In this test, we gave participants the chance to reconsider the presentation sources of all items endorsed during the recognition test. Five options were provided for each of the items: (1) seen during the first exposure to the pictures only, (2) seen during the second exposure to the pictures only, (3) seen during both exposures to the pictures, (4) brands conflicted across both photo exposure phases, (5) just guessed. We used this procedure in order to further affirm whether participants believed that they had seen the misleading detail during the original event (see Zhu et al., 2012). In order to reduce the risk of in-test priming effects, all brands of a category appeared in different testing blocks. The order in which brands of different categories appeared in these blocks as well as the order of block presentation was counterbalanced across participants. In all tests, half of the participants were exposed to brand stimuli in pictorial form (N = 30) whereas the other half was exposed to the brand names in a simple font (N = 30).

Measurement and analysis

The 72 items of the recognition test consisted of 24 of the original items (12 on which participants were misled and 12 on which participants were not misled), 12 misleading items that contradicted their original counterparts, and 36 non-presented foil items (including 12 foil items categorically related to the misled and 24 foil items related to the control item condition). Correct and incorrect yes-responses to these items were used to compute participant's overall memory performance (i.e. hits and false alarms of correctly or incorrectly stating that an item had appeared during the original event). Robust memory performance in the source-monitoring task consisted of the recognition test answers under stricter source-monitoring criteria. Original items in the misled item condition were coded robust true memories when option (1) 'seen during the first exposure to the pictures only' or (4) 'brands conflicted across both photo exposure phases' was correctly ticked (see options of the source-monitoring task described earlier). Original items in the control item condition were coded as robust true memories when option (3) 'seen during both exposures to the pictures' was correctly chosen. Misleading items were coded as robust false alarms when option (1) or (3) was incorrectly selected. Finally, foils in misled and control item conditions were coded as robust false memories when option (1) or (3) was falsely chosen (see Okado & Stark, 2005).

Based on previous research (e.g. Frost et al., 2002; Tversky & Tuchin, 1989) we analysed the uptake of misinformation by applying statistical tests that would first compare participants' memory performance (yes-responses to items) within the misled item condition and then across conditions (misled item vs. control item). These main analyses were carried out separately for participants' raw recognition scores, their Remember, Know, and Guess responses, as well as for their robust memory performance on the source-monitoring task. Despite multiple comparisons across conditions with different statistical tests, we decided to set an overall standard alpha level equal to .05 for our main analysis (see also Frost et al., 2002). Because our task used an implicit learning procedure with trends that were expected to be smaller than the effects usually achieved in classical misinformation studies, an alpha level of .05 seemed appropriate because a more conservative *p*-value might not have been sensitive enough to detect potential effects in our data. Several sub-analyses (such as an analysis by item) were also used to further investigate the misinformation data.

Results

Sample characteristics

Shapiro-Wilk's tests ($p > .05$) and visual inspections of histograms, normal Q-Q plots and box plots, were used to examine whether the dependent variables of this study were approximately normally distributed. Analysis showed that the dependent variable item endorsement was roughly normally distributed for Item type (original items and misleading items), Condition (misled item condition and control item condition), Stimuli test format (font and pictorial), and Time of test (immediately and 1-day delay). However, participants' foil false alarms in the misled item condition showed a skewness or kurtosis exceeding threshold values in some of the conditions (Shapiro-Wilk's tests: $ps < .05$). An inspection of the variable revealed two outlier data points for foil false alarms that contradicted the pattern found for all other participants. Thus, we decided to remove these data from the analyses.[5] The

---

[5] We used the outlier-labelling rule to identify the outliers in the variable (Tukey, 1977). The formula utilized the third and first quartile and a multiplier of 1.5 to determine upper and lower boundaries for potential outliers. This resulted in the elimination of two data points that exceeded the upper boundary of .68 (data points of two participants). This reduced the immediate test/font condition by two participants

elimination of these two participants transformed foil false alarm scores to be roughly normally distributed in most of the conditions. Further, neither participant's age nor gender had any effect on the dependent variables of this study. Hence, these variables were not included in the following analyses.

Recognition test data

Raw score analysis. Table 1 shows the proportion of yes-responses for the three item types (original details, misleading details, and foil details) correctly and incorrectly accepted as being part of the original event as a function of condition (i.e. whether participants were or were not misled on an item; a table showing the proportion yes-responses as a function of Time of Test and Stimuli test format can be found in Appendix C).

First, we compared participants' overall yes-responses to the three item types in the misled item condition. Here, we were interested in whether participants could differentiate between originally seen items and originally non-seen items (misleading details and the foils) and between the misleading details and the non-presented foil items. In addition, we were interested to see whether Time of test and Stimuli test format had any effect on participants' yes-responses. We ran a 3(Item type: original item vs. misleading item vs. foil item) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA. Analysis yielded a significant main effect of Item type, $F(2, 108) = 20.13$, $p < .001$, $\eta_p^2 = .27$. Bonferroni pairwise comparisons showed that participants correctly accepted more

---

leaving N = 13 participants in this condition. The amount of participants in all other conditions remained N = 15. It should also be noted that none of the effects reported in this section were crucially affected by this intervention but due to the unusual behaviour of these participants and for reasons of 'normality assumption' data points were excluded from analysis.

original items (*M* = .44, *SD* = .19) than they falsely accepted misleading items (*M* = .33, *SD* = .21; *p* = .018) and the related foil items (*M* = .24, *SD* = .17, *p* < .001). In addition, misleading items were more often falsely accepted than the foil items (*p* = .004). There were no other significant main effects or interactions (all *p*s > .05; see Appendix D for all test statistics).[6]

Table 1. Mean proportion (SE) of yes-responses with proportion of Remember, Know, and Guess responses for each item type as a function of condition.

		Item type		
Condition	Response type	*Original items (hits)*	*Misleading items (false alarms)*	*Foil items (false alarms)*
Misled item	**Total**	**.44 (.03)**	**.33 (.03)**	**.24 (.02)**
	Remember	.27 (.03)	.16 (.02)	.09 (.01)
	Know	.11 (.01)	.11 (.02)	.08 (.01)
	Guess	.07 (.01)	.06 (.01)	.06 (.01)
Control item	**Total**	**.55 (.02)**	**n.a.**	**.21 (.02)**
	Remember	.36 (.03)	n.a.	.07 (.01)
	Know	.13 (.02)	n.a.	.08 (.01)
	Guess	.07 (.01)	n.a.	.06 (.01)

Notes. In the misled item condition Original items were items seen in the first exposure to the photos that were contradicted by Misleading items in the second exposure to the photos. Foil items were the non-presented but categorically related items. In the control item condition, Original items were shown in a consistent manner during both event phases. Foil items were the non-presented but categorically related items. *Misleading items are not applicable to the control item condition because participants were not misinformed on the original items in this condition. Overall memory performance in bold font. Any anomalies in adding up are due to rounding errors.

[6] In participants' raw recognition scores as well as source-monitoring task performance, the factors Time of test as well as Stimuli test format produced null-effects with high *p*-values and small effect sizes. To reduce the complexity of the results section, test statistics of non-significant main effects and interactions of our main analysis was not reported in the results section but can be found in Appendix D.

For further comparison we examined participants' yes-responses to the item types across condition and conducted 2(Condition: misled item vs. control item) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVAs separately for the original-, the misleading-, and the foil details. For original items, there was a significant main effect of Condition, $F(1, 54) = 19.11$, $p < .001$, $\eta_p^2 = .26$, showing that participants correctly accepted more original details in the control item condition ($M = .55$, $SD = .18$) relative to the misled item condition. Misleading details (in the misled item condition) were compared to foil responses in the control item condition. This was done because foil items in the control item condition referred to a detail that was similar in nature to misleading items in the misled item condition and thus, retrieval of these items served as an additional baseline. Here, analyses revealed a significant main effect of Condition, $F(1, 54) = 25.40$, $p < .001$, $\eta_p^2 = .32$, with more false acceptances of misleading items (in the misled) relative to the foils in the control item condition ($M = .21$, $SD = .13$). Last, comparing foil items across condition revealed no significant main effect of Condition.[7] Further, no other significant main effects or interactions were found for all comparisons across conditions.

To have a closer look at the relationship between participants' hits and false alarms for the different item types, we computed Pearson product-moment correlation coefficients for participants' recognition scores. In the misled item condition, results revealed a positive correlation between endorsed original items and endorsed foil items, $r = .27$, $n = 58$, $p = .040$, and also between misleading items and foil details, r

[7] Note that the misleading item vs. foil and foil vs. foil comparison across condition will not be pursued in the following analyses. Because foil items in the control condition did not differ in any aspect from foils in the misled item condition (all ps > .05) these comparisons were not reported in R/K/G- as well as source-monitoring data analysis in order to reduce the complexity of the results section.

= .37, $n = 58$, $p = .004$. No significant correlation was found between original items and misleading items, $r = .06$, $n = 58$, $p = .68$. Hence, the more hits were produced for original items, the more related foils were also falsely accepted. This association was not found between original items and misleading items, suggesting that both false alarm types (for misleading items and the foils) reflected different processes. In the control item condition, no significant correlation was found between original items and the foil items, $r = .16$, $n = 58$, $p = .23$.

Overall, analysis of the recognition data suggests that participants were misled by the retroactively changed brands in the photographs. More specifically, participants endorsed the misleading items more often than the related but non-presented foil items, which shows that the misinformation effect was caused by more than just mere guessing. In addition, comparisons across conditions showed that participants produced more correct responses for the original details in the control item relative to the misled item condition, suggesting the presence of a memory impairment effect. The time of the memory test did not have any effect on participants' raw recognition scores. Whereas statistically, the stimuli test format manipulation did not reveal any differences between the means either, numerically, means for the original items were in the expected direction with higher scores of yes-responses in the pictorial relative to the font condition (.48 vs. .40 in the misled item and .58 vs. .52 in the control item condition; see table in Appendix C).

Remember, Know, and Guess analysis. Table 1 shows the proportion of Remember, Know, and Guess responses for each item type as a function of condition (a table showing the proportion Remember, Know, and Guess responses as a function of Time of Test and Stimuli test format can be found in Appendix E). First, we conducted the same ANOVAs as above for participants' remember responses only to see whether the same effects would be present when looking only at participants' conscious recollections. In the misled item condition, analysis yielded a significant main effect of Item type, $F(2, 108) = 21.12$, $p < .001$, $\eta_p^2 = .28$. Bonferroni pairwise comparisons showed that participants correctly remembered more original items (*M* = .27, *SD* = .20) than they falsely remembered misleading items (*M* = .16, *SD* = .16; *p* = .005) and the related foil items (*M* = .09, *SD* = .10, $p < .001$). In addition, misleading items were more often falsely remembered than the foil items (*p* = .008). The data revealed no significant interactions but there was a significant main effect of Time of test $F(1, 54) = 6.28$, $p = .015$, $\eta_p^2 = .10$. Results showed that overall, there were more remember responses in the immediate (*M* = .20, *SD* = .16), relative to the delay (*M* = .14, *SD* = .14), condition (see Figure 2a). Analysis also yielded a significant main effect of Stimuli test format, $F(1, 54) = 11.87$, $p = .001$, $\eta_p^2 = .18$, with more remember responses in the pictorial (*M* = .21, *SD* = .16), compared to the font (*M* = .13, *SD* = .12), condition (see Figure 2b). There was no significant interaction between Time of test and Stimuli test format. Looking at remember responses for original items across condition analysis revealed a main effect of Condition, $F(1, 54) = 16.21$, $p < .001$, $\eta_p^2 = .23$. More original items were remembered in the control item (*M* = .36, *SD* = .21) relative to the misled item condition (*M* = .27, *SD* = .20). No other significant main effects or interactions were found.

For completion, we conducted the same analysis separately for participants know and guess responses. For participants know responses we only found a significant Item type X Time of test interaction in the misled item condition, $F(2, 108) = 4.0$, $p = .021$, $\eta_p^2 = .07$. Further analysis of the simple main effects only revealed one borderline significant effect of interest looking at the effect of Time of test at each level of Item type. Independent sample *t*-tests with Bonferroni adjusted alpha levels of .016 (.05/3) showed that whereas original items were more often known in the delay (*M* = .14, *SD* = .09) relative to the immediate condition (*M* = .07, *SD* = .09), *t*(56) = 2.35, *p* = .021, *d* = .78, no differences in know responses were found for misleading items and the foil items (see Figure 2a). For guess responses, neither in the misled item nor across item conditions, any significant main effect effects or interactions were found.

Hence, the misinformation effect found in the overall recognition scores was clearly confirmed when participants' remember responses only were compared between item types. Original items were more often remembered than the misleading items and both were more often remembered than the foils. In addition, original items were more often remembered in the control item relative to the misled item condition. No such response pattern was detected in participants' know and guess responses. Data also suggest that Time of test and Stimuli test format had an effect on participants' remember responses that were not revealed in the raw recognition scores. Overall, the delayed test condition seemed to reduce participants' remember responses for all the item types whereas participants created overall more remember responses when brands were displayed in pictorial form at test. However, these factors did not interact.

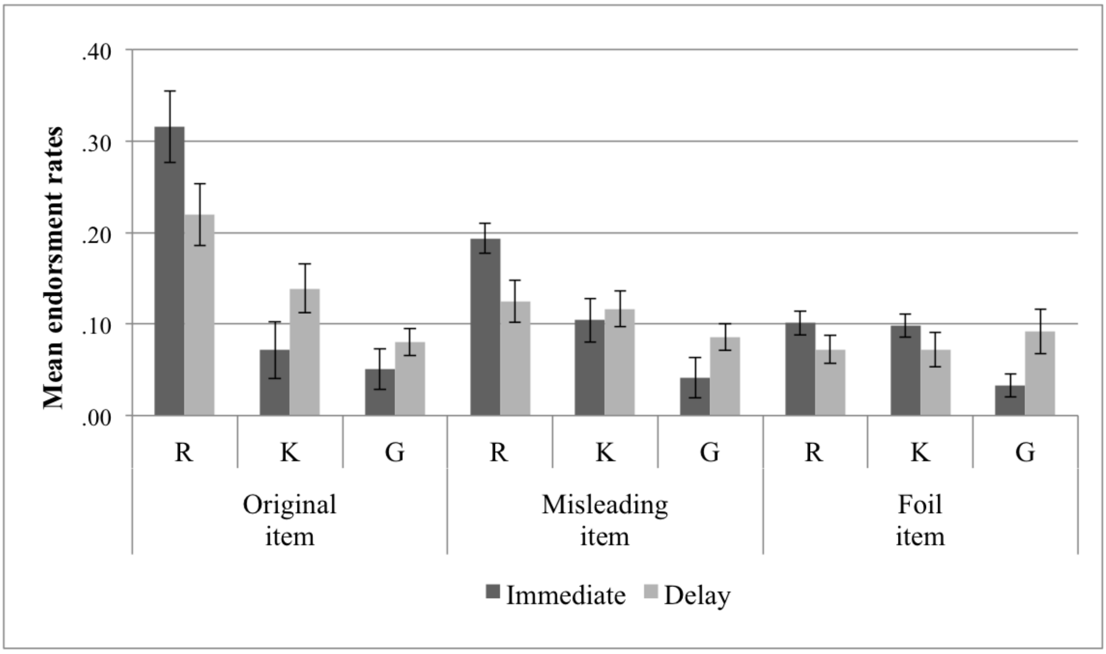


Figure 2a. Proportions of Remember (R), Know (K), and Guess (G) responses for original items, misleading items, and foil items in the misled item condition as a function of Time of test. Error bars represent standard errors of the mean.

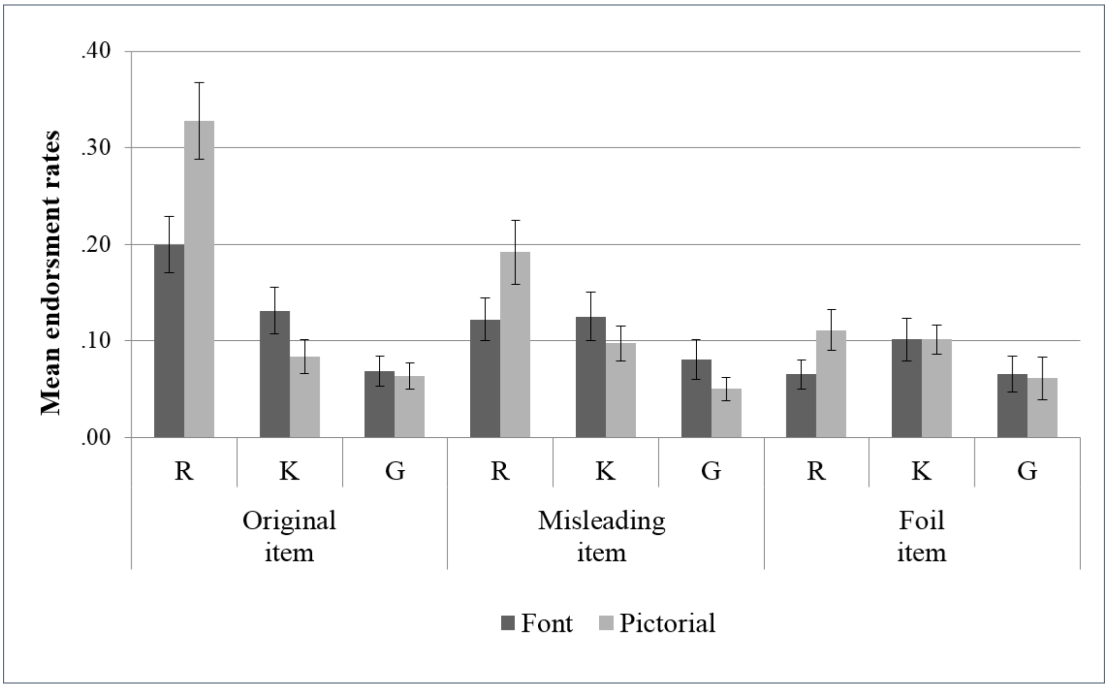


Figure 2b. Proportions of Remember (R), Know (K), and Guess (G) responses for original items, misleading items, and foil items in the misled item condition as a function of Stimuli test format. Error bars represent standard errors of the mean.

We also investigated Remember, Know, and Guess response patterns within the different Item types to see whether these patterns would differ as a function of Time of test and Stimuli test format. We ran 3(Response type: remember vs. know. vs. guess) x 2(Time of test: immediate vs. delay) x2(Stimuli format: font vs. pictorial) mixed factor ANOVAs separately for original items, misleading items, and foil items. For original items in the misled item condition there was a main effect of Response type, $F(2,108) = 32.19$, $p < .001$, $\eta_p^2 = .37$ as well as a significant Response type and Time of test interaction, $F(2,108) = 4.93$, $p = .009$, $\eta_p^2 = .08$. Analysis of the simple main effects was carried out by examining Response type at each level of Time of test. One-way repeated measures ANOVAs revealed a stronger main effect of Response type in the immediate, $F(2,54) = 29.82$, $p < .001$, $\eta_p^2 = .53$, relative to the 1-day delay condition, $F(2,58) = 6.51$, $p = .003$, $\eta_p^2 = .18$. Bonferroni pairwise comparison showed that whereas original items were more often remembered (M = .32, SD = .21) than known (M = .07, SD = .09) in the immediate testing condition (p < .001), this difference was not significant in the delayed testing condition (p > .05). Analysis also yielded a significant Response Type and Stimuli test format interaction, $F(2,108) = 5.73$, $p = .004$, $\eta_p^2 = .10$. Further analyses using one-way repeated measures ANOVAs revealed a weaker main effect of Response type in the font, $F(2,54) = 6.83$, $p = .002$, $\eta_p^2 = .20$; relative to the pictorial condition, $F(2,58) = 26.50$, $p < .001$, $\eta_p^2 = .48$). Bonferroni pairwise comparison showed that whereas original items were more often remembered (M = .33, SD = .22) than known (M = .08, SD = .10) in the pictorial test condition (p < .001), this difference was not revealed in the font test condition (p > .05). No other significant main effects or interactions were found (all ps > .05).

The same analysis for misleading items revealed a significant main effect of Response type as well, $F(2,108) = 8.42$, $p < .001$, $\eta_p^2 = .14$. Bonferroni pairwise comparisons showed that misleading items were more often remembered than guessed ($p = .001$). The difference between know and guess responses was only borderline significant ($p = .051$) with more know than guess responses. There was no difference between remember and know responses. Apart from this, there was only a significant Response Type and Stimuli test format interaction, $F(2,108) = 3.10$, $p = .049$, $\eta_p^2 = .54$. Further analysis only revealed a main effects of Response type in the pictorial condition, $F(2,58) = 9.47$, $p < .001$, $\eta_p^2 = .25$, but not in the font condition. Whereas Bonferroni pairwise comparison showed that misleading items were more often remembered ($M = .19$, SD = .18) than known ($M = .10$, SD = .10), and also more often known than guessed ($M = .05$, SD = .07) in the pictorial condition, there was no such effect in the simple font condition. No other significant main effects or interactions were found (all ps > .05).

For original items in the control item condition analysis yielded a main effect of Response type as well, $F(2,108) = 47.94$, $p < .001$, $\eta_p^2 = .47$. More original details were remembered than both known and guessed (both ps < .001) and more were known than guessed ($p = .006$). There were no further significant main effects or interactions. For foils in the misled and control item condition there were no significant main effects or interactions (all ps > .05).

To sum up, these data suggest that the response patterns within original items in the misled item condition differed depending on whether the memory test was carried out immediately or after a delay. Specifically, when original items were endorsed in the immediate condition, responses were more often associated with remember than know responses. However, the delay condition showed a different trend. Here, the reduction of remember responses and the increase of know responses led to a tie between the two response types. The misleading items showed a similar response pattern. As can be seen in Figure 2a, differences between Remember, Know, and Guess responses seemed to be more pronounced in the immediate relative to the delay condition. However, these differences were not statistically significant. Concerning the effects of Stimuli test format, data showed that the font condition somehow reduced differences between response types for original items as well as the misleading details. Whereas both items types were more often remembered than known and more often remembered and known than guessed in the pictorial condition, most of these differences were not present in the font condition. No difference in phenomenological experience was found for the foil items.

Source-monitoring test data

Table 2 shows the proportion of overall robust memory performance as well as individual responses in the source-monitoring task as a function of Condition. To recap, in the source-monitoring task participants were asked to reconsider the sources of their recognition test answers by choosing from different source options (see notes Table 2). We conducted the same main analysis as above on participants' robust memory performance. Again, in the misled item condition analysis revealed a significant main effect of Item type, $F(2, 108) = 10.73$, $p < .001$, $\eta_p^2 = .17$. Bonferroni pairwise comparisons showed that there was no difference between the original items and the misleading items ($p = .28$) but that original items were more often correctly attributed to the original event ($M = .21$, $SD = .19$) than the foil items were falsely attributed to the original event ($M = .07$, $SD = .07$, $p < .001$). In addition, more misleading items were falsely attributed to the original event ($M = .15$, $SD =$

.15) than foil items (*p* = .004). No other significant main effects or interactions were found.

Comparison of original items across condition (misled item vs. control item) revealed a main effect of Item Type as well, $F(1, 54) = 19.77$, $p < .001$, $\eta_p^2 = .27$, with more correct source attributions in the control item ($M = .33$, $SD = .20$) relative to the misled item condition. There were no other significant main effects or interactions.

Table 2. Mean proportion (SE) of robust memory performance (correct and incorrect source attributions to the original event) total and broken down by response for each item type as a function of condition.

	Original item (hits)		Misleading item (false alarms)		Foil Items (false alarms)	
	Misled	Control	Misled	Control	Misled	Control
Robust	.21 (.02)	.33 (.03)	.15 (.02)	--	.07 (.01)	.07 (.01)
(1) Saw 1 only	.17 (.03)	.05 (.01)	.03 (.01)	--	.03 (.01)	.03 (.01)
(2) Saw 2 only	.02 (.01)	.05 (.01)	.06 (.01)	--	.02 (.01)	.02 (.00)
(3) Both	.10 (.01)	.33 (.03)	.12 (.02)	--	.04 (.01)	.04 (.01)
(4) Conflicted	.04 (.01)	.03 (.01)	.03 (.01)	--	.03 (.01)	.02 (.01)
(5) Guessed	.11 (.01)	.09 (.02)	.10 (.02)	--	.11 (.02)	.10 (.01)

Notes. Item types were coded robust when one of the following options were ticked by a participant: Original item: misled (1) or (4), control (3); Misleading item: (1) or (3), Foil item: misled and control (1) or (3). Robust memory performance in bold font.

Thus, analysis of participants' robust memories mirrored most trends found in participants overall memory performance and remember responses. One exception was found in the misled item condition. Here, correct source attributions for the original items and false source attributions for the misleading items did not statistically differ from another, indicating that participants accepted the misleading alternative as often as the item actually seen during the original event. Unlike participants' remember responses, the effect of Time of test and Stimuli test format were not found in participants' robust memory performance. However, regarding the latter manipulation, there was a numerical trend for original items with higher scores of correct source-attributions in the pictorial relative to the font condition (.24 vs. .17 in the misled and .36 vs. .30 in the control item condition; see table in Appendix F).

Last, we examined participants' response patterns within item types in the source-monitoring task in order to examine participants' source-monitoring performance closer. Here, we were only interested in the misled item condition and whether response patterns for original items and the misleading items would differ as a function of Time of test and Stimuli test format. Remember that hits for original items in the misled item condition were only coded robust true memories when 'saw 1 only' and 'conflicted' was selected and that false alarms for the misleading items were coded robust false memories when 'saw 1 only' or 'both' was selected in the source task. We ran two 5(Response type: saw 1 only vs. saw 2 only. vs. both vs. conflicted vs. guessed) x 2(Time of test: immediate vs. delay) x2(Stimuli format: font vs. pictorial) mixed factor ANOVAs. For original items there was a significant main effect of Response type, $F(4, 216) = 12.86$, $p < .001$, $\eta_p^2 = .19$. Bonferroni pairwise comparisons showed no significant difference between options 'saw 1 only', 'both', and 'guessed', but all three options were more often selected than 'saw 2 only' (all *p*s < .001) and 'conflicted' (all *p*s < .001; see mean scores in Table 2). There were no other significant main effects or interactions. For the misleading items there was a significant main effect of Response type as well, $F(4, 216) = 9.66$, $p < .001$, $\eta_p^2 = .15$. Further comparisons revealed that whereas 'both' was equally often selected than 'guessed', both options were more often chosen than 'saw 1 only' (*p*s < .001), 'saw 2 only' (p = .006, p = .045), and 'conflicted' (ps < .001). In addition, 'saw 2 only' was more often selected than 'saw 1 only' (p = .022). There were no other significant main effects or interactions.

To summarize these findings, data suggest that participants showed some ability to correctly identify the sources of their memories. For original items in the misled item condition participants chose the 'Saw 1 only' option numerically more often than any of the other response types. However, statistically there was no difference between correctly choosing 'saw 1 only' or falsely choosing the 'both' option. This was different for the misleading items. Although participants correctly chose 'saw 2 only' more often than 'saw 1 only', 'both' was falsely chosen more often than any of these options. However, it should be noted that the option 'both' was equally often chosen for the misleading details than for the original items. Hence, source confusions were not only reserved for the misleading items but also for the original items on which participants were misled on. Last, none of these options were affected by our between-participants factors Time of test and Stimuli test format.

Item performance data

We examined differences in participants' true and false endorsement rates depending on where items were positioned in the photographs. Because three related brands of a category always appeared in the same position of a picture, we plotted the average hit and false alarm rates across the three related brands for each of the 24 categories. Figure 3a and 3b show the mean endorsement rates of some of these 'placement positions' when they appeared as original items in the misled item condition and when they appeared as misleading items. Inspection of these data revealed strong differences in memory performance between brand categories/brand positions. For example, hits for original items in the misled item condition ranged from .22 for service station brands to .72 for fast food and coffee shop brands. False alarms for the misleading items went from .19 for the sports brands to .55 for the bottled water brands.

To further analyse the effect of placement position on memory performance, we separated item positions into more prominent placements (*N* = 10; centrally placed items or items integrated into a scene) and less prominent placements (*N* = 14; peripherally placed items or items not integrated into a scene). Results of independent sample *t*-tests revealed no significant differences in true and false endorsement rates depending on the placement condition (all *p*s > .05). However descriptively, there was a trend of more hits for original items in the prominent placement condition compared to the less prominent condition (.49 vs. .40 in the misled and .62 vs. .54 in the control item condition).[8] Hence, data provided some indication that memory performance depended on where and how an item was positioned in the photos.

We also analysed memory performance for single brands across all categories and found that these often differed from the performance for other brands. For example, it was the mobile brand LG that had the lowest hit rate when it appeared as an original item in the misled item condition (.00) and it was the fast food brand McDonald’s and the chips brand Walkers that were remembered best (both .90). When it appeared as a misleading item the car rental brand Hertz caused the least false memories (.09) and the water brand Buxton the most (.82). Hence, overall the item analysis revealed strong differences in participants’ hit and false alarm rates for

[8] Please note that the attribution of placement positions to the prominently and non-prominently condition was decided based on a discussion by the researcher with an individual that was naïve concerning the study purpose. Although both parties agreed on all placement attributions in the end, it should be noted that above-mentioned trends were also found when ‘more complicated’ item positions (i.e. item positions on which agreement was not instantly obtained) were excluded from the analysis.

individual brands as well (a table showing the average hit and false alarm rates for all brands used in this study can be found in Appendix A).

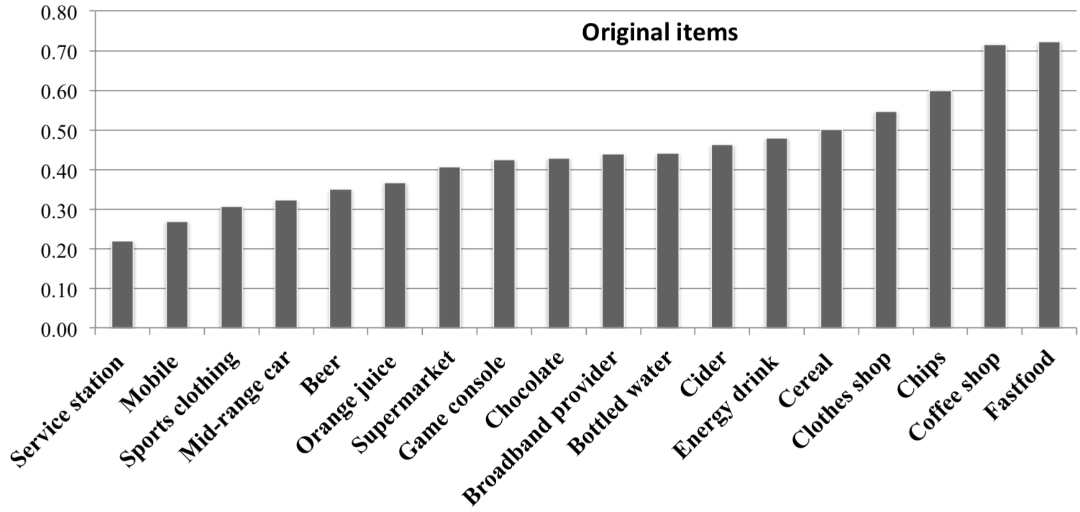


Figure 3a. Mean endorsement rates in the recognition test of original items in misled item condition per placement position (i.e. across the three items of a category).

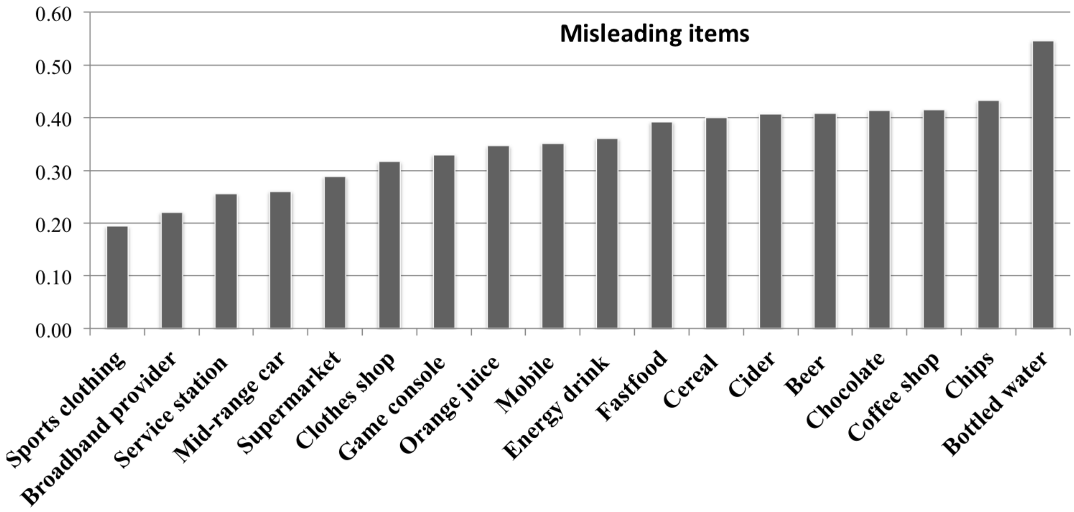


Figure 3b. Mean endorsement rates in the recognition test of misleading items per placement position (i.e. across the three items of a category).

To see if there would be a relationship between items correctly an incorrectly endorsed, we computed Pearson's r correlations scores between item types endorsed in the misled and control item condition. As can be seen in Table 3, data suggest that it was the brands with high hit rates that also produced the most false alarms when they appeared as misleading or as related foil items.

Table 3. Pearson's r correlations between yes-responses for each item type and Google hits as a function of condition

			Condition				
			Misled			Control	
		Google hits	Original items	Misleading items	Foil items	Original items	Foil items
Misled	Original items	.113					
	Misleading items	-.044	.358**				
	Foil items	-.031	.355**	.275*			
Control	Original items	.164	.509**	.157	.343**		
	Foil items	-.082	.199	.284*	.404**	.231	

Note. N = 72; * $p < .05$, ** $p < .01$

Last, we computed Pearson product-moment correlation coefficients between participants' memory performance for each item type and Google hits (i.e. the amount of Google hits when a brand was entered into the search engine; see earlier). This was done in order to examine whether brand awareness as measured by Google hits, and hence, the fact whether a brand was a leader of its category or not, was associated with true and false brand memories.[9] As can be seen in Table 3, none of the item types endorsed in misled and control item condition were significantly

[9] Please note that we considered running an analysis by item ANCOVA to analyse the effects of Time of test and Stimuli test format on memory performance by controlling for brand popularity as measure by Google hits. However, each of the 72 brands did not appear frequently enough in each of the between factor conditions to justify splitting and analysing our data correspondingly.

correlated with Google hits. However, inspection of the *r* values suggested small positive correlations between participants' true memories and Google hits. No such trend was seen for the misleading and non-presented items.

Discussion

This study used a modified version of the misinformation paradigm to examine for the first time whether retroactively replaced brands in photographs could influence memories for originally experienced brands. Participants were exposed to the same photographs including brand placements on two occasions. When participants saw the pictures the second time, some product brands were replaced by a competitor brand. A recognition test for the original event including Remember, Know, and Guess judgements as well as a subsequent source-monitoring task were used to measure the uptake of misinformation. In addition we examined whether a delay of the final memory tests as well as the presentation format of test stimuli in these tests would have any effect upon participants memory performance.

Effects of retroactive product replacement on memory performance

Results of this study revealed a reliable misinformation effect caused by retroactive brand replacements in photographs. Results of the recognition test showed that 33% of the misleading brands were falsely attributed to the original exposure to the photographs. In comparison, there were significantly fewer false alarms for the non-presented but related competitor brands. What this suggests is that the misinformation effect was not simply caused by mere guessing. Also, about 50% of the misinformation false alarms were associated with recollective (remember) experiences. That is, these memories seemed vivid and real, with many participants reporting remember judgments in the recognition test. Our data also suggest that participants' original event memories were affected by the study manipulation. Items that were originally seen in the photos but were later replaced by a competitor brand were correctly remembered in only 44% of the cases. In comparison, we found 55% correct recognition for control brands that were seen during both exposure phases to the photographs. As expected, these trends were not only confirmed in participants' overall memory performance, but also in their more refined remember responses (i.e. when responses based on familiarity and guessing were excluded from the analysis). In addition, the same result pattern was revealed when we gave participants the chance to reconsider the sources of their memories in the source-monitoring task (saw 1 only vs. saw 2 only vs. both vs. brands conflicted vs. guessed). However, when confronted with the source options, participants were able to correct some of their memory errors created in the recognition test. Importantly, 15% of all misleading items (50% of endorsed misleading items in the recognition test) were still robustly misattributed to the first or both exposures to the pictures. These results are consistent with the results of Okado and Stark (2005) who also used photographs to implant misleading information.

From a theoretical point of view, the misinformation effect found in this study is likely to be caused by source confusions, more specifically, by confusing the source of the misleading brand memory with the original brand exposure (Zaragoza & Lane, 1994). Our data suggest that some of these source misattributions might have been triggered by memory impairment processes, meaning that participant's original event memory trace for a brand placement was partially or completely overwritten, or simply blocked by the new memory trace for the misleading competitor brand. In other cases, the memory for the misleading information might have been accepted in order to 'fill in the gaps', for example when the original brand placement was never encoded the first place. In this scenario, participants might have created new memories that the misleading item had appeared during the first exposure to the photographs.

Another explanation for the misinformation-based false alarms is demand characteristics. More specifically, participants might have falsely attributed the misleading item to the original event in order to comply with the perceived desires of the experimenter. Although we do not exclude the possibility that strategic biases were behind some of the misinformation false alarms recorded here, we believe that our procedure and cover story should have kept such effects to a minimum. First, the critical items in the recognition test were embedded in a substantial amount of related foil items, which should have made it hard to apply any kind of strategy. Second, in cases in which demand characteristics might have influenced the recognition test results, such responses, including guessing biases, were likely to be filtered out in the final source-monitoring task. Here, we specifically encouraged participants to reconsider the sources of the recognition test answers. Hence it seems reasonable to assume that in most (if not all) cases, participants created real false memories that the retroactively inserted brands were experienced during the original exposure to the photographs.

In order to evaluate the overall outcome of our paradigm in more detail, several other findings need to be addressed. First, the overall hit rate for original items in the misled item condition was 44%. This hit rate was relatively low compared to other misinformation studies that have used more centrally presented target items (e.g. about 57% in Okado & Stark, 2005, who also used altered photos to implant misleading information). However, our finding seems to be in line with misinformation studies that have used rather peripherally presented target items (e.g. 46% in McCloskey & Zaragoza, 1985). In addition, our hit rate matched the one from

Yang et al. (2006), who examined recognition for product placements in computer games (*M* = .40; please note that participants in that study were not misled on the brand placements and that their hit rate might have been even lower in that case). Hence, our study suggests that encoding of rather peripheral brand placements in snapshot photographs as tested under the described conditions does not seem to differ greatly from other media such as games or picture slides showing a crime scene.

In relation to this, there was also a slightly higher than usual endorsement rate for related foils items (.24 in this study vs. approximately .10 in Okado & Stark, 2005, who used more centrally presented target items, or .06 in Frost, 2000, who used more pheripherally placed items). One explanation for these findings might be brand-specific characteristics. As mentioned earlier, using brand-specific stimuli has led to high false alarm rates for non-presented items. For example, the study of Yang et al. (2006) revealed a false alarm rate for non-presented brands of about 29%. Or Sherman and Moran (2011) who found a false alarm rate of .19 for weakly related but non-presented brands in the DRM paradigm. Hence, our data support the notion that there might indeed be special characteristics that differentiate brands from critical items that are not normally used in misinformation studies. Reasons such as the clustered environments in which brands of one category often appear with one another (e.g. in supermarket shelves; Sherman & Moran, 2011), and brand exposure frequency could have an impact on how brands are remembered. Due to these characteristics it could be that even if only one, or in some cases two, highly related brands of one category were presented in this study, this was enough to activate strong brand category themes, which gave rise to internally created false alarms for related foil items. This notion is supported by Associative Activation Theory (AAT; Howe et al., 2009) and also Activation Monitoring Theory (AMT; Roediger et al.,

2001) suggesting that it is the activation of highly interconnected concepts in one's knowledge base that is the driving force for the creation of internally generated false memories (Howe & Derbish, 2010; Howe & Wilkinson, 2011). One approach to test this idea could be the use of sets of more unrelated foil brands, which might reduce false memories for non-presented brands in a future study.

Effects of test delay on memory performance

The time delay between stimulus presentation and final test had no effect on participants' overall memory performance in the recognition test or on their performance in the source-monitoring task. An explanation for these null effects might be the rather short time delay of 24 hours between stimuli presentation and final test. However, the manipulation seemed to influence participants' conscious recollections in the recognition test. Here, relative to the immediate testing condition, the delayed condition led to an overall decrease in 'remember' responses for all item types. What this suggests is that participants' true and false item memory was experienced as less vivid and potentially less real after a time delay. Further investigation showed that the time delay specifically affected participant's response patterns for true recollections of original items in the misled item condition. Whereas overall, original items were more often remembered than known, and more often known than guessed, it turned out that this trend was more pronounced in the immediate compared to the delayed testing condition. In the delayed condition, remember responses decreased and know judgments increased to such an extent that both answer options were selected equally often (please note that these comparisons were only borderline significant). This trend is consistent with previous research and suggests that episodic and perceptual details of original event items decreased with time (e.g. Frost, 2000; Roediger et al., 1996). However, unlike previous research, the know responses for misinformation false alarms did not exceed remember judgements in either of the testing conditions. Instead, even if in weaker form, their phenomenological characteristics mirrored the trend found for the original items. That is, descriptively, the misleading items were more often remembered than known and more often known than guessed in the immediate condition (in non-significant or borderline significant form). This deviation from previous findings might be explained by the pictorial presentation format of the misleading items. Whereas verbally presented misinformation might have triggered the superiority of know judgments in previous studies, the pictorially presented misinformation in this study seemed to have led to a reversed trend or at least to a tie between both response types. Future research should investigate how these effects develop under longer time delay conditions.

