

THE IMPORTANCE OF A SYNCHRONY BETWEEN EMOTION AND MEMORY – CASES WITH DISSOCIATIVE AMNESIA

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Abstract

Episodic or episodic-autobiographical memory is considered to be a significant attribute of human cognition, depending on auto-noetic consciousness and allowing mental time travel into past and future. Furthermore, episodic memory is embedded in an appraisal system, in which individual episodes are evaluated. We used patients with a condition of ‘dissociative amnesia’ in order to study interdependencies between emotion and memory. Dissociative amnesia leads to a blockade of retrieving episodic memories, while the retrieval of general knowledge (“semantic memory”) is still possible usually. Forty-one patients with a diagnosis of dissociative amnesia were investigated neuropsychologically. Sixteen of them were subjected to fluor-positron-emission-tomography to study possible changes in their brain. Main questions were (a) in what ways their old – “forgotten” – memories differ from newly acquired ones, and (b) what are possible brain mechanisms leading to the dichotomy between emotional and non-emotional memory retrieval, respectively failure of retrieval. Results indicate that the forgotten or blocked personal memories are much more complex and self-centered than the semantic ones and require more effort for retrieval. Furthermore, blocked memories seem to remain in a subconscious, disconnected state, hindering the proper association between cognition and emotion. It was found that the failure of episodic retrieval is accompanied by a dysfunction or desynchronization between emotion- and fact-processing regions of the brain.

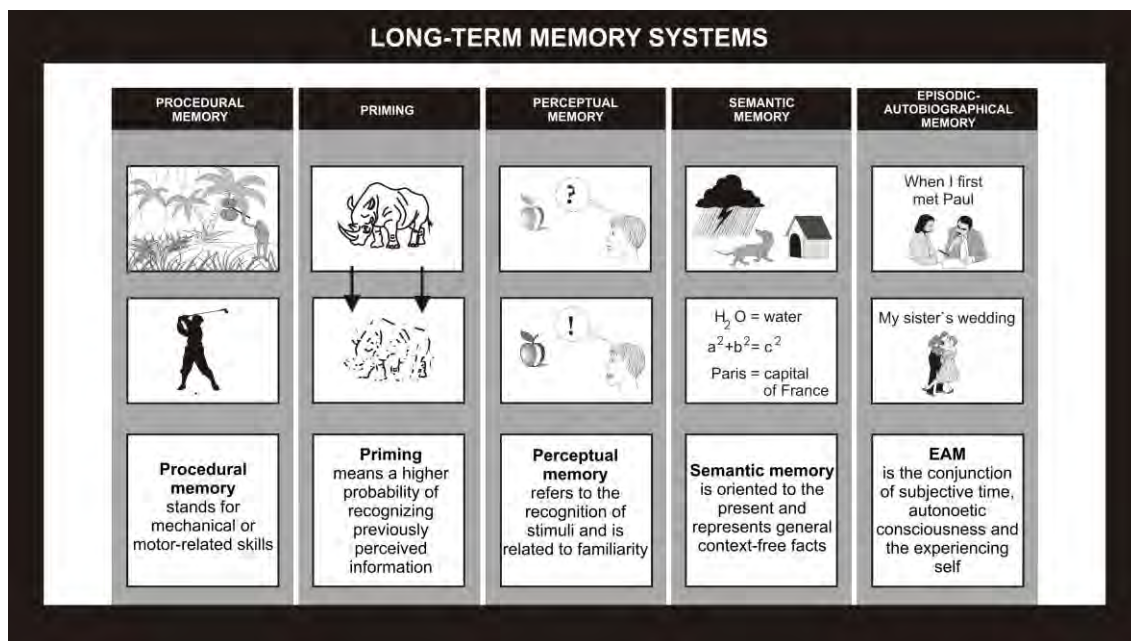
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1. Introduction

Long-term memory nowadays is divided into several systems which act independently of each other at encoding, but build-up hierarchically during ontogenesis and phylogenesis (Figure 1). Furthermore, they manifest different levels of complexity with respect to their conscious representation. These start in Figure 1 on the left with the two anoetic (“unconscious”) systems, termed ‘procedural memory’ and ‘priming’; then come two noetic (“conscious”) systems, namely ‘perceptual memory’ and ‘semantic memory’, and finally there is an auto-noetic (“self-conscious”) system, which nowadays is named ‘episodic-autobiographical memory’. It is assumed that the first four memory systems exist in animals and man, while the fifth – the episodic-autobiographic one – is reserved for human beings (Tulving, 2005; Tulving & Markowitsch, 1998). This memory system, on the other hand, is usually the main or principal one which is impaired both in patients with neurological (Markowitsch & Staniloiu, 2012) and psychiatric disturbances (Staniloiu & Markowitsch, 2014; Markowitsch & Staniloiu, 2016).

