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The learned reinterpretation of fluency in amnesia

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ABSTRACT

Fluency is one of many cues that are involved in memory decisions. To date, however, the extent to which fluency-based decisions are preserved in amnesia is not yet clear. In this study, we tested and found differences in how patients with amnesia (n = 8) and control participants (n = 16) use fluency when making recognition decisions (Experiment 1). Our results suggested that these differences could be due to changes in the readiness with which patients attribute the subjective feeling of fluency to pre-exposure when an alternative explanation is available (i.e., the perceptual quality of the item). Secondly, we explored the hypothesis that changes in attribution processes in patients with amnesia are explained by a decrease in contingency between processing fluency and previous occurrence of stimuli in patients' daily lives, leading them to consider that fluency is not a relevant cue for memory (Experiment 2). Specifically, 42 healthy participants were put either in a condition where the positive contingency between fluent processing and previous encounters with an item was systematically confirmed (classic condition) or in a condition where the classical association between fluency and prior exposure was systematically reversed (reversed condition). Results indicated that participants more readily attribute fluency to the alternative external source than to past experience in the reversed condition than in the classic condition, mimicking the pattern of results shown by participants with amnesia in Experiment 1. Implications of these findings are discussed.

1. Introduction

Processing fluency – typically defined as the speed and ease with which a stimulus is processed (Reber et al., 2004) – is one of many cues that are involved in memory decisions (Jacoby and Dallas, 1981; Whittlesea, 1993). Because people intuitively know that an earlier encounter with a stimulus generally enhances processing fluency, a feeling of "oldness" can result from attributional processes whereby people ascribe fluency to the past. Several studies conducted on healthy people indicate that the use of fluency in recognition decisions is a reliable phenomenon. For instance, studies that have artificially manipulated fluency at the time of test through masked visual priming (e.g., Jacoby and Whitehouse, 1989) or by varying the perceptual clarity of stimuli (e.g., Whittlesea, 1993) have established that recognition decisions are influenced by processing fluency.

Because priming-fluency effects are spared in amnesia (see Verfaellie and Keane, 2002), researchers usually assume that some degree of fluency-based recognition is preserved in patients with amnesia. Indeed, Verfaellie and Cermak (1999) found that, when items of a recognition test were presented as a series of gradually unmasked words, patients with amnesia increased their rate of "old" responses to stimuli identified faster. That is, more fluently processed items were more likely to be called "old" on a recognition test by patients with amnesia (see also Verfaellie and Keane, 2002). However, the extent to which these processes are preserved is not yet clear and still remains a subject of debate. For example, Squire (2004) reported the case of patient E.P. who did not use fluency as a cue for recognition decisions although he successfully completed priming tasks (Conroy et al., 2005).

More recently, Ozubko and Yonelinas (2014) found that conceptual fluency increased amnesia patients' recognition responses, but surprisingly only for new items, not for old ones. They postulated that patients' apparent inability to rely normally on fluency cues could result from a "reluctance to use fluency" and/or a "reduced ability to separate sources of fluency" (pp. 65–66). Patients with severe memory problems may be less inclined to regard a strong feeling of fluency (e.g., "old" items that have also been primed) as a reliable product of their impaired memory. The lack of attribution of fluency to memory could also be accentuated by their difficulty remembering the prior study phase as a possible source of their current feeling of fluency. So, in the context of multiple sources of processing fluency, amnesic patients may be more prone to attribute fluency to an external source. These hypotheses are consistent with the results of previous studies demon-

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strating that amnesic patients use fluency more readily when they are prompted to do so (Verfaellie et al., 2001; for similar findings in patients with Alzheimer's disease, see Simon et al., 2016) or when no competing sources of fluency are available (Keane et al., 2006).

These hypotheses mean that the conversion of processing fluency to a feeling of oldness is not automatic or mandatory, as proposed by Unkelbach, (2006, 2007), who conceptualized the use of fluency as a malleable heuristic that can evolve as a function of context and daily learning. Within this framework, fluency is viewed as a cue whose impact on judgments depends on its expected ecological validity. That is, if people learn (e.g., via feedback or implicit repeated exposure) that fluency is an experience that does *not* correlate with the previous occurrence of stimuli, then the likelihood that people will use fluency to guide their recognition decisions will decrease (see also Geurten et al., 2015). So it is possible that the fluency heuristic progressively evolves in amnesic patients if they learn that their impaired memory no longer provides reliable information or that the fluency cue can mislead their memory judgments. Indeed, fluency can frequently produce false recognitions in the absence of recollection of plausible or implausible previous encounters (Gold et al., 2007).

