

## THE FRAGILITY OF REMEMBERING – DATA FROM CLINICAL CASES

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### Abstract

False memories, memory distortions, confabulations, and other forms of memory aberrations and deficits occur in everyday life and – more frequently – in neurological and psychiatric patients. We studied such changes of memories in 42 patients with alcoholic Korsakoff's syndrome, 18 with clipped or ruptured aneurysms of the anterior communicating artery [ACoA], 41 with a diagnosis of dissociative amnesia, and 52 healthy control individuals. All three patient groups had severe memory deficits. The neurological patients had deficits both with respect to acquiring new semantic and episodic memories, while the psychiatric patients were unable to retrieve episodic memories only. Both the neurological and the psychiatric patients had major problems in retrieving old episodic memories. However, the groups differed in that way, that the neurological patients tried to compensate their deficits by showing numerous confabulations (especially patients from the Korsakoff's group), while the group with ruptures and repairs of their ACoAs showed a considerably tendency towards producing false memories. The psychiatric patients, on the hand, demonstrated a total lack of retrieving episodic memories from their past and showed no efforts to invent or generate alternative memories. It is concluded that especially the prefrontal cortex (frontal lobes) and its associated structures (mediodorsal thalamus, which is regularly degenerated in patients with Korsakoff's syndrome) are relevant in controlling proper and accurate retrieval of information. This statement also seems to be confirmed from functional imaging results in patients with dissociative amnesia who show a reduced prefrontal metabolism. For normal individuals, states which reduce alertness (e.g., fatigue, sleep deprivation) and consequently dampen prefrontal control functions, similarly can lead to a heightened degree of fragile memory retrieval.

**Keywords:** *Anterior communicating artery rupture, Korsakoff's syndrome, dissociative amnesia, prefrontal cortex, false memory.*

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### 1. Introduction

Remembering is central for our life – especially for planning the future; and, in general, we believe that we can rely on our personal past. Nevertheless, as already acknowledged by Sigmund Freud (1901), our memories are more fragile than we realize in everyday life. This holds true especially for personal events which have been acquired (encoded) at different periods of life and is found at higher quantities in patients with neurological or psychiatric disease conditions.

### 2. Objective

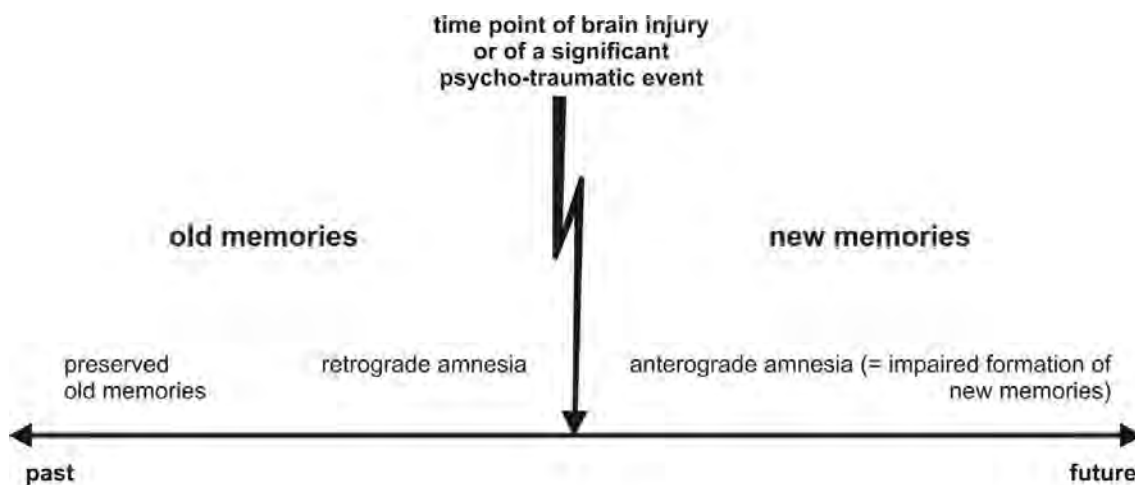
In order to investigate different mechanisms of memory distortions, we studied patients with different neurological and psychiatric disturbances together with healthy control individuals. Patients with Korsakoff's disease were chosen, because they show major memory problems – usually in the absence of intellectual deteriorations – and try to compensate these deficits by confabulating. Patients with clipped or ruptured aneurysms of the anterior communicating artery [ACoA] were chosen, because they tend to show various forms of memory distortions, including false memories. And patients with dissociative amnesia were selected because they usually have a radical loss of all retrograde episodic-autobiographical memories in the absence of corresponding visible brain damage.

