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Psychophysiological correlates of the misinformation effect

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ABSTRACT

The misinformation effect refers to memory impairment that arises after exposure to misleading information (Loftus, 2005, p. 361). The present study focuses on the peripheral psychophysiology of false memories induced in a misleading information paradigm. On the basis of Sokolov's orienting reflex and studies concerning the Concealed Information Test (CIT, Lykken, 1959), the main hypothesis assumes differences between true and false memories in terms of the accompanying autonomic measures. It also is assumed that a cued recall of original information preceding the recollection phase reduces misinformation effects. Seventy-five participants watched a video that included nine randomized details. After a ten-minute retention phase, the subjects read a narrative text. Six out of the nine details were replaced by misleading details. Following this, the participants completed a cued recall task for three of the original items. In a subsequent CIT with truthful answering electrodermal responses, phasic heart rate, respiration, and response behavior were measured. Finally, the level of confidence and source monitoring were assessed. The misinformation effect was replicated with newly developed materials in three recollection tasks. Cued recall had no influence on the misinformation effect. Autonomic measures did not differ between true and false memories in the CIT. Electrodermal responses reflected the subjective importance the participants attributed to details in the source monitoring task. Therefore, electrodermal responses are interpreted as a correlate of subjective remembering in a misinformation paradigm.

1. Introduction

Eyewitness testimony is crucial for concluding police investigations (Coupe and Griffiths, 1996; Paulo et al., 2013). However, most police officers do not know that eyewitness memory is often distorted (Kebbell and Milne, 1998). If memory impairment arises after exposure to misleading information, this is called a misinformation effect (Loftus, 2005, p. 361). The vulnerability to false memories has been a focus of memory and forensic research for nearly four decades. However, to date, there have been few studies investigating the physiological correlates of false memory (for a review, see Johnson et al., 2012; Schacter and Slotnick, 2004). In the present study, we examined peripheral physiological measures as possible indicators of false memories in a misinformation paradigm. Additionally, we aimed to reduce misinformation effects using a cued recall procedure.

1.1. The misinformation effect

False memory research dates to the 1970s. In a series of five experiments, Loftus et al. (1978) evoked false memories of a traffic sign. The three-stage procedure applied was named the misinformation paradigm and has since been used by various research groups (e.g., Belli et al., 1994; McCloskey and Zaragoza, 1985; Tversky and Tuchin, 1989). In the misinformation paradigm, the subjects first watch a video or slides typically showing crime or crime-related plots. After a distractor or retention phase, the researchers introduced misinformation hidden in a narrative or questions about the event (e.g., "How fast was the car going when it ran the *stop sign*?" Loftus et al., 1978, p.19). Finally, the subjects complete memory tasks about the event. Typically, forced-choice, recognition, source identification, or level-of-confidence tests are used to gather memory data (Johnson et al., 1993; Tversky and Tuchin, 1989). If misleading information successfully provoked a misinformation effect, this is reflected in two ways: in reduced recall of original information and enhanced recall of misleading information (Loftus, 2005).

To date, there is no clear explanation of how false memories emerge in a misinformation paradigm. Initially, it was assumed that misleading information replaces the original memory (Loftus, 1979; Loftus and

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Loftus, 1980). Later, an integration of misleading and original information into one mixed memory was considered (Loftus and Hoffman, 1989). However, the coexistence of original and misleading information has been demonstrated by several research groups (e.g., Bekerian and Bowers, 1983; Belli, 1988; Wright, 1993). Lindsay and Johnson (1989) assumed that the sources of information are confused during retrieval. In the source monitoring framework (Johnson et al., 1993; for a summary, see Lindsay, 2008) false memory occurs when misleading information is misattributed to the source of the original information. Such source monitoring is driven by judgment processes that interact with several characteristics of memories, which are typical of a specific source that a memory could have (Johnson et al., 1993). Based on the assumptions of the source monitoring framework, the present study employed a cued recall task to reduce misinformation effects.

1.2. Reduction of misinformation effects

As it is still unclear which exact processes drive the misinformation effect, it is an open question how it can be reduced reliably. Per the discrepancy detection principle, warnings before the misleading information (Eakin et al., 2003; Greene et al., 1982) or misinformation received from an unreliable source (Bodner et al., 2009; Dodd and Bradshaw, 1980) can reduce misinformation effects. However, the evidence the evidence concerning warnings given in between the misleading information phase and the recollection phase is still equivocal (for a review, see Blank and Launay, 2014).

The search for a procedure that can be applied after misleading information was given and that reduces the effect of misleading information on memory, is still ongoing. In applied forensic research, this is pursued with two approaches: the Cognitive Interview (CI; Fisher and Geiselman, 1992) and the Self-administered Interview (SAI; Gabbert et al., 2008). Both approaches rely mainly on a mental reinstatement of the crime (mentally recreating the context of an event, as well as the physiological, cognitive, and emotional states at the time of an event), that supports correct source identification (Fisher et al., 1989; Memon and Bull, 1991; Paulo et al., 2013). Both interviews were investigated in applied contexts and achieved large effect sizes (Dodson et al., 2015; Fisher et al., 1989; Gabbert et al., 2008; Hope et al., 2014; Köhnken et al., 1994; Köhnken et al., 1999). For example, a recent meta-analysis found average effect sizes of $d = 1.20$ for comparisons between correctly reported details in the Cognitive Interview compared to control interviews (Memon et al., 2010).

