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Research report

Mechanism of disorientation: Reality filtering versus content monitoring

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ABSTRACT

Disorientation is frequent after brain damage. It is a constituent component of post-traumatic amnesia and was part of the original definition of the Korsakoff syndrome, together with amnesia and confabulations. Orbitofrontal reality filtering is a pre-conscious memory control process that has been held accountable for disorientation and a specific type of confabulations that patients act upon. A recent study questioned the specificity of this process and suggested that confabulating patients who failed in orbitofrontal reality filtering similarly failed to monitor the precise content of memories, a critical step within the strategic retrieval account, which describes a series of processes leading up to the recollection of memories. In the present study we combined the proposed experimental requirements of both processes in a single continuous recognition task and tested a group of 21 patients with a matched deficit of delayed free recall. We found that only deficient reality filtering, but not content monitoring, significantly correlated with disorientation and distinguished between confabulators and non-confabulators. Thus, reality confusion, as evident in disorientation and behaviourally spontaneous confabulation, primarily reflects an inability to monitor memories' relation with ongoing reality rather than to monitor their precise content.

1. Introduction

Disorientation describes the inability to place and perceive oneself correctly in time and space. It has at least four dimensions: time, place, situation (knowledge about one's current role and duties), and personal information (one's name, birth date etc.). Orientation to time is the most fragile dimension, which normally takes longest to recover after brain damage. Orientation to person is most resistant to brain damage (Benton, Vanallen, & Fogel, 1964; Daniel, Crovitz, & Weiner, 1987; High, Levin, & Gary, 1990; Tate, Pfaff, & Jurjevic, 2000).

Early authors distinguished diverse forms of disorientation. Jaspers (1973), in large agreement with Kraepelin (1909), distinguished four forms: (1) Amnestic disorientation resulting from immediate forgetting; (2) Delusional disorientation characterized by false ideas of fully conscious patients about the present situation; (3) Apathetic disorientation, based on

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the patients' disinterest about where they are and what day it is; (4) Disorientation in disturbances of consciousness, also called stuporous or delirious disorientation (Kraepelin, 1909).

Outside the realm of psychiatry and psychosis, disorientation has received special attention in the context of two clinical syndromes. First, disorientation is a key element of post-traumatic amnesia (PTA), the period after traumatic brain injury in which patients are unable to store the sequence of daily events (Brooks, Aughton, Bond, Jones, & Rizvi, 1980). Normalization of disorientation has been taken to determine termination of PTA (Artiola et al., 1980; Brooks et al., 1980; Ellenberg, Levin, & Saydjary, 1996). This form of disorientation may correspond to stuporous or delirious disorientation in most cases. Secondly, disorientation was part of the original definition of the Korsakoff syndrome, along with amnesia and confabulation (Bonhoeffer, 1901).

Most authors viewed disorientation as the result of an inability to store the information necessary to maintain an idea about the present. Kraepelin (1909) suspected that temporal orientation resulted from the ability to order memories in a continuous sequence, whose endpoint would constitute the present. Bleuler (1923) suspected that orientation depended on memory, perception, and attention but further speculated on an independent function of orientation whose disturbance would not be proportional to these three mental domains. More recent authors attributed disorientation to the combination of anterograde amnesia and retrograde amnesia (Benton et al., 1964; Daniel et al., 1987; High et al., 1990; Tate et al., 2000): orientation to person was considered dependent on autobiographical memory while orientation to time and place was thought to depend on consolidation of new memories and on the capacity to update memory about time or location (High et al., 1990; Leach, Kinsella, Jackson, & Matyas, 2006). Attentional processes were also considered important for disorientation (Tittle & Burgess, 2011).

Our own studies on memory-impaired patients showed that the ability to learn new information, as measured with a continuous recognition task, was only weakly associated with orientation (Nahum, Bouzerda-Wahlen, Guggisberg, Ptak, & Schnider, 2012; Schnider, von Däniken, & Gutbrod, 1996b) and attained significance only when patient data from multiple studies were pooled (Schnider, 2008). In contrast, there was a very strong association with the ability to filter memories according to their relation with reality (Nahum et al., 2012; Schnider et al., 1996b): When patients made a second run of a continuous recognition task, composed of the same items as in the first run, and asked to indicate picture recurrences only within the ongoing run (the ongoing reality), disoriented patients had a steep increase of false positives in the second over the first run (Schnider, 2008; Schnider et al., 1996b). The ability to suppress this interference depends on the posterior medial orbitofrontal cortex (OFC), area 13 (Schnider et al., 1996b; Schnider & Ptak, 1999). We now call this process orbitofrontal reality filtering (Schnider, 2008, 2013).

Disorientation is strongly associated with, and often shares the mechanism with, behaviourally spontaneous confabulation, a specific form of confabulation in which patients act according to their confabulations (Nahum et al., 2012; Nahum, Ptak, Leemann, & Schnider, 2009; Schnider, 2008; Schnider et al., 1996a).

A recent study suggested that orbitofrontal reality filtering [whose failure we called "temporal context confusion" at the time (Schnider, von Daniken, & Gutbrod, 1996a)] was not a distinct memory control mechanism but rather represented a sub-form of memory monitoring within the strategic retrieval account, which describes a series of processes leading up to the correct recollection of memories (Gilboa et al., 2006). The study explored the occurrence of confabulations in patients who had suffered rupture of an aneurysm of the anterior communicating artery. The authors found that their confabulating patients not only failed in our task of reality filtering (Schnider, 2003) but also produced false positive responses in a continuous recognition task, which contained items that only resembled, but were not identical with, previously presented ones. The implication was that a failure of content monitoring, as tested by this task, similarly well explained spontaneous confabulation as a failure of reality filtering and, hence, that the two measures represented similar, or at least related, cognitive mechanisms. Contradicting this suggestion, we recently found an electrophysiological dissociation between the two mechanisms in healthy subjects who performed a task that combined their challenges (Wahlen, Nahum, Gabriel, & Schnider, 2011).

Disorientation was not a topic of the study by Gilboa et al. (2006). Indeed, the role of content monitoring for the maintenance of orientation has never been studied. Given the strong association between reality filtering and disorientation and between disorientation and behaviourally spontaneous confabulation described above, we conducted the present study to explore the contributions of content monitoring and reality filtering to disorientation using the same experimental paradigm as in the electrophysiological study (Wahlen et al., 2011), which juxtaposes the requirements of the two memory control mechanisms within a single task. In addition, we tested whether these mechanisms, tested within the same task, also separated the confabulating patients from the other amnesics.

2. Materials and methods

2.1. *Participants and methods*

Twenty-one patients (six females, age 54.0 ± 15.3 years), hospitalized for neurorehabilitation, participated in the study. Inclusion criterion was verbal amnesia, defined as a long-delay free recall of $\leq$3 in the CERAD word list memory task (Welsh et al., 1994), irrespective of lesion type or aetiology (two patients, one of them a confabulator, were included despite a score of 5 at the time they passed the CERAD memory test, because they were hospitalized for a memory impairment and had failed in other verbal memory tests). Exclusion criteria were: presence of a confusional state as evident in an impaired day–night rhythm and severely impaired attention; visual or language impairment interfering with the experimental task; or pre-existing dementia. Thus, the typical patient would have verbal memory impairment and participate in the daily rehabilitation program. They were included between 21 and 121 days after acute brain damage. Table 1