Effects of stimuli format at test on memory performance

The test font manipulation had little effect on the data. That is, no significant differences were found on participants' overall recognition scores. However, numerically, the means were in the expected direction with more yes-responses for participants' true memories when brand placements were pictorially reinstated at test. This trend was significant when participants' remember responses only were analysed and was not significant for participants' more refined robust memory performance scores. This pattern is consistent with previous findings and shows that the perceptual information provided at test somewhat facilitated the retrieval of participants' true brand placement memories.

Looking at participants' false memory retrieval of misleading and non-presented foil items, our study did not show any signs of a false memory suppression effect for either of the item types. This finding is partially consistent with the study of

Sherman and Moran (2011) who found that font manipulation in the DRM paradigm had little effect on participants' false recognition of non-presented items. Instead, we did find tendencies in our data that remember responses increased not only for the original items but also for the misleading as well as the foil items. Whereas this tendency can be explained for misleading items that shared the pictorial nature of the original items, it seems to be an anomaly for the spontaneously generated foil false alarms that had never been presented to begin with. Although more data collection would be necessary to see whether this effect is robust or not, an explanation for this finding could be again the characteristics that constitute different brands of the same category. Maybe the presentation of two categorically related brands in our study (one during the original event and the other during misinformation phase) activated vivid internally generated false memories for the brand logo of the third competitor. When the brand logos were seen at test, a rush of familiarity for these items might have led participants to falsely believe that the item was seen originally.

Effects of brand items on memory performance

Last, our item analysis revealed strong differences in hit and false alarm rates across brands items. Here, data showed that there were strong differences in memory performance between brand categories and hence placement positions. Although brand placement positioning was not manipulated in this study, the separation of placement positions into more and less prominently inserted brands provided some indication that participants' true memories were higher when brands were inserted more prominently. However, it should be noted that this sub-analysis was limited as it solely focused on the centrality and the integration of a placement in a scene. Other factors, such as the relative size of a brand placement, that were likely to influence the results of this study as well, were not considered. In addition, one photograph of this study contained a brand placement that was depicted twice (see coffee shop brands in the shopping centre scene in Appendix B). In this specific case it is unclear whether the high hit rate (.72) measured for the coffee shop brands resulted from the exposure frequency to the brands or from other factors, such as the relatively dominant size of the placement.

Further item analysis revealed strong differences in memory performance between single brand within and across brand categories as well. Hence, data indicated that the ability to remember a brand depended on multiple factors including brand positioning and brand specific characteristics. Regarding the latter, one factor that might have played a role in this context is the familiarity of a brand in a consumer's mind. How familiar a brand was to a consumer might have been influenced by a variety of factors including brand awareness, brand associations and maybe brand attitudes. Because brands with high hit rates were often the ones that were also falsely remembered the most often, it might have been these brand characteristics that influenced how brands were remembered. Although brand items were fully counterbalanced across conditions, brand familiarity information was only recorded by means of Google hits. The amount of Google hits was not correlated with participants' memory performance and perhaps the measure was too crude to use for brand norming purposes. Future research should consider using a more sensitive measure to select the brand stimuli (see Experiment 2).

Conclusion

To conclude, this study demonstrated that retroactive brand replacements in photographs could influence how participants remember an original brand experience. This effect was shown by using a rather atypical misinformation paradigm format with both original event and misinformation phase presented pictorially. Although the paradigm largely produced results consistent with previous misinformation research, there were also some unusual study outcomes that might have been caused by the pictorial presentation of misinformation materials. Another factor responsible might have been the characteristics that constitute brands of the same category. The latter factor might have driven the unusually high endorsement rate for the categorically related foil brands, a finding that was addressed again in Experiment 3. The time delay of our memory test as well as the font manipulation at test did have overall little effect on participants' memory performance. However, they seemed to influence the amount of remember judgements for true as well as false recognition across all item types. Future research should examine how these effects develop with bigger sample sizes and longer time delays between misinformation presentation and the final memory test. In general, it would be interesting to see how a longer delay between original event and misinformation phase would influence the results in this paradigm. Consumers might be exposed to retroactive brand replacements in photographs after a delay of time that allowed the original brand memory to weaken (Loftus, 2005), an effect examined in Experiment 3. Ultimately, a next study should also try to base the brand selection process on a more elaborated brand norming study. Our study recorded strong variances not only concerning placement positions but also regarding single brands of a category.

Chapter 4: Experiment 2 - A brand norming study

A brand norming study

Experiment 1 revealed a reliable misinformation effect caused by retroactively changing brands in photographs. However, the paradigm created some unusual study outcomes as well. One was the high endorsement rate of non-presented foil brands (e.g. the false alarm rate of 24% in comparison to 8% in Zhu et al., 2013). Also, even if the hit rate was consistent with some previous misinformation studies that have used rather peripherally presented slide details, our hit rate was relatively low (*M* = .44). An item analysis in Experiment 1 showed that memory performance varied considerably across brands. One reason for this variation might have been certain brand characteristics, such as the strength of a brand in consumer's mind. Whereas highly familiar brands might have attracted more attention, leading to better encoding, memory traces for brands lower in familiarity might have been forgotten more rapidly or never been created in the first place. Although we did use a norming procedure in Experiment 1, namely Google hits, when we examined correlations between participants' memory performance and this variable, no associations were obtained. The question arises as to whether the measure 'Google hits' was sensitive enough to capture potential brand perception processes that might have influenced the results in Experiment 1.

In order to avoid these issues in future studies, Experiment 2 was carried out to measure some aspects that might influence the perception of brands in a consumer's mind. The main aim was to use this information to make decisions about the single brands that would be used in later studies. However, in addition it was our aim to enrich the analysis of our research with variables that might be able to clarify results not only of future studies but also retroactively, for the results of Experiment 1.

We administered two tasks for our norming study, tasks that were chosen based on findings in marketing research. Here, research suggests that consumer perception of brands depends on their knowledge about these brands, which in turn involves not only brand awareness processes (such as recall and recognition) but also brand image factors. In this context, brand image is thought of as 'brand associations held in consumer memory', which involves brand perceptions such as quality and attitudes towards brands (Keller, 1993, p 3).

Based on these ideas, Task 1 was a brand recall task that aimed to obtain a pure measure of respondent's top-of-mind awareness of brands belonging in different brand categories (Keller, 1993). Task 2 was a brand rating task that involved evaluating a wide range of categorically related brands for participants' perceptions and attitudes towards these brands. By providing participants with brands to be rated, we would not only obtain additional information for brands belonging to different categories, but we would also record variables about potentially less familiar brands that were not recalled in Task 1. For Task 2 we chose semantic differentiation scale questions (Osgood, Suci, & Tannenbaum, 1957) – a measure frequently used to record consumer attitudes about objects (Low & Lamb, 2000). Here, participants are typically asked to indicate to what extent they agree with certain statements about objects by evaluating objects on a set of semantic scales. These scales present verbal opposites (e.g. good vs. bad) and a neutral middle. For this study, three word pairs were chosen based on Osgood et al.'s (1957) conclusions that there are three dominant and independent dimensions that are used to evaluate objects: Evaluation, potency and activity. Although studies typically use several bipolar scales falling under each of these categories to evaluate an object, we restricted the task to one verbal opposite per category in order to reduce the complexity of this task. As participants would have to rate a large range of brands in this task, additional rating scales might have led to boredom or fatigue and, hence, to less valid results. Hence, in this study participants had to indicate for a list of brands on 7-point scales whether they thought a brand was either good or bad (evaluation), well known or not well known (potency), and frequently used or not frequently used (activity). We chose these particular factors because they seemed to best reflect Osgood et al.'s (1957) dimensions in an everyday life brand context. We hoped that by using this technique, different dimensions about a brand were recorded that contributed to participants' overall brand image. To make sure that Task 2 created reliable results (i.e. to examine the stability of the three dimension scales over time), some participants were administered Task 2 twice.

Method

Participants

Fifty-one undergraduate and postgraduate students from City, University of London (mean age = 19.78 years, SD = 3.9; 31% male) participated in the experiment for course credit or remuneration. Ten of these participants were retested on Task 2.

Materials

Participants completed two computer-based questionnaires. In Task 1, the free recall task, participants were cued with a brand category (e.g. soft drinks). In total they were exposed to 28 brand categories of which 24 were obtained from Experiment 1. Brand information for four additional categories was recorded for future research. The order in which the brand categories appeared on the screen was fully counterbalanced across participants.

In Task 2, the semantic differential task, participants indicated on 7-point scales whether the listed brands were perceived as good or bad, well known or not well known, and whether these brands were frequently used or not. A ‘can’t say’ answer option was provided in case a brand was unknown to a participant. In total, 231 brands belonging to 28 brand categories (same categories as used in Task 1) were listed in category blocks and were presented in their brand specific logo font (see Appendix G for an overview of brand categories used in both tasks and for the brands that were rated in Task 2). Each of these category blocks were separated by a page break. For most of the categories, eight to ten brands had to be rated. However, for some brand categories, fewer brands were added to the test because only a limited number of brands were identified for that category (e.g. search engine brands). As in Experiment 1, brands for the task were selected by doing online research (e.g. UK grocery online shopping websites) to identify all relevant brands per category. In this process we checked that the brands selected were either internationally known or advertised in the UK. Crosschecks with the results of the brand recall task ensured that all relevant brands of a category were included in Task 2. The order in which category lists were evaluated, the order in which the semantic differentiations appeared, the order in which a positive or negative adjective appeared first or second on the scale, as well as the order in which the brands appeared in the presentation list itself was counterbalanced across participants.

Procedure

Participants were tested individually in a laboratory of City, University of London. All participants started with the brand recall task and then completed the semantic differential task. This order was kept constant throughout the entire study in order to avoid the influence of brand exposure in Task 2 on brand recall in Task 1. In Task 1, participants were exposed to one brand category after the other and were instructed to enter as many brands belonging to this brand category that came to mind. They were instructed to start with the first brand that came to mind when cued by the category, continue with the second, the third, and so on. We asked participants to try their best to enter at least five brands per category. After, participants continued seamlessly with Task 2. Participants were instructed to go through the brands listed for a category (e.g. chocolate brands) and to make their judgment on the first 7-point scale that was presented to them (e.g. the evaluation scale). Participants were asked to base their responses on their personal and current attitudes and perceptions towards the brands. Following this, the same brands were rated on the next dimension scale (e.g. the potency scale). After completion of the third dimension scale (e.g. the activity scale), the procedure was repeated for the next brand category (e.g. coffee shop brands). The 10 participants who were retested on the semantic differential task returned to the lab after seven days and completed the task again.

Measurement and analysis

In Task 1 (recall task) the measure was the percentage of respondents who recalled a specific brand. For Task 2 (semantic differentiation scale task) we calculated for each of the brands an average evaluation (good – bad), potency (well known – not well known), and activity score (frequently used – not frequently used; scores for both tasks can be found in Appendix G). To test for test-retest reliability in Task 2, we correlated the average rating scores for all three dimensions at time 1 and time 2. We first analysed our norming data recorded here and subsequently examined these data in light of our misinformation measures recorded in Experiment 1.

Results

Norming study data

Test-retest reliability analysis. In order to test whether Task 2 produced reliable results for each scale (evaluation, potency, and activity), we computed Pearson product-moment correlation coefficients between semantic differential test scores recorded at time 1 and at time 2 for each variable. For the variables potency and activity, results revealed strong correlations between test scores recorded at time 1 and time 2 (potency: $r = .96$, $n = 231$, $p < .001$ and activity: $r = .94$, $n = 231$, $p < .001$). However, for the brand evaluation variable, the correlation of test scores between time 1 and 2 turned out to be moderate ($r = .51$, $n = 231$, $p < .001$).

Main analysis. For the main analysis we first inspected our data descriptively. In Task 1, participants recalled 340 brands in total (excluding outliers that were removed in a data cleaning process in which, for example, brands not belonging to a particular category were removed). The brand category in which most brands were recalled was the category ‘clothes shop brands’ with 26 brands recalled followed by mid-range car brands and chocolate brands (both 23 brands). The category with the lowest count of brands was the search engine category with four brands, preceded by car rental and game console brands (both five brands). The most often recalled brand presented the fast food brand McDonald’s that was recalled by 100% of participants, followed by Google (98%), Coca Cola, Nike, Facebook and Nintendo (all 96%).

In Task 2 it was the search engine Google that was rated best on the 7-point evaluation-, potency-, as well as activity sales (*Ms* = 1.00, 1.08, 1.00). However, not surprisingly, further inspection showed that the ranking of a brand often differed depending on the particular scale that was examined. To analyse the strength of association between the three scales (evaluation, potency, and activity), we computed Pearson product-moment correlation coefficients for the test scores. Results revealed that potency scores were highly correlated with evaluation (r = .91, n = 231, p < .001) and activity (r = .91, n = 231, p < .001), as was evaluation with activity (r = .93, n = 231, p < .001). Hence, the more well known a brand was perceived by a participant the better the brand was evaluated and the more frequently it was used.

Last, we examined potential associations between variables across Task 1 and 2 and ran correlation analysis between brand recall scores as well as semantic differential test scores. Analysis was based on 183 brands that were both recalled in Task 1 as well as rated in Task 2. Results showed that recall frequency in Task 1 was significantly correlated with brand potency (r = -.71, n = 185, p < .001), brand evaluation (r = -.59, n = 185, p < .001), as well as brand activity (r = -.65, n = 185, p < .001). Hence the more often a brand was recalled in Task 1, the more well known, the better, and the more frequently used it was rated in Task 2.

Correlations with Experiment 1 data

Last, we examined if our misinformation measures recorded in Experiment 1 were associated with the brand awareness and brand image data recorded in this study. Hence, we computed Pearson product-moment correlation coefficients between our brand recall and brand rating data and the hit and false alarm rates for the item types recorded in Experiment 1 (correct and false acceptances of original, misleading, as well as foil items as being part of the original event). Looking at the brand recall data of Task 1, results only revealed significant correlations between brand recall and hits for original items in the misled item condition (original items on which participants were misled on; r = .34, n = 68, p = .007) and in the control item condition (items that had appeared in a consistent manner during both exposure phases to the photos; $r = .33$, $n = 68$, $p = .006$). Hence, the data suggest that the more often a brand was recalled in the current study, the higher the amount of hits that were created for these brands in Experiment 1.

For the potency scores of Task 2, results yielded moderate correlations for original items hits in the misled ($r = -.33$, $n = 69$, $p = .005$; please note that the negative *r* values stem from the fact that on a scale from 1 – 7, 1 presented the positive opposite) and the control item condition ($r = -.47$, $n = 69$, $p < .001$). In addition, the scores were correlated with foil false alarms in the misled ($r = -.30$, $n = 69$, $p = .012$) and control item condition ($r = -.26$, $n = 69$, $p = .032$). In a weaker but still significant form, the Evaluation score was correlated with the same variables; the original items in the misled ($r = -.25$, $n = 72$, $p = .038$) and control item condition ($r = -.30$, $n = 69$, $p = .012$) as well as with the foils in misled ($r = -.28$, $n = 69$, $p = .019$) and control item condition ($r = -.24$, $n = 69$, $p = .011$). Last, analysis revealed that the activity scale was correlated with original items hits in the control item condition ($r = -.38$, $n = 69$, $p = .001$) and with foil false alarms in the misled ($r = -.27$, $n = 69$, $p = .027$) and the control item condition ($r = -.27$, $n = 69$, $p = .026$). Hence, findings suggest that the better, the more well known, and the more frequently used a brand was rated in the current study, the more hits for these items were created when they appeared as an original item in Experiment 1. However, the same trend was found for participants' false alarms when these brands appeared as related but non-presented foil items in the memory test of Experiment 1. False alarms for the misleading items were not correlated with any of the brand norming variables.[10]

---

[10] Please note that we ran multiple regression analysis on these data as well to see if brand recall, brand evaluation, potency, and activity predicted hits and false alarms in Experiment 1. Using the enter method it was found that all factors explained a significant amount of the variance in true memories for original items in the control condition; $F(4, 61) = 4.65$, $p = .002$, $R^2 = .23$, $R^2_{Adjusted} = .18$, as well as in foil false

Last, we ran Pearson product-moment correlation coefficients between our norming variables and the amount of Google hits that were recorded in Experiment 1 (our norming variable in Experiment 1). Results showed that Google hits were correlated with brand recall (r = .50, n = 68, p < .001), Potency (r = -.37, n = 69, p = .002), as well as with activity (r = -.27, n = 69, p = .023). Hence, our norming variable in Experiment 1 was indeed associated with brand knowledge factors, particularly with brand recall.

Discussion

Based on the findings obtained in Experiment 1, the main aim of Experiment 2 was to obtain a pool of normed brands that could be used in future studies. In addition, it was the aim to create a set of brand variables that could be used to enrich the analysis of future and past experiments. In order to achieve this, participants of this study completed a brand recall task as well as a brand-rating task for a wide range of brands belonging to 28 product categories. We inspected potential associations between variables of both tasks and found that our brand awareness and brand image factors seemed to be associated. More specifically, we found high correlations between participants' brand recall scores and how these brands were rated on the evaluation, potency, and activity scale. Not surprisingly, it was the potency data (well known vs. not well known) that seemed to have the strongest

---

alarms in the control condition, $F(4, 61) = 3.16$, p = .020, R^2 = .17, $R^2_{Adjusted}$ = .12. For the original items, the analysis showed that only potency did significantly predict correct yes-responses (Beta = -.52, $t(65) = -2.29$, p = .025). For the foil items, it was the variable brand recall (Beta = -.53, $t(65) = -2.88$, p = .005) and (in at a borderline significant level) potency (Beta = -.47, $t(65) = -2.00$, p = .051) that did predict the false yes-responses in this condition. However, it should be noted that our data violated assumption of non-multicollinearity (with threshold Tolerance and VIF values) and that results should be taken with a pinch of salt.

relationship with brand recall. This outcome might be explained by certain well known and heavily advertised brands just being on top of one's mind regardless of more subjective criteria such as whether a brand was liked or frequently used or not. Looking at the fast food brand McDonald's for example that was recalled by 100% of study participants, data showed that this controversial brand did not appear on top on the list concerning how much the brand was liked. Nevertheless, all three dimensions recorded in Task 2 were highly correlated, indicating that an object's potency, evaluation and activity seem go hand in hand.

Regarding the consistency of Task, 2 (semantic differential task), data indicated that the measure created reliable results looking at brand potency and frequency of use. Here, very strong correlations were found between results recorded at time 1 and 2. Although significant, for brand evaluation (good - bad) this relationship did not turn out to be as strong as for the other two variables. Although it is possible that attitudes towards the brands somewhat changed during the 1-week retention interval (but please note that a paired sample *t*-test on these data revealed no difference in brand rating at Time 1 and Time 2), it might also have been biases caused by the test-retest procedure that were responsible for these results. Being a subjective criterion, participants might have been conscious about their good-bad judgements in order appear in a positive light and changed their answers correspondingly. Either way, it is questionable whether future brand decisions should be based on this variable.

When we analysed our norming data in light of the misinformation measures recorded in Experiment 1, results showed that both brand awareness and brand image variables of our norming study were associated with true brand placement memory recorded in Experiment 1. More specifically, data suggest that the stronger a brand was generally perceived in a consumer's mind (as measured in brand recall, evaluation, potency, and activity), the more often it was correctly remembered when it appeared as an original brand placement in Experiment 1. These results suggest that brand knowledge as recorded here, might indeed play a role in encoding and storing of peripherally placed brand information. In addition, correlations were found between our brand image variables and false alarms for related but non-presented competitor brands recorded in Experiment 1. Hence, variables that focused on the subjective perception about a brand might have contributed to the creation of these spontaneously created false memories.

This finding is somewhat in line with our argumentation why Experiment 1 triggered an unusually high false alarm rate for the related but non-presented competitor brands. We argued that it might have been the special characteristics of brands, such as their characteristic of occurring in their competitive environment (e.g. supermarket shelves, advertising, car dealers) that caused these results. Hence, it is possible that individual brand concepts are highly related because we are faced with the task of choosing among our brand preferences every day (e.g. do I go to Starbucks or Costa Coffee?). In this context, Associative Activation Theory (and Activation Monitoring Theory; Roediger et al., 2001) suggests that it is the activation particularly of highly interconnected concepts in one's knowledge base that is the driving force the creation of internally created false memories (Howe et al., 2009). Hence, the exposure to one or two categorically related brands in our study might have triggered false memories for the non-presented competitor brand. This effect might have been increased for the more familiar or preferred competitor brands because of a stronger connection to the corresponding brand concept.

The same analysis did not reveal any indication that false alarms for the misleading items were influenced by brand knowledge factors as measured in this study. None of the variables were associated with misinformation false alarms recorded in Experiment 1. This finding provides further support that false memories for the misleading brands and the false memories for non-presented foil brands were at least partially driven by different mechanisms. If it was source confusions that were responsible for the 'more' externally generated misinformation false memories, these might have not been affected by participants' perceptions toward the misleading brands. Instead, looking at the other side of the coin, maybe it was the perceptions and attitudes towards the original brand (on which participants were misled on) that were crucial regarding whether or not a misleading brand was falsely accepted or not. For example, an originally seen brand that was perceived as less strong and less preferred than other brands, might have been more prone to 'lose the battle' against the competing and misleading item, independent of how strong the misleading item itself was perceived. The fact that original items in Experiment 1 were associated with less hits the 'weaker' they were perceived in Experiment 2, speaks for this assumption. However, more research is necessary to see whether these findings are reliable (see the following Experiments for some more discussion on this topic).

A last finding to mention looking back at Experiment 1 is that the norming variable 'Google hits' seemed to be associated with brand awareness factors of this study. Hence, we were not wrong in believing that the variable captured some aspects of participant's brand awareness. However, the measure might not have been sensitive enough to show its influence in memory performance of Experiment 1 and future research might be advised to rely on classical norming procedures.

Chapter 5: Experiment 3 – A replication study - the effects of delayed retroactive product replacement on placement memory

Experiment 3 - A replication study - the effects of delayed retroactive product replacement on placement memory

Although we found a reliable misinformation effect in Experiment 1, our study revealed a higher than usual endorsement rate for related but non-presented competitor brands. Because foil false alarms were a baseline for misinformation acceptances in that study, the misinformation effect revealed was slightly weaker compared to other studies. Related to this, data revealed a relatively low hit rate for product placements in pictures, likely caused by weak encoding processes that acted at the time of studying the brand placements. To explore these effects further and to develop a set of normed brands that could be used for further studies a norming study (Experiment 2) was conducted that recorded factors potentially contributing to the overall consumer knowledge about a brand (including brand awareness and brand image factors). By correlating these brand knowledge data of the norming study with the hit and false alarm rates of Experiment 1, results revealed that brands higher in familiarity were not only more often correctly recognized but also more often falsely recognized when they appeared as non-presented foil item at test. Hence, these data indicated that brand awareness and brand image factors might have influenced the results in Experiment 1. In addition, item position analysis carried out as part of Experiment 1 indicated that the question of whether a brand was remembered or not might have depended on its position in a picture as well. Data indicated a numerical trend of more hits for originally seen items the more prominently items were positioned in the photographs.

The current study used the paradigm developed in Experiment 1 to further investigate the effects of brands as well as the effects of retroactively placed brands in photographs on consumers' true and false memories. The main aim was not only to replicate the ‘brand misinformation effect’ revealed in Experiment 1, but also to increase the effects found in Experiment 1 by increasing the hit rate (due to the use of ‘stronger’ and more prominently placed brands) as well as to lower false alarm rates for non-presented foil items (due to the use of a set of more unrelated foil items in the memory test) – consequently creating results more in line with findings typically achieved in misinformation studies. A more reliable paradigm would allow future studies to examine the effects of additional study manipulations potentially requiring a misinformation effect stronger in nature. Hence, the method and materials of this study were mainly in tune with Experiment 1, but some differences existed that will be elaborated on in the following.

We have previously mentioned that the question of how an item is positioned in movies or pictures slides can have an influence on if and how study items are later remembered. For example, looking at psychological literature, researchers have found evidence of higher hit rates for centrally relative to peripherally placed items in original misinformation slides (e.g. Wright & Stroud, 1998; but see Paz-Alonso & Goodman, 2008). However, closer inspection of materials showed that centrally placed items are often very dominantly placed in a picture slide and that they have a critical meaning in a scene (e.g. a shoplifter taking a bottle of wine that is positioned in the centre of the picture (see Wright & Stroud, 1998; and also Belli et al., 1992).

So how could these methods be translated into a product placement context? Placing products into pictures in a similar way would somehow contradict a more natural occurrence of brand placements in snapshot photographs. In regard to this, marketing research by Yang and Roskos-Ewolden (2007) found that the ‘level’ of product placement in movies influences explicit brand placement memory. The researchers applied a landscape model, positing that not all information activated in memory is activated at the same level. Based on the idea of limited attentional resources, the theory suggests that it is information central to a scene that is activated at the highest level, followed by items embedded in a story that allow the story to proceed. Background information receives the lowest level of activation because of its lack of visual prominence and because it is usually not necessary for comprehending a storyline. By using this framework, the researchers found that participants recognized a brand more often when the product was used by one of the main characters and when the brand was an integral part of the scene.

In line with these findings, the current study aimed to increase attentional resources on the brands and hence the hits rate of originally presented items by applying two measures: First, normed brands from Experiment 2 were used as study stimuli in order to ensure that the strongest brands per category appeared in our photographs. Second, the product placements were inserted in the photos based on the following rules that derived from previous research: A brand either had to contribute somehow to the meaning of a photo scene, it had to be centrally placed, or it had to be used by a leading character in the photograph.

We chose three different brand placement 'modalities' in order to preserve the incidental brand learning nature of the study. An obvious brand placement pattern (e.g. solely centrally placed brands) might have revealed the brand learning nature of the task. Although we predicted that these measures would increase the overall hit rates in this study, it was unclear how the production of misinformation false memories would be affected by these means. As previously demonstrated, research exists indicating that centrally presented original event information can suppress the creation of false memories for verbally presented misinformation (e.g. Wright & Stroud, 1998). Here, stronger encoding processes of originally presented pictorial items might enable participants to correctly reject the verbally presented and contradicting information. However, a question arises about how these effects develop in a paradigm that uses pictorial stimuli during both event phases? Strengthening brands and brand placements in study materials would potentially also strengthen the influence of the misleading information. Regarding the reduction and further examination of foil false alarms, we used a set of normed brands lower in brand familiarity compared to actual study items. More specifically, the final test included a set of foil brands that were still known to participants but that were rated as less well known and less frequently used compared to their competitors that appeared as original and misleading items. From an Associative Activation Theory perspective (Howe et al., 2009), this measure should result in less activation of associated foil brands from the studied brands, consequently leading to a reduced amount of foil false alarms.

This study included the manipulation of an independent variable, which again concerned the delay between the stages of the misinformation paradigm. But unlike Experiment 1, this study focused on the second important time delay in the literature, the delay between original event and misinformation phase (Loftus, 2005). Here, research has shown that longer time delays can affect how original as well as misleading information is remembered. For example, Loftus et al. (1978) exposed some participants to misleading information immediately after the original event and others after a delay of 20 min, 1 day, 2 days, or 1 week. The results of a forced-choice test revealed that adults were more vulnerable to misinformation (as measures in memory impairment - correct responses to original event items) after a long delay relative to misinformation shortly presented after the original event. In fact, effects were largest after a delay of one week. Paz-Alonso and Goodman (2008) replicated these findings by using a two-week delay between original event and misinformation phase. In their study, participants watched a murder video and read a misleading narrative either immediately or two weeks after. Shortly after the presentation of misinformation, participants completed a yes/no-recognition task for the video. The researchers found that misled participants falsely accepted more misleading details in the delay condition compared to participants in the immediate condition. The explanation proposed suggests that as memory for the original event fades with longer delays, participants tend to be more prone to falsely accept the misleading information because of higher alteration or interference processes (e.g. Brainerd & Reyna, 2005; Loftus et al., 1992). Alternatively, the Discrepancy Detection principle (Tousignant, Hall, & Loftus, 1986) posits that the likelihood of producing misinformation false memories is greater when inconsistencies between original event memory and misinformation phase are not instantly noticed. If a time delay allows the original event memory to weaken, the likelihood of detecting the inconsistencies is smaller compared to shorter delays (Loftus, 2005).

Based on these findings the current study included two delay conditions, a one-day as well as a one-week delay condition. Because at a practical level participants might be exposed to retroactive brand replacements in photographs following a delay of time, we considered a delay in both conditions appropriate. Also, delaying the misinformation for a day or more is a well-established manipulation in the literature (e.g. Pezdek & Roe, 1995). Equivalent to ‘time of test condition’ 2 of Experiment 1, we decided to conduct the final memory tests after another delay of one day instead of immediately after presentation of misinformation. While less common (but see Okado & Stark, 2005 for example), Experiment 1 has shown that this method has created a reliable misinformation effect and we believed that the additional delay between misinformation presentation and test would further improve the ecological validity of our paradigm. In line with previous research we predicted that participants would be more likely to accept misleading items in the long relative to the short delay condition. Furthermore, we expected that participants' original event memory would be weaker with a longer delay between the experimental stages.

We recorded an additional variable for Experiment 3. By using eye-tracking technology for a subset of participants, we recorded their eye-fixations on the brands during the first (original event) as well as during the second exposure to the photos (misinformation phase). This was important because these eye-fixations might provide additional information about the attention that was paid to the different brands, data that might improve our knowledge of what was being encoded and would benefit material selection in the following studies. For example, even though participants might have not remembered some of the brands in Experiment 1, no conclusions could be made about whether or not attention had been paid to brand placements. Analysing the fixation on the brands, might help to eliminate placement positions that were hardly ever fixated on.

On a related note, eye-fixations on the brands might shed light on the role of encoding processes in the misinformation effect. Research suggests that neural activity during encoding of the original event as well as the misinformation phase can predict false memories in the misinformation paradigm (Okado & Stark, 2005). More specifically, in an fMRI study, Okado and Stark (2005) found that when encoding activity was greater during the original event, the original items (hits) were subsequently recollected. When encoding activity was greater during the misinformation phase, the misleading items (false alarms) were subsequently recollected. Returning to visual attention data, even though it is possible that attention is paid to a brand when it is not currently fixated, research suggests that an eye movement is unavoidably accompanied by a shift of attention (Hervet & Gue, 2011). In this light it seems reasonable to assume that an eye movement to a brand would indicate that attention to the brand had been paid. Fixation duration on the brands might be a good indicator of the amount of attention that is paid to a brand placement (Hervet & Gue, 2011). In line with these findings and thoughts, we aimed to investigate whether fixation duration during the first as well as second exposure to the photographs was associated with hits for the original items as well as false alarms for the misleading and foil items. However, because to our knowledge no study has examined the involvement of encoding processes in the misinformation paradigm by using eye-tracking technology, the outcome of this measurement was somewhat exploratory in nature.

In addition to our main experiment, we conducted a sub-experiment as part of Experiment 3 that was motivated by the high endorsement rate for foil items recorded in Experiment 1. Our aim was to contribute to the debate concerning whether memory errors in the misinformation paradigm and memory errors recorded in the DRM paradigm are related. This debate is important because it sheds light on the nature of false memory phenomena (Gallo, 2010) and whether or not different false memory errors share a common psychological mechanism (Otgaar et al., 2016). On the one hand, it is possible that both false memory types are unrelated considering that one is based on external suggestion and the other generated internally. However, on the other hand, both types of false memories might share an underlying mechanism, which is that both could be seen as spread of associative activation (Howe et al., 2009; Otgaar et al., 2016), as failures in source-monitoring (Gallo, 2010), or both.

Although researchers have examined the relationships between DRM false memories and false memories created by means of other false memory paradigms (see Ost et al., 2013; Zhu et al., 2013, for reviews), only a few studies have specifically examined the correlations between misinformation and DRM effect measures. Findings across these studies have been mixed (Ost et al., 2013; Zhu et al., 2013). For example, whereas Ost et al. (2013) did not find any correlations between a broad range of misinformation and DRM effect measures (mean r = -.01; see also Otgaar & Candel, 2011), Zhu et al. (2013) found a small but significant correlation (r = .12, p = .02) between the misinformation and DRM false alarms. The reason for the effect in one but not the other study might lie in the sample size used (N = 120 vs. 430). Although the current experiment cannot match these sample sizes, we were specifically interested in examining a different correlation, namely, the one between the spontaneously generated false memories created in both paradigms. Is it possible that false alarms for the related but non-presented foils in the misinformation paradigm and false alarms for the lures and other non-presented but related items in the DRM task would be associated? Possibly because both are self-generated, participants who endorse foils in the one paradigm might also be more likely to endorse the non-presented items in the other paradigm. Studies exist that provide reason to assume that these variables could indeed be related. For example, Otgaar, Howe, Peters, Sauerland, and Raymaekers (2013) found moderate to strong positive correlations between false memories for the critical lure in the DRM paradigm and spontaneously generated false memories for obviously missing items in a ‘DRM video’ depicting a crime scene.

With these ideas in mind the current study aimed to replicate findings of Experiment 1 and examined whether retroactively replaced brands in photographs can influence memories for originally seen brand placements. First, we exposed participants to photographs embedded in a fictitious Facebook account in which each photo contained brand placements. Half of these brands were contradicted by a competitor brand when participants saw the pictures the second time either after a delay of one day or one week. After another delay of one day, participants completed a recognition test followed by a source-monitoring task. For some participants, eye-fixations were recorded to see whether fixation time on the brands would be associated the creation of true and false memories. In addition, all participants completed a DRM task after completion of the main study.

Method and Measurement

Participants

Fifty-two students and staff members (mean age = 25.63 years, *SD* = 6.70; 31% male) of City, University of London participated in the experiment for course credit or remuneration.

Materials

Misinformation task.

Brand norming. Brand selection was based on the norming data collected in Experiment 2. Brands selected for product placement (study items) were the three most popular brands of 24 brand categories. For selection of these items we mainly consulted the brand recall data as the more objective measure of participants 'top of mind' brand awareness. However, in some cases the semantic differential data was used as a decision parameter as well, for example when two brands were head-to-head in the list (i.e. if they were recalled equally often). In this process, the similarity of product packaging across brands of a category was controlled for. For example, using the orange juice brand Capri Sun as an orange juice brand in a breakfast scene was not considered to be a suitable placement next to Tropicana and Innocent because the nature of the product and the typical packaging stood out too much (small Capri sun pouch often consumed by children versus the more common fruit juice cartons of Tropicana and Innocent). This was done because a distinctive product packaging of one competitor in one category might direct participants to the study manipulation across brand categories in general. Hence, some brands in line that did not fit with their competitors were skipped in the brand selection process.

To select foil items for the memory test, the semantic differential data were used. Here, two brands per category with a total evaluation score of approximately 4-5 were chosen as test items (in comparison, original and misleading items had a total evaluation score of approximately 1- 3). One reason for using the brand rating data as opposed to brand recall was that often the latter did turn out to be unsuitable for choosing the categorically-related foils. For example, recalled brands in later positions were often not clearly defined by a category (e.g. brands such as Eat or Greggs in the coffee shop category). Hence, decisions were mostly based on the brand rating data by using an average score across the dimensions of potency and frequency (the evaluation score was a more unstable measure and was not used). In this process we made sure that the brands of interest had a low score of 'can't say' responses in the norming task. This way we tried to identify two brands per category that were still familiar to participants but that would also be weaker in associative strength to study items (the specific brand categories and brands used in this study can be found in Appendix H).

Study stimuli and apparatus. Study stimuli were presented in the same way as in Experiment 1. Twelve pictures were embedded into a fictitious Facebook account showing the account owner and/or groups of friends in different social situations (e.g. friends at breakfast). Because our current study aimed to control somewhat for the effect of placement positioning, some photographs of Experiment 1 were replaced based on our brand placement strategy to insert a brand placement in such a way that a brand either had to (1) contribute somehow to the meaning of a photo scene, (2) be centrally placed, or (3) be used by a leading character in the photograph. By using this rule of thumb, 24 brand categories were assigned to each of 12 photos (e.g. a cereal and orange juice brand in the breakfast scene). Thus, the brands appearing in different pictures were differentiated thematically (cereal in one picture, camera brands in another) in order to avoid semantic intrusions. That is, to reduce the chance that the appearance of a brand in one picture would trigger false memories for a related brand that was actually presented in a different picture (but that might not have been encoded). Again, we created three versions of each photograph that each hosted two of the selected study brands throughout the study (e.g. one of the orange juice brands: Tropicana, Innocent, or SunnyD and one of the cereal brands: Kellogg's Coco Pops, Nestlé Cheerios, or Weetabix, see Appendix I for examples of these photo versions). As in Experiment 1, during the original event participants were exposed to one out of three versions of these 12 pictures and hence, to one out of three categorically related study brands of each of the 24 brand categories.

Misleading information was provided for 12 out of 24 brands by replacing these items with contradicting/misleading brands during a second exposure to the pictures (misled item condition). For the remaining 12 brands that were originally shown, consistent information was provided (i.e. participants were not misled on these items – the non-misled control item condition). Whereas the remaining items of a brand category usually served as related foil items in the final memory test (e.g. in

Experiment 1), this was not done in this study. Instead, the weaker related foil items (see earlier) were next to original and misleading items included into the memory tests. For clarification, consider the following scenario in the breakfast scene: In the picnic photo a participant may have been misled on the cereal brand. If the cereal brand Weetabix was seen during the first exposure to the photos, Kellogg's Coco Pops may have been used to mislead this participant during the second exposure to the pictures. The orange juice brand Tropicana may have appeared in a consistent manner during both exposures to the pictures and presented the control item condition. Last, instead of the remaining brands Nestlé Cheerios, Innocent and SunnyD, the weaker related foil brands Alpen and Coldpress were used as foil items in the memory test (but see Footnote 12 in the results section; see Figure 4).

Assignment of the three study brands (e.g. Kellogg's Coco Pops, Nestlé Cheerios, and Weetabix) to item type (original item and misleading item) and to condition (misled item and control item condition) was counterbalanced across participants. Further, each of the competitor brands of a category served equally often as misleading/contradicting brand during the misinformation phase. To further reduce the risk of item effects, the two foils chosen per category (e.g. Alpen and Quaker) always appeared in the final memory test in a randomized order. To do all this this, twelve different conditions in which participants were exposed to different brand combinations (slide show combinations) were created for counterbalancing purposes. For each condition an individual memory test was created. Last, we also randomized the order in which participants were exposed to the single photographs.

For respondents in the eye-tracking condition, eye movements were recorded with a Tobii eye tracker (Tobii Technology, Tobii TX300, 2006). Here, a PC computer was used with a resolution of 1920x1080 pixels. The system's resolution and sampling rate were 0.258 and 300 Hz. The eye movements were captured by a camera integrated at the bottom of the 23'' computer screen that was located at about 60cm from the participants. Target areas of interest (AOIs) were set around target brands placed in the pictures.

DRM task. For the DRM task, five word lists were used that were obtained from the Stadler, Roediger, and McDermott (1999) norms in accordance with the study procedure of Ost et al. (2013). Each list consisted of 13 words (e.g. bed, rest, awake) that were all semantically related to a non-presented word (i.e. the critical lure, sleep). The specific word lists used in this experiment were related to the following critical lures: rough; doctor; smell; sleep; and chair (see Appendix J for the full list of semantic associates). The word lists were presented in descending order of associative strength to the corresponding critical lure (please note that each of the five lists actually contain 15 words but that the last three words in the lists were excluded and used as foil items in the memory test; see measurement and analysis section). The presentation order of the five lists was randomized across participants.

Procedure

Misinformation task.

Original event. Figure 4 shows the design of this study. The procedure was similar to Experiment 1. Participants were shown the Facebook profile and were instructed to gain an impression about their new but fictitious friend. Next, they clicked on 'Photos' and observed the personal pictures uploaded by their new acquaintance. To encourage engagement with the scenes, participants were asked to imagine that they were familiar with some of the account owner's friends seen in the photos. In addition, they were asked to imagine that they were part of the events shown (consider what was been discussed in the scene, what it may have taken place), even if they were of course not seen in the pictures. Importantly, at no point was reference made to any of the brand placements. To ensure that all participants engaged for the same time period with the pictures, photos changed automatically and participants were exposed to each photo for 12 seconds.

About half of all study participants (N = 24) completed this task in front of a normal computer screen. The remaining participants (N = 28) completed the task in front of an eye-tracker and eye-movements were recorded during the exposure to the stimuli. After informing these latter participants that their eye-movements would be recorded during the task, the eye-tracker system was calibrated before the beginning of the experiment: Participants were asked to follow with their gaze a red fixation dot that was moving over the computer screen.