Reasons for the selective impairment of episodic-autobiographic memory in patients with neurological or psychiatric illnesses probably lie in the complexity of this memory system, compared to the other four. Acquiring as well as retrieving episodic events requires a complex neuronal network which includes brain regions involved in imagery (Fletcher et al., 1995), in monitoring (Fletcher & Henson, 2001; Kühnel et al., 2008), mental time travel (Tulving, 2002, 2005) and in emotional colorization (Markowitsch & Staniloiu, 2011). Furthermore, the retrieval of episodes occurs state-dependent, that is, in the specific mood of the individual at the time point of retrieval and within the environmental circumstances and conditions, existing at retrieval. This specific retrieval form has therefore been named ‘ecphory’ (Calabrese et al., 1996; Markowitsch et al., 2003; Tulving, 2002). Ecphorizing old memory therefore may lead to scenarios congruent with the past ones – and thereby leading to further integration – or to disrudent scenarios, dissolving the old memories and consequently leading to new images, deviating from the consolidating ones.

Figure 1. The five long-term memory systems. It is assumed that they evolve from left to right and that only the last one is coupled to affect and is – in Tulving’s (2005) definition – reserved to human beings.



We will investigate these mechanisms by employing patients with dissociative amnesia. It is known that dissociative amnesia is a disease condition which leads to a blockade of old episodic-autobiographical memories, while in general leaving semantic memories intact. Patients with dissociative amnesia are unable to retrieve episodes from their past. They do not remember even their closest relatives and any information about their past existence (Staniloiu & Markowitsch, 2014; Markowitsch & Staniloiu, 2016). Consequently, patients with dissociative amnesia no longer possess the principal features necessary for a successful reinstatement of past memories, namely ‘autooetic consciousness’ (Markowitsch, 2003) and an ‘experiencing self’ (cf. the respective definition in Figure 1).

2. Methods

Altogether, 41 patients with a diagnosis of dissociative amnesia according to DSM-5 (APA, 2013) were employed. These patients had been recruited over a number of years and included a few with an additional so-called fugue condition. ‘Dissociative amnesia’ has been defined as a condition where patients are unable to retrieve episodes from their personal past. This even includes an inability to retrieve information about the closest relatives (partner, children), while usually general facts about the world are preserved – including the abilities to read, write and calculate. In DSM-5, the condition also includes patients who have left their usual home area and traveled to other places, named ‘fugue’ condition, and diagnosed separately in previous editions of the DSM (see, e.g., Markowitsch et al., 1997; Markowitsch & Staniloiu, 2013)

The patients were thoroughly investigated with neuropsychological tests and questionnaires. Furthermore, a subgroup of them (altogether 16 patients) were studied with brain imaging techniques. These were (a) fluor-positron-emission-tomography (FDG-PET), (b) magnetic resonance imaging, and (c) diffusion-tensor-imaging.

The neuropsychological tests and questionnaire were the following: All patients received screening instruments measuring their general intellectual status and estimating their intelligence with the *Mehrfach-Wahl-Wortschatz-Test (MWT-B)* (Lehrl, 2005). Furthermore, attention and concentration, problem solving abilities, visuo-constructive abilities, executive functions, and processing of emotions were measured. With respect to memory, the Rey-Osterrieth Figure, the Doors Tests (Baddeley et al., 1994) and the revised version of the Wechsler-Memory-Test (Härting et al., 2002) were usually applied. Furthermore, additional tests for semantic and autobiographical retrograde memory (German language versions of a Famous Faces Test and of an Autobiographical Memory Interview; see Fujiwara et al., 2008; Staniloiu & Markowitsch, 2014) were given. For testing emotions, we used the ‘Reading the Mind in the Eyes Test’ of Baron-Cohen et al. (2001) (24 items version), the visual subtests (subtests 1-5) of the Florida-Affect-Battery (Bowers et al., 1991; German language translation by Breitenstein et al., 1996) and a recognition set of emotional versus neutral photographs (Cramon et al., 1993). Furthermore, this group

received as questionnaires the Structured Clinical Interview for Dissociative Disorders (Wittchen et al., 1997), the Dissociative Experiences Scale (DES-II) (Gast and Rodewald, 2004), the revised Symptom-Check-List-90 (SCL-90-R; Hessel et al., 2001), and the Freiburg Personality Inventory (Fahrenberg et al., 2001).