### 3. Methods

*Subjects.* We studied 42 patients with alcoholic Korsakoff's syndrome, 18 patients with clipped or ruptured aneurysms of the ACoA (together referred to as 'neurological patients'), 41 patients with a diagnosis of dissociative amnesia (referred to as 'psychiatric patients'), and 52 healthy control individuals (largely relatives and friends of students). The Korsakoff's patients stemmed from several nursing home where they all were permanent residents (mean age: 57 years; duration of excessive alcohol consumption: 10-46 years). They had a documented history or residual signs of a Wernicke episode, which preceded the chronic state of the Korsakoff's Syndrome, but none of the participating individuals had signs of alcohol-related dementia. The ACoA-patients were recruited from two neurosurgical centers; all had rupture and repair of an aneurysm of the ACoA (17 by clipping the aneurysm and one by coiling) (mean age: 53 years; mean duration between surgery and testing: 39 days). The patients with dissociative amnesia (including patients with a fugue condition which in DSM-5 [APA, 2013] are subsumed under 'dissociative amnesia' as well) had more diverse backgrounds, but nearly all of them had been seen in medical clinics and had a chronic condition (on the average of more than half a year) (mean age: 33 years). The comparison groups in general were matched to the patients' groups for sex, age, years of education and occupation. Patients as well as healthy controls gave their informed consent to participate in the study according to the Declaration of Helsinki.

All patients had severe memory deficits; these were predominantly in the anterograde memory domain for the neurological patients, and predominantly in the retrograde domain for the psychiatric patients (Fig. 1). Consequently, the neurological patients had deficits both with respect to acquiring new semantic and episodic memories, while the psychiatric patients were unable to retrieve episodic memories, and a few of them had in addition problems in retrieving some semantic material as well.

*Figure 1.* After brain injury or one or more significant psycho-traumatic events memory may be impaired with respect to the remembering of old information (which was stored prior to the injury or the event), or with respect to the long-term acquisition with which the individual was confronted after the event or injury. The flash symbolizes the event or injury.



*Neuropsychological examinations.* All patients and control individuals were tested intensively neuropsychologically. That means, they all received screening instruments measuring their general intellectual status and estimating their intelligence with the *Mehrfach-Wahl-Wortschatz-Test (MWT-B)* (Lehrl, 2005), a measure similar to the National Adult Reading Test, or the *Leistungsprüfsystem* (Horn, 1983). 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, specific tests in the memory domain were given to the neurological and the psychiatric groups and the respective control individuals, namely an interview on confabulatory tendencies, constructed in German language after related interviews of Dalla Barba und co-workers (Dalla Barba et al., 1997a, b, 1999), named *Testbatterie zur Erfassung von Konfabulationstendenzen (TEKT)*; Borsutzky et al., 2006). This Interview was given to both neurological groups; in addition to questions, which only can be answered in a confabulatory ("untrue") manner, it also contains questions on personal and general semantic old memory. The ACoA group furthermore was tested with the

Deese–Roediger–McDermott (DRM) paradigm (Roediger&McDermott,1995). Five list of each 15 semantically associated words from those used by Roediger and McDermott (1995) were used. Critical lures of these lists were: chair, doctor, sleep, anger, and sweet. The critical lures are semantically closely associated to the items of their respective list, but were never presented.

The psychiatric patients and their controls received 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). 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).

#### 4. Results

All patients had at least normal intelligence on average: the Korsakoff's group had a mean estimated IQ of 104, the ACoA-patients of 101; the IQ of the patients with dissociative amnesia was for most cases average to above average. Similarly, measures of attention and concentration, on problem-solving abilities, and on visuo-constructive and executive functions were generally normal in all three patient groups (as well as in the control group).

A different picture emerged with respect to memory functions: Korsakoff's as well as ACoA-patients had anterograde memory deficits, while the patients with dissociative amnesia were largely unimpaired. Both the neurological and the psychiatric patients had major problems in retrieving old episodic memories.