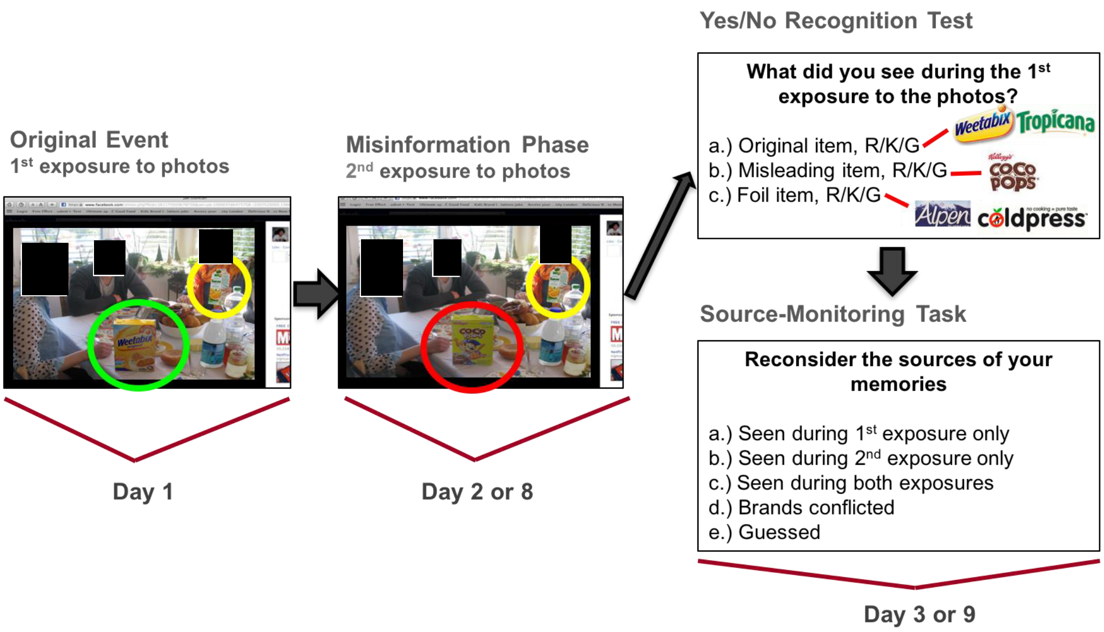


Figure 4. Study design

Misinformation phase. Twenty-four hours or one week later, participants (*Ns* = 26 each) were asked to look at the Facebook profile again and to indulge in reminiscence by watching of what they thought were the same photographs as seen on day 1. This time however, participants saw the photos that were manipulated such that one brand per picture was replaced with a different brand of the same category, while the other brand did not change during the process. Participants were not warned about the potential discrepancies between the photographs presented at Time 1 and Time 2 and each photograph was presented for 12 seconds. Again, calibration of the eye-tracker preceded the task for participants in the eye-tracking condition.

Final memory test. For all participants the final memory tests were carried out 24 hours later and the test format was identical to the ones used in Experiment 1 (besides the fact that all test items were presented in their brand specific logo font in this current study and that the nature of the foil items differed). First, participants completed a yes/no recognition test for the original event including Remember, Know, and Guess judgments. Following, a final source-monitoring task was carried out to measure participants' robust memory performance.

DRM task. About five minutes after completion of the misinformation memory tests, all participants were administered the DRM task. First, general instructions were read aloud to participants, explaining that different words would appear on the computer screen. Being an incidental learning task, participants were not informed that their memory for these words would be tested at a later stage. Instead, participants were told that the task was a word-pleasantness rating task that was carried out as part of a different experiment. Each word list was presented word-by-word following an initial fixation point. Participants were instructed to read each word and to rate it for its pleasantness after. Each word appeared on the screen for one second, followed by a blank screen for one second. After presentation of all lists, participants were given a 1-minute distractor task (simple math task) prior to the memory test. In an online-based recognition test, participants were asked to make old/new followed by Remember, Know, and Guess judgments.

Measurement and analysis

Misinformation task. The 60 items on the recognition test consisted of 24 of the original items (12 on which participants were misled and 12 on which participants were not misled), 12 misleading items that contradicted their original counterparts, and 24 non-presented and weakly related foil items (including 12 foil items categorically related to the misled and 12 foil items related to the control item condition). Correct and incorrect yes-responses to these items were used to compute participant's overall memory performance (i.e. hits and false alarms of correctly or falsely stating that an item had appeared during the original event). Robust memory performance in the source-monitoring task was the confirming scores of the recognition test answers under stricter source-monitoring criteria. These were coded as in Experiment 1 (but see notes of Table 5 in this Experiment).

Concerning the eye-tracking data, fixation duration on areas of interest (AOIs) in milliseconds and the number of fixations on AOI's were recorded. Thus, fixation duration recorded was the duration of each individual fixation within an AOI. If during the recording the participant returned to the AOI, the new fixation was also included in the calculation.

The main analysis was similar to Experiment 1. We analysed the uptake of misinformation by applying statistical tests that would first compare participants' memory performance (yes-responses to items) within the misled item condition and then across conditions (misled vs. control item condition). Because the foil items were not used as study items in this experiment, a comparison between the misleading item in the misled and the foil items in the control item condition (see Experiment 1) was not conducted (but see Footnote 12). These main analyses were carried out separately for participants' overall recognition scores, their Remember, Know, and Guess responses, as well as for participants' robust memory performance of the source-monitoring task. Again, we set an overall standard alpha level equal to .05 for our main analysis (e.g. see Frost et al., 2002). Concerning the eye-tracking data, descriptive statistics of fixations on the brands were reported and evaluated. In addition, correlation analysis between the eye-fixation data and participant's memory performance was computed.

DRM task. The 35-word DRM recognition test consisted of 15 old items (the words in the first, third and fifth positions of each DRM list), the five critical lures, as well as 15 related foil items (the last three items of each of the five DRM lists that were excluded from the study lists). Analysis involved comparing participants' correct and incorrect yes- (or old-) responses to list items, the obviously missing critical lure word, as well as the foil items (i.e. hits and false alarms for stating that an items was old). To analyse potential relationships between misinformation and DRM effect measures, correlation analysis between the yes-responses and signal detection measures in both tasks were computed.

Results

Sample characteristics

Shapiro-Wilk's tests (p > .05) and visual inspections of histograms, normal Q-Q plots and box plots were used to examine whether the dependent variables of this study were approximately normally distributed. Analysis showed that the dependent variable item endorsement was roughly normally distributed for Item type (original items and misleading items) Condition (misled and control item condition), and Time of misinformation (1 day and 1 week). However, participants' foil false alarms in the misled and control item condition showed a positive skewness exceeding threshold values particularly in the immediate testing condition (Shapiro-Wilk's tests: *ps* < .05). An inspection of the variables revealed no concrete outlier points that could have been removed from the data to solve the problem. Nevertheless, we decided to continue using parametric tests in this experiment for better comparability across experiments. However, please note that all analyses were rerun and results confirmed using non-parametric tests (however these tests are not reported here). Also, please note that neither participant's age nor gender had any effect on the dependent variables of this study. In addition, it made no statistically significant difference whether participants completed the misinformation task in front of a normal PC or the eye-tracker. Hence, these variables were not included in the following analysis.

Misinformation task

Recognition test data.

Raw score analysis. Table 4 shows the proportion of yes-responses to the three item types (original details, misleading details, and foil details) correctly and incorrectly accepted as being part of the original event as a function of Condition (i.e. whether participants were or were not misled on an item) and Time of misinformation (i.e. whether misinformation was received after a delay of one day or one week).

Table 4. Overall mean proportion (SE) of yes-responses with proportion of Remember (R), Know (K), and Guess (G) responses for each item type as a function of Condition and Time of misinformation.

Condition /Response type	*Item type/Delay Misinformation*								
	Original items (hits)			*Misleading items (false alarms)*			*Foil items (false alarms)*		
	Total	1 Day	1 Week	Total	1 Day	1 Week	Total	1 Day	1 Week
Misled Item									
Total	**.48 (.026)**	.49 (.046)	.46 (.045)	**.47 (.026)**	.43 (.036)	.51 (.043)	**.16 (.021)**	.16 (.036)	.16 (.024)
R	**.16 (.022)**	.19 (.033)	.14 (.028)	**.18 (.026)**	.11 (.024)	.25 (.036)	**.02 (.007)**	.03 (.010)	.02 (.010)
K	**.23 (.021)**	.23 (.029)	.22 (.031)	**.20 (.017)**	.21 (.025)	.19 (.024)	**.08 (.013)**	.07 (.016)	.09 (.019)
G	**.09 (.018)**	.08 (.026)	.10 (.026)	**.09 (.015)**	.11 (.023)	.07 (.021)	**.06 (.013)**	.06 (.022)	.05 (.013)
Control Item									
Total	**.57 (.025)**	.56 (.033)	.58 (.040)				**.15 (.019)**	.15 (.029)	.16 (.026)
R	**.31 (.026)**	.31 (.036)	.30 (.039)		n.a.		**.02 (.007)**	.03 (.010)	.02 (.008)
K	**.20 (.021)**	.18 (.024)	.22 (.034)				**.09 (.014)**	.07 (.016)	.11 (.022)
G	**.06 (.013)**	.07 (.020)	.05 (.017)				**.04 (.010)**	.05 (.017)	.03 (.010)

Notes. *Misleading items are not applicable to the control item condition since participants were not misinformed on the original items in this condition. Overall memory performances in bold font

First, we compared participants' overall yes-responses to the three item types in the misled item condition. We ran a 3(Item type: original item vs. misleading item vs. foil item) x2(Time of misinformation: 1 day vs. 1 week) mixed factor ANOVA. Analysis yielded a significant main effect of Item type, $F(2, 100) = 75.67$, $p < .001$, $\eta_p^2 = .60$. Bonferroni pairwise comparisons showed no difference between original items and the misleading items. However, participants correctly accepted more original items ($M = .48$, $SD = .23$) than they falsely accepted the related foil items ($M = .16$, $SD = .15$, $p < .001$). In addition, misleading items ($M = .47$, $SD = .20$) were more often falsely accepted than the foil items ($p = .004$). There was no main effect of Time of misinformation ($F < 1$) and no significant Item type X Time of misinformation interaction, $F(2, 100) = 2.11$, $p = .13$.

We also examined participants' yes-responses to the item types across condition and conducted 2(Condition: misled vs. control) x2(Time of misinformation: 1 day vs. 1 week) mixed factor ANOVAs separately for the original and the foil details. For original items, there was a significant main effect of Condition, $F(1, 50) = 12.56$, $p = .001$, $\eta_p^2 = .20$, showing that participants correctly accepted more original details in the control ($M = .57$, $SD = .18$) relative to the misled item condition. There was no main effect of Time of misinformation and no interaction between Item type X Time of misinformation ($Fs < 1$). Last, comparing foil items across condition revealed no significant main effect of Condition, Time of misinformation, and no interaction between the two variables (all Fs < 1).

Last, we examine whether participant's behaviour to respond yes to the different items stood in any relationship and ran correlation analysis between hits and false alarms separately for each of the misinformation delay conditions. We report findings in the misled item condition only in order to reduce the complexity of this section. In the 1-day delay condition, hits for the original items were not associated with false alarms for the misleading or the foil items. However, in the 1-week delay condition, hits and false alarms to all items types were strongly and significantly correlated. Analysis revealed significant correlations between hits for the original items and false alarms for the misleading details ($r = .75$, $n = 26$, $p < .01$), as well as between the original items and the foil items ($r = .45$, $n = 26$, $p = .004$). In addition, a significant correlation between the latter false alarm types was obtained ($r = .55$, $n = 26$, $p = .004$).[11]

[11] Please not that these trends were also confirmed in participants more refined remember as well as robust memory performance in the source-monitoring task. Here, negative correlations between original items and misleading items were found in the 1-day delay condition and significant positive correlations in the 1-week delay condition.

Hence, the overall recognition data suggest that participants were misled by the retroactively changed brands in the photographs. When participants were misled on an item, they did not have any ability to discriminate between originally seen items and the misleading details. In addition, they endorsed the misleading alternative more often than the related foil item.[12] Further comparisons across conditions showed that participants produced more correct responses for the original details in the control relative to the misled item condition, suggesting the presence of a memory impairment effect. Whereas statistically, the time of misinformation manipulation did not reveal any differences between the means, numerically, data revealed a trend in the expected direction. Whereas yes-responses to the original details (in the misled item condition) seemed to decrease in the 1-week delay relative to the 1-day delay condition (.49 vs. .46) data indicated an increase of yes-responses to the misleading details with the longer delay of misinformation (.43 vs. .51.). Concerning the

---

[12] One might argue that the endorsement of foil false alarms might not be an ideal baseline to determine whether this study created a reliable misinformation effect or not. Different to Experiment 1, the selected foil items in this study did never appear as original or misleading item in the photographs but only in the final memory test. We chose this approach because the aim was to investigate whether more weakly related test items would reduce the amount of foil false alarms. Concerning this matter, data of a small sub-experiment provides additional information that might ease potential concerns. A separate sample (N = 12) was exposed to the same Facebook photos only once and administered a yes/no recognition test two days later. Participants were not misinformed on the originally seen brands in that sub-study, but they underwent the remaining paradigm stages equivalent to the 1-day delay condition of main Experiment 3. Participants were tested on 24 originally seen items (e.g. Tropicana) as well as 48 highly related but non-presented foil items (e.g. SunnyD and Innocent). Thus, assignment of the brands to original items and foils was counterbalanced across the sample (for example a second participants might have seen SunnyD originally and Tropicana and Innocent were the foil items at test). We compared participants' foil false alarms of that study with the false alarm rate for misleading items of the current study. Results revealed that misleading items were significantly more often falsely accepted as being part of the original event (M = .43, SD = .18) than the foil items (M = .25, SD = .07; $t(36) = 3.24$, $p < .001$), overall providing more evidence that our paradigm created a reliable misinformation effect.

correlations between participants' hits and false alarms data revealed differences in behaviour when looking at the two time-delay conditions separately. Whereas no correlations were found in the immediate condition, in the delay condition more hits were associated with more false alarms for the misleading as well as the foil items.

Remember, Know, and Guess analysis. Table 4 shows the proportion of Remember, Know, and Guess responses for each item type as a function of Condition and Time of misinformation. First, we ran the same ANOVAs as above for participants remember responses only. A 3(Item type: original item vs. misleading item vs. foil item) x2(Time of misinformation: 1-day vs. 1-week) mixed factor ANOVA yielded a significant main effect of Item type, $F(2, 100) = 27.06$, $p < .001$, $\eta_p^2 = .35$. Pairwise comparisons showed no difference between original items and misleading items but participants correctly remembered more original items ($M = .16$, $SD = .16$) than they falsely remembered the related foil items ($M = .02$, $SD = .05$). In addition, the misleading items ($M = .18$, $SD = .17$) were more often falsely remembered than the foil items ($ps < .001$). Analysis showed no main effect of Time of misinformation $F(1, 50) = 1.59$, $p = .21$, but there was a significant interaction between Item type and Time of misinformation, $F(2,100) = 9.95$, $p < .001$, $\eta_p^2 = .16$. Further analysis of the simple main effects was conducted using Bonferroni adjusted alpha levels of .016 (.05/3). Looking at the effects of Time of misinformation at each level Response type, results showed that the misleading items were significantly more often remembered in the 1-week delay ($M = .25$, $SD = .18$) compared to the 1-day delay condition ($M = .11$, $SD = .12$), $t(50) = 3.38$, $p = .001$, $d = .85$. However, no such difference was found for the original and the foil items (all $ps > .30$; see Figure 5). Alternatively, looking at the effects of Response type at each level of Time of misinformation, results revealed main effects of Item type for both the 1-day delay,

$F(2, 50) = 10.60$, $p < .001$, $\eta_p^2 = .30$, as well as the 1-week delay condition, $F(2, 50) = 29.56$, $p < .001$, $\eta_p^2 = .54$. However, whereas in the 1-day delay condition pairwise comparisons showed a numerical trend of more remember responses for original items ($M = .19$, $SD = .17$) compared to the misleading items ($p = .22$), a reversed trend was found in the 1-week delay condition. Here, the misleading details were more often remembered than the original items ($M = .14$, $SD = .12$; $p = .002$). In both delay conditions, original as well as the misleading items were more often remembered than the foils ($ps < .007$).

Looking at remember responses for original items across condition, a 2(Condition: misled vs. control) x2(Time of misinformation: 1-day vs. 1-week) mixed factor ANOVA revealed a main effect of Condition, $F(1, 50) = 43.93$, $p < .001$, $\eta_p^2 = .47$. More original items were remembered in the control ($M = .31$, $SD = .19$) relative to the misled item condition. There was no main effect of Time of misinformation ($F < 1$), or a significant Item type X Time of misinformation interaction, $F(1, 50) = 1.39$, $p = .244$.

For completion, we ran the same analysis separately for participants' know and guess responses. For participants' know responses, there was significant main effect of Item type, $F(2, 100) = 32.41$, $p < .001$, $\eta_p^2 = .39$. Here, pairwise comparisons showed no significant difference between original items ($M = .23$, $SD = .15$) and misleading items ($M = .20$, $SD = .12$), but know responses to both item types were higher compared to know judgements to the foil items ($M = .08$, $SD = .09$, both $ps < .001$). There was no main effect of Time of misinformation and no significant Item type X Time of misinformation interaction. Across condition, there were no main effects or interactions for know responses. For guess responses, no main effects or interaction within or across conditions were found (all $Fs < 1$).

Hence, the misinformation effect found in the overall recognition scores was confirmed when participant's remember as well as know responses only were compared. Data also suggested that Time of misinformation had a significant effect on participant's remember responses that was only revealed numerically in the raw recognition scores. The 1-week delay of misinformation seemed to increase remember responses for the misleading items. Whereas statistically, no difference was found for the original and the foil items, numerically there was a reversed trend for original items in the misled item condition. Here, data suggest a decrease of remember responses in the 1-day delay compared to the 1-week delay condition (.19 vs. .14). In addition, data suggested that remember responses for the original items numerically exceeded these of the misleading items in the 1-day delay condition but that a reversed and significant trend was found in the 1-week delay condition.

We also investigated Remember, Know, and Guess response patterns within the different Item types in the misled item condition to see whether these patterns would differ as a function Time of misinformation. We ran 3(Response type: remember vs. know. vs. guess) x 2(Time of misinformation: 1-day vs. 1 week) mixed factor ANOVAs separately for original items, misleading items, and foil items. For original items there was a main effect of Response type, $F(2,100) = 10.39$, $p < .001$, $\eta_p^2 = .17$. Bonferroni pairwise comparisons showed that original items were more often known than guessed (M = .09, SD = .13; $p < .001$) and borderline more often remembered than guessed ($p = .06$). There was no difference between the amount of remember and guess responses ($p = .15$). There was no main effect of Time of misinformation and no significant Item type X Time of misinformation interaction (all *Fs* < 1).

The same analysis for misleading items revealed a significant main effect of Response type as well, $F(2,100) = 8.85$, $p < .001$, $\eta_p^2 = .15$. Whereas there was no difference between remember and know responses ($p = 1.00$), differences were found between remember and guess judgements ($p = .007$) and also between know and guess responses ($p < .001$). There was no significant main effect of Time of misinformation, $F(1,50) = 2.80$, $p = .10$, but as per the analysis above, there was a significant Item type X Time of misinformation interaction, $F(2,100) = 9$ 6.87, $p = .002$, $\eta_p^2 = .12$. Simple main effects were analysed by examining the effect of Response type at each level of Time of misinformation. One-way repeated measure ANOVAs revealed main effects of Response type in both, the 1-day delay, $F(2,50) = 4.89$, $p = .012$, $\eta_p^2 = .16$, as well as the 1-week delay condition, $F(2,50) = 10.16$, $p < .001$, $\eta_p^2 = .29$. However, pairwise comparisons revealed different response patterns within each of these conditions. Whereas the misleading items were more often known ($M = .21$, SD = .13) than remembered ($M = .11$, SD = .12) in the 1-day delay condition, after a delay of one week, there was no difference between remembering ($M = .25$, SD = .18) and knowing ($M = .19$, SD = .12, $p = .44$). In fact, numerically, the trend was reversed. For foil items a main effect of Response type was revealed as well, $F(2,100) = 8.22$, $p < .001$, $\eta_p^2 = .14$, with pairwise comparisons showing that these items were more often known ($M = .08$, SD = .09) than remembered ($M = .02$, SD = .05; $p < .001$) with no other differences between response types. There was no main effect of Time of misinformation and no significant Item type X Time of misinformation interaction (all *Fs* < 1).[13]

---

[13] In the control condition, analysis yielded a main effect of Response type for original items, $F(2,100) = 28.23$, $p < .001$, $\eta_p^2 = .36$. More original details were remembered ($M = .31$, SD = .19) than both known ($M = .20$, SD = .15; $p = .032$) and guessed ($M = .06$, SD = .09; *p*s < .001). In addition, they were more often known than

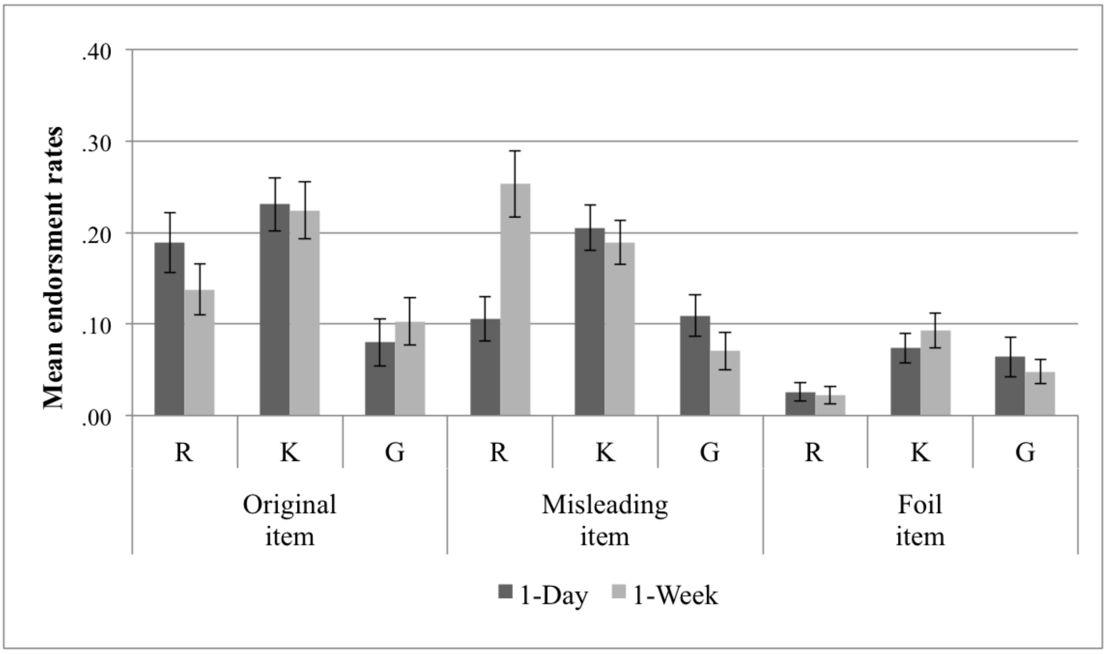


Figure 5. Proportions of Remember (R), Know (K), and Guess (G) responses in the misled item condition as a function of Time of Misinformation. Error bars represent standard errors of the mean.

To summarize, data suggest that the response pattern within an item type only differed for the misleading items depending on the time the misinformation was presented. Whereas overall, there was no difference between remember and know judgements for the misleading items, further analysis showed that this trend was only valid in the 1-week delay condition. When misinformation was received after 24 hours, know responses exceeded the amount of remember responses. However, with a longer delay between original event and misinformation phase, the trend was almost reversed with misleading items being (numerically) more often remembered than known. Whereas there was no difference between remember and know judgments for original items in the misled item condition, in the control item condition a clear

---

guessed (p < .001). There was no main effect of Time of misinformation and no significant Item type X Time of misinformation interaction (all *Fs* < 1). Last, there was a main effect of Response Type for control foil items, $F(2,100) = 2.04$, $p < .001$, $\eta_p^2 = .20$, with foils being more often known (M = .09, SD = .10) than remembered (M = .02, SD = .05; p < .001) and more often known than guessed (M = .04, SD = .07; p = .006). There was no main effect of Time of misinformation and no significant Item type X Time of misinformation interaction (all *Fs* < 1).

pattern of more remember than know and more remember and know than guess responses was found. Last, the foil false alarms in misled and control item conditions were more often based on know, relative to remember responses.

Source-monitoring test data. Table 5 shows the proportion of overall robust memory performance as well as individual responses in the source-monitoring task to all three item types as a function of Condition and Time of misinformation. To recap, in the source-monitoring task participants were asked to reconsider the sources of their recognition test answers by choosing from different source options (see notes Table 5). We ran the same main ANOVAs as above on participants' robust memory performance. Again, in the misled item condition, analysis revealed a significant main effect of Item type, $F(2, 100) = 21.66$, $p < .001$, $\eta_p^2 = .30$. Bonferroni pairwise comparisons showed that more misleading items were falsely attributed to the original event (*M* = .23, *SD* = .17) than original items were correctly attributed to the original event phase (*M* = .14, *SD* = .16; *p* = .019). In addition, both items types were more often attributed to the original event than the foil items (*M* = .06, *SD* = .09, $p < .001$, *p* = .004). There was no main effect of Time of misinformation ($F < 1$), but there was a significant interaction between Item type and Time of misinformation, $F(2,100) = 5.67$ $p = .005$, $\eta_p^2 = .10$. Further analysis of the simple main effects with Bonferroni adjusted alpha levels of .016 (.05/3) revealed that robust false memory rates for misleading items were higher in the 1-week delay condition (*M* = .29, *SD* = .17) compared to the 1-day delay condition (*M* = .17, *SD* = .14), $t(50) = 2.57$, *p* = .013, *d* = .77. However, there was no difference in robust memory performance for the original and the foil items (all *p*'s > .05).

Comparison of original items across condition (misled vs. control) revealed a main effect of Item Type as well, $F(1, 50) = 24.22$, $p < .001$, $\eta_p^2 = .33$, with more correct source attributions in the control (M = .19, SD = .18) relative to the misled item condition. There were no other significant main effects or interactions (Fs < 1).

Table 5. Mean proportion (SE) of robust memory performances (source attributions) total and broken down by response for each item type as a function of Condition and Time of misinformation.

Condition/ Response type	*Item type/Delay of Misinformation*								
	Original items (hits)			*Misleading items (false alarms)*			*Foil items (false alarms)*		
	Total	1 Day	1 Week	Total	1 Day	1 Week	Total	1 Day	1 Week
Misled item									
Robust	**.14 (.022)**	.17 (.040)	.11 (.019)	**.23 (.023)**	.17 (.027)	.29 (.034)	**.06 (.012)**	.06 (.014)	.06 (.019)
(1) Saw 1 only	**.11 (.023)**	.14 (.041)	.07 (.018)	**.05 (.009)**	.03 (.008)	.07 (.015)	**.03 (.008)**	.02 (.007)	.04 (.015)
(2) Saw 2 only	**.05 (.012)**	.04 (.016)	.06 (.018)	**.05 (.009)**	.04 (.011)	.06 (.014)	**.01 (.003)**	.01 (.005)	.01 (.004)
(3) Both	**.13 (.017)**	.13 (.020)	.14 (.027)	**.18 (.020)**	.14 (.027)	.22 (.029)	**.03 (.008)**	.04 (.013)	.02 (.010)
(4) Conflicted	**.03 (.008)**	.03 (.009)	.04 (.013)	**.04 (.010)**	.04 (.012)	.05 (.017)	**.01 (.005)**	.01 (.005)	.02 (.008)
(5) Guessed	**.15 (.019)**	.16 (.026)	.15 (.028)	**.15 (.016)**	.18 (.023)	.12 (.021)	**.08 (.018)**	.08 (.033)	.08 (.015)
Control item									
Robust	**.29 (.026)**	.29 (.036)	.30 (.037)				**.06 (.011)**	.06 (.016)	.06 (.016)
(1) Saw 1 only	**.07 (.015)**	.05 (.019)	.08 (.024)				**.03 (.009)**	.04 (.011)	.03 (.015)
(2) Saw 2 only	**.06 (.012)**	.05 (.015)	.08 (.019)		**n.a.**		**.01 (.003)**	.01 (.004)	.01 (.004)
(3) Both	**.29 (.026)**	.29 (.036)	.30 (.037)				**.03 (.006)**	.03 (.008)	.03 (.009)
(4) Conflicted	**.03 (.011)**	.04 (.020)	.03 (.009)				**.01 (.003)**	.01 (.004)	.01 (.005)
(5) Guessed	**.11 (.013)**	.12 (.023)	.10 (.014)				**.08 (.013)**	.07 (.019)	.08 (.019)

Note. Item types were coded robust when one of the following options were ticked by a participant: Original item: misled (1) or (4), control (3); Misleading item: (1) or (3), Foil item: misled and control (1) or (3). Robust memory performances in bold font.

Hence, analysis of participants' robust memories mirrored most trends found in participants' overall memory performance and remember responses. One exception was found in that false attributions of the misleading items even exceeded correct source attributions of the original items in this task.[14] As with participants remember responses, Time of misinformation affected false source attributions of the

[14] Please note that this effect depends on how original items are coded as being robust in the source-monitoring task. One might argue that if false alarms for the misleading items are coded robust if 'saw1 only' and 'both' is selected, the latter being a 'half true' option, this should also apply for original items in the misled item condition. Please note that differences in robust memories performance between the item types disappear if 'both' is included in coding for the original items.

misleading items. After a delay of 1-week participants falsely attributed more misleading items to the original event than after a delay of 1-day. Whereas no such trend was found for the foil items, there was again a reversed numerical trend (non-significant) for original items in the misled item condition suggesting a decrease of correct source attributions in the 1-week delay compared to the 1-day delay condition (.17 vs. .11).

To analyse participants' robust false memories for the misleading items further we examined individual responses in the source-monitoring task as a function of Time of misinformation. Recall that a false alarm for a misleading detail was considered robust when participants falsely indicated that the misleading detail appeared during photo exposure 1 only ('saw 1 only') or during both exposure phases ('both'). A 5(Response type: saw 1 only vs. saw 2 only. vs. both vs. conflicted vs. guessed) x 2(Time of misinformation: 1-day vs. 1-week) mixed factor ANOVA yielded a significant main effect of Response type, $F(4, 200) = 22.69$, $p < .001$, $\eta_p^2 = .31$. Pairwise comparisons showed that participants falsely chose the 'both' option more often than the falsely chose the 'saw 1 only' option ($p < .001$). The correct options 'saw 2 only' and 'conflicted' were less often selected than 'both' was falsely selected or 'guessed' was chosen (*ps* < .001). In addition, 'guessed' was more often selected than 'saw 1 only' (*ps* < .05). No difference between 'saw 1 only', 'saw 2 only', and 'conflicted' were revealed. There was no main effect of Time of misinformation, $F(1, 50) = 2.40$, $p = .13$, but there was a significant Response Type x Time of misinformation interaction, $F(4, 200) = 3.24$, $p = .013$, $\eta_p^2 = .06$. Simple main effects were examined by analysing the effect of Time of misinformation at each level of Response type. However, using Bonferroni adjusted alpha levels of .01 (.05/5) revealed no significant differences between the misinformation delay conditions. Nevertheless, several trends approaching significance are noteworthy. Whereas more participants falsely selected 'saw 1 only' as well as 'both' in the 1-week delay relative to the 1-day delay condition ('saw 1 only': .07 vs. .03, $t(50) = 2.03$, $p = .048$; 'both': .22 vs. .14, $t(50) = 1.96$, $p = .055$), the amount of time 'guessed' was selected was lower in the 1-week delay relative to the 1-day delay condition, .22 vs. .14, $t(50) = 1.90$, $p = .070$. No numerical differences were found for 'saw 2 only, and 'conflicted' (*p*s > .30; see Figure 6)

In sum, data suggest that participants' robust false memories for the misleading items mainly stemmed from falsely believing that the misleading items were seen during both exposures to the pictures (relative to believing that the items appeared during the first exposure to the photos only). Whereas this pattern persisted in both misinformation delay conditions, there was an increase of selecting 'both' and 'saw 1' only in the 1-week delay condition. Here, it seemed that a shift of guessing responses to more 'saw1 only' and 'both' responses was the driving force for this effect. Although not reported above, it should be noted that there was no interaction between Item type and Time of misinformation for the original items in the misled item condition (Fs < 1). However, looking at the means in Table 5, the reduction of robust hits for original items in the 1-week delay condition seemed to stem from choosing the correct 'saw 1' option less often in that longer delay condition. It should also be noted that as in Experiment 1, participants frequently but falsely attributed the original items in the misled item condition to both exposures to the picture, again suggesting that source confusions were not reserved for the misleading details alone.

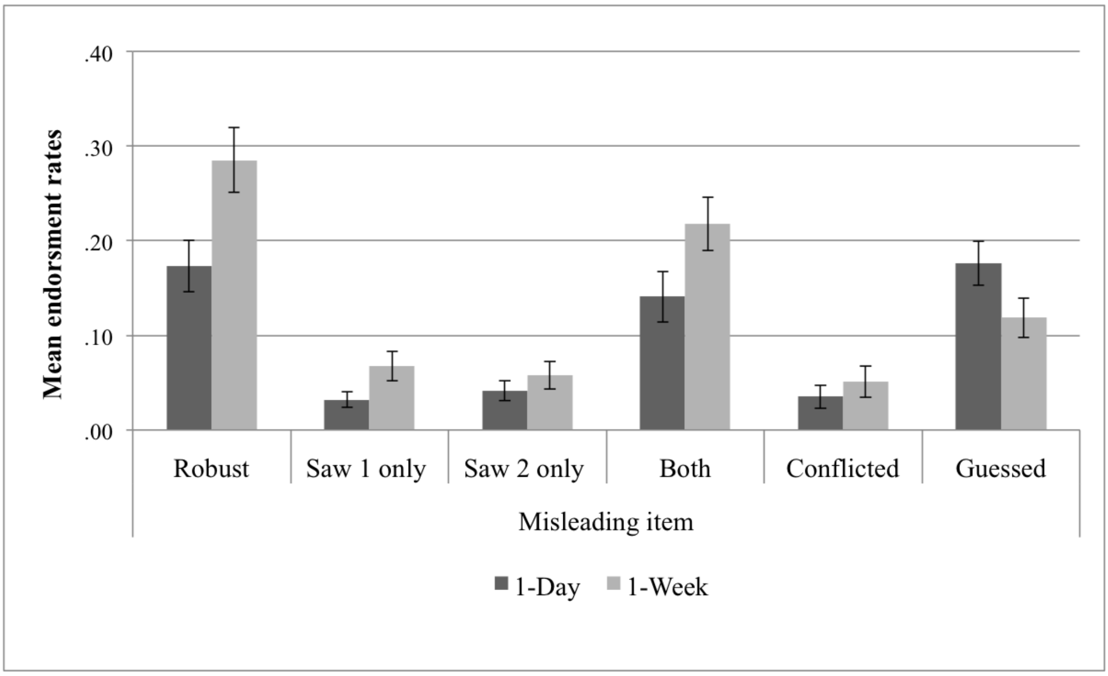


Figure 6. Mean proportion of robust memory performance for misleading items total and broken down by response as a function of Time of misinformation. Error bars represent standard errors of the mean.

Results for the eye-tracking data

In total, 28 participants were tested in front of the eye-tracker. Of these, six participants had to be excluded from this analysis because of high blink rates or eye-calibration problems. Eleven participants were tested in the 1-day delay and the other 11 in the 1-week delay condition.

Descriptively, results of the eye-tracking data showed that participants fixated brands during the first exposure to the pictures on average 26 times (repeated fixations included). Repeated fixations excluded, on average 17.5 different brands were looked at which represented 73% of all brand placements. These values were similar for the misinformation phase (*M* = 24 and *M* = 16.8). Looking at total fixation times on brands during the first exposure to the pictures, results showed that participants fixated the brands on average for 8.6 seconds (*SD* = 3.8; range = 1.04 - 19.28 seconds). During the misinformation phase, again, brands were fixated for almost the same amount of time (*M* = 8.7, *SD* = 4.2; range = 2.21-18.00 seconds). Finally, correlation analysis revealed a significant positive relationship between fixation times on brands during exposure 1 and 2 ($r = .62$, $n = 22$, $p = .002$), suggesting that the longer a participant looked at brands during the first exposure to the pictures, the longer brands were fixated during the misinformation phase (please note that all these trends were similar looking at both delay conditions separately).

To examine whether participant's fixation on the brands had some influence on our misinformation effect measures, we computed Pearson's correlation coefficients between visual fixation on the brands and memory performance rates recorded in recognition and source memory tests. Collapsed over both delay of misinformation conditions, not many of these trends turned out to be significant. However, data revealed a consistent trend of positive correlations between fixation duration during both exposure phases to the photos (Fix 1st and Fix 2nd) and hits for original items (in misled and control item condition) and negative correlations between Fix 1st and Fix 2nd and foil false alarms (in misled and control item condition).[15] For the misleading items this trend was not as consistent as for the other memory types but one correlation was significant. Fix 2nd was correlated with indicating that misleading brands 'conflicted' across phases in the source-monitoring task ($r = .56$, $n = 22$, $p = .008$). Hence, the longer participants fixated on the brands

[15] Here, a few correlations between visual attention and hits as well as foil false alarms turned out to be significant. First, remember responses for the foil false alarms were significantly correlated with fixation duration on brands during the second exposure to the pictures ($r = -.53$, $n = 22$, $p < .010$). Second, in the misled item condition, fixation duration during the first as well as the second exposure to the photos was correlated with choosing the option 'saw 1 only' in the source-monitoring task for original items ($r = .46$, $n = 22$, $p = .035$, $r = .53$, $n = 22$, $p = .014$). Last, an association between fixation duration on brands during the first and second exposure to the photos and falsely choosing 'both' for foils in the misled item condition was found ($r = -.47$, $n = 22$, $p = .033$, $r = -.43$, $n = 22$, -44, $p = .053$).

during the second exposure to the photos, the more often they correctly indicated in the source task that the misleading item conflicted with the originally seen brand.

Table 6. Spearman's rank correlations between visual fixation data on the brands during both exposures to the photographs (Fix 1st and Fix 2nd) and hits and false alarms (including overall recognition data, R, K, G judgements and source-monitoring judgements) for original and the misleading items in the misled item condition as a function of Time of Misinformation.

	Response Type/ItemType									
Condition	Overall	R	K	G	Robust	Saw 1 only	Saw 2 only	Both	Conflict	Guessed
	Original item									
1-day										
Fix 1st	.434	.622*	.299	-.512	.351	.532	-.418	.101	-.711*	-.241
Fix 2nd	.480	.311	.491	-.245	.812**	.824**	-.418	-.482	.000	.234
1-week										
Fix 1st	.101	.417	.005	-.245	.019	-.050	-.326	-.061	.035	.014
Fix 2nd	.311	.216	.323	-.078	-.076	-.271	-.276	.229	.151	.139
	Misleading item									
1-day										
Fix 1st	-.483	-.142	.028	-.504	.120	.569	-.039	-.020	-.472	-.362
Fix 2nd	-.336	-.538	-.283	-.014	-.247	.640*	-.247	-.521	.319	.032
1-week										
Fix 1st	.493	.619*	-.052	-.200	.496	-.289	-.213	.553	.764**	-.070
Fix 2nd	.696*	.826**	-.052	-.020	.608*	-.318	.075	.708*	.815**	.010

Notes: $N = 11$; *$p < .05$, **$p < .01$.

Despite of the small sample size (Ns = 11) we decided to ran the same correlation analysis (Spearman's Rank Order) separately for the 1-day delay and the 1-week delay condition. Table 6 shows these correlations for the misleading items, as well the original items in the misled item condition. Looking at the original items, data revealed a trend of correlations in the expected direction including some significant effects (see Table 6). Data suggest that the longer participants fixated the brands, the more overall hits, remember responses, as well as robust hits they later created for these items. However, these correlations seemed to be somewhat stronger in the short compared to the long delay condition. For the misleading items the correlational trend seemed to slightly differ depending on the delay of misinformation. In the 1-day delay condition, longer fixations to the brands seemed to result in a reduced occurrence of false alarms. However, after a delay of one week 1-week the trend was reversed with more false alarms for the misleading items the longer brands had been fixated. Hence, overall data provide some indication that fixation on the brands did influence how these brands were later remembered.

Results of the DRM task

Of 52 participants 50 completed the DRM task (two participants were not able to stay for DRM task completion).

Memory performance on the DRM task. We first examined whether the DRM paradigm produced a reliable false memory effect. To do this, participants' yes-responses (or 'old' responses) to the three item types (list items, critical lures, and foil items) were entered into a one-way within-participant ANOVA. There was a main effect for Item type, $F(2,98) = 377.65$, $p < .001$, $\eta_p^2 = .89$. Pairwise comparisons revealed that there were more correct yes-responses to list items ($M = .96$, $SD = .06$) than false yes-responses to the critical lure items ($M = .62$, $SD = .28$, $p < .001$). In addition, there were more yes-responses to both list items and critical lures than to the foil items ($M = .08$, $SD = .09$, $ps < .001$). Hence, our data indicated a reliable false memory effect.

Participants' Remember, Know, and Guess responses to the three items types were analysed using separate one-way within-participant ANOVAs. For remember responses there was a main effect of Item type, $F(2,98) = 324.32$, $p < .001$, $\eta_p^2 = .97$. Pairwise comparison showed that list items ($M = .89$, $SD = .12$) were significantly more often remembered than the critical lure items ($M = .36$, $SD = .28$) and foil items ($M = .02$, $SD = .04$, $ps < .001$) Further, lure items more often remembered than the foils (p < .001). Hence, participants remember responses confirmed the trend found in the overall recognition scores. For know responses, there was a significant main effect of Item type as well, $F(2,98) = 22.26$, $p < .001$, $\eta_p^2 = .35$. Here, results revealed more know responses for lures ($M = .20$, $SD = .20$) than for the list items ($M = .06$, $SD = .09$) and foils ($M = .04$, $SD = .05$, $ps < .001$). Last, there was a main effect of Item type looking at the guess responses, $F(2,98) = 8.7$, $p < .001$, $\eta_p^2 = .15$, with more guesses for the lures ($M = .06$, $SD = .11$) than for list items ($M = .01$, $SD = .02$, $p < .01$) and the foils ($M = .02$, $SD = .04$, $p < .05$).

Correlations between DRM and misinformation measures. To see whether there was a relationship between our misinformation and the DRM effect measures we computed Pearson's correlation coefficients between raw scores, signal detection parameters[16], as well as Remember, Know, and Guess judgments recorded in both tasks. Table 7 shows these correlations for participants' false memories recorded in both tasks, more specifically for their raw recognition scores and signal detection parameters. As can be seen, none of these correlations turned out to be significant. Looking at the correlations of core interest, it can be seen that false alarms for the misleading and the foil items in the misinformation paradigm and false memories for the lures and the foils in the DRM paradigm were not at all or even negatively correlated with each other. The strongest correlation ($r = -.19$, $p = .18$) was with participants' foil discrimination in the misinformation task (4. Mis: STD d' FOIL) and participants lure discrimination in the DRM task (9. DRM: STD d' Lures).