3. Results

The 41 patients were nearly equally distributed between sexes. Their mean age was 33 years and they had diverse socio-economic backgrounds. All of them had nine or more years of schooling. The events triggering the dissociative amnesic condition can be grouped into (1) accidents with vehicles, sometimes leading to minor head concussions, (2) injuries of the body (e.g., breast, bone fracture) (3) life threatening events or other threats or subjectively dangerous situations, (4) police accusations, (5) major stress, (6) family problems, (7) ideas of being or becoming severely ill (e.g., becoming an Alzheimer's patient), (8) unknown causes.

3.1. Neuropsychological results

The patients generally had average to good average intelligence. Their executive functions, problem solving abilities, visuo-constructive abilities, and attention-concentration rates were within normal limits. With respect to memory, all patients failed to retrieve any or nearly any episode or event from their personal as tested by the Autobiographical Memory Interview (which requests one or two episodes from all decades or half-decades of their past). When asking them informally in conversation, they still remained unable to retrieve past personal memories. Several of the patients furthermore showed problems in retrieving old semantic memories. While these deficits were seen especially during the first month or two after amnesia onset, they remained for a few patients even after more than half a year. We noted, however, that these semantic memories had a personal connotation to the individual. For example, one patient had changed his university studies several times and still had not finished them. So, he still could not work as a teacher to provide an income for his young family. It seemed that he disliked his present study of Latin, which he, however, did in order to become a teacher of Latin in high school, and to satisfy his father, who no longer wanted to support his family. Apparently, as a consequence, after becoming amnesic, he even was unable to translate the simplest Latin proverbs (like "plenus venter non studet libenter") or common Latin sayings from Catholic church services (though he was Catholic).

The majority of the patients was deficient in at least one or two of the three tests on emotions applied. This finding corresponded with their everyday appearance that showed some bluntness in affect and unconcern about their personal situation. Especially, with respect to their family and relatives, most of the patients seemed to show no empathy and even no interest. (This might be understandable, as they anyway did not recognize them as their partners, parents, or children.) However, in general social life conditions, this lack of concern and of emotional engagement was observed as well. On the other hand, they could be guided and directed much more easily than normal individuals, that is, they were suggestible to influences from others.

3.2. Brain imaging results

More than half of the 41 patients were subjected to brain imaging. Magnetic resonance imaging was done in those patients where brain damage due to concussions, car accidents, or because of other reasons had to be excluded. FDG-PET was done in 17 of the patients (see also Brand et al., 2009; Staniloiu & Markowitsch, 2010; Staniloiu et al., 2011). Consistent finding was a hypometabolic regional combination of inferolateral prefrontal and anterior temporal cortex of the right hemisphere. This region includes the amygdala and is interconnected bidirectionally by a prominent fiber system, the uncinate fascicle, which has prominent roles in mnemonic processing – especially episodic memory (Von der Heide et al., 2013) – and in social cognition and emotional valence (Von der Heide et al., 2013).

One patient received diffusion-tensor-imaging of his brain which resulted in a reduced connectivity between fibers of the thalamus and the visual cortex, a finding which suggests problems with imagery.

4. Discussion and conclusions

Dissociative amnesia is understood as a disconnection syndrome, that is normally integrated functions diverge or break up. These normally integrated or synchronized functions can be defined as (episodic) memory, affect, and self-consciousness. In a healthy individual, there is a unity of the self which enables it to integrate events or episodes with the subjective feeling about them and by reflecting

that oneself is the owner of the respective episode (Markowitsch, 2003). In a patient with dissociative amnesia, this synchrony breaks down which is reflected on the brain level by the hypometabolic state in regions necessary for monitoring and retrieval (prefrontal cortex) and by those adding the emotional colorization (and therefore personal intimacy) (anterior temporal cortex and amygdala). The synchronizing fiber bundle of the uncinate fascicle is more expanded in the right than in the left hemisphere (Highley et al., 2002) and seems to grow with advancing age (Lebel et al., 2008). Our finding of a right hemispheric hypometabolism and consequently malfunctioning is in line with our prefrontal findings that damage to the right frontotemporal region leads to retrograde amnesia in the episodic-autobiographical domain (Calabrese et al., 1996; Kroll et al., 1997) and that successful retrieval of autobiographical memories leads to activation in this right-hemispheric area (Fink et al., 1996). The right hemisphere is considered in general to be the “emotional hemisphere” (Phillips et al., 2003), which is also involved in representing the own self and self-regulatory processes (Schmitz et al., 2004; Marsh et al., 2006), while the left is seen as the “rational hemisphere”.

The emotional flattening seen in patients with dissociative amnesia is a phenomenon, which already Janet (1893) described as “belle indifférence” and which is found quite regularly in patients with dissociative amnesia (e.g., Reinhold & Markowitsch, 2009). Together with the retrograde amnesia, it may be interpreted as a protective factor against an otherwise “unbearable” past.

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