To our knowledge, however, the "reluctance to use fluency" account (Ozubko and Yonelinas, 2014) has never been tested directly. Yet such a finding could provide critical information on how to improve recognition memory in patients with amnesia. For this reason, in a first experiment, we examined the effect of the introduction of a competing source of fluency on amnesic and control participants' recognition decisions (Experiment 1). To this end, patients with severe memory deficits and matched controls were recruited. In the study phase, we presented unfamiliar drawings in a rapid serial visual presentation (RSVP; Potter and Levy, 1969) in order to promote fluency-based recognition and eliminate the influence of declarative memory (Whittlesea et al., 2005). Then, we investigated the influence of an additional source of fluency at test by manipulating the perceptual quality of the studied items during forced-choice recognition judgments. More specifically, we prepared three types of target-distractor pairs by combining stimuli with high and low visual quality. It has been shown that pictures with a high figure-ground contrast are perceived as clearer and easier to process than low-contrast ones (Checkosky and Whitlock, 1973; Whittlesea et al., 1990). If the picture quality manipulation is undetected or is not judged to be the source of the feeling of fluency, we would expect to observe a direct effect of the perceptual manipulation on participants' decisions (i.e., a greater recognition rate for targets with higher picture quality; Willems and Van der Linden, 2006). However, if the perceptual manipulation is detected and judged to be the principal source of the feeling of fluency, we would expect participants to attribute fluency to this external source (Whittlesea and Williams, 2000). In this case, they should not use it to guide their recognition decisions. In Experiment 2, we further investigate the "reluctance to use fluency" hypothesis by examining whether healthy participants behave like patients with amnesia after they are repeatedly exposed to situations where the association between fluency and past experience is artificially broken (Unkelbach, 2006).

2. Experiment 1

The first requirement for patients with amnesia to use fluency as a cue for recognition is to attribute fluency to prior exposure rather than to other sources (e.g., intrinsic perceptual features of the stimuli). For these reasons, the primary aim of Experiment 1 was to test whether the changes in fluency-based memory decisions that are frequently observed in amnesia are due to the fact that participants with amnesia do not attribute fluency to their past experience as readily as control participants when an alternative explanatory source is available. If this is the case, we expect control participants to show a higher rate of correct recognitions when the competing source induces a strong feeling of fluency than when it induces a weak feeling of fluency. Conversely, we expect patients with amnesia to produce a lower rate of correct recognitions when the competing source induces a strong feeling of fluency than when it induces a weak feeling of fluency.

Table 1
Summary of amnesic patients' neuropsychological characteristics.

Etiology	Age	Ed.	Time since diagnosis (years)	WAIS–III	WMS-III			
					WM	GM	AD	VD
Anoxia	55	15	6	81	97	45	60	56
Anoxia	28	12	28	135	127	59	54	75
Encephalitis	51	16	3	96	88	69	79	75
Korsakoff	51	8	1	88	85	47	60	52
Korsakoff	52	12	1	118	111	65	60	78
Closed-head injury	37	15	4	110	82	45	57	52
Closed-head injury	43	12	7	103	80	45	57	45
Closed-head injury	40	15	13	119	82	45	60	45

Notes. WAIS–III: Wechsler Adult Intelligence Scale – third edition; WMS–III: Wechsler Memory Scale – third edition; Ed.: education in years; WM: working memory index; GM: general memory index; AD: auditory delay index; VD: verbal delay index.

2.1. Method

2.1.1. Participants

Eight French-speaking patients (3 females) with amnesia participated in this study. Patients were recruited from several neuropsychological units in Belgium and France. Major attentional and executive function deficits constituted an exclusion criterion. Patients' characteristics are presented in Table 1. The time since diagnosis ranged from 1 to 28 years (*Mean* = 7.8, *SD* = 9.01). The mean age of the amnesic group was 45 (*SD* = 9.3) years and the mean education level was 13 (*SD* = 2.6) years. General intellectual efficiency was assessed using the Wechsler Adult Intelligence Scale (WAIS-III; Wechsler, 1997a). The Wechsler Memory Scale (WMS-III; Wechsler, 1997b) was used to appraise patients' working memory and episodic memory abilities. All patients showed normal intellectual functioning (IQ = 119; *SD* = 18) and working memory performance (Working memory index = 94; *SD* = 17). However, they had severe episodic memory deficits (general memory index = 52.5; *SD* = 10; visual delay index = 60; *SD* = 14; and auditory delay index = 61; *SD* = 8). The evaluation of these patients took place in the context of a more global neuropsychological assessment. No prior revalidation or cognitive education work has been performed to inform these patients about the role of fluency in their memory decisions.

Two healthy participants who had no history of psychiatric or neurological illness were matched with each amnesic patient for age, gender (6 females), and education level. Their ages ranged from 26 to 55 years (*Mean* = 46 years; *SD* = 11); they had a mean IQ of 118 (*SD* = 23), and a mean education level of 12 (*SD* = 2.2) years. The control and amnesic groups did not differ significantly in age, education, or IQ, all *ps* > .30.

2.1.2. Material

Sixty unfamiliar drawings created from abstract paintings (retrieved from http://gillesbalmet.free.fr) were used as stimuli in this experiment (see Fig. 1). We selected unfamiliar pictures in order to limit pre-experimental familiarity. In a preliminary phase, we prepared 60 figures with homogeneous complexity. For this purpose, 150 figures were rated for "subjective complexity" by 12 undergraduate students on a 5-point Likert scale. Figures with the lowest and highest complexity were excluded to limit an additional fluency source. Figures were assigned randomly to Sets A and B. Half of the participants were presented with Set A as targets and Set B as distractors; the other half of