[16] Please note that we generally ran signal detection analysis for our misinformation studies throughout this work to separate participant's memory discrimination (*d'*) from their response bias (*c*). However, these results are not reported since all results confirmed the analyses of our raw recognition analyses (including the effects and null-effects caused by our study manipulations). Generally, results showed better discrimination ability for foil items relative to misleading items and more bias to tick 'No' when confronted with a foil item than when presented with a misleading item.

However, this trend was opposite to our expectations. Correlation analysis for remember responses and for participants' true memories for presented items did not reveal any significant correlations either.

Table 7. Pearson's r correlations between raw recognition scores and signal detection parameters of misinformation effect measures and DRM memory performance measures (false alarms only).

		Misinformation measures					DRM measures					
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Mis: Misleading item	.416**	-.360*	.097	-.824**	-.578**	**-.121**	**.000**	**.080**	**-.042**	**.136**	**.063**
2	Mis: Foil item		.029	-.425**	-.447**	-.770**	**-.160**	**-.129**	**.172**	**.107**	**.133**	**.092**
3	Mis: SDT d'			.634**	-.224	-.420**	**.138**	**.032**	**-.139**	**-.042**	**-.111**	**-.022**
4	Mis: SDT d' Foil				-.488**	-.226	**.141**	**.136**	**-.193**	**-.172**	**-.077**	**-.033**
5	Mis: SDT c					.856**	**.029**	**-.036**	**.019**	**.089**	**-.067**	**-.045**
6	Mis: SDT c Foil						**.041**	**.034**	**-.024**	**.003**	**-.054**	**-.055**
7	DRM: Lures							.361*	-.922**	-.196	-.939**	-.429**
8	DRM: Foil								-.464**	-.876**	-.226	-.751**
9	DRM: SD d' Lures									.468**	.734**	.258
10	DRM: SDT d' Foils										-.069	.350*
11	DRM: SDT c Lures											.528**
12	DRM: SDT c Foil											

Notes: N = 50; $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. Mis = Misinformation. SDT = Signal detection theory measures. Correlations of interest in bold font.

Comparison of findings Experiment 1 and 3

In order to see whether measures present in Experiment 3 (more prominent brands placement and the use of normed brands) led to statistical differences in participants' hit and false alarm rates, we ran an analysis across Experiments 1 and 3. However, in order to reduce the risk of confounding variables, we only compared the conditions that had used similar delay intervals between the paradigm stages (original event, misinformation phase, final tests). More specifically, we compared results of Experiment 1's 'Time of test condition 2' (*N* = 30; Original event Day 1; Misinformation Phase 30 min later; Final test Day 2) and Experiment 3's 'Time of misinformation condition 1' (*N* = 26; Original event Day 1; Misinformation Phase

Day 2; Final test Day 3). Whereas still not ideal for comparison, we believed that such an analysis would be a valid way of examining any potential trends due to these changes.

First, we ran a 3(Item type: original item vs. misleading item vs. foil item) x2(Experiment: Experiment 1 vs. Experiment 2) mixed factor ANOVA in the misled item condition. Here, we were specifically interested in whether there would be an interaction between Item type and Experiment. Analysis yielded a main effect of Item type, $F(2,108) = 39.48$, $p < .001$, $\eta_p^2 = .42$. There was no main effect of Experiment ($F < 1$) but there was a significant Item type x Experiment interaction, $F(2,108) = 4.54$, $p = .013$, $\eta_p^2 = .08$. However, further analysis with Bonferroni adjusted alpha levels did not reveal any significant differences between the means. Nevertheless, the numerical trends should be reported. Whereas foil items were more often falsely endorsed in Experiment 1 ($M = .24$, $SD = .27$) compared to Experiment 3 ($M = .16$, $SD = .18$), $t(54) = 2.07$, $p = .043$, the misleading items were more often falsely endorsed in Experiment 3 ($M = .43$, $SD = .18$) compared to Experiment 1 ($M = .33$, $SD = .20$), $t(54) = 1.90$, $p = .063$. Numerically, also the hit rate for original items increased from Experiment 1 to 3 (.44 vs. .49). Last, running the analysis across condition, there was no significant Item type x Experiment interaction ($F < 1$) for original items. Here, the hit rate for control items did not increase from Experiment 1 to 3 (.55 vs. .56).

Hence, comparison of results across experiments gave some indication that the measures applied in Experiment 3 were effective. That is, foil items were indeed less often falsely endorsed in Experiment 3 and at least in the misled item condition, hits for the original items slightly increased. However, the false endorsement rate for misleading items also increased in Experiment 3. In fact, participants in Experiment 3 were not able to discriminate between original items on which they were misled from their misleading alternatives. However, it is unclear whether these effects did indeed stem from the changed study materials or whether it was the further delay of 1 day between original event and misinformation phase in Experiment 3 that was responsible for this change.

Discussion

Experiment 3 aimed to replicate the brand misinformation effect found in Experiment 1 and to deal with some unexpected study outcomes that were revealed in that study (low hit rates for presented items and high foil false alarm rates for non-presented foils). To increase the hit rates in the paradigm, altered study materials were used with normed as well as more prominently positioned brands. To explore and to reduce the occurrence of foil false alarms, more weakly associated foils replaced the highly related foil items in the final memory test. In addition, the experiment explored whether the production of hits and false alarms of this study would differ depending on whether misinformation was received after one day compared to one week. Last, examination of eye-fixation data as well as a sub-experiment examining potential correlations between misinformation and DRM effect measures, accompanied this study.

Effects of retroactive product replacement on memory performance

Experiment 3 revealed a reliable misinformation effect caused by retroactive brand replacements in photographs. In the recognition test, 47% of the misleading brands were falsely attributed to the original exposure to the photos. This was the same amount that participants correctly attributed the originally seen brands to the original photo exposure (.48; but on which they were later misled). This finding suggests that participants were not able to discriminate between the originally seen and the misleading brands. However, both original as well as the misleading brands were clearly more often attributed to the original event compared the weakly related foils, suggesting that our results were more than just caused by pure guessing mechanisms. Our data also suggest the presence of a memory impairment effect. Original event accuracy in the control item condition exceeded accuracy in the misled item condition (in which participants were misled on an original item). Again, we found all these patterns not only in the overall recognition scores but also in participants' more refined remember responses as well as robust memory performance in the source-monitoring task (see theoretical discussion of Experiment 1). Hence Experiment 3 replicated the brand misinformation effect that was already found in Experiment 1. In addition, even if in non-significant form, changes in study materials as well as brand norming in Experiment 3 seemed to slightly increase these effects. For instance, Experiment 3 did evince an overall higher hit rate as well as less foil false alarms compared to Experiment 1.

Effects of misinformation delay on memory performance

Although numerically our data supported the predicted trends concerning the delay of misinformation (i.e. more false alarms for misleading items in the 1-week delay condition and more hits for original items in the 1-day condition) the effect was not significant in participants' overall recognition scores. However, false alarms for the misleading brands were more often remembered and also more often robustly endorsed in the source-monitoring task after the long compared to the short delay of misinformation exposure. Further inspection of participants' robust false alarms indicated that it might have been a shift of guessing responses (in the short delay condition) to more often falsely attributing the misleading items to the original event only or both event phases that seemed to have caused this effect in the long delay condition (please note that this effect was not statistically significant). Hence, after a longer delay, participant's belief that the misleading items indeed appeared during the first exposure to the photos seemed to be stronger. The explanation for these effects is likely to be found in the perceptual characteristics of the original event memory that changed over the delay (Loftus et al., 1992; Paz-Alonso & Goodman, 2008).

From a Discrepancy Detection principle point of view (Tousignant et al., 1986) it is likely that these effects occurred because the delay reduced participants' capability to detect the discrepancies between the original event and the misinformation phase. Specifically, for remember responses, over the short delay participants might have been more likely to reject a misleading item as being remembered because perceptual detail of the competing original memory trace was still relatively strong. This might have facilitated discrimination ability between the items. The fact that remember responses to the original items numerically exceeded those for the misleading items in the short delay condition speaks for this assumption. However, over the long delay, this trend shifted with participants remembering the misleading items more often than the original items. As specific details about the original event might have further decayed, discrepancies between perceptual details of both event phases might have been not or less often detected. Thus, the amount of remember responses for the misleading details increased. In this process the pictorial presentation format of our misinformation materials might have further boosted the amount of remember responses because they enforced perceptual detail for the misleading items. Similar mechanisms might have acted when participants robustly endorsed their recognition test answers in the source-monitoring task. As the original event memory weakened over the delay, participants were more vulnerable to falsely attribute the misleading details to the original event because discrepancies were less often noticed.

In this context, the relationships between participant's hits and false alarms should be mentioned that differed between both misinformation delay conditions. In the 1-day delay condition, participants' hits for original items and false alarms for the misleading items were not correlated. However, looking at the long delay condition, it seemed that the more hits for original items, the more false alarms for the misleading as well as the foil items were produced by a participant. These results may be explained by using the Fuzzy Trace Theory positing that participants may have incorrectly recognised the (in this case) pictorial misinformation because it activated gist memory for the original information. Over the short delay, verbatim information for the original event information may have still been strong and stood in direct competition with the misleading and new foil information. However, with the delay of time, verbatim memory for the original event might have decayed more rapidly than the gist memory, resulting in accessing the latter representation when decisions were made. Because it is known that gist memory can lead to memory errors, this might have been what caused the increase in remember judgements as well as in robust memory performance (Reyna & Titcomb, 1997).

The reason why overall memory performance in the recognition test was not significantly affected by the time delay may have been due to the time intervals used in this study. Previous research typically compared relatively short (e.g. 10 minutes) to long intervals (e.g. 1 or 2 weeks). In our study we chose to compare 24 hours versus 1 week. In addition, the final memory test was not administered immediately after misinformation presentation but with another delay of one day. However, previous research suggests that misinformation effects are the strongest with a substantial amount of time between the original event and misinformation phase and a final memory test that is applied soon after (i.e. minutes after the presentation of misinformation; Belli et al., 1992; Loftus et al., 1978). It is likely that the additional delay included in this study somewhat diluted our effects. This design was chosen because revisiting your Facebook page and the subsequent brand choice situations (e.g. choosing a brand in supermarket shelves) is unlikely to happen immediately. Anyway, our results provided some reason to assume that a delay of exposure to retroactively inserted brands in photos could strengthen consumer's belief that such brands were originally experienced.

Effects of visual fixation on the brands.

Participants' eye-movements on the brands were recorded in order to see whether fixation on the brands would shed some light on the role of fixation/encoding processes in the misinformation effect. In regard to this a more general analysis showed that fixation time on the brands did not differ between the first and the second exposure to the pictures and that both variables were positively correlated. This means that the longer a participant looked at the brands during the first exposure to the pictures, the longer she or he fixated the brands during the misinformation phase. In turn this could suggest that some participants were aware of the brand placements in the pictures and others were not.

When looking at the correlation analysis, data revealed some evidence that the amount of time participants fixated the brands was associated with the hits and more false alarms that were later created. However, data also suggested that these effects differed depending on the misinformation delay condition. More specifically, more visual attention to the brands during both exposures to the photos seemed to be associated with more remember responses, as well as more robust true memories for the originally seen brands. However, whereas visual attention to brands seemed to rather reduce misinformation false alarms in the short delay condition, over the long delay, visual fixation, particular during the second exposure to the photos, seemed to increase false alarms for the misleading items. Although data were based on a small sample size only, our results show that eye-tracking technology and visual fixation data might help to better understand encoding specific processes involved in the misinformation effect. Future studies should consider using a larger sample size to run more comprehensive analysis on bigger datasets. For example, due to time delay differences in participants' behaviour our small sample size in each condition was not suitable to compute more comprehensive regression modelling.

Concerning improving the study materials for future studies, item position analysis showed that some placement positions were fixated longer than others but all in all only a few outliers were detected in the data (these data were not reported in the results section). On the lower end it was the computer brands, which were quite small and non-prominently placed, that were fixated the shortest. Website comparison brands on the other hand, which contributed strongly to the meaning of the scene and which might have presented rather unusual placements, were fixated the longest. A future study should consider excluding these placements from study materials.

DRM and misinformation effect measures. The aim of the DRM sub-experiment was to see whether DRM false memories were somehow related to false memories created in the misinformation paradigm. Rather than only focussing on potential correlations between false alarms for the misleading items and false alarms for the critical lures, we were specifically interested in whether spontaneously created false memories in both paradigms were associated. To investigate this, participants completed a DRM task that was, similar to the misinformation task, an incidental memory task. Although both false memory paradigms obtained a robust false memory effect, none of the variables recorded in our studies were significantly correlated. Consistent with previous research (e.g. Ost et al., 2013), no correlations between false alarms for the misleading items and any of the DRM effect measures were found. Hence, our findings are in line with studies supporting the notion that false alarms for the critical lures in the DRM paradigm and false alarms for the misleading items in the misinformation paradigm are different in nature. Considering that one memory error is internally generated (DRM false alarms) and the other based on external suggestion (misinformation false alarms), the memory errors created in the different paradigms may indeed rely on different underlying mechanisms (Ost et al., 2013; but see Otgaar et al., 2016).

Also in regard to spontaneously generated false memories created in both paradigms, no significant relation was found. Data did not provide any indication that those participants who were prone to falsely accept a non-presented foil brand in the misinformation paradigm were prone to create lure or foil false alarms in the DRM paradigm as well. In fact, if at all a negative relationship was found between the variables. These findings seem to be consistent with the study of Zhu et al. (2013) who did not find an association between spontaneously generated errors in both paradigms. However, rather than concluding that spontaneously created false memories across paradigms do not stand in any relationship either, it is possible that these null-effects may lay in methodological differences between the tasks. For example, on a more general level it is an entire associated word list that serves to trigger memory errors for the lures and foils in the DRM paradigm, whereas only one or two categorically related items lay the basis for the foil false alarms in the misinformation paradigm. Related to this, a study by Otgaar et al. (2016) did find significant and positive relationships between DRM and misinformation effect measures by increasing the amount of associated items during the original event of a misinformation experiment. Hence, a next study should increase the amount of categorically related brands in the photos to see whether these results can be replicated in the brand paradigm used here. In addition, the characteristics of the study stimuli might be responsible for the null effect. For instance, whereas brands were used as study stimuli in the misinformation paradigm, participants dealt with presented and non-presented words in the DRM task. Future research should consider using a DRM brand learning task instead (Sherman, 2012; Sherman & Moran, 2011). Last, the small sample size used in this study should be noted of course and in order to reveal more conclusive results it should be increased in a future study.

Implications of Experiment 1 and 3

In relation to the implications for consumers and advertising, Experiment 3 and 1 support previous findings that post-experience advertising can influence consumer memory for previously seen brands (e.g. Braun & Loftus, 1998). The findings suggest that memory for an originally seen brand placement can be altered by using manipulated photographs. For advertisers, social network platforms provide the ideal and unique platform to expose consumers to misleading brand information. Billions of new pictures are uploaded on social network platforms each day – pictures that are liked, shared and re-shared by many other members of the social network. Many of these pictures show social situations at parties or group pictures that frequently contain unintentional brand insertions such as beer brands, soft drink brands, or crisp brands. Even without misleading measures, our data suggest that these brand occurrences might have an influence on consumer memory. In order to increase recognition and awareness of their brands, advertisers could make use of this knowledge and strategically replace brands and products in pictures to their advantage.

It appears, then, that retroactive brand replacement could be a powerful tool. In Experiments 1 and 3, participants experienced the brands by seeing impersonalized photographs and brands that were not witnessed in a real-life setting. This approach was chosen in in a first step because photos might be watched and re-watched on social network platforms. Even if participants were not shown themselves in those photos, results of these proof of concept studies provide insights regarding how brands in photographs are remembered and how retroactive brands replacements in the photographs can influence such an original brand memory. However, in a next step it would be interesting to examine how these effects will develop under more real-life circumstances. Research has shown that participants can be misled on personally witnessed events and actions (e.g. Holmes & Weaver, 2010; Nash et al., 2009). How will retroactively inserted brand photographs influence the original experience of a brand?

Conclusion

To conclude, twice we have shown that retroactive brand replacements in photographs could mislead on brands that were originally experienced in photographs. Although Experiments 1 and 3 both revealed a reliable misinformation effect, more prominent brand placements as well as normed brands at study and test somewhat led to stronger effects in Experiment 3. Results showed that the timing of misinformation presentation might play an important role when participants are exposed to retroactive brand replacements. The greater the delay, the more the original event memory is forgotten, and the stronger the participants' belief that misleading brands were experienced during an original event. We found evidence to suggest that visual fixation on the brands as measured using eye-tracking technology might be a useful tool to better understand the encoding processes involved in the misinformation effect. Some evidence was found that longer fixations on the brands led to more true memories for originally seen brands but it also led to more false memories for the misleading brands. On the other hand, these results provide some reason to assume that longer fixation of study brands might reduce false alarms for non-presented foil items. However, the present data suggest that it might not only be attention to the brands that influences memory performance in the misinformation paradigm, but that this factor may interact with delay of misinformation presentation. More research using larger sample sizes is needed in order to further explore these effects. Last, our study did not reveal any indication that spontaneously created false memories between DRM and misinformation tasks are in any way related. However, future research needs to clarify whether the effect is indeed absent or whether it was methodological differences that were responsible.

Chapter 6: Experiment 4 – Memory distortions for self-experienced brands caused by misleading SenseCam pictures

Experiment 4 – Memory distortions for self-experienced brands caused by misleading SenseCam pictures

Experiments 1 and 3 revealed a reliable brand misinformation effect caused by retroactively changed brands in photographs. In both experiments, participants were exposed to the same photographs including brand placements on two occasions. When participants saw the pictures the second time, some product brands were replaced by a competitor brand. Results revealed that in some cases, participants indeed falsely attributed the competitor brands (misinformation) to the original photo exposure. Hence, both studies provided the first support for the effectiveness of retroactively replaced brands in photos on consumer memory.

However, in these studies, the original brand experience was induced by exposing participants to photographs of strangers and brands were not personally experienced. One question that naturally arises then is how effects will develop under more personalized circumstances? We have already discussed research showing that manipulated pictorial stimuli can mislead on self-experienced events (e.g. Nash & Wade, 2008; Nash et al., 2009). As well, we have seen that contradicting brand information can mislead on previously self-experienced brands. For example, the study of Holmes and Weaver (2010) used a modified version of the misinformation paradigm to mislead on brand experiences (compiling a brand care package) via misleading narratives (misleading text on website) and were able to reveal a reliable misinformation effect. However, to our knowledge research has not yet used manipulated photographs to mislead on personally experienced brand information.

Another question that is important concerning the creation false memories is that of individual differences. For instance, research has shown that cognitive traits such as intelligence, working memory, and perception can be linked to performance in the misinformation paradigm (see Zhu, Chen, Loftus, Lin, He, Li, Moyzis, et al., 2010; Zhu, Chen, Loftus, Lin, He, Li, Xue, et al., 2010 for a review of such factors). One variable associated with several of these traits is a participant's age, because it is well known that some cognitive abilities decline with increasing age. On a practical level this question is interesting because older customers represent an attractive market for businesses. For example, the number of people aged 65 and over has increased by 47% since mid-1974 and now makes up 18% of the total UK population ("Ageing of the UK population," 2015). These age trends are expected to continue so that by 2020 people aged 65 or over will increase by another 12% ("Political challenges relating to an aging population: Key issues for the 2015 Parliament," 2015). In addition, more and more older adults use the Internet including social networking sites. According to a report by Pew Research Center (2015), 35% of all American adults aged 65 and older use social media, which is more than three times as much as reported in 2010 ("Social Media Usage: 2005-2015," 2015). Hence, it can be assumed that older adults will increasingly become targets of online and social media advertising. Returning to retroactive product placement, the question arises how such deceptive advertising measures would affect the older adults?

Research has examined whether a participant's age influences suggestibility to misinformation and findings generally suggest that older adults are more vulnerable to misleading information than younger adults (Karpel, Hoyer, & Toglia, 2001; Loftus et al., 1992). For example, Cohen and Faulkner (1989) exposed 32 younger (age range: 25 – 45) and 32 older (age range: 62 - 82) adults to a video clip depicting a crime scene and subsequently to a narrative about the video. Whereas the narrative described the video accurately for half of the participants in each age group, for the other half two original event details were contradicted in the narrative (e.g.

that a man carried a letter instead of a book when he was kidnapped). In a subsequent multiple choice-task, misled older and younger participants falsely accepted the misleading alternative more often compared to their non-misled counterparts. In addition, the misled older participants produced more false alarms for the misleading alternatives compared to the misled younger adults. The study of Schacter et al. (1997) showed a similar effect by using photographs to mislead participants on an originally seen video. When participants were shown photographs of scenes that had not appeared in the video, older but not younger adults falsely attributed the misinformation to the original event. In addition, accuracy for original event information of younger individuals exceeded that of the older participants.

A commonly used explanation for these findings is that older adults have more problems in monitoring the sources of their memories due to age-related declines in some of their cognitive abilities (Schacter et al., 1997). However, studies exist that did not find age differences in the suggestibility to misinformation. For example, by using a source-monitoring task as opposed to simple recognition testing, studies have found that younger and older adults were equally vulnerable to misleading postevent information (e.g. Bulevich & Thomas, 2012; Dodson & Krueger, 2006, but see Mitchell, Johnson, & Mather, 2003). These studies suggest that source-monitoring problems of older adults may be improved by explicit source memory instructions (Bulevich & Thomas, 2012). So how will these age-related differences develop in an advertising context, more specifically, when participants are misled on self-experienced brand information?

Experiment 4 was carried out to address these gaps. It was conducted as part of a collaboration on a study of autobiographical memory in healthy ageing (referred to as the ‘main study’ henceforth). In that main study, younger and older participants took part in several ‘group activities’, during which SenseCams were worn (sensor-augmented wearable still cameras; Hodges et al., 2006). After two weeks, participants returned for the main study and memories for the activities experienced two weeks earlier were recorded. In this main study, SenseCam photographs were used to aid participants’ memories. Experiment 4, a misinformation study, was integrated into the main study such that participants were exposed to some brands on Day 1. Allegedly, these brands had to be evaluated by participants as part of a separate University survey. On Day 14, participants were then exposed to staged SenseCam pictures showing the brand arrangement seen on Day 1 as well as a staged survey result chart that both included misleading brand information. After 80 minutes, in which respondents continued with the normal autobiographical memory study, a recognition test followed by a source-monitoring task were used to examine the uptake of misinformation.

Hence, Experiment 4 differed from the preceding experiments of this project in that the brand stimuli were not seen as brand replacements in photographs, but that they were personally experienced during the original event. In addition, contrary to our previous experiments, the brands were consciously experienced during both event phases and were not presented as background information, a difference likely to influence test performance due to encoding specificity (Campbell, Edwards, Horswill, & Helman, 2007). Nevertheless, research has found reliable misinformation effects under comparable circumstances (e.g. Holmes & Weaver, 2010) and in line with such findings we predicted that participants would create source-confusions and falsely attribute the contradicting brand information to the original brand rating event. Another difference of Experiment 4 is that younger as well as older participants took part in this study and hence individual differences in false memory production were examined. In line with previous research we predicted that older participants would not only falsely attribute more misleading details to the original event but also that the accuracy for original event information of younger participants would exceed that of the older individuals. Whereas this effect might be present in participants' recognition test answers, these differences might disappear in the source-monitoring data.

Method and Measurement

Participants

Participants were 28 younger adults between 18 and 30 years old (mean age = 22.89 years, *SD* = 3.80; 14% male) and 32 healthy older individuals over 65 years old (mean age = 71.31 years, *SD* = 9.55; 34% male). The two age groups were equivalent concerning their Geriatric Depression Scale test scores (*M* = 7.33, *SD* = 3.83 for younger adults; *M* = 7.22, *SD* = 6.46 for older adults; Yesavage & Brink, 1983) and their formal years in education (*M* = 15.93 years, *SD* = 2.62 for younger adults; *M* = 14.81 years, *SD* = 3.65 for older adults). However older participants scored higher on a modified version of the WAIS (Wechsler Adult Intelligence Scale test scores that were estimated from National Adult Reading Test scores; *M* = 107.50 years, *SD* = 11.09 for younger adults; *M* = 117.95, *SD* = 28.30 for older adults), $t(56) = 4.01$, $p < .001$, $d = 1.08$; see section sample characteristics for further discussion). Participants completed the study in 10 groups of five to seven people.

Stimuli

Brand selection. Study stimuli were selected based on the brand recall data collected in Experiment 2 and were the two most popular brands of eight brand categories. To be in line with our cover story (evaluation of brands for a new University shop), all brands fell under the food category. Here, we tried to make sure that brand categories chosen were not gender and age biased, respectively that those brands were anticipated to be familiar to male, female, younger as well as older participants.[17] In the end, study stimuli comprised a crisp brand (Walkers, Doritos), a chocolate brand (Cadbury, Galaxy), a water brand (Evian, Volvic), an orange juice brand (Tropicana, Innocent), a fizzy soft drink brand (Coca Cola, Pepsi), a coffee shop brand (Starbucks, Costa), a beer brand (Heineken, Carling), as well as a cider brand (Strongbow, Bulmers). To increase the ecological validity of our study, each of the brands was represented by a typical product of its category (e.g. a 100g Cadbury and Galaxy milk chocolate bar in the chocolate category). To select foil items for the memory test, the semantic differential data of Experiment 2 were used. Here, two brands per category with a total evaluation score of approximately 4-5 were chosen as test items (in comparison, original and misleading items had a total evaluation score of approximately 1- 2.5).

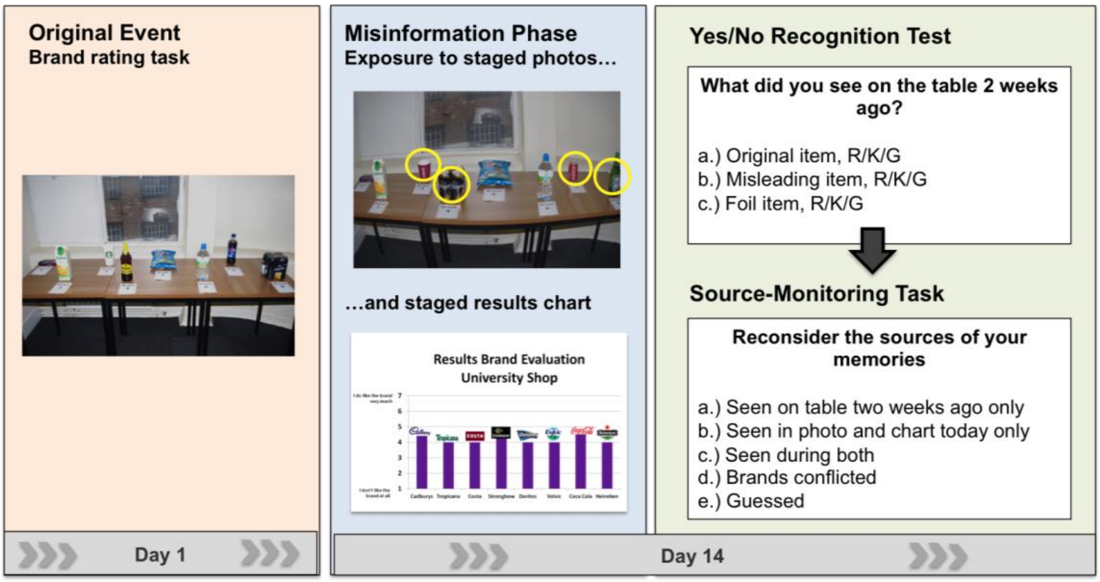


Figure 7. Study design

[17] Please note that the brand categories and single brand were not normed for the older adults. The collaborative nature of the experiment did not allow a preceding norming study for this age group. This matter will be addressed and examined in the results as well as the discussion section of this report.

Study stimuli. Figure 7 shows the design of this study. During the original event (brand rating task), participants were exposed to eight different brands (i.e. to one out of two categorically related study items for each of the eight categories; e.g. a Starbucks cup). The product brands were presented on a table that was placed outside of the main experiment area. The brands were clearly separated from each other and numbered from one to eight. For the brand evaluation task, short questionnaires were provided that listed eight 7-point Likert scales that were also numbered from one to eight. Numbers rather than the brand names were provided on the form in order to force participants to look at the products on the table when judgments were made.

Participants were later misled on four out of eight originally rated brands by replacing these items with the remaining competitor brand of the category (misled item condition; e.g. the Starbucks cup was replaced by a Costa Coffee cup). For the remaining four brands that were originally rated, consistent information was provided (i.e. participants were not misled on these items – control item condition; e.g. the crisp brand Doritos remained the same). To expose participants to the brands again and to induce misinformation, two different media were used. First, participants were shown three manipulated SenseCam pictures of the brand arrangements (one full-length shot of the table and two close-up shots of each side of the table). The second medium used was a staged survey results chart of the brand-liking data. The medium was added to the misinformation phase in order to provide a reasonable storyline about why participants were exposed again to the brands.

Because participants took part in the study in groups, five to seven participants were always exposed to the same combination of originally rated and misleading brands. However, assignment of the two study brands (e.g. Pepsi and

Coca Cola) to item type (original item and misleading item) and to condition (misled and control) was counterbalanced across the 10 groups. To further reduce the risk of item effects, the two foils chosen per category always appeared in the final memory test in a randomized order. For each of the 10 groups, an individual memory test was created. And finally, the order in which brands appeared on the table was counterbalanced across the groups.

Concerning the photos used to induce misinformation it should be noted that rather than manipulating pictures retroactively by means of photo editing software, brands on the table were simply replaced by a competitor brand and the new arrangements were captured with a conventional camera after participants had left. These pictures were later edited to look like the outcome of a SenseCam photograph. This procedure allowed equally good quality shots for all 10 participant groups, which could not have been assured by using participants' SenseCam pictures. In addition, results of the brand liking bar chart were manipulated in such a way that all brands scored more or less equally on how much they were liked. This was done to avoid differences in recognition depending on higher and lower scores.

Procedure

Original event. After completion of the main study tasks on Day 1, participants met for a final gathering in the refreshment and waiting area, with most participants still wearing their SenseCams. Here, participants were exposed to the brands that were positioned on a table. Brands were laid out just prior to the final gathering in order to avoid different exposure times to the brands. Participants were told that a sponsor (the University) supports the experiment in return for a short and anonymous survey on these eight brands – ones that were considered to be included into the product range of a new University shop. Participants were asked to simply indicate for each of the eight brands how much they liked these brands by using 7-point scales.[18] With this procedure we ensured that all participants encoded the original brand information.

Misinformation phase. On Day 14 participants returned to the lab for the recall and review session of the main experiment. However, before participants started the tasks concerning the main experiment, they were shown the staged SenseCam pictures as well as the manipulated survey chart that depicting the misleading information. Participants were told that the University would like to inform participants about the outcome of the brand liking task due to ethical reasons of appropriate research conduct. To remind participants of the brands, first the three SenseCam pictures were shown to participants (for 12 seconds each). Participants were (falsely) told that the photos were taken by different SenseCams of their group colleagues two weeks earlier. This approach was chosen because it was not plausible to tell participants that the pictures were taken by their own SenseCam. Participants rated the brands in groups and might have become suspicious to learn that their own camera had produced such clear shots of the brand arrangement. Following the photo exposure, the bar chart with the brand liking was shown to participants for 14 seconds. Participants were not warned about the potential discrepancies between brands rated two weeks earlier and brands seen in the manipulated media. After, participants continued with the main experiment.

Final memory test. The final memory tests were carried out after participants completed the main experiment, which took on average 80 minutes. First, participants completed a yes/no recognition test for the original event. Here,

---

[18] Please note that these brand evaluation data were not used for analysis. The reason was the collaborative nature of the study that required the task to be quick, simple, and anonymous.

participants were explicitly told that the test strictly referred to the brand-rating task that was completed two weeks earlier. Brand logos appeared on the screen one at a time and participants were instructed to press the ‘yes’ key for brands that were rated and seen on the table two weeks earlier and to press the ‘no’ key if they were not. If ‘yes’ was clicked were participants asked to make a Remember, Know, or Guess judgment. Participants were asked to press ‘Remember’ when they were able to consciously recollect and mentally relive the appearance of that item on the table two weeks earlier. They were asked to consider whether they could visually re-experience the item as well as its position on the table. To press ‘Know’ when the judgment was based on a feeling of familiarity, described as a sensation that the item was on the table but could not be visually re-experienced it on the table. Finally, to press ‘Guess’ for items when they could neither recollect nor recognize it on the basis of familiarity, but which they could not definitely reject. Following this, a final source-monitoring task was carried out. Five options were provided for each of the items endorsed in the recognition test: (1) seen on the table two weeks earlier only, (2) seen in the pictures and the graph at the beginning of this session today only, (3) seen during both phases (on the table two weeks ago and in the pictures and the graph today), (4) brands conflicted with each other across both events, (5) just guessed (see Zhu et al., 2012).

Measurement and analysis

The 20 items of the recognition test consisted of eight of the original items (4 on which participants were misled on and 4 on which participants were not misled on), 4 misleading items that contradicted their original counterparts, and 8 non-presented foil items (including 4 foil items categorically related to the misled and 4 foil items related to the control item condition). Robust memory performance in the source-monitoring task was coded in line with previous research (e.g. Okado & Stark, 2005; but see notes of Table 9).

The main analysis was similar to Experiments 1 and 3. We analysed the uptake of misinformation by first comparing participants' memory performance (yes-responses to items) within the misled item condition and then across conditions (misled item vs. control). These main analyses were carried out separately for participants' overall recognition scores, their Remember, Know, and Guess responses, as well as for participants' robust memory performance of the source-monitoring task. Again, we set an overall standard alpha level equal to .05 for our main analysis (see also Frost et al., 2002). Apart from that, further sub-analyses such as a by-item analysis complemented the results section.

Results

Sample characteristics

Because our dependent variables (yes-responses to the item types) were hits and false alarm scores out of four questions only, data were not normally distributed and often strongly skewed (e.g. foil items that were hardly ever robustly endorsed). Despite this, given the analyses used in the literature for similar datasets (e.g. Frost, 2000; Frost et al., 2002), we used parametric test statistics for the analysis of our data. However, note that all analyses were rerun and effects and null-effects confirmed using non-parametric tests (however these tests are not reported here).

As mentioned earlier, older participants of our sample scored higher on the WAIS compared to younger participants. Entering WAIS scores as a covariate did not influence the effect of age group on the dependent variables of this study. Hence the variable was not included in the analyses reported here. Also, please note that inspection of the data showed participant's gender had no effect on the dependent variables of this study and that the variables was not further considered in the analysis.

Recognition test data

Raw score analysis. Table 8 shows the proportion of yes-responses to the three item types (original details, misleading details, and foil details) correctly and incorrectly accepted as being part of the original event as a function of Condition and Age group.

Table 8. Overall Mean proportion (SE) of yes-responses with proportion of Remember (R), Know (K), and Guess (G) responses for each item type as a function of Condition and Age group.

	Item type/Age group								
Condition /Response type	*Original items (hits)*			*Misleading items (false alarms)*			*Foil items (false alarms)*		
	Total	Younger	Older	Total	Younger	Older	Total	Younger	Older
Misled item									
Total	**.58 (.041)**	.61 (.058)	.56 (.057)	**.61 (.036)**	.63 (.054)	.59 (.050)	**.07 (.021)**	.05 (.027)	.08 (.031)
R	**.34 (.036)**	.29 (.050)	.38 (.050)	**.35 (.039)**	.35 (.059)	.35 (.052)	**.01 (.006)**	.00 (.000)	.02 (.012)
K	**.17 (.026)**	.22 (.041)	.13 (.032)	**.18 (.026)**	.19 (.042)	.18 (.034)	**.04 (.012)**	.05 (.018)	.03 (.015)
G	**.07 (.019)**	.09 (.032)	.05 (.022)	**.07 (.018)**	.09 (.032)	.05 (.019)	**.02 (.010)**	.00 (.000)	.03 (.019)
Control item									
Total	**.89 (.021)**	.90 (.027)	.88 (.032)				**.06 (.015)**	.04 (.018)	.08 (.024)
R	**.68 (.034)**	.65 (.049)	.70 (.047)		n.a.		**.02 (.011)**	.01 (.010)	.03 (.019)
K	**.18 (.026)**	.21 (.040)	.16 (.033)				**.03 (.010)**	.02 (.015)	.03 (.015)
G	**.03 (.010)**	.04 (.017)	.02 (.013)				**.02 (.011)**	.01 (.012)	.02 (.018)

We compared participants' overall yes-responses to the three item types in the misled item condition to examine whether participants could distinguish between originally seen items and originally non-seen items (misleading details and the foils). In addition, we examined whether Age group had any effect on participants' yes-responses in the misled item condition. We ran a 3(Item type: original item vs. misleading item vs. foil item) x2(Age group: younger vs. older adults) mixed factor

ANOVA. Analysis yielded a significant main effect of Item type, $F(2, 116) = 76.54$, $p < .001$, $\eta_p^2 = .57$. Bonferroni pairwise comparisons showed that there was no difference between yes-responses to original items ($M = .58$, $SD = .31$) and the misleading items ($M = .61$, $SD = .28$) but that both were more often accepted than the foil items ($M = .07$, $SD = .16$; both ps < .001). There was no main effect of Age group, and no significant Item type X Age group interaction (Fs < 1).

For further comparison we examined participants' yes-responses to the item types across condition and conducted 2(Condition: misled vs. control) x2(Age group: younger vs. older adults) mixed factor ANOVAs separately for the original and the foil details. For original items, there was a significant main effect of Condition, $F(1, 58) = 48.14$, $p = .001$, $\eta_p^2 = .45$, showing that participants correctly accepted more original details in the control ($M = .89$, $SD = .16$) relative to the misled item condition. There was no main effect of Age group and no interaction between Item type X Age group (Fs < 1). Last, comparing foil items within and across condition revealed no significant main effect of Condition, Age group, and no interaction between the two variables (all Fs < 1).

When combined, the endorsement rates for original items as well as misleading items exceeded a total of 100%. This suggests that in some cases, participants' responded yes to both brands of a category.[19] To examine the relationship between hits and false alarms to these items types, we computed Pearson product-moment correlation coefficients. A negative correlation between original items in the misled and the misleading items was found, $r = -.28$, $n = 60$, $p = .028$, suggesting that the more misleading items were falsely accepted, the less original

[19] Please note that this finding is not of concern because it was for this reason, among others, that a source-monitoring task followed the recognition test. Here, participants had the chance to correct the sources of their recognition test answers.

items were correctly endorsed. No associations between original items and the foils and between misleading items and the foils were found.

Hence, the overall recognition data suggest that participants were misled by the retroactively changed brands in the photographs. When participants were misled on an item, they did not have any ability to discriminate between originally seen items and the misleading items. Further comparisons across conditions showed that participants produced more correct responses for the original details in the control relative to the misled item condition, suggesting the presence of a memory impairment effect. The factor age group did not lead to any statistical differences in the data.[20] Numerically, small trends of more hits and less foil false alarms for the younger compared to older participants can be seen in the data. For misleading items, if at all, the amount of false alarms was numerically higher for the younger participants.

Remember, Know, and Guess analysis. Table 8 shows the proportion of Remember, Know, and Guess responses for each item type as a function of Condition and Age group. We first ran the same ANOVAs as above for participants' remember responses only. Analysis yielded a significant main effect of Item type, $F(2, 116) = 38.28$, $p < .001$, $\eta_p^2 = .40$, but no main effect of Age group, $F(1, 58) = 1.08$, $p = .30$, or an interaction between the two variables ($F < 1$). Pairwise comparisons of the significant main effect showed no differences between remember responses to original ($M = .34$, $SD = .28$) and the misleading items ($M = .35$, $SD = .30$) but both

[20] Please note that we additionally ran all analyses reported in the results section with a sample that only included participants less than 25 years of age ($N = 18$) and over 70 years of age ($N = 18$). This was done to see whether 'Young-younger' and 'Old-Older' participants would differ concerning their memory performance. However, none of the comparisons led to any significant differences between the dependent variables of this study. Also, no effects were found when older participants who obtained a score greater than one standard deviation above the mean reported for the WAIS were excluded from the analysis.

were more often remembered than the foil items (*M* = .01, *SD* = .05; both *p*s < .001). Looking at remember responses for original items across condition, analysis revealed a main effect of Condition, $F(1, 58) = 55.06$, $p < .001$, $\eta_p^2 = .49$. More original items were remembered in the control (*M* = .68, *SD* = .26) relative to the misled item condition.

For participants' know responses in the misled item condition, there was significant main effect of Item type as well, $F(2, 116) = 14.28$, $p < .001$, $\eta_p^2 = .20$. Pairwise comparisons revealed no significant difference between original items (*M* = .17, *SD* = .20) and misleading items (*M* = .18, *SD* = .21), but know responses to both item types were higher compared to the foil items (*M* = .04, *SD* = .09, both $ps < .001$). There was no main effect of Age group, $F(1, 58) = 2.03$, $p = .16$, or an interaction between the variables, $F(2, 116) = 1.35$, $p = .26$. Analysis of original items across condition showed no main effect of Item type ($F < 1$), but a significant main effect of Age group, $F(1, 58) = 4.53$, $p = .038$, $\eta_p^2 = .07$, with more know responses to original items in the younger (*M* = .22, *SD* = .21) compared to the older age group (*M* = .14, *SD* = .18). There was no Item type X Age group interaction ($F < 1$).

Last, there was a main effect of Item type for guess responses in the misled item condition as well, $F(2, 116) = 4.74$, $p = .010$, $\eta_p^2 = .08$, with more guess responses to original (*M* = .22, *SD* = .21) and misleading items (*M* = .22, *SD* = .21) compared to foil items (*M* = .04, *SD* = .09, $ps = .031$ and .011). There was no main effect of Age group, ($F < 1$) and no significant Item type X Time of misinformation interaction, $F(2, 116) = 1.62$, $p = .203$. Across condition no main effects or interactions were found for guess responses to the items (all $Fs < 1$).