In our study, we employed a simple task preceding the recollection phase that aimed to strengthen correct source identification in a misinformation paradigm. We designed the task using the mental reinstatement principle that is utilized in both interview forms of applied forensic research. The simple procedure used the original scene in the video as a cue to facilitate correct source identification. This process resulted in a cued recall task, which will be described later.

1.3. Physiological correlates of false memory

The main goal of our study was to examine peripheral physiological measures as possible indicators of false memories in a misleading information paradigm. Past research has mainly comprised studies using functional magnetic resonance imaging (fMRI), positron emission tomography (PET), or event-related potential (ERP) and other false memory paradigms (for a review, see Johnson et al., 2012). To the authors' knowledge, only one study has used autonomic measures (Baioui et al., 2012). Also, only few studies used the misinformation paradigm (e.g., Okado and Stark, 2005). The combination of autonomic measures and the misinformation paradigm, however, is promising. Autonomic measures might function as sensible indicators of false memories, which rely on the principles of the orienting reflex (OR; Sokolov, 1963).

The OR is the physiological, cognitive, and behavioral response to a given stimulus (Sokolov, 1963). Autonomic measures like electrodermal activity (EDA), respiration line length (RLL), and phasic heart rate (pHR) are discussed to reflect this basal process (Sokolov, 1963). The strength of an OR is influenced by the novelty, intensity, and significance of the stimulus (Sokolov, 1963). The stimulus significance is the special importance and meaning a subject attributes to an item (see also Ambach et al., 2011), and, for this study, the stimulus significance is crucial for examining the physiological responses to true memories compared with false memories. The difference between less and highly significant stimuli is well-reflected, particularly by EDA (Barry, 1996). A method that uses autonomic measures to differentiate between stimuli of different significance is the Concealed Information Test (CIT; Lykken, 1959).

The CIT is a well-designed and valid method to detect information using physiological measures (for a review, see Ben-Shakhar and Elaad, 2003; Meijer et al., 2014). The CIT assumes that physiological responses differ between crime-relevant and crime-irrelevant information if a subject has knowledge about a crime (Lykken, 1959). Besides other approaches, the OR is discussed as the main explanation of this difference (Verschuere et al., 2011). The CIT asks several questions referring to different crime-relevant categories. Typically, a question (e.g., “Was this fruit lying on the window sill?”) is combined with five items showing possible alternatives. Only subjects with crime-related knowledge will recognize the right answer and react differently to crime-related items. In a typical response pattern, test subjects respond to crime-relevant (significant) items with greater EDA and smaller RLL and pHR (Ambach et al., 2008; Ben-Shakhar and Elaad, 2003; Elaad and Ben-Shakhar, 2008; Gamer et al., 2006; Verschuere et al., 2004). The CIT also reflects recognition if the information is not concealed. This outcome is especially true for EDA, which mainly reflects OR, whereas, pHR and RLL are also discussed in the light of concealment processes (Ambach et al., 2008; Klein Selle et al., 2015).

In misinformation paradigms, the recognition of original information is impaired by misinformation. Based on orienting theory, we assumed that a special importance and meaning is attributed to the original but not the misleading information; therefore, original information is more significant to the person than misleading information. Referring to the typical response patterns in studies dealing with concealed information, it is assumed that the original information will be accompanied by greater EDA as well as smaller pHR and RLL responses, compared to the misleading or unknown information.

Baioui et al. (2012) already examined data on autonomic measures gathered in a Deese-Roediger-McDermott paradigm (DRM, Deese, 1959; Roediger & McDermott, 1995). In a DRM paradigm, participants first learn lists of closely related words (e.g., *bed*, *pillow*, *sheet*) and are asked to recognize the learned words in an upcoming recognition phase. Often, participants then falsely remember words related to the categories they have studied before (e.g., *sleep*) (Roediger & McDermott, 1995). In contrast to the misleading information paradigm, false memories in a DRM paradigm are not evoked by misleading information but by the activation of a conceptual scheme of the studied items. Baioui et al. (2012) also suggested that false memories are accompanied by less subjective importance and meaning and, thus, by a smaller OR in contrast to true memories. Their results yielded greater EDA responses associated with true memories rather than false memories. No significant effects of pHR or RLL were found. It is still an open question whether this response pattern can be replicated and transferred to a misinformation paradigm.

1.4. Aims of the present study

1.4.1. Methodologically advanced replication of the misinformation effect

A methodologically advanced version of the typical misinformation paradigm was applied. The original information was presented in a video instead of slides because of advances in external validity; a video presents motion sequences of action and is thus easier for a person to