The groups differed in that way that both groups of neurological patients tried to compensate their deficits by showing numerous confabulations in the episodic memory domain (especially patients from the Korsakoff's group). The group with ruptures and repairs of their ACoAs in addition manifested a considerably tendency towards producing false memories. The psychiatric patients, on the hand, demonstrated a total lack of retrieving episodic memories from their past, but showed no efforts to invent or generate alternative memories. A few of the patients with dissociative amnesia furthermore had deficits in retrieving old semantic memories. When analyzing possible reasons of the failure to retrieve these, it turned out that some of the semantic facts had an emotional connotation to the respective patient. For example, one patient had to study Latin, but apparently had an aversion against the language. He was unable to even retrieve or to translate simple everyday proverbs (e.g., "plenus venter non studet libenter"), or common Latin sayings from the church.

More generally, a number of the patients showed emotional changes. For the group of Korsakoff's patients, these were more in the fields of apathy and lack of initiative, while for the patients with dissociative amnesia they reflected what already Janet (1893) and Breuer and Freud (1895) termed "belle indifference" – a flattening of emotions. This condition was found in the majority of our patients and we had described it already in 2009 (Reinhold & Markowitsch, 2009). The patients have a lack of concern, especially about their own psychic condition and about their future. They do not seem to care about their family. On the other hand, they can be guided and directed much more easily than normal individuals, that is, they are suggestible to influences from others.

#### 5. Discussion and conclusions

Our results demonstrate that different patient group manifest deviances from normal memory retrieval which are attributable to their brain damage. For both neurological groups the relevant brain regions are localized in the frontal lobes and their connections with the mediodorsal nucleus of the thalamus. For patients with a Korsakoff's symptomatology it is well-known that their principal neural degeneration is in the medial thalamus (see Staniloiu et al., 2021, and within this publication especially Figure 1, which provides a detailed sketch of thalamo-frontal connections). For the patients of the ACoA-group, there is usually bilateral orbitofrontal damage which similarly leads to degeneration within the mediodorsal thalamus. The mediodorsal thalamus, on the other hand, is one of the hub regions within limbic circuits, whose damage leads to amnesia (Markowitsch, 1982; Markowitsch & Staniloiu, 2012).

Similarly, for the patients with dissociative amnesia, changes – in particular hypometabolic zones – have been documented in the prefrontal and anterior temporal cortex of the right hemisphere (Brand et al., 2009; Staniloiu et al., 2011; Staniloiu & Markowitsch, 2014). It can be concluded that the right prefronto-temporal hypometabolism leads to similar functional impairments - namely an inability to retrieve episodic old memories – as direct brain damage of this regional complex (Calabrese et al., 1996). Right-hemispheric lesions furthermore lead to increased emotional bluntness (Anderson et al., 2011;

Cimino et al., 1991; Quirin et al., 2013; Schore, 2005), a fact which corroborates the “belle indifference”, observed in many patients with dissociative amnesia. Related to the emotional flatness is the overgeneral memory effect, which can be found in different patient groups with reduced emotional reactivity (Seidl et al., 2006; Williams et al., 1996; Watkins et al., 2000; Valentino et al., 2009).

The prefrontal/orbitofrontal cortex is well-known as a region for monitoring in general. Its monitoring functions were postulated to exist for working memory (Redondo-Camós et al., 2022), executive functions (Markowitsch & Kessler, 2000; Jones & Graff-Radford, 2021), decision making (Labudda et al., 2010) and related operations (Hedden & Gabrieli, 2010). Consequently, a malfunctioning of this region is likely to interfere with processes of memory retrieval, especially, if this retrieval is more complex as in episodic-autobiographical information retrieval, where a synchrony between fact retrieval and their emotional colorization is required. As the prefrontal and orbitofrontal cortices are engaged in mechanisms of attention and alertness (Yao et al., 2018), it becomes obvious that even in normal individuals' states of reduced alertness (e.g., fatigue, sleep deprivation) lead to a heightened degree of fragile memory retrieval (see Manousakis et al., 2019; Dimitrov et al., 2021). Variables, such as vividness, detail, contents, and emotional colorization affect individual memories, especially if they cover different time periods, as was remarked already several decades ago by Squire and Cohen (1982).

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