To summarize, the trends revealed in participants' overall recognition scores were also revealed when looking separately at participants' remember, know, and partially also their guess judgments to the item types. Statistically, participant's age had little to no effect on memory in this task. However, numerically, the data suggested a trend concerning participants' yes-responses to the original items. Whereas participants' overall raw recognition scores (see earlier) suggested a trend of more hits for younger compared to older participants, participants' remember responses showed a trend that was reversed. Here, more original items were remembered by older compared to younger participants. Considering that the younger participants seemed to respond overall more with know judgments to original items, it seems to have been 'knowing' that led to the initial lead in original item hits for the younger participants.

To examine Remember, Know, and Guess response patterns within the different Item types, we ran 3(Response type: remember vs. know. vs. guess) x 2(Age group: younger vs. older adults) mixed factor ANOVAs separately for original items, misleading items, and foil items. To summarize and emphasize results of interest: Analysis revealed significant main effects of Response type for original items in misled, $F(2, 116) = 20.98$, $p < .001$ $\eta_p^2 = .27$, and control item condition, $F(2, 116) = 126.43$, $p < .001$ $\eta_p^2 = .67$, as well as for the misleading items, $F(2, 116) = 18.08$, $p < .001$ $\eta_p^2 = .24$. No effect of Response type was found for the foils in either of the conditions (Fs < 1). Pairwise comparisons for original and misleading items showed that all items types were more often remembered than known, and also more often known than guessed (all ps < .015). There was no main effect of Age group and no Response type X Age Group interaction for any of the item types (Fs < 1). Hence, participants' yes-responses to original items and the misleading items were overall more often remembered, than known, and also more often known than guessed. For the foils, no significant difference between response types was found. If at all, these items were more often known than remembered.

Source-monitoring test data

Table 9 shows the proportion of overall robust memory performance as well as individual responses to all three item types in the source-monitoring task as a function of Condition and Age group. We conducted the same main analysis as above on participants' robust memory performance. In the misled item condition, analysis revealed a significant main effect of Item type, $F(2, 114) = 32.04$, $p < .001$, $\eta_p^2 = .36$. Bonferroni pairwise comparisons showed that more misleading items were falsely attributed to the original event ($M = .38$, $SD = .27$) than original items were correctly attributed to the original event phase ($M = .24$, $SD = .28$; $p = .012$). In addition, both item types were more often attributed to the original event than the foil items ($M = .02$, $SD = .06$, $ps < .001$). There was no main effect of Age group and no interaction between Item type and Age group ($Fs < 1$).

Comparison of original items across condition (misled vs. control) revealed a main effect of Item Type as well, $F(1, 57) = 39.95$, $p < .001$, $\eta_p^2 = .41$, with more correct source attributions in the control ($M = .59$, $SD = .34$) relative to the misled item condition. There was no main effect of Age group, $F(1, 57) = 2.81$, $p = .10$, and no significant interaction between Item type and Age group ($F < 1$). Hence, analysis of participants' robust memories mirrored the trends found in participants' overall memory performance and remember responses. The factor Age group did not lead to significant differences in participants' robust endorsement rates.

Table 9. Mean proportion (SE) of robust memory performance (source attributions) total and broken down by response for each item type as a function of Condition and Age group.

Condition/ Response type	*Item type/Age group*								
	Original items (hits)			*Misleading items (false alarms)*			*Foil items (false alarms)*		
	Total	Younger	Older	Total	Younger	Older	Total	Younger	Older
Misled item									
Robust	**.24 (.038)**	**.26 (.056)**	**.24 (.048)**	**.38 (.035)**	**.37 (.049)**	**.40 (.052)**	**.02 (.008)**	**.02 (.012)**	**.02 (.011)**
(1) Saw 1 only	.20 (.037)	.22 (.057)	.19 (.048)	.08 (.021)	.06 (.021)	.09 (.036)	.01 (.006)	.01 (.010)	.01 (.008)
(2) Saw 2 only	.02 (.009)	.03 (.015)	.02 (.011)	.08 (.021)	.14 (.037)	.03 (.015)	.01 (.009)	.01 (.010)	.02 (.016)
(3) Both	.22 (.036)	.20 (.047)	.25 (.053)	.31 (.037)	.30 (.052)	.31 (.054)	.01 (.006)	.01 (.010)	.01 (.008)
(4) Conflicted	.04 (.014)	.04 (.017)	.05 (.021)	.03 (.011)	.03 (.015)	.03 (.015)	.01 (.007)	.01 (.010)	.02 (.011)
(5) Guessed	.09 (.021)	.13 (.033)	.06 (.025)	.11 (.018)	.09 (.026)	.12 (.026)	.02 (.009)	.01 (.010)	.03 (.015)
Control item									
Robust	**.59 (.044)**	**.66 (.060)**	**.52 (.062)**				**.01 (.007)**	**.01 (.010)**	**.02 (.012)**
(1) Saw 1 only	.18 (.037)	.13 (.049)	.23 (.053)				.01 (.004)	.01 (.010)	.00 (.000)
(2) Saw 2 only	.05 (.014)	.05 (.020)	.04 (.020)		**n.a.**		.01 (.006)	.01 (.010)	.01 (.008)
(3) Both	.59 (.044)	.66 (.061)	.52 (.062)				.01 (.006)	.00 (.000)	.02 (.012)
(4) Conflicted	.02 (.008)	.04 (.017)	.00 (.000)				.01 (.007)	.01 (.010)	.02 (.012)
(5) Guessed	.05 (.015)	.03 (.015)	.07 (.024)				.04 (.016)	.03 (.020)	.05 (.024)

Notes. Item types were coded robust when one of the following options were ticked by a participant: Original item: misled (1) or (4), control (3); Misleading item: (1) or (3), Foil item: misled and control (1) or (3). Robust memory performance in bold font.

When analysing participants' response patterns within the source-monitoring task individually for the misleading items and the original items in the misled item condition, significant main effects of Response type were found, $F(4,228) = 11.51$, $p < .001$, $\eta_p^2 = .17$; $F(4,228) = 18.73$, $p < .001$, $\eta_p^2 = .25$, but no interaction effects between Response type and Age Group for both items types. Hence, the individual responses made when monitoring the sources of the memories seemed not to be significantly affected by participant's age. However, looking at Table 9, it can be seen that the younger adults chose the 'saw 2 only' for misleading items option more often than older participants. Because an analysis including all source-monitoring options might not have been sensitive enough to reveal this effect we ran an independent *t*-test with Bonferroni adjusted alpha levels of .01 (.05/5). Analysis showed that younger participants (*M* = .14, *SD* = .20) selected the ‘saw 2 only’ option significantly more often than the older adults (*M* = .03, *SD* = .09), $t(57) = 2.84$, $p = .006$, $d = .71$. What this suggests is that older compared to the younger participants hardly ever noticed that the misleading items falsely endorsed in the recognition test did only appear in the misleading materials.

Results item analysis

Last, performance by item was plotted overall as well as separately for younger and older adults (see Appendix K for a table showing the average hit and false alarm rates for all brands used in this study overall and split by age group). First, we computed Pearson product-moment correlation coefficients for correct and incorrect yes-responses to the items between younger and older adults. This was done to see whether younger and older participants behaved similar concerning particular items. Only participants’ hits for original items in the misled item condition were significantly correlated between younger and older adults. This suggest that the more hits for a certain item in that condition was created by one age group, the higher the amount endorsed by the other age group as well, $r = .65$, $n = 16$, $p = .007$. Although not significant, this trend was also found for foil endorsement in misled, $r = .44$, $n = 16$, $p = .086$, and control item conditions, $r = .52$, $n = 16$, $p = .057$. However, although not significant, negative correlations were found for the original items in the control as well as the misleading items, which indicates a different behaviour to particular brands between age groups in these conditions.

Table 10. Pearson's r correlations between yes-responses for each item type and brand knowledge variables recorded in Experiment 2 as a function of condition and age group

	Condition/Item Type/Age Group				
	Misled item condition			Control Item condition	
Brand knowledge variables Ex. 2	Original Item	Misleading item	Foil item	Original Item	Foil item
	Young adults				
Potency	-.045	-.390	-.163	-.326	-.194
Evaluation	-.108	-.399	-.385	-.396	-.010
Activity	-.154	-.458	-.290	-.347	-.162
Recall	.072	.253	n.a.*	.353	n.a.
	Older adults				
Potency	-.110	-.085	-.444	.178	-.303
Evaluation	-.375	-.113	-.398	.151	-.024
Activity	-.348	-.045	-.159	.004	-.426
Recall	.008	.156	n.a.	-.346	n.a.

Notes: N = 16. *Not applicable because no recall data existed for the weakly associated foils

To see whether brand familiarity could play a role in different behaviour of age groups to the item types, we also ran correlation analyses between our brand norming data recorded in Experiment 2 and the hit and false alarm rates for the items recorded in this study (see Table 10). None of the correlations were significant. However, for younger adults, particularly for misleading items and original items in the control item condition, a trend of moderate and negative correlations with the brand rating scale variables as well as positive correlations with the recall data were found. In addition, false endorsement of foil items seemed to be associated with the brand rating variables. Hence, the data suggest a trend of more hits as well as more false alarms for items that were more often recalled and that were rated more well known, better, and as more frequently used in Experiment 2. However, whereas for the older adults this trend was found for original items in the misled item condition as well as for foil items as well, correlation coefficients were weaker for the misleading items and indicated an opposite trend for original items in the control item condition (compared to the younger adults). Hence, considering that brand selection of this study was based on brand preferences of younger individuals (because brand norming in Experiment 2 was administered by younger adults), it might be that the knowledge about a brand led to different behaviour when these items appeared as misleading items or control items. For example, it might have been different mechanisms that drove these hits as well as false alarms in the older age group.

Discussion

Experiment 4 differed from previous studies in that participants were misinformed on event details that were consciously experienced. Misinformation was induced by exposing individuals to staged SenseCam pictures as well as to a staged survey result chart. The main aim of this study was to see whether the staged materials could misinform participants about actual pasts with brands. In line with our previous studies, results suggested that participants confused the sources of information and falsely attributed the misleading brands from the misinformation materials to the original brand-rating event. Again, these effects were not only found in participants' overall recognition scores but also in the more refined remember responses. For the majority of the falsely accepted brands, participants indicated remembering having rated these brands on the table two weeks earlier. In comparison, false memories for the foil items were more often associated with know responses (i.e. participants had the sensation that a brand was presented but they did not remember specific details about the brand on the table). In general, results showed that participants Remember, Know, and Guess response patterns for the falsely accepted misleading items matched that of the original items and not that of the foils. Overall, this indicates that foil and misinformation false alarms were not only different in nature but that the latter false memory type contained the same phenomenological characteristics as participants' veridical memory retrieval of the original items.

A misinformation effect was also revealed when we gave participants the chance to reconsider the sources of their memories. More specifically, even the clear instruction to rethink the sources of their memories led participants to falsely attribute 38% of the misleading brand to the original event exposure. Here, most participants falsely believed that the item appeared during both the original event and the misinformation phase rather than during the original event only. This suggests that participants remembered the misleading details from the misinformation materials.

The effects obtained in this study are stronger compared to the findings of Experiment 1 and 3. Overall, participants produced higher hit rates with more remember responses and also more correct source attributions of originally seen brands. Even if participants were not informed in this experiment that their memories for the brands would be tested at a later stage, it was likely these encoding specific differences led to this outcome. However, stronger original encoding processes seemed not to protect participants from creating high false alarms rates for the brands that were suggested to them.

Two factors may be responsible for this effect. First, the time delay between the original and misinformation events was two weeks. It can be assumed that this delay allowed the original event to be forgotten to such an extent that participants simply did not notice the discrepancies between the original event and the misinformation phase. Second, we believe that the staged SenseCam pictures were perceived as compelling evidence that the depicted misinformation must be true. The fact that we told participants that the pictures were taken by one of their colleague's SenseCams might have increased the credibility that was associated with these photographs. Although we cannot determine how far the staged survey results chart contributed to this effect, we believe that these two factors, combined with a credible cover story, might have led to the adoption of lower source-monitoring criteria when judgments were made.

Participant age hardly affected the dependent variables of this study. Neither did the older participants attribute more misleading items to the original event nor did they show any sign of reduced accuracy for original event items. Only one effect was found in the source-monitoring task potentially suggesting a different behaviour between the age groups. When participants received the chance to reconsider the sources of their recognition answers, data suggested that the younger participants correctly selected the 'saw 2 only' option for the misleading items more often compared to the older participants (M = .14 vs. .03). Hence, although the older participants might have overall not been more suggestible to misleading information, they hardly ever seemed to be aware of the fact that some brands had indeed only appeared in the staged materials seen on Day 14.

Although there might be some weak indication that older adults were more vulnerable to misleading brand information in this study, it is surprising that participant's age did not affect memory performance in the recognition task. In a meta-analysis recently conducted by Wylie et al. (2014), results indicated that 31 out of 39 independent effect sizes showed a trend in the predicted direction (i.e. older adults were more prone to misleading information than younger adults). The remaining eight studies either revealed an opposite effect or null results. Because our sample size was comparable with that of other studies (e.g. Cohen & Faulkner, 1989; Schacter et al., 1997) why is it that our study produced a null effect?

Several factors might be responsible for this outcome. First, it might be methodological issues that suppressed a potential age effect. Although the meta-analysis of Wylie et al. (2014) did not find any moderating effects of factors such as how the original event was presented (video or slides/ photographs), the type of misinformation materials (narrative, recall questions, photographs, audio), or type of memory test (free recall, cued recall, or recognition) on age related differences in misinformation performance, it is possible that our paradigm was not sensitive enough to tap these effects. For example, the ceiling effect for original items in the control item condition might be an indication that our task was simply too easy to produce differences in memory accuracy. On the other hand, our study manipulation might have been so effective that false memory production was pushed to its limits in both age groups with no scope for age related differences. Maybe additional test items including a warning that misinformation was received would create a test sensitive enough to uncover age-related differences in our paradigm.

Second, it might be that the older participants of our study were high functioning individuals with comparable cognitive abilities to the younger adults. The fact that the older participants scored overall higher on the WAIS speaks for this assumption. Although controlling for IQ in our analysis did not lead to any differences in the overall outcome, it might be other cognitive traits such as participant's working memory that were superior in the older sample as well. These variables were not recorded in the main study and further research is needed to gain clarity. In any event, our results showed that younger and older adults were equally vulnerable to be misled on originally experienced brands.

Lastly, Experiment 4 provides further evidence that brand familiarity factors may influence how brand stimuli are correctly and incorrectly recognized. Particularly for the younger participants, there was a trend that suggested associations between brand knowledge variables recorded in Experiment 2 and the hits and false alarms recorded in this study. This trend was not found for the older adults, which is not surprising considering that brand norming in Experiment 2 was based on brand perceptions of younger adults. Although none of these correlations turned out to be significant (but data showed a consistent trend), Experiment 4 is the first to show that false alarms for the misleading items might have been associated with these brand knowledge variables. Data suggested that the younger participants created more false alarms for misleading brands when these brands were rated in Experiment 2 as more well known, better, and as more frequently used.

Although our study provides evidence to suggest that retroactively changed brands in photos have the potential to influence one's past experience with a brand, it would be interesting to see how these effects develop under even more personalized circumstances. In this study, the original brand liking task on Day 1 was included to trigger brand evaluation processes potentially reflecting brand consideration behaviour in everyday life consumer choice situations. However, an important next step would be to examine whether retroactive brand replacements in photographs could also mislead on brands that are chosen based on a participant's individual brand preferences. In this context it would also be important to ask the question whether false brand memories will have any consequences for individuals. This is important because previous research has shown that false memories can be associated with attitudinal and behavioural consequences for falsely remembered experiences. For example, Bernstein, Laney, Morris, and Loftus (2005) let participants falsely believe that they got sick in their childhood consuming some food. Later, these subjects reported less interest in eating those foods. In this light, appropriate next steps in this research would necessitate an examination of the effects of retroactive product placement in a more personalized environment and to investigate potential brand preference changes and brand buying changes associated with false brand memories.

Conclusion

Results of this study showed that participants could be misled on personally experienced brands when they were exposed to retroactively changed brands in photographs. This finding extends the brand misinformation effect revealed in Experiments 1 and 3 to a context in which brands were originally not only seen in photographs, but personally witnessed. The misinformation effect revealed was equally strong for younger and older adults and there was hardly any indication that the older participants of our study were more suggestible to the misleading information. Future research has to clarify whether it was the method used or the specific sample characteristics of the older adults (i.e. higher IQ of older adults) that was responsible for this null-effect. Because our research has established that brand misinformation effects are robust, a next study should examine the potential downstream consequences of falsely remembered brand information.

Chapter 7: Experiment 5 – Using retroactive brand replacements in doctored photographs to influence brand preferences

Experiment 5 – Using retroactive brand replacements in doctored photographs to influence brand preferences

Experiment 4 showed that retroactively replaced brands in photographs were able to mislead participants on actual pasts with a brand. Hence, the study showed that source misattributions of misleading brands in photographs occurred under more personalized circumstances. However, brands presented during the original event were not tailored to participants' own preference. Because data from previous Experiments suggested an involvement of brand knowledge factors (including brand awareness and brand image factors; see Experiment 2) in the creation of true and false memories, it remains unclear whether a misleading brand could challenge participants' memories for personally selected and preferred brands. For example, could we replicate a misinformation effect under circumstances in which participants were misled that a 'less-liked' competitor brand was chosen when in fact, a more favoured brand was initially selected. Or would participants simply reject this suggestion because stronger and more connected memory traces for the original brand choice stand in stronger competition with the misleading information? To our knowledge, no study exists that has misled on preference for brands that were self-selected based on preference. In this context, the perceived plausibility of the misleading information might play an important role. As stated earlier, it is generally believed that relatively implausible events are less often falsely remembered than more plausible events (Hyman & Loftus, 1998; Pezdek et al., 1997). On the other hand, research has shown that participants could be led to falsely believe that events were plausible (Mazzoni et al., 2001). In this regard, doctored images may skew participants' plausibility judgments as they may be perceived as authoritative evidence that an event really occurred (Otgaar et al., 2009; Wade et al., 2002). In particular when participants appear in doctored images themselves the adoption of lower source-monitoring criteria when judgments are made may increase the likelihood of memory errors (Nash et al., 2009).

Another important question in this context is whether false brand memories created under such personalized circumstances would have any consequences for individuals. More specifically, if participants create false memories for brands, do these false memories have any attitudinal and behavioural effects downstream? This is of concern because several studies have provided evidence to suggest that memory distortions may have practical repercussions. Earlier, we reviewed studies that have demonstrated these effects in an 'advertising misinformation effect' context. For example, one of these studies examined the effects of misleading advertising information on the taste of a previously tasted product (Braun, 1999). Participants first tasted an orange juice and were asked to describe its flavour afterwards. Following this, some participants were exposed to misleading advertising that described the juice as better than it in fact had been (e.g. as 'sweet, pulpy and pure' when in fact the juice had a salty and sour taste). As a result, participants remembered the taste of the original orange juice as better as it had been (see also Braun-LaTour, LaTour, & Loftus, 2006; Braun, 1998, for similar findings in different advertising contexts). However, these studies used false advertising in the traditional 'narrative form' to mislead on original experience. To our knowledge, only the study of Sacchi, Agnoli, and Loftus (2007) has used doctored photos to examine the consequences of misleading information on an original event. Here, participants were exposed to doctored images depicting real protests in Beijing and Rome as being more violent than they actually were. As a result, participants remembered these events as more violent, negative and they recalled more damage compared to participants who had viewed the original and non-doctored photo version. In addition, misled participants indicated that they would be less inclined to participate in future protests.

The explanation proposed for these findings suggests that in the reconstructive process of remembering, participants may retrieve pieces of information consistent with the misleading suggestion and consequently misattribute and integrate the information into the original event experience (e.g. Braun, 1999; Sacchi, Agnoli, & Loftus, 2007). Hence, what these studies have in common is that they focused on false memories for misleading attributes of experienced events and the consequences for the original brand experience. However, returning to retroactive product replacement, we are specifically interested in the consequences of false memories for misleading and competitive brands that directly challenge a consumer's original brand choice. Hence, not only the consequence for the originally chosen brand (once it is potentially overwritten or blocked by the misleading information) is important, but also how the misleading information itself is evaluated after having been falsely accepted. As well, clearly monitoring potential preference changes for real brand stimuli requires measuring preference changes before and after exposure to the misleading information – an approach not applied in these studies. Several implanted false memory studies exist that tracked participants' preference changes from pre-to post manipulation and that examined preference changes specifically for the misleading event. For example, by using personalized false feedback based on a series of food preference questionnaires, Laney et al. (2008) planted the positive food suggestion that participants loved asparagus as a child. Misinformed participants did not only show an increase in their confidence that they loved asparagus the first time they tried it but also an increase in their general liking of asparagus and willingness to pay more for the food from pre- to post-manipulation relative to control participants (see also Berkowitz et al., 2008, for similar findings in a different context). So how would these effects develop when participants are misled on a previous experience with a brand that is contradicted in a doctored postevent photograph?

With these ideas in mind the following experiment examined whether retroactively ‘less-liked’ competitor brands in doctored photographs can change memories for personally chosen brands. In addition, we examined whether false memories might lead to attitudinal and behavioural consequences for falsely remembered brands. We invited participants to the lab under the auspices of examining their personal brand lifestyle. Participants constructed a ‘brand profile basket’ that was then captured in a photo showing participants and their ‘shopping’ basket. After a delay, participants were exposed to a doctored photograph, in which some of the self-chosen brands were replaced by their ‘less-liked’ competitor brands. Memory tests for the original event as well as pre- and post-manipulation brand preference ratings were used to examine the uptake of misleading information as well as potential preference changes for falsely remembered brands. In line with previous research, we expected that misinformation would interfere with participants’ original memories and consequently lead to the false acceptance of misinformation items. In addition, we predicted that participants would rely on their false memories in the post-manipulation preference rating task and rate falsely remembered misinformation brands more favourably from pre- to post-test.

Method and Measurement

Participants

Fifty university students and staff (mean age = 23.54 years, *SD* = 7.03; 26% male) of City, University of London individually took part in this experiment over three sessions for either course credit or remuneration.

Stimuli

Figure 8 shows the design of this study. Stimulus selection for pre- and post-manipulation brand rating task, brand compiling task, as well as memory tests was based on the norming data collected in Experiment 2. Of these, 12 product groups belonging to the food category were chosen and the six most popular brands per category were selected. Of these, three brands per category were used as actual study stimuli and the remaining three brands were used as filler items in the memory and brand rating tasks. In order to increase the ecological validity of the study we decided to represent all brands by a typical product of its category throughout the whole study (e.g. a 30g Doritos crisp pack in physical form during the brand-compiling task and in pictorial form in memory test and preference ratings). In order to limit the influence of characteristic product packaging on memory performance, we made sure that the packaging of categorically related brands was similar to each other (e.g. we made sure that for the fizzy soft drink brands Coca Cola, Pepsi, Dr Pepper, Fanta, Sprite, and Tango each brand was represented as a 500ml bottle). In this process, some brands from the norming data had to be excluded because of typical packaging differences. For example, using the crisp brand Pringles (usually sold in long cylindrical containers) would not be a suitable brand next to Walkers and Doritos because the nature of the product and the typical package form stood out too much next to its competitors.

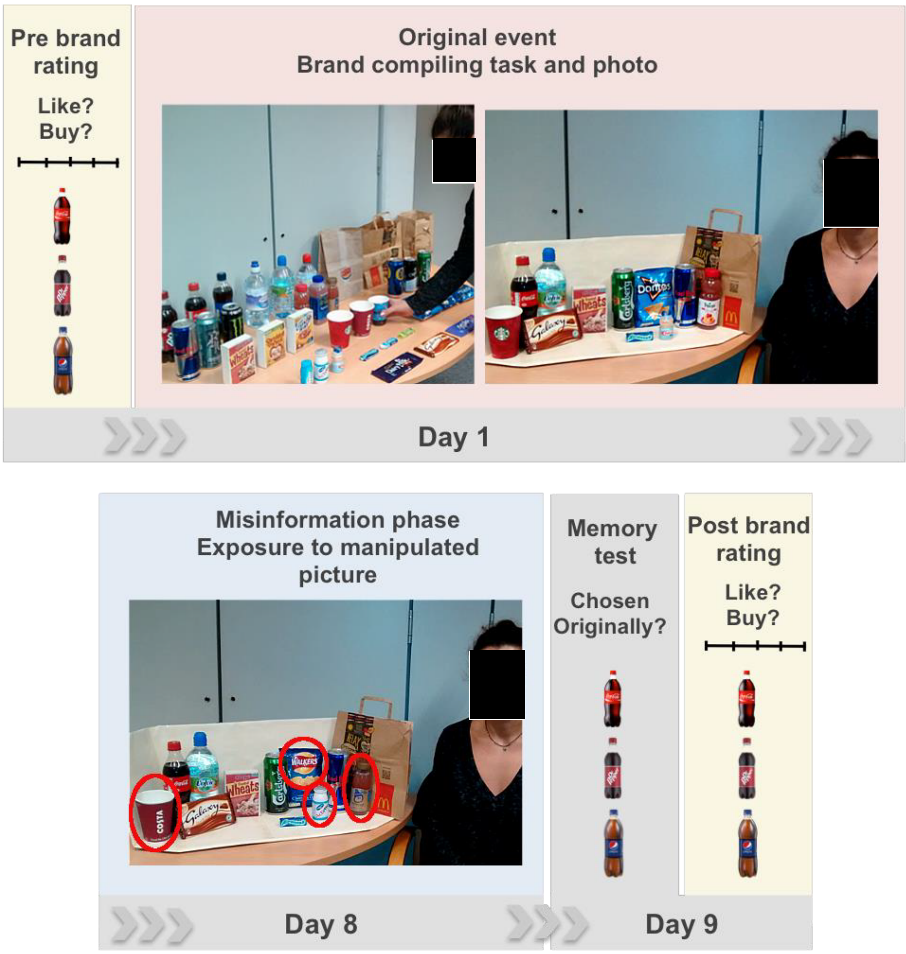


Figure 8. Study design

Brands provided for creating the brand basket (offered items) were the three most popular brands of each of the 12 brand categories. Of these, participants chose one brand per category for basket inclusion so that each personal brand basket contained 12 products in total. To induce misinformation, participants were later misled on four of these originally chosen items by replacing the brands with contradicting brands in the manipulated photograph (misled item condition). More specifically, misinformation was presented for four brand categories using a competitor brand that had not been picked from the offered items in the construction of the personalized brand basket (out of two remaining brands of a category). For the remaining eight brands consistent information was provided in the photograph, i.e.

participants were not misled on these items (control item condition). Last, unused offered basket items served as foil items in the final memory test

Assignment of the brands to the three item types (original item, misinformation item, and foil item) and to the condition (misled item and control item condition) was counterbalanced across participants as best as possible; however, given this is a personal preference task, counterbalancing was partially out of our hands. For example, we could not influence a participant's original brand choice and hence, whether a brand appeared as an original item or not was contingent on the particular participant. Nevertheless, given the design we did the best that we could to assure that: (1) originally chosen brands appeared in the misled and in the control item condition in a balanced manner and (2) that brands appeared about the same number of times as a misinformation or a foil item. However, it should be noted that the assignment of brands to an item type was also influenced by other factors. For example, misinformation selection was subject to the constraint that the item's preference lay somewhere between the most (the brand that was originally chosen for the basket) and the least preferred brand of the three offered basket items. We obtained this information from the earlier pre-manipulation brand preference rating. Thus, a misinformation brand was always less liked than its original counterpart but it was not the least liked brand. Here, we chose the brand 'in the middle' in order that manipulation appeared as plausible as possible given that the least preferred brand of a category might have been too distinctive relative to the originally chosen item. Nevertheless, the preference 'distance' between original and misinformation items differed across items in the study (i.e. one misinformation item may have been two scale points 'less-liked' than the original item and the next four scale points 'less-liked' than its original counterpart).

Last, we also included some measures that were aimed at reducing the risk of the influence of any confounding variables. Specifically, we made sure that the misinformation categories chosen for each participant varied in overall favourability for a brand category, meaning that the categories chosen included not only categories in which brands were generally highly rated but also others that included brands that were less highly rated. The same was done for how often brands of the chosen categories were purchased by a participant in general, a question that was asked at the end of the previous brand rating questionnaire for each of the categories. These measures were included to avoid a behaviour driven by the prominence of certain types of misinformation categories (e.g. high false memory rates driven by categories much liked or frequently purchased).

The memory test as well as the pre- and post-manipulation preference-rating tasks contained all 72 brands that were selected from the norming study. These included all 36 offered brand items classified in three item types of interest: original items, misleading items, and foil items, as well as the 36 categorically-related filler items. Brands were presented in random order except in the preference rating tasks where brand category blocks were presented in a random order.

Procedure

Session 1. On arrival in the lab on Day 1 we informed participants that the purpose of the study was to create different brand lifestyle profiles as part of a wider consumer research study. They were also told that their profile would include a picture showing them and a personal brand profile basket that they would compile during the first session of the experiment. To limit the influence of demand characteristics, we did not tell participants that their memory for brands as well as potential preference changes for brands would be recorded at a later stage.

Participants first completed the brand preference questionnaire and evaluated 72 brands on 10 point Likert-type scales for how much they liked these brands (1 = Absolutely hate the brand - 10 = Absolutely love the brand) as well as for the likelihood of buying these brands (1 = Absolutely not - 10 = Absolutely yes). Here, participants were instructed to make judgments based on their personal and current attitudes towards the brands. We chose scale labels to be quite extreme in order to allow room for potential attitude changes at both ends of the scale. For the case where a participant did not know a particular brand, a 'can't say' answer option was provided. In order to measure how much experience participants had with the different product categories, participants rated how often products from these 12 categories were purchased. Following the brand preference task, participants were shown the brands for the basket-compiling task. Participants were told that they would now get the chance to compile their personal brand lifestyle basket by choosing one brand per brand category that they preferred the most and to hand it to the experimenter. In total, 12 brands were chosen and were placed into the brand basket by the researcher. In order to ensure encoding of the selected brands, participants were asked to specify in written form approximately how much they had paid for each individual product in the past. Afterward all the brands had been selected and placed in their basket, a photograph was taken showing the participant and basket. Overall, Session 1 took about 20 minutes to complete.

Session 2. On Day 8, participants returned to the lab for a short session and were exposed to their brand profile picture. They were asked to confirm whether they were comfortable with this picture being included into their brand profile. To induce misinformation from the picture, four brands that were initially packed into the brand basket were replaced by less-liked competitor brands. In order to ensure that this misinformation was processed, participants completed a short questionnaire about the brands in which they indicated for each of the specific brands the maximum price that they would pay for that product in a shop. To make sure that participants would not retrieve their basket items from memory, we asked them to write down the brand name of each individual item from the basket in the photograph. In order to reinforce the cover story used for the experiment, participants then provided some information about their general attitudes towards advertising.

Session 3. On Day 9, we invited participants back to the lab under the pretence that some final follow up questionnaires about their brand profile had to be filled out. However, participants were confronted with a surprise memory test instead. First, participants were given a recognition test that recorded their overall memories for the original event. Here, participants were explicitly told that the test strictly referred to the items from the original brand-packing task carried out nine days earlier. Brand items appeared on the screen one at a time and participants were instructed to press the ‘yes’ key for brands that were included in the original personal brand basket and to press the ‘no’ key if they were not. Only if ‘yes’ was clicked were participants asked to make a Remember, Know, and Guess judgment. Participants were asked to press ‘remember’ when they were able to vividly remember choosing a particular brand for the basket; to press ‘know’ when the judgment was based more on a feeling of familiarity (i.e. they had the sense that they included the brand into the basket but they could not really remember it); and finally to press ‘guess’ when they guessed the brand was included but they were not really sure. It should be noted that response times were recorded in this task. However, participants were not informed about that fact and completed the task in their own pace.

Following the recognition test, a final source-monitoring task was carried out in which we gave participants the chance to reconsider the presentation sources of items endorsed during the recognition test. Five options were provided for each of the items: (1) included in brand basket on Day 1 only, (2) seen in the photo on Day 8 only, (3) included in brand basket and seen in photo, (4) item differed between the actual basket and the photograph, (5) just guessed. We used this procedure in order to further affirm whether participants believed that they had chosen the misleading detail themselves during the original event (see Zhu et al., 2012). We chose this practice over an explicit 'misinformation-warning' procedure because we did not want to bias participants' behaviour for the task that would follow.

After participants completed the memory test, a filler activity consisting of three short working memory tasks was carried out for about 10 – 15 minutes. Following these tasks, the post-manipulation preference rating was completed. Here, we gave participants the same preference-rating task they completed on Day 1 in which they were asked about their current attitudes about brands and the likelihood that they would purchase each of the 72 brands. Before participants were fully debriefed and dismissed, we asked them if they had noticed anything during the experiment that they would like to share and what they thought the experiment was about. These questions were included so we had an additional and objective measure about the effectiveness of our cover story about the purpose of our study, one that could later be used to examine differences in participant's behaviour. Overall, this session took about 35 minutes to complete.

Measurement and analysis

Our study addressed two main questions. The first was whether participants would create false memories for misleading items and the second, whether these false memories would have any consequences for individuals, namely, lead to attitudinal and behavioural after effects for falsely remembered brands. To answer Question 1, data were analysed as in preceding experiments. We analysed the uptake of misinformation by first comparing participants' memory performance (yes-responses to items) within the misled item condition and then across conditions (misled item vs. control item condition). These main analyses were carried out separately for participants' overall recognition scores, their Remember, Know, and Guess responses, as well as for participants' robust memory performance of the source-monitoring task.

To answer Question 2, we examined attitudinal and behavioural changes for falsely remembered misleading items from pre- to post-manipulation. The dependent measure was a participant's mean rating on the liking as well as the likelihood of buying scales for endorsed misleading items at Times 1 and 2. To create a more comprehensive test, we added a variable where we compared attitude changes between endorsed (falsely accepted) and non-endorsed (correctly rejected) misleading items. In this way each participant served as his or her own control. For further comparison, we ran the same analysis with other item types and also compared preference changes across endorsed item types.

Results

Sample characteristics

Regarding the memory data, as in Experiment 4, the dependent variables (yes-responses to the item types) were hits and false alarm scores out of four to eight questions only. In addition, ceiling effects were found for some variables (e.g. yes-responses to original items in the control item condition). Hence, data were not normally distributed and often strongly skewed. However, we used parametric test statistics for the analysis of our data. However, please note that all analyses were rerun and effects and null-effects confirmed using non-parametric tests (however these tests are not reported here). Hence these variables were not further considered in the analysis. Concerning the preference rating data, the dependent variables (average preference rating data for item types) Shapiro-Wilk's tests ($p > .05$) and visual inspections of histograms, normal Q-Q plots and box plots showed that most variables were approximately normally distributed. Inspection of the data showed that participant's gender, age as well as performance on the working memory tasks had no effect on the dependent memory variables of this study and were not considered in the following analysis.

Misinformation effect data

Recognition test data.

Raw score analysis. Table 11 shows the proportion of yes-responses for the three item types (original details, misinformation details, and foil details) correctly and incorrectly accepted as being part of the original event as a function of condition (i.e. whether participants were or were not misled on an item).[21]

---

[21] Responses to filler items were not considered in this report in order to reduce the complexity of the analysis. Please note that false alarm rates for fillers (*M* = .02, *SD* =

To see whether participants were misinformed by the retroactively inserted brands in the photos, we first compared their overall endorsement rates of original items, misleading items, as well as foil items in the misled item condition. A one-way repeated measures ANOVA revealed a significant main effect of Item type, $F(2, 98) = 51.57$, $p < .001$, $\eta_p^2 = .51$. Bonferroni pairwise comparisons showed that participants falsely accepted more misleading items ($M = .69$, $SD = .33$) than they correctly accepted original items ($M = .30$, $SD = .32$, $p < .001$). Results also showed that both the misleading and the original items were more often accepted than were the related foil items ($M = .05$, $SD = .11$, *p's* < .001).

Table 11. Mean proportion of 'Yes' responses with proportion of Remember, Know, and Guess responses (SE) for each item type as a function of condition.

		Item type		
Condition	Response type	*Original items (hits)*	*Misleading items (false alarms)*	*Foil items (false alarms)*
Misled item	**Total**	**.30 (.046)**	**.69 (.047)**	**.05 (.016)**
	Remember	.17 (.034)	.54 (.046)	.01 (.007)
	Know	.11 (.028)	.13 (.029)	.03 (.012)
	Guess	.02 (.010)	.02 (.010)	.01 (.007)
Control item	**Total**	**.95 (.013)**	--	**.03 (.006)**
	Remember	.80 (.032)	--	.01 (.003)
	Know	.12 (.024)	--	.01 (.003)
	Guess	.02 (.009)	--	.02 (.005)

Next we examined participants' responses to the item types across condition (misled item vs. control item condition). For original items, analysis showed that participants correctly accepted more original details in the control item condition (*M*

.05) did not statistically differ from that for foils ($M = .05$, $SD = .11$), $t(49) = 1.57$, $p > .05$.

= .95, *SD* = .09) than in the misled item condition, $t(49) = 13.14$, $p < .001$, $d = 2.39$. We also compared misinformation false alarms in the misled item condition with foil false alarms in the control item condition. Analysis revealed more false alarms for the misleading items in the misled than foil false alarms in the control item condition (*M* = .03, *SD* = .04), $t(49) = 13.75$, $p < .001$, $d = 2.66$. No difference was found between the foils retrieved in misled and control item condition ($p > .05$). Hence, the overall memory performance data showed that participants were misled by the retroactively changed brands in the photographs.

Last, we examined whether participant's behaviour to respond yes to the different items stood in any relationship and ran correlation analysis between hits and false alarms to the item types. Analysis showed significant negative correlations between hits for the original item in the misled item condition and false alarms for the misleading items ($r = -.76$, $n = 50$, $p < .01$). No significant correlation was found between original items and the foils as well as misleading items and the foils.

Hence, analysis of participants' raw recognition data suggest that participants were misled by the retroactively replaced brands in the photographs. When participants were misled on an item, they accepted the misleading alternative more often than they accepted the item they actually chose. However when they were not misled on an item, participants had not only higher hit rates for the originally chosen items, but they also accepted the categorically related foil items less often than the misleading alternatives in the misled item condition.[22]

[22] One might argue that the endorsement of original items in the control condition might not be an ideal baseline to determine whether memory impairment occurred in this study or not. Because original items in the control condition were seen twice compared to only once for original items in the misled item condition the question rises whether it was retrieval strength in the control condition that led to this advantage in hit rates. Concerning this matter, data of a sub-experiment provides additional information. A separate sample ($N = 17$) was simply asked to create their

Response time analysis. We analysed participants' reaction times to respond to trials in the recognition test. Figure 9 shows response times in milliseconds to say 'yes' that an item was seen during the original event (hit for original items and false alarm for the misleading and foil item) and 'no' that it had not (miss for original items and correct rejections for the misleading and the foil items) as a function of condition. First, we compared whether reaction times to falsely respond 'yes' to a misleading item differed from correctly stating 'yes' that an original item was chosen originally. Results of paired sample *t*-tests showed no difference in response times between false alarms for the misleading items (*M* = 1858.59 ms, *SD* = 1271.17) and hits for original items in the misled (*M* = 2378.65, *SD* = 1368.95) and control item condition (M = 1614.95 ms, *SD* = 589.10). Hence, data indicate that incorrect responses to the misleading items were as quickly made as correct responses.

Comparing response times for hits across condition, analysis showed that participants were slower in the misled compared to the control item condition, *t*(30) =

---

personal brand baskets and administered a yes/no recognition test 8 - 10 days later. Although a photo was taken from participants and their basket on Day 1, participants were not exposed again to the photo and hence, they were not misinformed on the originally seen brands. In the recognition test participants were tested on 12 originally chosen brands, 24 presented foil items (i.e. foils that were offered basket items but that were not chosen), as well as 36 categorically related filler items. We ran a 2(Item type: Original item vs. misleading item vs. filler item) x 2(Experiment: Main vs. Sub-experiment) mixed factor ANOVA (please note that the equivalent of misinformation items in the sub-experiment were the offered but non chosen foils). There was a main effect of Item type, $F(2, 130) = 38.78$, $p < .001$, $\eta_p^2 = .37$, as well as a significant Item type x Experiment interaction, $F(2, 130) = 44.26$, $p < .001$, $\eta_p^2 = .41$. Further analysis of the simple main effects with Bonferroni adjusted alpha levels of .008 (.05/6) revealed more hits for original items in sub- (*M* = .78, *SD* = .17) compared to the main experiment (*M* = .30, *SD* = .32), *t*(65) = 7.85, *p* < .001, as well as less false alarms for the foils in the sub- (*M* = .13, *SD* = .10) compared to false alarms for the misleading items in the main experiment, (*M* = .69, *SD* = .33), *t*(65) = 10.40, *p* < .001. No difference was found for the filler items between experiments. Hence, even when the original items were not shown a second time, participants created significantly more hits for these items when they were not later misled on them. Overall this finding provides further support that participant's original event memory was impaired as a result of the retroactive product replacement.

-2.70, p = .012, d = .72. Thus, when participants were misled on an original item, they were slower to correctly press 'yes' compared to when an item had appeared in a consistent manner during original event and misinformation phase. For 'No' responses (misses) to the original items no significant difference was found between misled (M = 1874.26, SD = 996.49) and control item condition (M = 1619.81, SD = 1246.68). Hence, when an originally chosen item on which participants were misled was missed, response times did not differ from misses of the control items. Last, false 'yes' responses to foil items in the control item condition (M = 2208.14, SD = 1781.81) did not differ from these to the misleading items and participants' hits (not enough participants endorsed foils in the misled item condition to run statistical analysis, N = 7).[23]

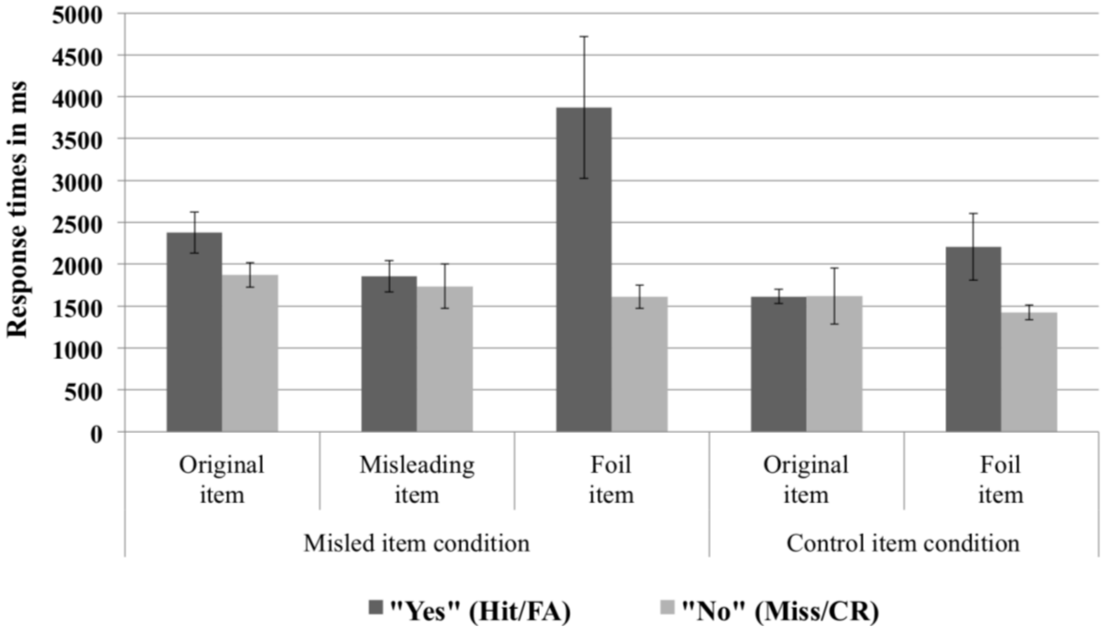


Figure 9. Mean response times in ms (SE) for each item type as a function of condition and response.

[23] Please note that a more comprehensive statistical analysis was not possible due to missing reaction time data points for certain item types. For example, many participants did not falsely endorse any of the foil items in the misled item condition, meaning that no response times existed in these cases. A more comprehensive analysis including response types of several item types would have reduced the analysis to a few cases.

Remember, Know, and Guess analysis. The pattern found for participants' raw recognition scores was clearly confirmed when participants' recollective experiences only were analysed. Participants falsely remembered the misleading alternative more often than they correctly remembered the item they actually chose. In addition, when they were not misled on an item, participants had not only more remember responses for the originally chosen items, but they also remembered the categorically related foil items less often than the misleading alternatives in the misled item condition (remember responses; all *p*s < .001; see Table 11). For know responses in the misled item condition, there was significant main effect of Item type as well, $F(2, 98) = 4.28$, $p = .017$, $\eta_p^2 = .08$. Pairwise comparisons revealed no significant difference between original items ($M = .11$, $SD = .20$) and misleading items ($M = .13$, $SD = .20$), but know responses to both item types were higher compared to the foil items ($M = .03$, $SD = .08$, $p = .024$; $p = .005$). Across condition there was no significant main effect of Item type for know judgments ($F < 1$). For guess responses no effect of Item type within or across conditions was found (all *Fs* < 1).

Analysis of Remember, Know, and Guess response patterns within the different Item types, revealed significant main effects of Response type for original items in misled, $F(2, 98) = 8.06$, $p = .001$ $\eta_p^2 = .14$, and control item condition, $F(2, 98) = 224.93$, $p < .001$ $\eta_p^2 = .82$, as well as for the misleading items, $F(2,98) = 64.18$, $p < .001$ $\eta_p^2 = .57$. No effect of Response type was found for the foils in either of the conditions (*F*s < 1). Pairwise comparisons showed that original control items and the misleading items were more often remembered than known, and also more often known than guessed (all *p*s < .004). For original items in the misled item condition, there was no difference between remember and know responses, but both were more often made than guess responses (ps < .004).

Source-monitoring test data

Table 12 shows the proportion of overall robust memory performance as well as individual responses to all three item types in the source-monitoring task. We conducted the same main analysis as above on participants' robust memory performance. In the misled item condition analysis revealed a significant main effect of Item type, $F(2, 98) = 15.03$, $p < .001$, $\eta_p^2 = .24$. Pairwise comparisons showed no significant difference between original items ($M = .18$, $SD = .29$) and the misleading items ($M = .32$, $SD = .31$: $p > .05$) but both items types were more often attributed to the original event than the foil items ($M = .02$, $SD = .06$, $ps < .001$). Comparison of original items across condition (misled vs. control) revealed a main effect of Item Type as well, $F(1, 49) = 78.75$, $p < .001$, $\eta_p^2 = .62$, with more correct source attributions in the control ($M = .68$, $SD = .26$) relative to the misled item condition.

To analyse participants' robust false memories for the misleading items further we examined individual responses in the source-monitoring task. A one-way (Response type: chosen 1 only vs. saw 2 only. vs. both vs. conflicted vs. guessed) repeated measures ANOVA yielded a significant main effect of Response type, $F(4, 196) = 15.36$, $p < .001$, $\eta_p^2 = .24$. Pairwise comparisons showed that there was no difference between the false option 'Both' and the correct option 'saw 2 only' but that both were significantly more often selected than all of the other options (all ps < .006).

Table 12. Mean proportion (SE) of robust memory performance (correct and incorrect source attributions to the original event) total and broken down by response for each item type as a function of condition.

	Original item (hits)		Misleading item (false alarms)		Foil Items (false alarms)	
	Misled	Control	Misled	Control	Misled	Control
Robust	.18 (.041)	.68 (.037)	.32 (.043)	--	.02 (.011)	.01 (.004)
(1) Chosen 1	.12 (.034)	.08 (.019)	.03 (.017)	--	.00 (.000)	.00 (.001)
(2) Saw2	.01 (.005)	.10 (.028)	.28 (.049)	--	.02 (.011)	.00 (.002)
(3) Both	.09 (.022)	.68 (.037)	.29 (.043)	--	.00 (.000)	.01 (.003)
(4) Conflicted	.06 (.026)	.07 (.016)	.07 (.019)	--	.03 (.011)	.00 (.002)
(5) Guessed	.03 (.012)	.02 (.007)	.03 (.012)	--	.01 (.007)	.01 (.005)

Note. Item types were coded robust when one of the following options were ticked by a participant: Original item: misled (1) or (4), control (3); misleading item: (1) or (3), foil item: misled and control (1), or (2), or (3).

Preference rating data

Results for the misleading items. To answer our second question, namely, whether false memories would have any consequences for individuals, we examined attitudinal and behavioural changes for falsely remembered misleading items from pre- to post-manipulation (participants overall yes-responses in the recognition test). Here, we analysed participants' mean rating on the liking as well as the likelihood of buying scales for endorsed misleading items at Times 1 and 2. We started with participants' attitudes towards the brands (liking scale). As predicted, results of paired samples t-tests showed that participants rated endorsed misleading items higher at Time 2 (M = 6.87, SD = 1.45) than at Time 1 (M = 6.26, SD = 1.42), $t(44) = -3.28$, $p = .002$, $d = .49$. Next, we conducted the same analysis for our behavioural measure (likelihood of buying scale). Again, as expected, participants rated endorsed misleading brands higher at Time 2 (M = 6.75, SD = 1.58) than at Time 1 (M = 6.13, SD = 1.45), $t(44) = -2.89$, $p = .006$, $d = .43$.

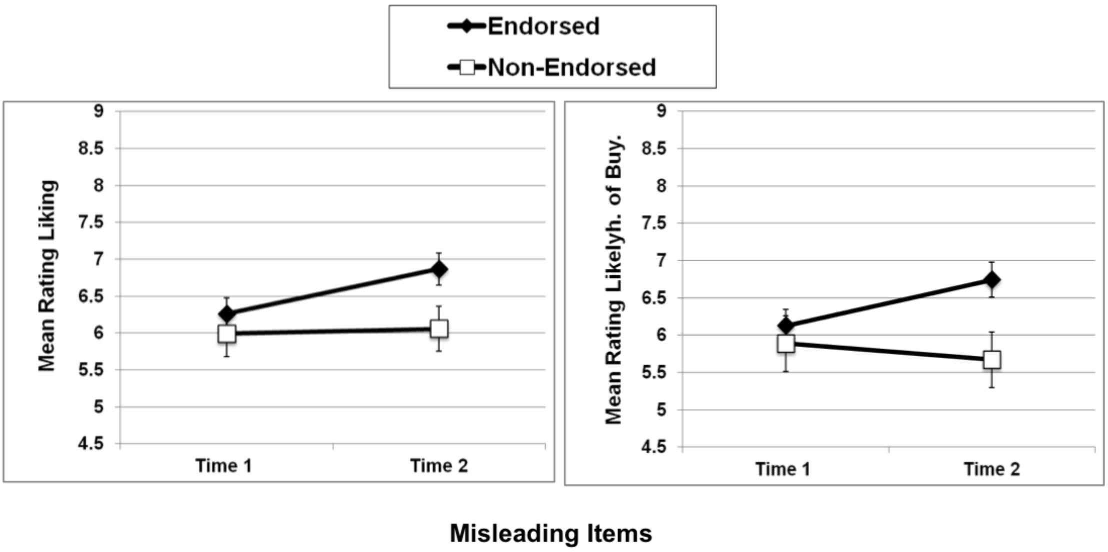


Figure 10. Mean ratings of endorsed and non-endorsed misleading items on the liking- (left) and the likelihood of buying (right) questionnaire, pre- and post-manipulation. Error bars represent standard errors of the mean.

To create a more comprehensive test, we added a variable where we compared attitude changes between endorsed (falsely accepted) and non-endorsed (correctly rejected) misleading items (see Figure 10). In this way each participant served as his/her own control. To do this this, we conducted a two-way repeated measures ANOVA using the factors Misinformation endorsement (endorsed vs. non-endorsed) and Time (time 1 vs. 2). For the liking scale the analysis revealed a significant main effect of Endorsement, $F(1, 25) = 5.78$, $p = .024$, $\eta_p^2 = .19$, where participants rated endorsed misinformation items higher than non-endorsed misinformation items. However, there was no significant interaction of Time and Endorsement, $F(1, 25) = 1.65$, $p = .21$, $\eta_p^2 = .06$. Thus, although the data showed a trend in the expected direction (i.e. that there was an increase in liking from time 1 to 2 for endorsed misleading items but not for non-endorsed items), the trend was not statistically significant.[24]

The likelihood of buying scale analysis yielded a significant main effect for endorsement, $F(1, 25) = 6.56$, $p = .017$, $\eta_p^2 = .21$ as well, showing that participants rated endorsed misinformation items higher than non-endorsed misinformation items. In addition, there was a significant Endorsement X Time interaction, $F(1, 25) = 4.80$, $p = .038$, $\eta_p^2 = .16$. Analysing the simple main effects with Bonferroni using adjusted alpha levels of .0125 per test (.05/4), confirmed that participants rated endorsed misinformation higher at Time 2 than at Time 1 (see test statistics for this *t*-test at the beginning of this section) while this was not the case for non-endorsed misinformation items). In addition, they rated endorsed misinformation items ($M = 7.10$, $SD = 1.53$) higher at time 2 than non-endorsed items ($M = 5.57$, $SD = 1.92$), $t(25) = 3.39$, $p = .002$, $d = .67$ (whereas no difference was found at time 1).[25]

---

[24] A prior power computation with a medium effect size $f = 0.25$ and power = 0.95, showed that the sample size needed would be N = 36 [G*Power 3.1.7 (Faul, Erdfelder, Lang, & Buchner, 2009)]. Thus, a sample size of 50 was considered adequate for revealing the expected effect. However, because our study manipulation turned out to be very effective, analysis reported was based on only 25 participants who created both false alarms as well as correct rejections for misinformation items (endorsed vs. non-endorsed misinformation items). Forty per cent of our participants falsely endorsed all misinformation items and 10% correctly rejected all misleading items. Hence, these participants were not included into the analysis due to missing data points, which reduced statistical power by 50%. This was supported when we used the Expectation-Maximization (EM) method to impute the missing values for our liking data (SPSS 22.0). When we ran the same two-way ANOVA with the new and complete data set, results revealed not only a significant main effect for endorsement $F(1, 49) = 11.17$, $p = .002$, $\eta_p^2 = .19$, but also a significant time and endorsement interaction, $F(1, 49) = 4.90$, $p = .032$, $\eta_p^2 = .09$.

[25] We also compared attitude and behaviour changes for remember responses only vs. non-endorsed items in the recognition test and compared robust misinformation acceptances vs. non-endorsed items in the source-monitoring task. Here, trends were similar to the findings reported, but for these subjective experiences of recognition, the findings were not significant.

Comparison across item types. For additional comparison, we conducted an analysis that would compare preference changes over time between endorsed misleading items and other endorsed item types. For this, we conducted two-way repeated measures ANOVAs with the factors endorsed item type (misleading item vs. other item type) and time (time 1 vs. 2) separately for original items and foil items in the misled and control item conditions. However, because foil items were hardly ever endorsed in the misled item condition (N = 7), we decided to collapse the foil responses across conditions (misled vs. control) (the preference change trend in both conditions was the same). Also, in order to reduce the complexity of this section, we focused on the matter of interest: the interaction between Item type and Time that would show whether or not potential preference change effects were more pronounced for one item type or the other (a table showing the descriptive statistics of the preference data for all items types can be found in Appendix L).[26]

When we conducted the analysis with original items in the misled item condition, results showed significant Item type X Time interaction for liking, $F(1, 25) = 4.53$, $p = .043$, $\eta_p^2 = .15$, as well as one for likelihood of buying, $F(1, 25) = 5.55$, $p = .027$, $\eta_p^2 = .18$. Further analysis of the simple main effects using paired sample *t*-tests showed that the preference change effect found for misleading items (see earlier) was not present for originally chosen items on which participants were misled on (for both scales *p*s $> .05$). Conducting the analysis with original items in the control item condition, the Item type X Time delay interaction did not turn out to be significant (liking: $F(1, 44) = 3.29$, $p = .070$; likelihood of buying: $F(1, 44) = 3.70$, $p = .061$).

[26] Please note that the analysis revealed significant main effects of item type when comparing misinformation items with original items in misled and control condition. Here, results showed that endorsed original items were rated higher on the liking and likelihood of buying scale than misinformation items. Considering how misinformation items were chosen in this study (less-liked competitor brands) this is outcome is not surprising. No main effects were found for the foil items.

Nevertheless, we used the low *p*-values as justification to do a further analysis of the simple main effects. Results showed that only on the liking scale, participants rated endorsed original items higher at Time 2 (M = 7.89, SD = 1.29) than at Time 1 (M = 7.63, SD = 1.43), $t(48) = 2.85$, $p = .006$, $d = .42$. Thus, the preference change trend found for misleading items was also present for participants' attitudes towards brands that had appeared in a consistent manner in basket and photo. Last, we found significant Item type X Time delay interactions for the foil items as well, with $F(1, 19) = 11.00$, $p = .004$, $\eta_p^2 = .37$ for liking and $F(1, 19) = 4.23$, $p = .039$ for likelihood of buying. Further analysis showed that participants' preferences for foil items did not change from time 1 to time 2 on both scales (all *p*s > .05).

Results for the other item types. For completion, we also ran the same Endorsement (endorsed vs. non-endorsed) X Time (time 1 vs. 2) AVOVA as above separately for the other item types. The only significant effect we found was for foil items (foils collapsed across condition). Analysis revealed a significant endorsement main effect for liking, $F(1, 22) = 22.65$, $p < .001$, $\eta_p^2 = .51$, as well as for likelihood of buying, $F(1, 22) = 20.31$, $p < .001$, $\eta_p^2 = .48$, showing that endorsed foil items were higher rated than non-endorsed items on both scales. However, in contrast to misleading items, changes for the endorsed foils differed not only from non-endorsed foils at Time 2 but also at Time 1, suggesting that endorsed foil items were more preferred in the first place compared to non-endorsed foils.

Discussion

By using a modified version of the misinformation paradigm, Experiment 5 examined if memories for personally chosen brands could be altered by exposing individuals retroactively to 'less liked' competitor brands embedded in manipulated photographs. In addition, we investigated whether memory errors would lead to preference changes for falsely remembered brands. Participants were asked to compile their personal ‘brand lifestyle basket’, which was then captured in a photo showing the basket and participant. After one week, participants were exposed to the photograph, in which some originally chosen brands were replaced by different brands of the same category. The final memory test as well as the post manipulation preference-rating task were administered to participants after another delay of one day.

Results of Experiment 5 indicated a reliable and strong misinformation effect caused by retroactive brand replacements in photographs. In the recognition test, 70% of the non-chosen and less-liked misleading brands were falsely attributed to the original brand-packing event. Of these, the majority of responses were associated with recollective experiences (Remember judgments), meaning that in about 80% of the cases, participants were able to vividly remember choosing a particular misinformation brand for the brand basket. Our data also suggest that participants’ original event memories were strongly affected by the study manipulation. Items that were originally chosen for the basket but were later replaced by a competitor in the photo were correctly remembered in only 30% of the cases and only half of these were vividly remembered. In comparison, we found 95% (85% remembered) correct recognition for control brands that were included into the basket and that did appear in the photo. When we gave participants the chance to reconsider the sources of their memories in the source-monitoring task (included on Day 1 vs. seen on Day 8 vs. both vs. brands conflicted vs. guessed) these trends were still present in the data. However, when confronted with the source options, participants were able to correct some of their memory errors created in the recognition test. Importantly, 32% of the misleading items were still robustly misattributed to the brand-packing event on Day 1.

From a memory impairment point of view it is possible that participants falsely remembered the misleading brands because the misleading information somehow changed the memory trace for the originally chosen brands. As a result, participants might have updated their memory for the original brand compiling task by including the memory for the misleading competitor brand (Loftus et al., 1978). The fact that participants created considerably more hits for control brands (shown in a consistent manner) compared to items on which they were misled speaks for this assumption. Additional support for a memory impairment view comes from the sub-experiment reported in Footnote 22. The results of that sub-study revealed evidence of memory impairment even when a more conservative baseline measure was used. More specifically, when the original control item was solely encountered during the brand compiling task (and not again in the photograph) and tested after a delay of one week, participant's hit rate for these brands was still significantly higher compared to the hit rate found in the misled item condition (.78 in sub-experiment vs. 30 in main experiment). This suggests that participant's original event memory was initially strong but that it was affected by the false information. This might indicate that participants did not solely 'fill in' memory gaps with the memory for the misleading post event items.

From a source-monitoring point of view participants might have falsely accepted the misleading brands because they confused the sources of the memory for the misleading brand with the memory for the brand originally chosen (Zaragoza & Lane, 1994). One reason for these source confusions might have been participant's failure to successfully access source-relevant information when the judgements were made (Johnson et al., 1993). This source-monitoring failure might have been facilitated by the photographic nature of the misleading materials that might have triggered thoughts, feelings, and images similar to the original brand experience (Wade et al., 2002). In addition it is likely that that the doctored photographs were perceived as compelling evidence that the misleading brands were indeed originally chosen. In line with the arguments by Nash et al. (2009), it is possible that the strong misinformation effect revealed was at least partially due to the high credibility that was associated with these photographs that depicted participants themselves. It is possible that these factors, combined with an effective cover story, led to the adoption of lower source-monitoring criteria when judgments were made.

Our data also suggest that false brand memories can lead to attitudinal and behavioural consequences for individuals. Specifically, after participants created false memories for retroactively inserted brands they rated these brands more positively on the liking and likelihood of buying scales. Also, misleading brands that were falsely accepted for basket inclusion were more positively rated on both scales than misleading brands that were correctly rejected. In addition, we have seen that this preference change effect was more pronounced for misleading items than for any of the other items types. Indeed, for these other item types, the effect was either completely absent or weaker. To explain this positive shift in ratings, consider the findings from Laney et al. (2008). In a first attempt to analyse the underlying mechanisms of their preference change effect, Laney et al. (2008) discovered that in combination with the false feedback, the mere sight of a photo showing their critical item ‘asparagus’ led some participants to rate asparagus more positively in the photo rating task. These two steps (false feedback and photo) were combined in our experiment and the post manipulation rating was carried out shortly after in pictorial form (i.e. product picture icons were rated). When participants saw the misinformation brands in our post-rating test, product icons might have been processed more fluently because of the previous encounter in the photograph. If this fluency was interpreted as brand familiarity, this might be what caused the shift in favourable ratings (Laney et al., 2008).

Some might argue that this effect was simply a mere exposure effect rather than being associated with false memories. We argue that this is unlikely due to several factors. First, our analysis was based on comparing endorsed versus non-endorsed misleading items. If a mere exposure effect was responsible for the trend we obtained, then we would expect a positive shift in attitudes for non-endorsed items as well (all misleading items appeared equally often and we made sure that all misleading items were processed during the misinformation phase). Second, the shift in preferences was not found for the other item types to this extent. For example, if we compare control items (packed in basket and seen in photo) with misleading items, then we are comparing item types that were seen the same amount of time (in pre-test, on the table, in the photo, in the post-test). In fact, we can assume that control items were processed even more intensively because participants themselves chose them for basket inclusion. Hence, if a mere exposure effect had been the driving force behind our effect one would expect an even greater preference change for these control items. However, although we did measure an increase of preference for these control brands as well, the effect was weaker and was only present for the attitudinal measure, not the behavioural scale.

Others might suggest that demand characteristics are responsible for our effects. However again, this seems unlikely. First, participants were invited to the lab under false pretences and we made sure that the cover story was plausible throughout the entire experiment. Second, we asked participants at the end of the study if they had noticed anything during the experiment that they would like to share. Here, only six participants pointed out a suspicion that something was wrong with the picture. Of these, only three participants were positive that the picture was manipulated. However, when participants were asked if they could guess what the real purpose of the study was, only two participants made a guess in the right direction. That is, they assumed the study was about false brand memories, but no participant suspected that our intent was to measure preference changes for falsely remembered brands. When debriefed on the purpose of our study, most participants appeared surprised. Also, five of our six suspicious participants produced zero misinformation false alarms. If demand characteristics had been the driving force of our effects, then we would assume high false alarm rates in these cases as well. Furthermore, it should be mentioned that our target items were embedded in a substantial number of filler items which would have made it hard for participants to apply any kind of strategy (see Laney et al., 2008, for a similar argument on this matter). Last, reaction times recorded for false acceptances of misleading brands did not statistically differ from that of original memories, which speaks against the involvement of deliberation processes.

It would seem reasonable to conclude that the effects we obtained are largely driven by the fact that participants relied on their false memories when post-rating the brands. However, on reflection given these considerations, it would be important to examine whether it was specific responses in this experiment that led to the preference changes in our paradigm. We did reveal the positive shift in attitudes and behaviour for the misleading brands when analysing participants overall yes-responses in the recognition tests. Although the same trends were found when we analysed preference changes in remember responses only and participants' robust memory performance in the recognition test, not all of these trends were statistically significant. Whereas this could be due to a power issue (because less misleading items were remembered and robustly endorsed compared to the overall recognition scores), another explanation might be indeed the specific nature of these responses. In regard to this, previous research has shown that preference changes accompanied participants' false beliefs rather than participants' false memories when memory and belief questionnaires were used to examine the uptake of false memories (Bernstein et al., 2015; Bernstein & Loftus, 2009). Our study was not designed to disentangle these processes but future research should consider using alternative questionnaires such as memory and belief questionnaires.

Nevertheless, our findings contribute to the false memory literature in two ways. First, we extend the applicability of the classical misinformation paradigm by showing reliable misinformation effects in a new and ecologically relevant context – retroactively changed brands in personal photos. Second, following from this, our research builds on previous studies and shows the additional consequences of false memories for highly competitive stimuli that aimed to overwrite or suppress participants' original brand choice. However, these results go beyond showing the after effects of misinformation-based false memories and extend previous research by providing insights into other changes (attitudinal and behavioural) that occur downstream following a memory task. Interestingly, we did not find any indication that preferences for originally chosen but replaced items changed once they were 'missed' and potentially overwritten by misleading information. Hence, rather than completely restructuring participants' brand attitudes and behaviour, these changes occurred (to this extent) only for the misleading brands. For internally generated foil false memories, a very different trend was obtained. In contrast to all item types, here preferences at Time 1 differed significantly between endorsed and non-endorsed foils, suggesting that it was the more preferred brands of this category in the first place for which spontaneously generated false memories were created. In addition, and in contrast to misinformation false alarms, no preference changes for foil brands were recorded. In fact, endorsed foils were more negatively rated at Time 2 than at Time 1 (but these differences were not significant). Future research should examine whether this trend applies in general for all forms of spontaneously generated false memories.

Finally, our study has several limitations that should be addressed. Coming back to our initial question of whether retroactively replaced brands in photos have the potential to influence one's past experience with a brand, additional research is needed to fully answer this question. Although this study provides evidence to suggest that this might be the case, the way in which participants in this study encoded the misleading stimuli (focusing the attention to each brand by answering a question) does not accurately reflect how peripheral details in photos would be normally processed. In addition, considering that the post-manipulation preference-rating task was carried out shortly after the final memory test, the question rises whether these preference changes last over a longer delay. In a next step a follow up questionnaire should be administered to examine this matter. Last, a next step in this research would be to investigate whether false brand memories affect participant's real purchasing behaviour. An increase of preferences on a scale might not necessarily mean that particular brands will actually be purchased. However, as discussed earlier, rather than completely restructuring participants' brand preferences we only found a positive shift in attitudes for the falsely accepted misleading items but not a negative shift for the missed originally chosen brands. Hence, participant's preferred brand might still be the originally chosen one. Future studies should monitor the development of these effects with repeated exposure to misinformation materials. It is possible that retrieval strength might lead to changes in participant's brand preference structure.

Conclusion

Experiment 5 showed that it is possible to implant false memories for 'less-liked' competitor brands that were retroactively inserted into personal photographs. Hence, this study replicated a brand misinformation effect in a context in which brand stimuli were tailored to a specific participant. Moreover, we showed that once these false memories were formed, they were associated with a positive increase in attitudinal and behavioural consequences. Future research should examine whether preference change effects can be elicited under more implicit retroactive product placement circumstances.

Chapter 8: Final Discussion

Final Discussion

By using a modified version of the misinformation paradigm, this thesis examined the effectiveness of a futuristic advertising measure: Retroactive brand replacements in photographs. Two main research questions were addressed of which the first was whether retroactively replaced brands in photographs could distort memories for previously experienced brands. Second, if we form false memories about brand experiences, do these memory errors have any attitudinal or behavioural effects downstream? To examine these questions five experiments were carried out that included four misinformation studies (Experiment 1, 3, 4 and 5) as well as one brand norming study (Experiment 2). Whereas all four misinformation studies examined the effects of a 'brand misinformation effect', Experiment 5 went one step further and looked at consequences of false brand memories. Data collected in Experiment 2, the brand norming study, served to provide a pool of normed brands that could be used for stimuli selection in Experiments 3-5 and to obtain information about the role of brand awareness factors in the misinformation effect.

In line with previous research, the results of all misinformation studies indicated reliable brand misinformation effects caused by retroactively replaced brand in photographs. More precisely, when participants were misled on a brand placement or a product brand, many of the competitor brands in the misleading photos were later falsely attributed to the original event. In addition, these memory distortions were often rated as being 'remembered', meaning that participants were able to re-experience the misleading brands as part of the original event. On the other hand, data suggested that participant's original brand memory was impaired as a result of the intervention (i.e. when originally experienced brand details were contradicted by a misleading brand in the photographs, the hit rates for these original brand details were lower compared to the hit rates for original items in a non-misled control item condition). Throughout this project, these results were not only revealed in participants' overall yes-responses in the recognition test but also in participants' remember responses as well as in their more refined source-monitoring judgments. Furthermore, the results of this thesis suggest that false brand memories can have practical repercussions. That is, data of Experiment 5 showed that false brand memories led to attitudinal and behavioural effects downstream. Together, these findings contribute to the false memory literature in two ways. First, we extend the applicability of the classical misinformation paradigm by showing reliable misinformation effects in a new and ecologically relevant context – retroactively changed brands in personal photographs. Second, our research shows the additional consequences of false memories for a new kind of stimuli that are real and competitive in nature and are associated with participants' personal preferences.

Experiment 1 and 3 tested the effects of retroactive brand replacements on memory in a setting in which brand placements occurred naturally in social snapshot photographs. Participants watched what they thought was the same Facebook photos twice but during second exposure, some brand insertions were replaced by a competitor brand. The experimental design aimed to reflect a situation in which a social network user browses a person's Facebook photos twice and is incidentally exposed to original and misleading brand placements in this process. Results of both studies showed that a misinformation effect could be replicated in this context. However, analysis revealed relatively low hit rates in the misled and control item conditions, suggesting that originally seen brands might not have always been encoded. This outcome may be not too surprising considering the 'product placement nature' of these tasks and that no mention of the studies' brand focus was made until test. As well, the hit rates are consistent with some previous misinformation studies that have used rather peripherally placed critical items in slide shows (e.g. McCloskey & Zaragoza, 1985). A surprising finding of Experiments 1 and 3 was that they elicited relatively high false-alarm rates for non-presented but related foil brands. Because the endorsement of these foil items was a baseline rate for misinformation false alarms, the misinformation effect revealed was not as strong compared to other misinformation studies. On the one hand, it might have been the weak encoding processes that caused these findings. For example, from a Fuzzy Trace Theory point of view, it is possible that participants' verbatim memory traces for the originally seen placements decayed rapidly so that judgements at test were predominantly based on the gist of originally seen brands. Consequently, not only the related misleading brands but also the associated foil brands were readily endorsed. However, on the other hand, it is possible that it was brand specific characteristics responsible for the effect because previous research has obtained similar results in explicit brand learning tasks (e.g. Sherman & Moran, 2011). Every day we are exposed to brands in their competitive environment (e.g. in supermarket shelves), which might activate strong brand category themes. Because, according to associative-activation theories it is the spreading activation of particularly highly interconnected concepts in one's knowledge base that drives the creation of internally created false memories (Howe & Derbish, 2010; Howe et al., 2009) this is what might have caused the high error rates.

However, this work also showed that these study outcomes could be somewhat 'improved'. For instance, by using more loosely associated foil brands in the test, Experiment 3 did obtain a lower false alarm rate for these foils. In addition, by placing brands more prominently into the photos and by using brands that were normed, we were able to increase attention to the brands and hence, increase the hit rates in Experiment 3. However, in turn, these measures seemed to increase the susceptibility to misinformation because these measures seemed to trigger stronger encoding of the misleading brand placements as well. In this regard, more research is necessary to examine the factors that are likely to influence performance in the misinformation paradigm when examining product replacement in photographs. For example, research that used narratives to implant misinformation showed that more prominently inserted items in original picture slides led to an increase in hit rates for these details. This has also been shown to reduce false alarm rates for verbally suggested information (depending on factors such as retention interval or source credibility; Belli et al., 1992). However, when misleading details are suggested via photographs, it is exactly these measures that strengthen the influence of the misleading information as well. Here, research examining the effectiveness of product placement on memory may be informative as numerous factors have been identified that are likely to influence memory for brands placed in movies or game scenes (La Ferle & Edwards, 2006; Law & Braun, 2000). These factors include exposure time (Brennan, Dubas, & Babin, 1999), placement prominence (Gupta & Lord, 1998; Lee & Faber, 2007), the degree of brand integration in a scene (Yang et al., 2006), as well as whether a placement is referred to by a leading character or not (d'Astous & Chartier, 2000). Future research should further examine these factors in in a retroactive product placement context.

Turning to Experiments 4 and 5, data revealed strong misinformation effects in settings in which participants were misled via doctored photographs on actual pasts with a brand. Whereas this effect has generally been found before using brand details in a suggestive narrative paradigm (Holmes & Weaver, 2010), Experiments 4 and 5 were the first to extend these effects to doctored photographs. However, between Experiments 4 and 5, the degree of personalization of study materials differed. Participants in Experiment 4 evaluated a set of brands as part of the original event and saw misleading SenseCam photos (allegedly taken by one of the participants' SenseCams) of that brand arrangement during the misinformation phase. In Experiment 5, participants chose their preferred target brands themselves and were misled via photographs that depicted not only the misleading brands but also themselves. Hence, study materials in Experiment 5 were tailored to a specific participant. Comparing the results of both studies, data suggest that although both types of experimental design elicited strong misinformation effects, the effects were somewhat stronger in Experiment 5 (Experiment 5: M = .70, Experiment 4: M = .60). In fact, these differences may be somewhat underestimated considering that the retention interval between the original event and the misinformation phase in Experiment 4 was twice as long as that in Experiment 5 (2 weeks vs. 1 week).

For further comparison, maybe the most similar study to ours is that of Holmes and Weaver (2010) who used a modified version of the misinformation paradigm to mislead on brand experiences (compiling a brand care package) via misleading narratives (misleading text on website). The researchers recorded false memory rates of .16 to .31 depending on when the final memory test was conducted in that study (immediately vs. 1-week delay). Hence, comparing these false alarm scores to our data suggest that misleading photographs may be more effective to mislead on an experience with a brand compared to misleading narratives. However, these differences have to be seen in the context of methodological differences. Whereas our studies included delays between original event and misinformation phase, the study of Holmes and Weaver (2010) manipulated when the final test occurred. Although both retention intervals have shown to increase the suggestibility to information (e.g. Loftus et al., 1978) a future study should keep such manipulations constant in order to draw more reliable conclusions. In this context, the study by Garry and Wade (2005) should be considered who used the implanted false memory approach to specifically investigate the effectiveness of misleading narratives versus misleading photos. The researchers found that it was narratives that were more likely to elicit false childhood memory reports. The explanation proposed suggests that narratives are more likely to trigger feelings of familiarity. These in turn may encourage cognitive processes that lead to mental representations that are more likely to be confused with actual experiences (Garry & Wade, 2005). However, research has yet to examine whether or not these effects can be replicated in the classical misinformation procedure in which participants are misled on existing memories.

Last, Experiment 5 also showed that false brand memories led to attitudinal and behavioural repercussions. Specifically, after participants created false memories for retroactively inserted brands in the photos, they rated these brands as being more positive on the liking and likelihood of buying scales. This finding is consistent with previous research that has examined behavioural consequences for implanted false memories (e.g. the experience of a fictitious brand; Rajagopal & Montgomery, 2011). However, although Experiment 5 uncovered these effects, the way in which participants encoded the misinformation stimuli (focusing the attention to each brand by answering a question) did not accurately reflect how peripheral details in photos would be normally processed. We showed in Experiments 1 and 3 that brand misinformation effects could be revealed under more implicit learning conditions. However, in these studies the brand stimuli were not personalized to a participant.

Future research has yet to address the question of whether false memories as well as preference change effects can be elicited under such circumstances. Because the effects in Experiments 1 and 3 were generally less strong compared to Experiment 5, it is possible that more sensitive tests would have to be used in order to tap into potential preference change effects in such a study. For example, one possibility is to measure preference changes using an implicit association test as supposed to an explicit brand rating task.

From a theoretical point of view, the source-monitoring framework is a suitable model to explain our results. From this perspective, the misinformation effect found in this study is likely to be caused by source confusions, more specifically, by confusing the source of the misleading brand memory with the original brand exposure (Zaragoza & Lane, 1994). Several findings of this project speak for a source-monitoring account. First, participants falsely attributed the misleading items to the original event phase even when their source-memory was directly tested by using a source-monitoring task. Hence, even if presumably more extended reasoning was involved at test, participants still misattributed some of the misleading postevent details to the original event phase. Moreover, the original items in the misled item condition (seen during the first brand exposure only) were sometimes falsely attributed to the second or both event phases. Hence, these memory errors were not reserved for the misleading items alone but occurred for other item types as well.

However, it is possible that these source-monitoring errors might have interacted with memory impairment and memory interference mechanisms and that participant’s original event memory trace was affected by the study manipulations. Throughout this project, evidence for a memory impairment view was found in more accurate item memory in the control relative to the misled item condition.

Participants created more hits for control brands (shown in a consistent manner) compared to items on which they were misled. A sub-experiment in Experiment 5 revealed this trend even when a more conservative baseline measure was used. More specifically, when participants were not misled on originally experienced brands (and also not exposed twice to them) but were tested on these items after a delay of one week, the hit rate for these brands was still higher compared to that recorded in the misled item condition of Experiment 5. These findings suggest that participant’s original event memory was initially existent and strong but that it was affected by the misleading information.

Another explanation for the misinformation-based false alarms recorded in this project are ‘non-false memory’ related mechanisms such as social demands, recency effects, as well as guessing biases. Although we do not exclude the possibility that these mechanisms were behind some of the misinformation false alarms recorded here, we believe that our methodology and cover stories should have kept such effects to a minimum. First, the critical items in the recognition tests were embedded in a substantial amount of related foil items, which should have made it hard to apply any kind of strategy. Second, in cases in which these mechanisms might have influenced the recognition test results, such responses were likely to be filtered out in the final source-monitoring task. Here, we specifically encouraged participants to reconsider the sources of their recognition test answers.

It is possible that, to some extent or other, several of the above-mentioned processes contributed to the brand misinformation effects revealed in this work. Although some control measures were applied, the mechanisms reported above cannot be disentangled in the paradigm used. Nevertheless, it seems reasonable to assume that in some cases, participants genuinely believed that a misleading brand from the photos was indeed experienced originally. In cases in which misinformation false alarms were indeed based on more endogenous processes (i.e., memory traces as supposed to more exogenous possesses such as demand characteristics), alternative theories can account for our findings. For example, according to Fuzzy Trace Theory (Reyna & Brainerd, 1995) participants might have falsely recognized the misleading detail because it triggered memory for the gist of the originally seen information (Reyna & Titcomb 1997). Alternatively, spreading activation models such as Activation Monitoring Theory (Roediger et al., 2001) and Associative-Activation Theory (Howe et al., 2009) suggest that at encoding of the original event information the related but misleading item was activated due to spreading activation across meaning-connected information in memory (Otgaar et al., 2016). Together with the actual presentation of the misleading item, strong activation for these items might have been responsible for the false memories revealed. From an Activation Monitoring Theory perspective (see also Source of Activation Confusion model; Ayers & Reder, 1998) false memories might have been created at the time of memory retrieval as well, in which participants distinguished between activation resulting from originally presented items and the more recently seen and potentially stronger activated misleading detail. In this process, source monitoring-errors might have occurred (Steffens & Mecklenbräuker, 2007).

The misinformation effects revealed in this work were found by using different ‘types’ of photographs. That is, a reliable misinformation effect was detected by using misleading photos taken by strangers (Experiments 1 and 3), photos that were (allegedly) taken by participants (Experiment 4), as well as photographs that showed the participants themselves (Experiment 5). Hence, independent of the type of picture that was used, participants falsely attributed the misleading brands to the original event. In line with the findings of Nash et al. (2009), these results suggest that feelings of familiarity might have been one factor why participants created these source-misattributions. When the misleading brands were accompanied by a rush of familiarity that was also experienced for the originally experienced brands, participants might have falsely assumed that the misleading brands must have appeared or must have been chosen originally (Nash et al., 2009). In addition, data suggest that the credibility associated with the photographs might have played a role in these effects. More specifically, in Experiment 5, in which participants were depicted in the photo, the false alarm rate for the misleading items was higher compared to Experiment 4, in which participants were not depicted in the photos. Hence, it is possible that participants in Experiment 5 perceived the photos as being more credible and as a result, they adopted a lower source-monitoring criteria when the judgments were made (Nash et al., 2009). However, although these results are somewhat in line with previous research, this work did not specifically examine how misinformation effects differ depending of the specific type of photograph.

In order to further evaluate the nature of misinformation acceptances revealed in our studies, some measures can be reviewed across experiments. For example, looking at participant’s phenomenological experience associated with memory retrieval of misleading items, the results of all experiments provided evidence that the Remember, Know, and Guess pattern for misinformation false memories often matched that of participants’ veridical memories. Experiments 4 and 5, that included a delay between original event and misinformation phase, revealed a clear pattern of more remember than know, and more know than guess responses for misleading items. Whereas in Experiment 4 the same pattern was found for original items in the control and misled item conditions, in Experiment 5 this was only the case for original items in the control item condition. In the misled item condition, no statistical difference between remember and know judgements was found. Interestingly, the same pattern (more remember than know judgements for misleading items but no difference for original items in misled item condition) was found in Experiment 3's 1-week delay condition, in which the same retention intervals were used as in Experiment 5. Overall this suggests that particularly in longer delay situations, false memories for the misleading brands seem to be perceived as having the same subjective qualities that veridical memories enjoy (compared to veridical memories for non-misled, control items).

Previous research that has used false narratives to implant misleading information suggests a different trend for items that contradicted an original event detail. In these studies, the false retrieval of contradicting misinformation items was associated with higher scores of know than remember responses, independent of the question when the final test was carried out. However, these studies specifically examined delays between the original event and final test and it is unclear whether it was the misleading photos or the different retention intervals that caused these differences. Nevertheless, in the paradigm used here, the distinct psychological experiences that accompanied participants' true and false memory retrieval turned out to be similar in nature. Interestingly, in all studies, no difference between Remember, Know, and Guess judgements were found for the foil items. In the main, foil false alarms were more often known than remembered, suggesting that misinformation false alarms and foils false alarms were indeed perceived as having different subjective qualities.

Another measure that provides information about the nature of misinformation acceptances is the attributions of items to the individual source options in the source-monitoring task. When we further analysed participants' source attributions, consistent with previous research (e.g. Zaragoza & Lane, 1994), we found that most robust source misattributions were made because participants falsely attributed the misleading brand to both the original event and the misinformation phase. Rarely were misleading items falsely attributed to the original event only. In addition, although many false alarms recorded in the recognition test were corrected when judgments were made under more systematic decision-making processes in the source-monitoring task, throughout all studies, participants hardly used the 'brands conflicted across phases' answer option. Together these results suggest that many participants did not notice that the brands differed across original event and misinformation phase.

Another finding that speaks for this fact is that many of the originally experienced brands were also falsely attributed to both event phases. Although these findings are not unusual (e.g. see Okado & Stark, 2005), results suggest that source misattributions to both event phases were not reserved for the misleading items alone (particularly in Experiments 1, 3, and 4). An explanation for this finding comes from a consistency assumption perspective (Blank, 2009). Here, it is proposed that unless participants are warned or are suspicious about the misinformation, they presume the misleading postevent information to be consistent with the original event. Although we did ask participants to reconsider the sources of their recognition test answers in the source-monitoring task, we did not explicitly warn participants about potential inconsistencies in the materials. Hence, in a next step it would be interesting and important to examine how the effects revealed in our studies would develop in a misinformation warning condition. Although warnings have been shown to reduce the magnitude of the misinformation effect compared to non-warning conditions, reliable misinformation effects have been revealed under these conditions (e.g. Eakin et al., 2003).

Our findings have implications for marketers including insights into the effectiveness of a new, albeit futuristic, advertising measure. Traditional advertisements serve to 'remind' consumers to purchase a product again. However, advertisements are often thought of with disdain, designed to manipulate buying habits. As a result, consumers develop advertising avoidance strategies such as using online advertising blockers or online TV services such as Netflix. Retroactive implicit brand placement could lead consumers to reinterpret and reconstruct their past experiences (believed that they consumed one particular brand over the other; Braun, 1999; Braun & Loftus, 1998; Loftus & Pickrell, 1995). This then becomes part of their own decision-making experiences. Our study provides evidence that brand attitudes and buying behaviour might be influenced as a result. Indeed, as Loftus and Pickrell (see also Braun & Loftus, 1998) note, this type of situation may be ripe for memory distortion: `New information invades us, like a Trojan horse, precisely because we don't detect its influence' (Loftus & Pickrell, 1995, p. 720).

Another point to mention is the importance of protecting consumers from such implicit advertising techniques. This is particularly important for young consumers who create sophisticated 'online personalities' and spend many hours on unregulated Internet sites and thus might be particularly vulnerable to these manipulations. Our results will also help policy makers evaluate the effects of deceptive advertising techniques and develop programs for stopping them at an early stage. But even if the manipulation of personal photos on social network platforms fails on legal grounds, our findings can be translated into other marketing techniques. For example, in ambush marketing, advertisers try to associate their own brand with a sponsoring event (without paying for official sponsoring rights) at the cost of a true and official sponsor (Cornwell & Humphreys, 2013). If marketers manage to create false positive associations between brands and the sponsored event, attitudes and purchasing behaviour for these brands might change (see also Braun-LaTour et al., 2006, for potential areas of application of the advertising misinformation effect and its consequences). It appears, then, that retroactive brand replacement could be a powerful tool.

This research has implicated cognitive mechanisms by which consumers fall prey to deceptive advertising techniques (see also Braun, 1999; Braun & Loftus, 1998; Loftus & Pickrell, 1995). However, marketers should be aware that these very cognitive mechanisms might also lead to product liability. Holmes and Weaver (2010) highlight the issue of civil 'toxic tort' cases. Here, individuals allege that some product they used in the past caused them harm. For example, the past exposure to asbestos in various products is now causing serious health problems. Witnesses maybe shown a series of photographs to 'refresh' their recollection of products they may have used from the past that are now known to contain asbestos. However, we have seen that in the memory literature the extent to which a witness' memory is 'refreshed' as opposed to 'created' or 'altered' is a matter of heated discussion, and has clear serious implications for these civil product liability cases (Holmes & Weaver, 2010).

We have already mentioned several limitations of this research and made suggestions how these shortcomings could be addressed in future research. Examples include a further investigation of factors that potentially influence encoding processes of brand placements in photos, the usage of alternative tests to examine the uptake of misinformation and preference change phenomena, as well as the need for ‘misinformation warnings’ in future studies. Another factor to consider is the inclusion of different control groups/conditions in future studies. In this regard, a commonly used baseline for misinformation acceptances is the false alarm rate for foil items in the control condition. In a counterbalanced design this can be done because these foils ‘would’ have been used to mislead on original event experience in the misled condition. This design was used in Experiment 1 and 5. However, although we included a small control sample in Experiment 3 (see Footnote 12), the more loosely associated foils in Experiments 3 and 4 were not used as actual study items. The reason for applying this method was our specific research question, which centred on the high amount of foil false alarms recorded in Experiment 1. However, detached from this motivation, a more elegant design would have included the foils at study in Experiments 3 and 4. Related to this, one might argue that the endorsement of original items in the control item condition might not be an ideal baseline to determine whether memory impairment occurred in our studies or not. Because original items in the control item condition were seen twice compared to only once for original items in the misled item condition, the question arises as to whether it was retrieval strength in the control item condition that led to this advantage in hit rates. Although this approach has been used in other studies (e.g. Holmes & Weaver, 2010; Loftus et al., 1978) typically, original items are not or are only vaguely mentioned again during the exposure to misinformation. As mentioned above in this discussion, in Experiment 5 we did report the results of a sub-experiment (see Footnote 22), suggesting the occurrence of memory impairment even by using a more conservative baseline. However, the effects in Experiment 5 were generally quite strong and it has yet to be examined whether or not these effects can be replicated in a more incidental brand learning design as used in Experiments 1 and 3. Again, we believe that the usage of more sensitive tests might be needed in order to reveal these effects.

Even with these limitations in mind, this research has given insight into a creative, albeit controversial, advertising method. Today marketers encounter a fierce advertising environment that demands creative and effective measures that specifically target the potential consumer. We showed that it is possible to implant false memories for brands that were retroactively inserted into personal photographs. Thus, naturally-occurring misinformation can be implanted to make consumers falsely believe that a past experience contained details other than what was originally experienced (Braun & Loftus, 1998). Moreover, the data suggested that once these false memories are formed, they might be associated with a positive shift in attitudinal and behavioural consequences. These findings provide good evidence that many of the laboratory-based false memory effects are robust when examined in a more ecologically relevant environment and serve to extend the generalizability of these effects. Although several questions remain to be addressed as part of this research agenda, we have provided convincing evidence to suggest that retroactive product replacement might be a powerful tool in an advertiser's armament. Although false memories are neither inherently good nor bad (Howe, 2011; Schacter, Guerin, & St. Jacques, 2011), the current research has demonstrated that in yet another context, the emergence of memory illusions can have some potentially costly consequences.

Appendices

Appendix A

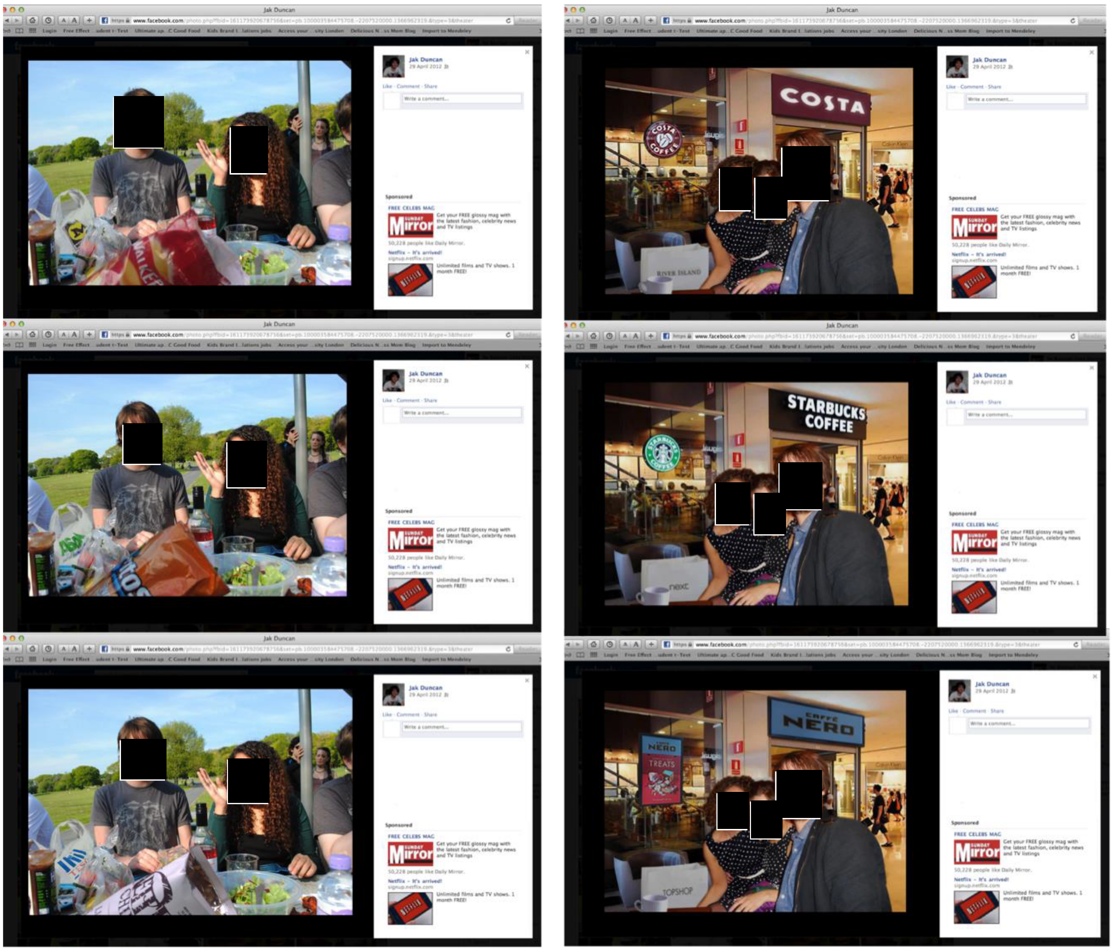
Experiment 1: Table showing brand categories and brands used with mean proportions of yes-responses in the recognition test as a function of Item type and Condition.

		Condition/Item Type				
		Misled item			Control item	
Brand categories	**Brand names**	**Original Item**	**Misleading Item**	**Foil Item**	**Original Item**	**Foil Item**
Beer	**Total**	**0,35**	**0,41**	**0,34**	**0,60**	**0,37**
	Fosters	0,67	0,50	0,69	0,77	0,63
	Stella	0,20	0,45	0,22	0,43	0,28
	Heineken	0,18	0,27	0,11	0,60	0,19
Bottled Water	**Total**	**0,44**	**0,55**	**0,30**	**0,69**	**0,29**
	Buxton	0,64	0,82	0,33	0,64	0,29
	Evian	0,38	0,56	0,31	0,43	0,23
	Volvic	0,30	0,27	0,27	1,00	0,35
Broadband	**Total**	**0,44**	**0,22**	**0,21**	**0,82**	**0,29**
	Sky	0,42	0,23	0,00	0,85	0,23
	BT	0,55	0,18	0,13	0,60	0,27
	Virgin	0,36	0,25	0,50	1,00	0,38
Camera	**Total**	**0,39**	**0,26**	**0,23**	**0,63**	**0,44**
	Nikon	0,54	0,25	0,55	1,00	0,42
	Kodak	0,20	0,18	0,14	0,45	0,38
	Canon	0,42	0,33	0,00	0,43	0,54
Car rental	**Total**	**0,60**	**0,30**	**0,35**	**0,52**	**0,18**
	Sixt	0,67	0,33	0,54	0,60	0,23
	Hertz	0,55	0,09	0,33	0,64	0,12
	Europcar	0,60	0,46	0,18	0,33	0,20
Cereal	**Total**	**0,50**	**0,40**	**0,41**	**0,73**	**0,29**
	Special K	0,55	0,70	0,56	0,50	0,45
	Nestle Fitnesse	0,40	0,29	0,43	0,68	0,17
	Weetabix	0,56	0,21	0,25	1,00	0,25
Cider	**Total**	**0,46**	**0,41**	**0,18**	**0,40**	**0,20**
	Strongbow	0,56	0,63	0,29	0,64	0,29
	Bulmers	0,33	0,18	0,25	0,00	0,07
	Blackthorn	0,50	0,42	0,00	0,57	0,24
Chips	**Total**	**0,60**	**0,43**	**0,40**	**0,54**	**0,49**
	Walkers	0,90	0,40	0,70	0,67	0,63
	Dorritos	0,50	0,45	0,22	0,58	0,31
	Kettle	0,40	0,44	0,27	0,38	0,53
Chocolate	**Total**	**0,43**	**0,41**	**0,18**	**0,65**	**0,22**
	Cadbury	0,13	0,38	0,44	0,79	0,44
	Milka	0,55	0,64	0,10	0,50	0,15
	Galaxy	0,62	0,23	0,00	0,67	0,08
Clothes shop	**Total**	**0,55**	**0,32**	**0,31**	**0,80**	**0,28**
	Topshop	0,62	0,42	0,25	0,77	0,25
	River Island	0,71	0,20	0,31	0,83	0,22
	next	0,31	0,33	0,38	0,80	0,37
Coffee shop	**Total**	**0,72**	**0,41**	**0,30**	**0,91**	**0,26**
	Costa	0,64	0,50	0,78	1,00	0,36
	Nero	0,88	0,30	0,00	0,87	0,11
	Starbucks	0,64	0,44	0,11	0,86	0,31
Compare website	**Total**	**0,38**	**0,22**	**0,14**	**0,51**	**0,15**
	Confused	0,20	0,11	0,00	0,29	0,13
	Gocompare	0,55	0,25	0,25	0,64	0,20
	Comparethem	0,40	0,30	0,18	0,62	0,11
Energy drink	**Total**	**0,48**	**0,36**	**0,24**	**0,31**	**0,21**
	Monster	0,46	0,42	0,09	0,46	0,23
	Rockstar	0,25	0,17	0,17	0,00	0,21
	Red Bull	0,73	0,50	0,46	0,45	0,20

		Condition/Item Type				
		Misled item			**Control item**	
Brand categories	**Brand names**	**Original Item**	**Misleading Item**	**Foil Item**	**Original Item**	**Foil Item**
Fastfood	**Total**	**0.72**	**0.39**	**0.32**	**0.71**	**0.17**
	KFC	0.60	0.45	0.45	0.50	0.12
	McDonalds	0.90	0.56	0.38	0.92	0.33
	Burger King	0.67	0.17	0.13	0.71	0.06
Fizzy soft drink	**Total**	**0.32**	**0.29**	**0.30**	**0.63**	**0.22**
	Dr Pepper	0.22	0.36	0.29	0.60	0.12
	Coca Cola	0.25	0.22	0.10	0.64	0.24
	Pepsi	0.50	0.29	0.50	0.64	0.29
Game console	**Total**	**0.42**	**0.33**	**0.19**	**0.48**	**0.18**
	Playstation	0.63	0.45	0.14	0.50	0.23
	X Box	0.27	0.29	0.22	0.60	0.12
	Wii	0.38	0.25	0.20	0.33	0.19
Orange juice	**Total**	**0.37**	**0.35**	**0.21**	**0.29**	**0.21**
	Innocent	0.45	0.36	0.00	0.22	0.36
	Tropicana	0.56	0.45	0.45	0.65	0.21
	Don Simon	0.09	0.22	0.18	0.00	0.04
Low cost airline	**Total**	**0.42**	**0.37**	**0.13**	**0.65**	**0.18**
	Easyjet	0.67	0.20	0.38	0.80	0.28
	Ryanair	0.50	0.33	0.00	0.79	0.14
	Flybe	0.10	0.57	0.00	0.36	0.13
Mid-range car	**Total**	**0.32**	**0.26**	**0.11**	**0.51**	**0.25**
	Peugeot	0.38	0.40	0.23	0.54	0.23
	Ford	0.40	0.18	0.00	0.33	0.38
	VW	0.18	0.20	0.10	0.67	0.13
Mobile	**Total**	**0.27**	**0.35**	**0.14**	**0.40**	**0.20**
	HTC	0.44	0.50	0.13	0.71	0.14
	LG	0.00	0.33	0.18	0.22	0.24
	Motorola	0.36	0.22	0.13	0.27	0.22
Search engine	**Total**	**0.51**	**0.39**	**0.19**	**0.56**	**0.13**
	Yahoo	0.70	0.63	0.11	0.73	0.21
	Bing	0.38	0.30	0.13	0.40	0.05
	Google	0.44	0.25	0.33	0.56	0.15
Service station	**Total**	**0.22**	**0.26**	**0.14**	**0.38**	**0.17**
	Shell	0.36	0.45	0.33	0.50	0.19
	Aral	0.11	0.20	0.09	0.36	0.11
	Total	0.18	0.11	0.00	0.29	0.20
Supermarket	**Total**	**0.41**	**0.29**	**0.28**	**0.61**	**0.16**
	Tesco	0.50	0.57	0.30	0.73	0.33
	Asda	0.50	0.11	0.40	0.71	0.00
	Morrisons	0.22	0.18	0.14	0.40	0.16
Sports clothes	**Total**	**0.31**	**0.19**	**0.20**	**0.31**	**0.25**
	Nike	0.29	0.25	0.18	0.33	0.30
	Adidas	0.33	0.11	0.13	0.27	0.29
	Puma	0.30	0.22	0.29	0.33	0.17

Appendix B

Experiment 1: Example photo versions ‘Picnic scene’ and ‘Shopping Centre scene’



Appendix C

Experiment 1: Recognition test responses: Table showing the mean proportion of yes-responses (SE) for each item type as a function of Condition, Time of test, and Stimuli test format (Format)

Condition/ Format	*Item type/Time of test* Original items (false alarms)			*Misleading items (false alarms)*			*Foil items (false alarms)*		
	Total	Immediate	Delay	Total	Immediate	Delay	Total	Immediate	Delay
Misled item									
Font	.40 (.04)	.40 (.06)	.40 (.04)	.33 (.04)	.29 (.06)	.36 (.05)	.23 (.03)	.25 (.04)	.22 (.05)
Pic	.48 (.04)	.47 (.05)	.48 (.05)	.34 (.04)	.38 (.05)	.30 (.06)	.24 (.03)	.22 (.05)	.27 (.04)
Total	**.44 (.03)**	.44 (.04)	.44 (.03)	**.33 (.03)**	.34 (.04)	.33 (.04)	**.24 (.02)**	.23 (.03)	.24 (.03)
Control item									
Font	.52 (.03)	.51 (.05)	.53 (.04)	n.a.*	n.a.	n.a.	.22 (.02)	.21 (.03)	.24 (.03)
Pic	.58 (.04)	.61 (.05)	.56 (.05)	n.a.	n.a.	n.a.	.20 (.03)	.19 (.04)	.21 (.03)
Total	**.55 (.02)**	.56 (.04)	.55 (.03)	n.a.	n.a.	n.a.	**.21 (.02)**	.20 (.03)	.22 (.02)

Appendix D

Experiment 1: ANOVA summary tables recognition test raw score analysis

Appendix D_1: Raw recognition score analysis misled item condition

Test statistics of 3(Item type: original item vs. misleading item vs. foil item) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA in the misled item condition

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	1.149	2	0.575	20.126	0.000	0.272
Item Type * Time of Test	0.002	2	0.001	0.039	0.962	0.001
Item Type * Stimuli Test format	0.041	2	0.021	0.722	0.488	0.013
Item Type * Time of Test * Stimuli Test format	0.091	2	0.046	1.595	0.208	0.029
Error (IT)	3.083	108	0.029			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	19.507	1	19.507	361.090	0.000	0.870
Time of Test	0.000	1	0.000	0.001	0.971	0.000
Stimuli Test format	0.047	1	0.047	0.861	0.358	0.016
Time of Test * Stimuli Test format	0.003	1	0.003	0.061	0.807	0.001
Error	2.917	54	0.054			

Appendix D_2

Raw recognition score analysis comparisons across condition

Test statistics of 2(Condition: misled vs. control) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA separately for original items, misleading items, and foil items

Original items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.391	1	0.391	19.108	0.000	0.261
Item Type * Time of Test	0.002	1	0.002	0.091	0.765	0.002
Item Type * Stimuli Test format	0.002	1	0.002	0.091	0.765	0.002
Item Type * Time of Test * Stimuli Test format	0.008	1	0.008	0.407	0.526	0.007
Error (IT)	1.105	54	0.020			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	28.318	1	28.318	551.882	0.000	0.911
Time of Test	0.000	1	0.000	0.009	0.926	0.000
Stimuli Test format	0.135	1	0.135	2.624	0.111	0.046
Time of Test * Stimuli Test format	0.007	1	0.007	0.135	0.715	0.002
Error	2.771	54	0.051			

Misleading items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.432	1	0.432	25.403	0.000	0.320
Item Type * Time of Test	0.008	1	0.008	0.478	0.492	0.009
Item Type * Stimuli Test format	0.011	1	0.011	0.635	0.429	0.012
Item Type * Time of Test * Stimuli Test format	0.032	1	0.032	1.874	0.177	0.034
Error (IT)	0.919	54	0.017			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	8.479	1	8.479	197.453	0.000	0.785
Time of Test	0.002	1	0.002	0.046	0.832	0.001
Stimuli Test format	0.001	1	0.001	0.022	0.884	0.000
Time of Test * Stimuli Test format	0.037	1	0.037	0.872	0.355	0.016
Error	2.319	54	0.043			

Foil items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.022	1	0.022	2.272	0.138	0.040
Item Type * Time of Test	0.002	1	0.002	0.205	0.653	0.004
Item Type * Stimuli Test format	0.008	1	0.008	0.818	0.370	0.015
Item Type * Time of Test * Stimuli Test format	0.014	1	0.014	1.454	0.233	0.026
Error (IT)	0.530	54	0.010			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	5.778	1	5.778	162.740	0.000	0.751
Time of Test	0.008	1	0.008	0.226	0.636	0.004
Stimuli Test format	0.002	1	0.002	0.057	0.813	0.001
Time of Test * Stimuli Test format	0.011	1	0.011	0.308	0.581	0.006
Error	1.917	54	0.036			

Appendix D_3: ANOVA summary tables recognition test analysis remember responses

Analysis remember responses misled item condition

Test statistics of 3(Item type: original item vs. misleading item vs. foil item) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA in the misled item condition

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.920	2	0.460	21.118	0.000	0.281
Item Type * Time of Test	0.037	2	0.018	0.842	0.433	0.015
Item Type * Stimuli Test format	0.048	2	0.024	1.099	0.337	0.020
Item Type * Time of Test * Stimuli Test format	0.022	2	0.011	0.508	0.603	0.009
Error (IT)	2.353	108	0.022			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	5.008	1	5.008	212.213	0.000	0.797
Time of Test	0.148	1	0.148	6.279	0.015	0.104
Stimuli Test format	0.280	1	0.280	11.873	0.001	0.180
Time of Test * Stimuli Test format	0.056	1	0.056	2.376	0.129	0.042
Error	1.274	54	0.024			

Appendix D_4

Analysis remember responses across condition

Test statistics of 2(Condition: misled vs. control) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA separately for original items, misleading items, and foil items

Original items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.221	1	0.221	21.202	0.000	0.282
Item Type * Time of Test	0.024	1	0.024	2.350	0.131	0.042
Item Type * Stimuli Test format	0.022	1	0.022	2.148	0.149	0.038
Item Type * Time of Test * Stimuli Test format	0.022	1	0.022	2.148	0.149	0.038
Error (IT)	0.563	54	0.010			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	1.479	1	1.479	77.585	0.000	0.590
Time of Test	0.035	1	0.035	1.811	0.184	0.032
Stimuli Test format	0.051	1	0.051	2.652	0.109	0.047
Time of Test * Stimuli Test format	0.038	1	0.038	1.994	0.164	0.036
Error	1.029	54	0.019			

Misleading items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.010	1	0.010	2.716	0.105	0.048
Item Type * Time of Test	0.002	1	0.002	0.443	0.508	0.008
Item Type * Stimuli Test format	0.007	1	0.007	2.020	0.161	0.036
Item Type * Time of Test * Stimuli Test format	0.005	1	0.005	1.382	0.245	0.025
Error (IT)	0.200	54	0.004			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	0.716	1	0.716	54.229	0.000	0.501
Time of Test	0.005	1	0.005	0.369	0.546	0.007
Stimuli Test format	0.026	1	0.026	1.979	0.165	0.035
Time of Test * Stimuli Test format	0.014	1	0.014	1.034	0.314	0.019
Error	0.713	54	0.013			

Foil items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.230	1	0.230	16.212	0.000	0.231
Item Type * Time of Test	0.014	1	0.014	0.977	0.327	0.018
Item Type * Stimuli Test format	0.019	1	0.019	1.306	0.258	0.024
Item Type * Time of Test * Stimuli Test format	0.049	1	0.049	3.483	0.067	0.061
Error (IT)	0.766	54	0.014			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	11.081	1	11.081	179.410	0.000	0.769
Time of Test	0.139	1	0.139	2.249	0.140	0.040
Stimuli Test format	0.290	1	0.290	4.687	0.035	0.080
Time of Test * Stimuli Test format	0.073	1	0.073	1.174	0.283	0.021
Error	3.335	54	0.062			

Appendix D_5: ANOVA summary tables recognition test analysis know responses

Analysis know responses misled item condition

Test statistics of 3(Item type: original item vs. misleading item vs. foil item) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA in the misled item condition

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.020	2	0.010	1.212	0.302	0.022
Item Type * Time of Test	0.065	2	0.033	3.990	0.021	0.069
Item Type * Stimuli Test format	0.002	2	0.001	0.123	0.884	0.002
Item Type * Time of Test * Stimuli Test format	0.017	2	0.009	1.044	0.356	0.019
Error (IT)	0.885	108	0.008			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	1.768	1	1.768	90.479	0.000	0.626
Time of Test	0.012	1	0.012	0.605	0.440	0.011
Stimuli Test format	0.054	1	0.054	2.768	0.102	0.049
Time of Test * Stimuli Test format	0.001	1	0.001	0.072	0.789	0.001
Error	1.055	54	0.020			

Appendix D_6

Analysis know responses across condition

Test statistics of 2(Condition: misled vs. control) x2(Time of test: immediate vs. delay) x2(Stimuli test format: font vs. pictorial) mixed factor ANOVA separately for original items, misleading items, and foil items

Original items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.015	1	0.015	1.389	0.244	0.025
Item Type * Time of Test	0.028	1	0.028	2.579	0.114	0.046
Item Type * Stimuli Test format	0.003	1	0.003	0.283	0.597	0.005
Item Type * Time of Test * Stimuli Test format	0.012	1	0.012	1.073	0.305	0.019
Error (IT)	0.593	54	0.011			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	1.583	1	1.583	100.876	0.000	0.651
Time of Test	0.036	1	0.036	2.302	0.135	0.041
Stimuli Test format	0.034	1	0.034	2.138	0.149	0.038
Time of Test * Stimuli Test format	0.000	1	0.000	0.008	0.931	0.000
Error	0.847	54	0.016			

Misleading items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.027	1	0.027	4.658	0.035	0.079
Item Type * Time of Test	0.000	1	0.000	0.013	0.910	0.000
Item Type * Stimuli Test format	0.001	1	0.001	0.168	0.683	0.003
Item Type * Time of Test * Stimuli Test format	0.004	1	0.004	0.764	0.386	0.014
Error (IT)	0.308	54	0.006			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	1.066	1	1.066	78.019	0.000	0.591
Time of Test	0.002	1	0.002	0.183	0.671	0.003
Stimuli Test format	0.033	1	0.033	2.410	0.126	0.043
Time of Test * Stimuli Test format	0.001	1	0.001	0.045	0.833	0.001
Error	0.738	54	0.014			

Foil items

Tests of Within-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Item Type	0.001	1	0.001	0.228	0.635	0.004
Item Type * Time of Test	0.009	1	0.009	2.539	0.117	0.045
Item Type * Stimuli Test format	0.000	1	0.000	0.071	0.790	0.001
Item Type * Time of Test * Stimuli Test format	0.007	1	0.007	1.810	0.184	0.032
Error (IT)	0.196	54	0.004			

Tests of Between-Subjects Effects

Source	SS	df	MS	F	Sig.	η_p^2
Intercept	0.807	1	0.807	69.320	0.000	0.562
Time of Test	0.003	1	0.003	0.256	0.615	0.005
Stimuli Test format	0.039	1	0.039	3.315	0.074	0.058
Time of Test * Stimuli Test format	0.002	1	0.002	0.135	0.715	0.002
Error	0.628	54	0.012			

Appendix E

Experiment 1: Recognition test responses: Table showing the mean proportion of Remember (R), Know (K), and Guess (G) responses (SE) for each item type as a function of condition, Time of test, and Stimuli test format (format).

Condition/ Time of test	Format	*Item type/Response type*								
		Original items (false alarms)			Misleading items (false alarms)			*Foil items (false alarms)*		
		R	K	G	R	K	G	R	K	G
Misled item										
Immed.	Font	.24 (.05)	.08 (.03)	.07 (.02)	.12 (.03)	.13 (.04)	.04 (.02)	.06 (.02)	.13 (.04)	.06 (.02)
	Pic	.38 (.05)	.06 (.02)	.03 (.01)	.26 (.05)	.08 (.03)	.04 (.02)	.14 (.04)	.07 (.02)	.01 (.01)
Delay	Font	.16 (.03)	.17 (.04)	.07 (.02)	.12 (.03)	.12 (.03)	.11 (.03)	.07 (.02)	.08 (.02)	.07 (.03)
	Pic	.28 (.06)	.11 (.03)	.09 (.02)	.13 (.04)	.11 (.03)	.06 (.02)	.08 (.02)	.07 (.02)	.12 (.04)
Control item										
Immed.	Font	.29 (.06)	.15 (.04)	.07 (.03)	n.a.	n.a.	n.a.	.06 (.02)	.09 (.02)	.05 (.02)
	Pic	.46 (.05)	.11 (.02)	.04 (.02)	n.a.	n.a.	n.a.	.08 (.03)	.06 (.02)	.04 (.01)
Delay	Font	.34 (.04)	.13 (.04)	.06 (.02)	n.a.	n.a.	n.a.	.06 (.02)	.11 (.02)	.07 (.02)
	Pic	.32 (.06)	.13 (.03)	.11 (.03)	n.a.	n.a.	n.a.	.07 (.02)	.06 (.01)	.08 (.02)

Appendix F

Experiment 1: Table showing proportion of correct and incorrect source attributions (robust memory performance rates) for each item type as a function of Condition, Time of test, and Stimuli test format (Format).

Condition/ Format	*Item type/Time of test*								
	Original items (false alarms)			*Misleading items (false alarms)*			*Foil items (false alarms)*		
	Total	Immediate	Delay	Total	Immediate	Delay	Total	Immediate	Delay
Misled									
Font	.17 (.03)	.19 (.04)	.16 (.04)	.14 (.02)	.12 (.03)	.16 (.04)	.07 (.01)	.06 (.01)	.07 (.02)
Pic	.24 (.04)	.23 (.06)	.24 (.06)	.15 (.03)	.16 (.05)	.14 (.04)	.08 (.02)	.07 (.03)	.08 (.02)
Total	.21 (.02)	.21 (.04)	.20 (.03)	.15 (.02)	.14 (.03)	.15 (.03)	.07 (.01)	.07 (.02)	.08 (.01)
Control									
Font	.30 (.04)	.31 (.06)	.28 (.05)	n.a.*	n.a.	n.a.	.07 (.01)	.06 (.02)	.07 (.01)
Pic	.36 (.04)	.40 (.06)	.32 (.04)	n.a.	n.a.	n.a.	.06 (.01)	.06 (.02)	.07 (.02)
Total	.33 (.03)	.36 (.04)	.30 (.03)	n.a.	n.a.	n.a.	.07 (.01)	.06 (.01)	.07 (.01)

Appendix G

Experiment 2: Table showing the brand recall data of Task 1 including the six most often recalled brands per category in alphabetical order of brand categories used

Brand Category	Brands	Recall Score	Brand Category	Brands	Recall Score
Beer	Heineken	0.41	Coffee shop	Starbucks	0.92
	Guinness	0.37		Costa	0.65
	Fosters	0.33		Nero	0.55
	Carlsberg	0.31		Pret a manger	0.53
	Stella Artois	0.25		Greggs	0.04
	Budweiser	0.24		Eat	0.04
Bottled water	Evian	0.76	Comparison website	Compare the market	0.51
	Volvic	0.37		Gocompare	0.41
	Highland Spring	0.25		Moneysupermarket	0.22
	Buxton	0.20		Confused	0.22
	Nestle	0.10		Money Saving Expert	0.06
	San Pellegrino	0.10		Admiral	0.04
Camera	Nikon	0.73	Crisps	Walkers	0.82
	Samsung	0.59		Doritos	0.47
	Sony	0.49		MCCoys	0.29
	Canon	0.35		Pringles	0.27
	Fuji	0.20		Hula Hoops	0.20
	Kodak	0.18		Sensations	0.18
Cereals	Kelloggs	0.65	Energy drink	Red Bull	0.84
	Coco Pops	0.47		Monster	0.47
	Weetabix	0.39		Lucozade	0.43
	Nestle	0.31		Boost	0.24
	Cornflakes	0.22		Relentless	0.22
	Rice crispies	0.20		Powerrate	0.10
Car rental	Hertz	0.20	Facial cream	Nivea	0.59
	Europcar	0.14		L'oreal	0.37
	Rent a Car	0.12		Simple	0.31
	Sixt	0.08		Garnier	0.25
	Avis	0.08		Dove	0.22
Chocolate	Cadbury	0.61		Clinique	0.18
	Galaxy	0.43	Fashion shop	Topshop	0.71
	Nestle	0.39		Primark	0.57
	Kinder	0.29		H&M	0.55
	Mars	0.25		River Island	0.49
	Lindt	0.24		New Look	0.47
Cider	Strongbow	0.31		Zara	0.39
	Bulmers	0.18	Fast Food	McDonalds	1.00
	Magners	0.14		KFC	0.90
	Stella Artois	0.10		Burger King	0.90
	Koppaberg	0.08		Subway	0.49
	Gaymers	0.04		Pizza Hut	0.41
				Dominos	0.20

Brand Category	Brands	Recall Score		Brand Category	Brands	Recall Score
Fizzy soft drink	Coca Cola	0.96		Mobile	Samsung	0.86
	Fanta	0.75			Nokia	0.71
	Pepsi	0.65			Sony	0.67
	Sprite	0.45			Apple	0.61
	7-up	0.39			Blackberry	0.47
	Dr. Pepper	0.33			HTC	0.47
Game console	Nintendo Wii	0.96		Online shopping	Asos	0.51
	Sony Playstation	0.84			Boohoo	0.39
	Microsoft X-Box	0.75			Missguided	0.20
	Sega	0.18			Very	0.14
	Atari	0.04			Nasty Gal	0.04
Grocery shop	Tesco	0.94			Alienware	0.06
	Sainsburys	0.86		Orange juice	Tropicana	0.55
	Asda	0.82			Innocent	0.33
	Waitrose	0.69			SunnyD	0.16
	Morrisons	0.59			Robinsons	0.10
	Lidl	0.45			Capri Sun	0.10
Internet provider	Virgin	0.73			Copella	0.08
	BT	0.73		Petrol station	Shell	0.57
	Sky	0.63			BP	0.51
	Talk Talk	0.51			Texaco	0.27
	o2	0.24			Esso	0.24
	Orange	0.18			Total	0.06
Laptop	Apple	0.94			Jet	0.06
	dell	0.80		Search engine	Google	0.98
	Asus	0.73			Yahoo	0.69
	Samsung	0.55			Bing	0.61
	Sony	0.51			Ask Jeeves	0.49
	HP	0.29		Social network	Facebook	0.96
Lowcost airline	Easy Jet	0.76			Twitter	0.86
	Ryanair	0.61			Instagram	0.61
	Monarch	0.16			MySpace	0.41
	Flybe	0.08			Tumblr	0.29
	Wizzair	0.06			Linked In	0.22
	BMI Baby	0.04		Sports clothing	Nike	0.96
	German Wings	0.04			Adidas	0.67
Mid-range car	Ford	0.59			Puma	0.57
	Toyota	0.47			Reebok	0.55
	Volkswagen	0.39			Converse	0.20
	BMW	0.37			Umbro	0.12
	Vauxhall	0.33				
	Mercedes	0.31				

Experiment 2: Table showing the brand rating data of Task 2 per category in alphabetical order of brand categories used

Brand Category	Brand	Potency	Evaluation	Activity
Beer	Stella Artois	2.23	2.78	4.38
	Carlsberg	2.55	3.25	4.03
	Guinness	2.31	3.16	5.13
	Carling	2.64	3.15	4.85
	Corona	3.41	2.81	4.59
	Becks	2.81	3.29	4.71
	Foster's	2.57	3.50	4.79
	Budweiser	3.10	3.67	4.86
	Peroni	4.35	2.95	4.96
	John Smith's	5.33	4.30	6.43
	Tennent's	5.43	4.73	6.16
Bottled water	Evian	1.44	1.11	1.64
	Volvic	1.97	2.22	2.27
	Buxton	3.06	2.55	3.24
	Highland Spring	3.03	2.83	3.06
	Nestle Waters	4.26	3.28	4.41
	San Pellegrino	4.58	3.88	5.42
	Perrier	4.87	3.73	5.41
	Iceni	5.83	5.13	6.00
Camera	Sony	1.61	1.92	2.57
	Canon	1.97	2.03	2.69
	Nikon	2.11	2.05	3.00
	Kodak	2.76	2.56	3.33
	Panasonic	2.54	2.85	3.43
	Casio	3.24	3.09	3.72
	Pentax	5.61	5.09	5.41
	Leica	5.59	4.85	6.00
Cereals	Coco Pops	1.50	2.59	2.92
	Weetabix	2.22	2.26	2.89
	Corn Flakes	1.51	2.68	3.47
	Special K	2.30	2.60	3.73
	Crunchy Nut	2.61	2.89	3.64
	Cheerios	2.39	3.17	4.29
	All Bran	3.54	3.13	4.68
	Alpen	3.94	3.63	4.70
Car rental	Hertz	3.18	2.55	3.73
	Europcar	4.00	2.71	4.29
	Sixt	4.06	2.81	4.65
	Avis	4.22	4.00	5.54
	National	5.39	4.25	5.83
	Budget	5.78	4.56	5.54
	Easyrent	6.48	5.50	6.21
	Alamo	6.35	5.71	6.15
Chocolate	Cadbury	1.58	1.66	2.00
	Galaxy	1.76	1.97	2.00
	Lindt	2.29	1.89	2.68
	Nestle	1.84	2.46	2.82
	Toblerone	2.49	2.91	3.76
	Milka	3.16	3.19	4.14
	Green & Blacks	4.70	3.70	4.90
	Ritter Sport	5.21	4.86	5.79

Brand Category	Brand	Potency	Evaluation	Activity
Cider	Strongbow	2.73	3.84	4.96
	Magners	3.11	3.81	5.00
	Bulmers	3.92	3.47	4.83
	Koppaberg	4.04	3.50	5.08
	Olde English	4.96	3.73	5.65
	Sommersby	5.00	4.10	5.59
	Thatchers	4.86	4.38	5.65
	Blackthorn	5.35	4.40	5.80
Coffee shop	Costa Coffee	1.71	2.14	2.22
	Starbucks	1.55	1.83	2.70
	Caffee Nero	2.97	2.71	3.89
	McCafe	4.43	4.00	5.33
	Coffee Republic	5.19	4.06	5.94
	Pumpkin Cafe Shop	5.48	4.38	5.86
	Caffe Ritazza	5.48	5.36	6.30
	ATM Coffee	5.78	5.67	6.20
Comparison website	Gocompare.com	1.94	2.42	4.13
	Comparethemarket.com	2.41	2.29	3.87
	Confused.com	2.29	2.50	4.03
	Moneysupermarket.com	2.91	2.86	4.40
	swiftcover.com	5.43	5.06	5.88
Crisps	Walkers	1.19	1.92	2.00
	Pringles	1.46	1.82	2.61
	Doritos	1.63	2.00	2.35
	Mc Coy's	2.38	2.54	2.94
	Kettle	3.58	2.81	4.09
	Golden Wonder	5.00	4.74	5.53
	Seabrook	6.03	4.83	6.23
	Real	6.20	5.27	6.27
	Jones	6.30	5.58	6.40
Energy drink	Red Bull	1.51	2.05	3.36
	Lucozade	1.94	2.13	3.86
	Monster	3.13	3.24	4.58
	Relentless	3.24	3.29	5.00
	Rockstar	4.65	4.30	5.70
	Emerge	5.15	4.80	6.00
	Kick	5.54	4.72	6.04
	No Fear	5.56	4.63	6.20
	V	5.33	5.25	6.16
	Ngine	5.10	5.54	6.50
Facial cream	Dove	1.61	1.92	2.17
	Nivea	1.56	2.06	2.42
	Vaseline	1.74	1.97	2.34
	Loreal	1.95	2.44	3.57
	Garnier	2.11	2.75	3.28
	Johnson & Johnson	2.17	2.59	3.71
	Simple	2.89	2.54	3.07
	Olay	2.33	2.97	4.49
	Nr7	2.81	3.04	4.40
	Vichy	4.80	3.68	5.21
	Eucerin	5.81	5.61	6.21
Fashion shop	H&M	1.58	2.03	2.13
	New Look	2.11	2.33	2.57
	Topshop	1.63	2.25	3.18
	River Island	2.16	2.31	2.78
	Next	2.32	3.31	4.03
	French Connection	2.97	2.84	4.67
	Oasis	3.11	3.42	4.32
	Gap	2.27	3.54	5.06
	Bershka	3.67	3.35	4.18
	Banana Republic	4.15	3.21	4.14

Brand Category	Brand	Potency	Evaluation	Activity
Fast food	Subway	2.11	1.86	2.67
	Nandos	1.97	2.07	3.16
	McDonalds	1.37	2.86	3.08
	Pret A Manger	2.59	2.24	3.68
	KFC	1.81	3.14	3.81
	Pizza Hut	2.08	2.68	4.24
	Burger King	1.82	3.44	4.27
	Dominos	2.59	3.00	4.37
	Eat	4.42	2.91	5.19
	Chicken Cottage	4.55	4.21	4.79
Fizzy soft drink	Coca Cola	1.03	1.70	2.26
	Fanta	1.79	2.70	3.32
	Sprite	2.19	2.81	3.26
	7Up	2.37	2.67	3.51
	Pepsi	1.66	2.97	4.24
	Oasis	3.36	2.78	3.80
	Dr Pepper	2.97	3.38	4.47
	Tango	3.59	3.70	5.14
	Orangina	5.09	4.74	5.68
Game console	Atari	5.48	5.26	6.40
	Ouya	6.29	5.82	6.48
	Playstation	1.24	1.59	2.46
	Sega	3.47	3.37	4.73
	Wii	1.66	1.70	2.69
	XBox	1.39	1.80	3.20
	Zeebo	6.52	6.00	6.76
Grocery shop	Tesco	1.16	2.32	1.55
	Sainsbury's	1.50	2.25	1.87
	Asda	1.94	2.43	3.11
	Waitrose	2.24	1.70	4.08
	Marks & Spencer	2.26	2.08	3.74
	Morrisons	2.72	3.20	4.48
	The co-operative	3.31	3.19	4.32
	Booths	6.45	4.71	6.46
Internet provider	Sky	1.51	1.97	2.59
	Virgin	1.49	2.21	3.03
	BT	1.81	2.31	2.79
	O2	2.21	2.35	3.41
	Orange	2.81	3.77	4.42
	Three	2.75	3.88	4.46
	Talk Talk	2.95	3.77	4.73
	Plusnet	5.52	4.88	6.13
Laptop	Apple	1.16	1.61	2.21
	Asos	1.70	1.68	2.38
	Samsung	1.66	2.16	2.75
	Sony Vaio	2.00	2.06	2.84
	Dell	1.87	2.45	2.64
	HP	1.89	2.45	3.05
	Acer	2.94	3.32	4.17
	Toshiba	2.87	3.27	4.31
	Compaq	5.09	4.85	5.48
	Lenovo	5.26	4.76	5.61
Low cost airline	Easyjet	1.34	3.08	2.92
	Ryanair	2.38	4.15	3.89
	Monarch	4.85	4.33	4.96
	Flybe	5.12	4.31	5.42
	Germanwings	5.86	5.23	5.85
	Jet2	5.59	5.21	6.15
	Wizz	6.07	5.50	6.12

Brand Category	Brand	Potency	Evaluation	Activity
Mid-range car	VW	1.86	1.97	2.43
	Ford	1.61	2.40	2.70
	Peugeot	2.50	3.06	3.47
	Nissan	2.42	3.06	3.57
	Renault	3.22	3.49	4.03
	Volvo	2.92	3.39	4.53
	Fiat	3.16	3.86	4.53
	Skoda	4.53	4.72	5.33
	Seat	5.03	5.10	5.12
Mobile	Apple	1.11	1.67	1.84
	Samsung	1.61	1.92	2.08
	Sony	2.24	2.57	3.65
	Nokia	2.00	3.03	3.97
	Blackberry	2.14	3.38	4.17
	HTC	3.30	3.34	4.15
	LG	3.68	4.29	5.14
	Motorola	3.95	4.91	5.59
Online shopping	Boohoo	2.77	3.67	4.29
	Littlewoods	2.90	3.76	5.04
	Very	3.14	3.58	5.00
	Missguided	4.11	3.24	4.56
	Fujitso Siemens	4.97	4.92	5.90
	Just Fabulous	5.85	4.63	6.00
	Zalando	5.92	4.63	6.33
Orange juice	Tropicana	1.81	2.09	2.47
	Innocent	2.03	2.03	3.19
	Capri-Sun	2.26	2.79	3.11
	Robinsons	2.37	2.88	3.43
	Sunny D	3.29	3.66	5.00
	Copella	4.22	3.67	4.67
	Don Simon	5.77	4.69	5.64
	Coldpress	6.14	5.17	6.20
Petrol station	Shell	2.11	2.41	2.69
	BP	1.77	2.70	2.91
	Esso	2.74	2.63	3.52
	Total	3.94	3.12	4.48
	Texaco	3.74	4.28	4.88
	Jet	4.30	4.10	5.28
Search engine	Google	1.00	1.08	1.00
	Yahoo	2.14	2.95	4.00
	Bing	2.82	3.26	4.68
	Volunia	6.71	6.39	6.80
Social network	Youtube	1.28	1.37	1.50
	Facebook	1.08	2.03	1.74
	Twitter	1.47	2.36	3.43
	Instagram	1.91	2.17	3.32
	Tumblr	3.57	3.26	5.45
	Google+	3.64	4.06	4.68
	Myspace	3.40	4.56	6.26
	LinkedIn	4.61	4.50	5.93
	Flickr	4.97	4.64	6.37
	Bebo	5.11	5.48	6.59
Sports clothing	Adidas	1.26	1.62	2.03
	Asics	4.97	4.36	5.58
	Nike	1.11	1.34	1.62
	Puma	2.45	2.67	3.70
	Reebok	2.45	3.24	4.46
	Slazenger	4.34	4.14	5.13
	Umbro	3.86	4.22	5.00
	Wilson	5.42	5.04	6.07

Appendix H

Experiment 3: Table showing brand categories and brands used in this study with mean proportions of yes-responses in the recognition test as a function of Item type and Condition.

Original, misleading items, and foil items (latter collapsed over condition)

		Condition/Item Type				
		Misled item		**Control item**		(Collapsed)
Brand categories	**Brand names**	**Original Item**	**Misleading Item**	**Original Item**	**Brand names**	**Foils**
Beer	**Total**	**0.69**	**0.69**	**0.67**	**Total**	**0.13**
	Carlsberg	0.67	0.67	0.50	Tennent's	0.00
	Carling	0.67	0.86	0.71	John Smith's	0.26
	Guinness	0.75	0.56	0.80		
Bottled Water	**Total**	**0.43**	**0.57**	**0.69**	**Total**	**0.02**
	Buxton	0.57	0.67	0.78	Iceni	0.04
	Volvic	0.40	0.50	0.50	San Pellegrino	0.00
	Evian	0.33	0.56	0.78		
Broadband	**Total**	**0.47**	**0.63**	**0.50**	**Total**	**0.28**
	Sky	0.50	0.38	0.50	Plusnet	0.25
	BT	0.57	0.83	0.44	EE	0.32
	Virgin	0.33	0.67	0.56		
Car rental	**Total**	**0.65**	**0.62**	**0.62**	**Total**	**0.07**
	Avis	0.33	0.60	0.50	Alamo	0.00
	Europcar	0.75	0.56	0.80	Budget	0.13
	Hertz	0.86	0.71	0.57		
Compare website	**Total**	**0.54**	**0.59**	**0.65**	**Total**	**0.00**
	Comparethemarke	0.40	0.38	0.50	Admiral	0.00
	Confused	0.71	0.83	0.89	Swiftcover	0.00
	Gocompare	0.50	0.56	0.56		
Crisps	**Total**	**0.50**	**0.42**	**0.66**	**Total**	**0.06**
	Walkers	0.57	0.67	0.67	Seabrook	0.12
	Doritos	0.60	0.25	0.75	Golden Wonder	0.00
	McCoy's	0.33	0.33	0.56		
Chocolate	**Total**	**0.36**	**0.44**	**0.41**	**Total**	**0.04**
	Cadbury	0.11	0.60	0.17	Ritter Sport	0.00
	Galaxy	0.22	0.29	0.57	Green & Black's	0.09
	Nestle	0.75	0.44	0.50		
Cereal	**Total**	**0.66**	**0.48**	**0.56**	**Total**	**0.11**
	Nestle Cheerios	0.88	0.67	0.60	Alpen	0.22
	Weetabix	0.56	0.50	0.50	Quaker	0.00
	Coco Pops	0.56	0.29	0.57		
Cider	**Total**	**0.55**	**0.61**	**0.55**	**Total**	**0.15**
	Koppaberg	0.57	0.67	0.56	Blackthorn	0.31
	Bulmers	0.40	0.38	0.75	Olde English	0.00
	Strongbow	0.67	0.78	0.33		
Clothes shop	**Total**	**0.49**	**0.46**	**0.47**	**Total**	**0.12**
	H&M	0.63	0.80	0.33	Bershka	0.00
	River Island	0.50	0.13	0.63	Banana Republic	0.23
	Topshop	0.33	0.44	0.44		
Coffee shop	**Total**	**0.69**	**0.76**	**0.89**	**Total**	**0.09**
	Starbucks	0.75	0.78	1.00	Coffee Republic	0.00
	Costa	0.89	0.71	1.00	Pumkin CafÌe Sho	0.17
	Caffé Nero	0.44	0.80	0.67		
Energy drink	**Total**	**0.58**	**0.45**	**0.57**	**Total**	**0.02**
	Red Bull	0.63	0.67	0.80	No Fear	0.00
	Monster	0.67	0.29	0.57	Kick	0.04
	Lucozade	0.44	0.40	0.33		
Facial Creme	**Total**	**0.31**	**0.05**	**0.20**	**Total**	**0.04**
	Dove	0.22	0.00	0.17	Vichy	0.00
	Nivea	0.25	0.00	0.30	Eucerin	0.09
	Loreal	0.44	0.14	0.14		

		Condition/Item Type				
		Misled item		Control item		(Collapsed)
Brand categories	**Brand names**	**Original Item**	**Misleading Item**	**Original Item**	**Brand names**	**Foils**
Fastfood	**Total**	**0.69**	**0.48**	**0.83**	**Total**	**0.13**
	KFC	0.63	0.33	0.50	Chicken Cottage	0.26
	McDonalds	0.44	0.40	1.00	Eat	0.00
	Burger King	1.00	0.71	1.00		
Fizzy soft drink	**Total**	**0.39**	**0.36**	**0.52**	**Total**	**0.07**
	Pepsi	0.33	0.30	0.50	Tango	0.13
	Coca Cola	0.63	0.22	0.50	Orangina	0.00
	Fanta	0.22	0.57	0.57		
Game console	**Total**	**0.54**	**0.46**	**0.47**	**Total**	**0.04**
	Wii	0.33	0.33	0.50	Atari	0.09
	Playstation	0.50	0.33	0.20	Sega	0.00
	X-Box	0.80	0.71	0.71		
Laptop	**Total**	**0.29**	**0.54**	**0.50**	**Total**	**0.12**
	Apple	0.33	0.78	0.56	Lenovo	0.00
	Asus	0.10	0.00	0.50	Compaq	0.23
	Dell	0.43	0.83	0.44		
Low cost airline	**Total**	**0.52**	**0.37**	**0.74**	**Total**	**0.06**
	Monarch	0.57	0.17	0.56	Flybe	0.12
	Easyjet	0.50	0.50	1.00	Jet2	0.00
	Ryanair	0.50	0.44	0.67		
Mid-range car	**Total**	**0.34**	**0.36**	**0.34**	**Total**	**0.12**
	Toyota	0.40	0.25	0.25	Seat	0.23
	Volkswagen	0.33	0.33	0.44	Skoda	0.00
	Ford	0.29	0.50	0.33		
Orange juice	**Total**	**0.48**	**0.46**	**0.65**	**Total**	**0.10**
	Innocent	0.63	0.60	0.67	Don Simon	0.00
	Tropicana	0.50	0.67	0.67	Coldpress	0.19
	SunnyD	0.30	0.13	0.63		
Search engine	**Total**	**0.28**	**0.40**	**0.54**	**Total**	**0.02**
	Google	0.43	0.50	0.67	Ask Jeeves	0.04
	Yahoo	0.40	0.38	0.50		
	Bing	0.00	0.33	0.44		
Service station	**Total**	**0.51**	**0.22**	**0.61**	**Total**	**0.09**
	Esso	0.67	0.33	0.56	Texaco	0.00
	Shell	0.57	0.33	0.89	Jet	0.17
	Total	0.30	0.00	0.38		
Sports clothing	**Total**	**0.35**	**0.55**	**0.38**	**Total**	**0.02**
	Reebok	0.11	0.60	0.17	Asics	0.00
	Nike	0.50	0.33	0.70	Slazenger	0.04
	Adidas	0.44	0.71	0.29		
Supermarket	**Total**	**0.48**	**0.46**	**0.65**	**Total**	**0.11**
	Innocent	0.63	0.60	0.67	The co-operative	0.22
	Tropicana	0.50	0.67	0.67	Iceland	0.00
	SunnyD	0.30	0.13	0.63		

Appendix I

Experiment 3: Example photo versions 'Breakfast'

Appendix J

Experiment 3: Full list of semantic associates used in the DRM paradigm

Critical targets with list items and foils (last three words per list) from the Stadler, Roediger, and McDermott (1999) norms

DOCTOR: nurse, sick, lawyer, medicine, health, hospital, dentist, physician, ill, patient, office, stethoscope, surgeon, clinic, cure

SMELL: nose, breathe, sniff, aroma, hear, see, nostril, whiff, scent, reek, stench, fragrance, perfume, salts, rose

SLEEP: bed, rest, awake, tired, dream, wake, snooze, blanket, doze, slumber, snore, nap, peace, yawn, drowsy

ROUGH: smooth, bumpy, road, tough, sandpaper, jagged, ready, coarse, uneven, riders, rugged, sand, boards, ground, gravel

CHAIR: table, sit, legs, seat, couch, desk, recliner, sofa, wood, cushion, swivel, stool, sitting, rocking, bench

Appendix K

Experiment 4: Table showing brand categories and brands used in this study with mean proportions of yes-responses in the recognition test as a function of Item type, Condition and Age group.

		Condition/Item Type/Age group								
		Misled item						Control item		
		Original items			Misleading items			Original items		
		Overall	Younger	Older	Overall	Younger	Older	Overall	Younger	Older
Crisp	Walkers	1.00	1.00	1.00	0.67	0.50	0.82	0.93	0.75	1.00
	Doritos	0.70	0.60	0.80	0.62	0.78	0.25	1.00	1.00	1.00
Chocolate	Galaxy	0.69	0.67	0.75	0.62	0.50	0.73	0.86	1.00	0.80
	Cadbury	0.57	0.50	0.64	0.54	0.56	0.50	0.92	0.80	1.00
Bottled water	Evian	0.77	0.78	0.75	0.81	0.80	0.82	0.79	1.00	0.70
	Volvic	0.38	0.30	0.45	0.62	0.67	0.50	0.85	0.60	1.00
Orange juice	Innocent	0.62	0.56	0.75	0.52	0.60	0.45	0.71	0.75	0.70
	Tropicana	0.81	0.80	0.82	0.62	0.67	0.50	0.92	1.00	0.88
Fizzy soft drink	Coca Cola	0.29	0.40	0.22	0.54	0.75	0.44	0.94	0.89	1.00
	Pepsi	0.31	0.25	0.33	0.64	0.60	0.67	0.81	0.90	0.67
Coffeee shop	Costa Coffee	0.64	0.80	0.56	0.46	0.50	0.44	1.00	1.00	1.00
	Starbucks	0.38	0.25	0.44	0.50	0.60	0.44	0.81	1.00	0.50
Beer	Heineken	0.50	0.20	0.67	0.62	0.75	0.56	1.00	1.00	1.00
	Carling	0.38	0.50	0.33	0.57	0.60	0.56	1.00	1.00	1.00
Cider	Strongbow	0.64	0.80	0.56	0.46	0.50	0.44	0.72	0.56	0.89
	Bulmers	0.54	0.50	0.56	0.57	0.40	0.67	0.81	0.70	1.00

		Foil items						Foil items		
		Overall	Younger	Older				Overall	Younger	Older
Crisp	Golden Wonder	0.00	0.00	0.00				0.25	0.00	0.16
	Seabrook	0.00	0.00	0.00				0.00	0.00	0.00
Chocolate	Green & / Blacl	0.20	0.11	0.00				0.13	0.17	0.13
	Ritter Sport	0.00	0.10	0.00				0.07	0.00	0.08
Bottled water	San Pellegrino	0.33	0.20	0.50				0.14	0.40	0.17
	Iceni	0.00	0.00	0.00				0.00	0.00	0.00
Orange juice	Don Simon	0.25	0.00	0.00				0.00	0.17	0.00
	Coldpress	0.00	0.00	0.00				0.00	0.00	0.00
Fizzy soft drink	Tango	0.00	0.00	0.19				0.00	0.14	0.00
	Orangina	0.00	0.25	0.08				0.33	0.04	0.29
Coffeee shop	Pumpkin Cafe	0.00	0.00	0.00				0.00	0.00	0.00
	Coffee Republic	0.14	0.00	0.00				0.00	0.05	0.00
Beer	John Smith's	0.11	0.00	0.13				0.00	0.13	0.00
	Tennent's	0.10	0.25	0.21				0.00	0.17	0.20
Cider	Olde English	0.00	0.00	0.08					0.05	0.00
	Blackthorn	0.00		0.25				0.00	0.13	0.00

Appendix L

Experiment 5: Tables showing the mean ratings (SE) for liking and likelihood of buying of all item types as a function of Condition, Endorsement, and Time

Liking scale

	Item type/Condition							
	Misled item				Control item		(Collapsed)	
Endorsement/ Time	Original items		Misleading items		Original item		Foil items	
Endorsed								
Time 1	8.38	(.26)	6.26	(.21)	7.63	(.20)	6.93	(.45)
Time 2	8.33	(.30)	6.87	(.22)	7.89	(.18)	6.62	(.45)
Non-Endorsed								
Time 1	8.08	(.18)	5.99	(.31)	5.85	(.76)	5.37	(.16)
Time 2	7.93	(.19)	6.06	(.30)	6.45	(.77)	5.34	(.18)

Likelihood of buying scale

	Item type/Condition							
	Misled item				Control item		(Collapsed)	
Endorsement/ Time	Original items		Misleading items		Original item		Foil items	
Endorsed								
Time 1	8.47	(.28)	6.13	(.22)	7.62	(.20)	6.87	(.49)
Time 2	8.54	(.27)	6.75	(.24)	7.80	(.20)	6.67	(.53)
Non-Endorsed								
Time 1	8.09	(.19)	5.89	(.37)	5.85	(.84)	5.16	(.17)
Time 2	7.76	(.22)	5.67	(.38)	6.67	(.75)	5.09	(.18)

Notes. It should be noted that the means for the misleading items do occasionally not match these reported in-text. The reason is missing data points that slightly change the means when more complex analysis (e.g. two-way repeated measures ANOVA including Misinformation endorsement (endorsed vs. non-endorsed) and Time (time 1 vs. 2) is used.

References

Ackil, J. K., & Zaragoza, M. S. (1995). Developmental differences in eyewitness suggestibility and memory for source. *Journal of Experimental Child Psychology*, *60*, 57–83.

Ageing of the UK population. (2015). Retrieved September 18, 2016, from http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/mid-2014/sty-ageing-of-the-uk-population.html

Ayers, M. S., & Reder, L. M. (1998). A theoretical review of the misinformation effect: Predictions from an activation-based memory model. *Psychonomic Bulletin & Review*, *5*, 1–21.

Bekerian, D. A., & Bowers, J. M. (1983). Eyewitness testimony: Were we misled? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *9*, 139–145.

Belli, R. F. (1989). Influences of misleading postevent information: Misinformation interference and acceptance. *Journal of Experimental Psychology: General*, *118*, 72–85.

Belli, R. F. (1993). Failure of interpolated tests in inducing memory impairment with final modified tests: Evidence unfavorable to the blocking hypothesis. *The American Journal of Psychology*, *106*, 407–427.

Belli, R. F., Lindsay, D. S., Gales, M. S., & McCarthy, T. T. (1994). Memory impairment and source misattribution in postevent misinformation experiments with short retention intervals. *Memory & Cognition*, *22*, 40–54.

Belli, R. F., Windschitl, P. D., McCarthy, T. T., & Winfrey, S. E. (1992). Detecting Memory Impairment With a Modified Test Procedure: Manipulating Retention Interval With Centrally Presented Event Items. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *18*, 356–367.

Berkowitz, S. R., Laney, C., Morris, E. K., & Loftus, E. F. (2008). Pluto behaving badly: False beliefs and their consequences. *American Journal of Psychology*, *121*, 643–660.

Bernstein, D. M., Laney, C., Morris, E. K., & Loftus, E. F. (2005). False memories about food can lead to food avoidance. *Social Cognition*, *23*, 11–34.

Bernstein, D. M., & Loftus, E. F. (2009). The consequences of false memories for food preferences and choices. *Perspectives on Psychological Science*, *4*, 135–139.

Bernstein, D. M., Scoboria, A., & Arnold, R. (2015). The consequences of suggesting false childhood food events. *Acta Psychologica*, *156*, 1–7.

Blank, H. (1998). Memory states and memory tasks: An integrative framework for eyewitness memory and suggestibility. *Memory*, *6*, 481–529.

Blank, H. (2009). Remembering: A Theoretical interface between memory and social psychology. *Social Psychology*, *40*, 164–175.

Blank, H., & Launay, C. (2014). How to protect eyewitness memory against the misinformation effect: A meta-analysis of post-warning studies. *Journal of Applied Research in Memory and Cognition*, *3*, 77–88.

Brainerd, C. J., & Reyna, V. F. (2005). *The science of false memory*. New York: Oxford University Press, USA.

Braun-LaTour, K. A., LaTour, M. S., & Loftus, E. F. (2006). Is that a finger in my chili? Using affective adversing for postcrisis brand repair. *Cornell Hotel and Restaurant Administration Quarterly*, *47*, 106–120.

Braun-LaTour, K. A., LaTour, M. S., Pickrell, J. E., & Loftus, E. F. (2004). How and when advertising can influence memory for consumer experience. *Journal of Advertising*, *33*, 7–25.

Braun, K. A. (1999). Postexperience advertising effects on consumer memory. *Journal of Consumer Research*, *25*, 319–334.

Braun, K., Ellis, R., & Loftus, E. (2002). Make my memory: How advertising can change our memories of the past. *Psychology and Marketing*, *19*, 1–23.

Braun, K., & Loftus, E. (1998). Advertising's misinformation effect. *Applied Cognitive Psychology*, *12*, 569–591.

Brennan, I., Dubas, K. M., & Babin, L. A. (1999). The influence of product placement type and exposure time on product placement recognition. *International Journal of Advertising*, *18*, 323–337.

Bulevich, J. B., & Thomas, A. K. (2012). Retrieval effort improves memory and metamemory in the face of misinformation. *Journal of Memory and Language*, *67*, 45–58.

Campbell, J. M., Edwards, M. S., Horswill, M. S., & Helman, S. (2007). Effects of contextual cues in recall and recognition memory: The misinformation effect reconsidered. *British Journal of Psychology*, *98*, 485–498.

Ceci, S. J., Crotteau Huffman, M. L., Smith, E., & Loftus, E. F. (1994). Repeatedly thinking about a non-event: Source misattributions among preschoolers. *Consciousness and Cognition*, *3*, 388–407.

Cohen, G., & Faulkner, D. (1989). Age differences in source forgetting: Effects on reality monitoring and on eyewitness testimony. *Psychology and Aging*, *4*, 10–17.

Cornwell, T. B., & Humphreys, M. S. (2013). Memory for sponsorship relationships: A critical juncture in thinking. *Psychology & Marketing*, *30*, 394–407.

d'Astous, A., & Chartier, F. (2000). A study of factors affecting consumer evaluations and memory of product placements in movies. *Journal of Current Issues & Research in Advertising*, *22*, 31–40.

Dewhurst, S. A., & Anderson, S. J. (1999). Effects of exact and category repetition in true and false recognition memory. *Memory & Cognition*, *27*, 665–73.

Dodson, C. S., & Krueger, L. E. (2006). I misremember it well: why older adults are unreliable eyewitnesses. *Psychonomic Bulletin & Review*, *13*, 770–775.

Donders, K., Sehooler, J. W., & Loftus, E. F. (1987). Troubles with memory. In *Annual meeting of the Psychonomic Society*. Seattle: Geiselman.

Eakin, D. K., Schreiber, T. A., & Sergent-Marshall, S. (2003). Misinformation effects in eyewitness memory: the presence and absence of memory impairment as a function of warning and misinformation accessibility. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *29*, 813–25.

Faul, F., Erdfelder, E., Lang, A., & Buchner, A. (2009). G*Power.

Frenda, S. J., Knowles, E. D., Saletan, W., Slate, T., Washington, G., & Loftus, E. (2013). False Memories of Fabricated Political Events Author ' s personal copy False memories of fabricated political events. *Journal of Experimental Social Psychology*, *49*, 280–286.

Frost, P. (2000). The quality of false memory over time: Is memory for misinformation “remembered” or “known”? *Psychonomic Bulletin & Review, 7,* 531–536.

Frost, P., Ingraham, M., & Wilson, B. (2002). Why misinformation is more likely to be recognised over time: A source monitoring account. *Memory*, *10*, 179–185.

Gallo, D. A. (2010). False memories and fantastic beliefs: 15 years of the DRM illusion. *Memory & Cognition*, *38*, 833–848.

Garry, M., & Wade, K. A. (2005). Actually, a picture is worth less than 45 words: narratives produce more false memories than photographs do. *Psychonomic Bulletin & Review*, *12*, 359–366.

Gould, S. J., & Gupta, P. B. (2006). “Come on down”: How consumers view game shows and the products placed in them. *Journal of Advertising*, *35*, 65–81.

Gupta, P., & Lord, K. (1998). Product placement in movies: The effect of prominence and mode on audience recall. *Journal of Current Issues and Research in Advertising*, *20*, 47–59.

Henkel, L. A., & Carbuto, M. (2008). Remembering what we did: How source misattributions arise from verbalization, mental imagery, and pictures. *Applied Memory*, *99*, 213–234.

Hervet, G., & Gue, K. (2011). Is banner blindness genuine? Eye tracking internet text advertising. *Applied Cognitive Psychology*, *716*, 708–716.

Hodges, S., Williams, L., Berry, E., Izadi, S., Srinivasan, J., Bulter, A., … Wood, K. (2006). SenseCam: a retrospective memory aid. *UbiComp 2006: Ubiquitous Computing*, *4206*, 177–193.

Holmes, A. E., & Weaver, C. A. (2010). Eyewitness memory and misinformation: Are remember/know judgments more reliable than subjective confidence? *Applied Psychology in Criminal Justice*, *6*, 47–61.

Howe, M. L. (2011). The adaptive nature of memory and its illusions. *Current Directions in Psychological Science*, *20*, 312–315.

Howe, M. L., & Derbish, M. H. (2010). On the susceptibility of adaptive memory to false memory illusions. *Cognition*, *115*, 252–267.

Howe, M. L., & Wilkinson, S. (2011). Using story contexts to bias children's true and false memories. *Journal of Experimental Child Psychology*, *108*, 77–95.

Howe, M. L., Wimmer, M. C., Gagnon, N., & Plumpton, S. (2009). An associative-activation theory of children's and adults' memory illusions. *Journal of Memory and Language*, *60*, 229–251.

Hyman, I. E., & Loftus, E. F. (1998). Errors in autobiographical memory. *Clinical Psychology Review*, *18*, 933–947.

Israel, L., & Schacter, D. L. (1997). Pictorial encoding reduces false recognition of semantic associates. *Psychonomic Bulletin & Review*, *4*, 577–581.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, *114*, 3–28.

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review*, *88*, 67–85.

Johnson, M. K., Suengas, A. G., Foley, M. A., & Raye, C. L. (1988). Phenomenal Characteristics of Memories for Perceived and Imagined Autobiographical Ecents. *Journal of Experimental Psychology: General*, *117*, 371–376.

Karpel, M. E., Hoyer, W. J., & Toglia, M. P. (2001). Accuracy and Qualities of Real and Suggested Memories: Nonspecific Age Differences. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *56*, 103–110.

Keller, K. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *The Journal of Marketing*, *57*, 1–22.

La Ferle, C., & Edwards, S. (2006). Product placement How brands appear on television. *Journal of Advertising*, *35*, 65–86.

Laney, C., Morris, E. K., Bernstein, D. M., Wakefield, B. M., & Loftus, E. F. (2008). Asparagus, a love story: healthier eating could be just a false memory away. *Experimental Psychology*, *55*, 291–300.

Law, S., & Braun, K. (2000). I'll have what she's having: Gauging the impact of product placements on viewers. *Psychology and Marketing*, *17*, 1059–1075.

Lee, M., & Faber, R. J. (2007). Effects of product placement in on-line games on brand memory: A perspective of the limited-capacity model of attention. *Journal of Advertising*, *36*, 75–90.

Lindsay, D., & Johnson, M. (2000). False memories and the source monitoring framework: Reply to Reyna and Lloyd (1997). *Learning and Individual Differences*, *12*, 145–161.

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.

Lindsay, D. S., & Johnson, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition*, *17*, 349–358.

Loftus, E. F. (1977). Shifting human color memory. *Memory & Cognition*, *5*, 696–699.

Loftus, E. F. (2003). Make-believe memories. *The American Psychologist*, *58*, 867–73.

Loftus, E. F. (2005). Planting misinformation in the human mind: a 30-year investigation of the malleability of memory. *Learning & Memory*, *12*, 361–366.

Loftus, E. F., & Cahill, L. (2007). Memory distortion: From misinformation to rich false memory. In J. S. Narine (Ed.), *The Foundations of Remembering: Essays in Honor of Henry L. Roediger III* (pp. 413–425). New York: Psychology Press.

Loftus, E. F., & Hoffman, H. G. (1989). Misinformation and memory: The creation of new memories. *Journal of Experimental Psychology: General*, *118*, 100–104.

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.

Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals*, *25*, 720–725.

Loftus, E., Levidow, B., & Duensing, S. (1992). Who remembers best? Individual differences in memory for events that occurred in a science museum. *Applied Cognitive Psychology*. Wiley Online Library.

Low, G. S., & Lamb, C. W. (2000). The measurement and dimensionality of brand associations. *Journal of Product & Brand Management*, *9*, 350–370.

Manning, C. G., & Loftus, E. F. (1996). Eyewitness testimony and memory distortion. *Japanese Psychological Research*, *38*, 5–13.

Mazzoni, G. A., Loftus, E. F., & Kirsch, I. (2001). Changing beliefs about implausible autobiographical events: a little plausibility goes a long way. *Journal of Experimental Psychology. Applied, 7,* 51–59.

Mazzoni, G., & Kirsch, I. (2002). Autobiographical memories and beliefs: A preliminary metacognitive model. In T. J. Perfect & B. L. Schwartz (Eds.), *Applied metacognition* (pp. 121–146). Cambridge, UK: Cambridge University Press.

McCloskey, M., & Zaragoza, M. (1985). Misleading postevent information and memory for events: arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology. General, 114,* 1–16.

Mitchell, K. J., Johnson, M. K., & Mather, M. (2003). Source monitoring and suggestibility to misinformation: Adult age-related differences. *Applied Cognitive Psychology, 17*, 107–119.

Nash, R. A., & Wade, K. A. (2008). Innocent but proven guilty: Eliciting internalized false confessions using doctored-video evidence. *Applied Cognitive Psychology*, *23*, 624–637.

Nash, R. A., Wade, K. A., & Brewer, R. J. (2009). Why do doctored images distort memory? *Consciousness and Cognition, 18,* 773–80.

New technology can turn TV shows into sophisticated adverts. (2015). Retrieved November 15, 2015, from http://www.bbc.co.uk/news/entertainment-arts-34727307

Okado, Y., & Stark, C. (2005). Neural activity during encoding predicts false memories created by misinformation. *Learning & Memory*, 12, 3–11.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. (1957). *The Measurement of Meaning*. University of Illinois Press.

Ost, J., Blank, H., Davies, J., & Jones, G. (2013). False memory≠ false memory: DRM errors are unrelated to the misinformation effect. *PloS One*, *8*, 1–6.

Otgaar, H., & Candel, I. (2011). Children's false memories: Different false memory paradigms reveal different results. *Psychology, Crime & Law*, *17*, 513–528.

Otgaar, H., Candel, I., Merckelbach, H., & Wade, K. A. (2009). Abducted by a UFO: Prevalence information affects young children's false memories for an implausible event. *Applied Cognitive Psychology*, *23*, 115–125.

Otgaar, H., Howe, M. L., Brackmann, N., & Smeets, T. (2016). The Malleability of Developmental Trends in Neutral and Negative Memory Illusions. *Journal of Experimental Psychology: General*, *145*, 31–55.

Otgaar, H., Howe, M. L., Peters, M., Sauerland, M., & Raymaekers, L. (2013). Developmental trends in different types of spontaneous false memories: Implications for the legal field. *Behavioral Sciences and the Law*, *31*, 666–682.

Otgaar, H., Peters, M., & Howe, M. L. (2012). Dividing attention lowers children's but increases adults' false memories. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *38*, 204–10.

Otgaar, H., Verschuere, B., Meijer, E. H., & van Oorsouw, K. (2012). The origin of children's implanted false memories: Memory traces or compliance? *Acta Psychologica*, *139*, 397–403.

Paz-Alonso, D. P. M., & Goodman, G. S. (2008). Trauma and memory: Effects of post-event misinformation, retrieval order, and retention interval trauma and memory. *Memory*, 16, 37–41.

Pezdek, K., Finger, K., & Hodge, D. (1997). Planting False Childhood Memories: The Role of Event Plausibility. *Psychological Science*, *8*, 437–441.

Pezdek, K., & Lam, S. (2007). What research paradigms have cognitive psychologists used to study "false memory," and what are the implications of these choices? *Consciousness and Cognition*, *16*, 2–17.

Pezdek, K., & Roe, C. (1995). The effect of memory trace strength on suggestibility. *Journal of Experimental Child Psychology*, *60*, 116–128.

Pickrell, J. E., McDonald, D., Bernstein, D. M., & Loftus, E. F. (2016). Misinformation effect. In R. F. Pohl (Ed.), *Cognitive Illusions: Intriguing Phenomena in Judgement, Thinking and Memory* (pp. 406–423). New York: Psychology Press.

Political challenges relating to an aging population: Key issues for the 2015 Parliament. (2015). Retrieved September 18, 2016, from http://www.parliament.uk/business/publications/research/key-issues-parliament-2015/social-change/ageing-population/

Rajagopal, P., & Montgomery, N. V. (2011). I imagine, I experience, I like: The false experience effect. *Journal of Consumer Research*, *38*, 578–594.

Raskin, A. (2010). Your memories will be rewritten. Retrieved February 24, 2013, from http://readwrite.com/2010/10/18/facebook_product_placement

Reyna, V. (2000). Fuzzy-trace theory and source monitoring: An evaluation of theory and false-memory data. *Learning and Individual Differences*, *12*, 163–175.

Reyna, V. F., & Brainerd, J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning and Individual Differences*, *7*, 1–75.

Reyna, V. F., & Lloyd, F. (1997). Theories of false memory in children and adults. *Learning and Individual Differences*, *9*, 95–123.

Reyna, V. F., & Titcomb, A. L. (1997). Constraints on the suggestibility of eyewitness testimony: A fuzzy-trace theory analysis. In D. G. Payne & F. G. Conrad (Eds.), *Intersections in basic and applied memory research* (pp. 157–174). Mahwah, NJ: Erlbaum.

Roediger, H. L., & Gallo, D. A. (2004). Associative memory illusions. In R. F. Pohl (Ed.), *Cognitive illusions: A handbook on fallacies and biases in thinking, judgement and memory* (pp. 309–326). New York: Psychology Press.

Roediger, H. L., Jacoby, J. D., & McDermott, K. B. (1996). Misinformation effects in recall: Creating false memories through repeated retrieval. *Journal of Memory and Language*, *318*, 300–318.

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

Roediger, H. L., Watson, J. M., McDermott, K. B., & Gallo, D. A. (2001). Factors that determine false recall: A multiple regression analysis. *Psychonomic Bulletin & Review*, *8*, 385–407.

Russell, C. A. (2002). Investigating the effectiveness of product placements in television shows: The role of modality and plot connection congruence on brand memory and attitude. *Journal of Consumer Research*, *29*, 306–318.

Sacchhi, D. L. M., Agnoli, F., & Loftus, E. F. (2007). Changing history: Doctored photographs affect memory for past public events. *Applied Cognitive Psychology*, *21*, 1005–1022.

Schacter, D. L., Guerin, S. A., & St. Jacques, P. L. (2011). Memory distortion: An adaptive perspective. *Trends in Sognitive Sciences*, *15*, 467–474.

Schacter, D. L., Israel, L., & Racine, C. (1999). Suppressing false recognition in younger and older adults: The distinctiveness heuristic. *Journal of Memory and Language*, *24*, 1–24.

Schacter, D. L., Koutstaal, W., Johnson, M. K., Gross, M. S., & Angell, K. E. (1997). False recollection induced by photographs: a comparison of older and younger adults. *Psychology and Aging*, *12*, 203–215.

Sherman, S. M. (2013). False recall and recognition of brand names increases over time. *Memory (Hove, England)*, 21, 219–229.

Sherman, S. M., Follows, H., Mushore, A. B. R., Hampson-Jones, K., & Wright-Bevans, K. (2015). Television advertisements create false memories for competitor brands. *Journal of Applied Research in Memory and Cognition*, *4*, 1–7.

Sherman, S. M., & Moran, E. J. (2011). Creating false memories for brand names. *Applied Cognitive Psychology*, *25*, 336–340.

Social Media Usage: 2005-2015. (2015). Retrieved September 18, 2016, from http://www.pewinternet.org/2015/10/08/social-networking-usage-2005-2015/

Stadler, M. A., Roediger, H. L., & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition*, *27*, 494–500.

Steffens, M. C., & Mecklenbräuker, S. (2007). False Memories Phenomena, theories, and implications. *Zeitschrift Für Psychologie / Journal of Psychology*, *215*, 12–24.

Tousignant, J. P., Hall, D., & Loftus, E. F. (1986). Discrepancy detection and vulnerability to misleading postevent information. *Memory & Cognition*, *14*, 329–38.

Tukey, J. W. (1977). *Exploratory Data Analysis*. JOUR, Reading, Mass.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology/Psychologie Canadienne*, *26*, 1–12.

Tversky, B., & Tuchin, M. (1989). A reconciliation of the evidence on eyewitness testimony- Comments on McCloskey and Zaragoza. *Journal of Experimental Psychology. General*, *118*, 86–91.

Underwood, J., & Pezdek, K. (1998). Memory suggestibility as an example of the sleeper effect. *Psychonomic Bulletin & Review*, 5, 449-453.

Wade, K. A., Sharman, S. J., Garry, M., Memon, A., Mazzoni, G., Merckelbach, H., & Loftus, E. F. (2007). False claims about false memory research. *Consciousness and Cognition*, *16*, 18-28-30.

Wade, K., 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*, *9*, 597–603.

Wright, D. B., & Loftus, E. F. (1998). How misinformation alters memories. *Journal of Experimental Child Psychology*, *71*, 155–64.

Wright, D. B., & Stroud, J. N. (1998). Memory quality and misinformation for peripheral and central objects. *Legal and Criminological Psychology*, *3*, 273–286.

Wright, E., Khanfar, N. M., Harrington, C., & Kizer, L. E. (2010). The lasting effects of social media trends on advertising. *Journal of Business & Economics Research*, *8*, 73–80.

Wyler, H., & Oswald, M. E. (2016). Why misinformation is reported: evidence from a warning and a source-monitoring task. *Memory (Hove, England)*, *8211*, 1–16.

Wylie, L. E., Patihis, L., Mcculler, L., Davis, D., Brank, E. M., Loftus, E. F., & Bornstein, B. H. (2014). Misinformation Effect in Older Versus Younger Adults A Meta-Analysis and Review. In M. P. Toglia, D. F. Ross, J. Pozzulo, & E. Pica (Eds.), *The Elderly Eyewitness in Court* (pp. 38–66). UK: Psychology Press.

Yang, M., Roskos-Ewoldsen, D., Dinu, L., & Arpan, L. (2006). The effectiveness of “in-game” advertising: Comparing college students’ explicit and implicit memory for brand names. *Journal of Advertising*, *35*, 143–152.

Yang, M., & Roskos-Ewoldsen, D. R. (2007). The effectiveness of brand placements in the movies: Levels of placements, explicit and implicit memory, and brand-Choice behavior. *Journal of Communication*, *57*, 469–489.

Yesavage, J. A., & Brink, T. L. (1983). Development and validation of a geriatric depression screening scale: a preliminary report. *Journal of Psychiatric Research*, *17*, 37–49.

Zaragoza, M. S., & Lane, S. M. (1994). Source misattributions and the suggestibility of eyewitness memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*, 934–945.

Zaragoza, M. S., Lane, S. M., Ackil, K. K., & Chambers, K. L. (1997). Memory for Everyday and Emotional Events. In N. L. Stein, P. A. Ornstein, B. Tversky, & C. Brainerd (Eds.), *Memory for Everyday and Emotional Events* (pp. 401–425). Hillsdale, New Jersey: Erlbaum.

Zhu, B., Chen, C., Loftus, E. F., He, Q., Lei, X., Lin, C., & Dong, Q. (2012). Brief exposure to misinformation can lead to long-term false memories. *Applied Cognitive Psychology*, *26*, 301–307.

Zhu, B., Chen, C., Loftus, E. F., Lin, C., & Dong, Q. (2013). The relationship between DRM and misinformation false memories. *Memory & Cognition, 41*, 832–8.

Zhu, B., Chen, C., Loftus, E. F., Lin, C., He, Q., Li, H., … Dong, Q. (2010). Individual differences in false memory from misinformation: cognitive factors. *Memory, 18*, 543–55.

Zhu, B., Chen, C., Loftus, E. F., Lin, C., He, Q., Li, H., … Dong, Q. (2010). Individual differences in false memory from misinformation: Personality characteristics and their interactions with cognitive abilities. *Personality and Individual Differences, 48*, 889–894.