



## Perceptually or conceptually driven recognition: On the specificities of the memory deficit in schizophrenia



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### ABSTRACT

This study explored the effects of exemplar changes on visual object recognition in patients with schizophrenia and paired control subjects. The experimental design was derived from the process-dissociation procedure (PDP; [Jacoby, 1991](#)). The objects presented at test could be the same exemplar as at study (physically identical picture), a different exemplar of the same object category, or a new, non-studied object. In the inclusion task, participants had to generalize their recognition to the conceptual level by accepting both different and identical exemplars as old. In the exclusion task, on the other hand, they had to accept only the same exemplars of the studied objects as old. Overall, performance was better on the inclusion task than on the exclusion task; schizophrenia patients performed worse than controls on the inclusion task but not the exclusion task, misrecognizing different exemplars more often than healthy controls. The present findings reveal that both recollection and familiarity are impaired in patients with schizophrenia, who present a relational, conceptually driven memory deficit. This deficit does not allow them to recognize an object as a member of a specific category independently of perceptual variations. This retrieval mode influences their subjective awareness of items' familiarity, and should be considered as a target for remediation.

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### 1. Introduction

Episodic memory was one of the first cognitive abilities to be studied in schizophrenia ([Hull, 1917](#)). Memory deficits associated to schizophrenia have been attributed to inefficient encoding ([Traupmann, 1980](#)), poor use of retrieval strategies ([Golberg et al., 1989](#)) or a difference between impaired conscious recall and a gross sense of familiarity with the material ([Danion et al., 1999](#)). We have all had the uncomfortable experience of recognizing an object as familiar, but being unable to recollect any specific qualitative or contextual information about it (e.g., “I know this car, this is Mary's car”). Such experiences suggest that recognition can be based on an a contextual sense of familiarity (e.g., “I know this car”) or on the retrieval of specific contextual information derived from a prior episode (“This is Mary's car”). Motivated in part by these phenomenological experiences, dual-process theories propose that recognition is the product of two distinct memory processes: familiarity and recollection ([Mandler, 1980](#);

[Gillund and Shiffrin, 1984](#); [Jacoby, 1991](#); [Hintzman and Curran, 1994](#); [Yonelinas, 1994](#)).

This dual-process view is especially relevant in schizophrenia, where reality or source monitoring deficits are observed ([Bentall et al., 1991](#); [Henquet et al., 2005](#); [Woodward et al., 2007](#)). Many studies have shown that conscious recollection is consistently impaired in schizophrenia, while familiarity is generally spared ([Brébion et al., 2002](#); [Niezanski, 2002](#); [Achim and Lepage, 2003](#); [Moritz et al., 2003](#); [Bonner-Jackson et al., 2008](#); [Tendolkar et al., 2002](#); [Van Erp et al., 2008](#)). Conscious recollection has been found to be consistently impaired for words ([Huron et al., 1995](#); [Huron and Danion, 2002](#); [Van Erp et al., 2008](#); [Grillon et al., 2010](#); see also [Tendolkar et al. \(2002\)](#)), line drawings ([Huron et al., 2003](#)) and pictures of pairs of objects ([Danion et al., 1999](#)). While the Remember/Know procedure ([Gardiner, 1988](#)) has been the most used in this context, alternative methods such as the process-dissociation procedure (PDP), which contrasts situations of inclusion and exclusion ([Jacoby, 1991](#)) or receiver operating characteristics (ROCs: e.g., [Yonelinas, 1994](#)) based on confidence judgments have been also used. These studies have revealed not only recollection deficits, but also familiarity deficits in schizophrenia ([Martin et al., 2004, 2011](#); [Thoma et al., 2006](#); [Guillaume et al., 2007](#); [Ragland et al., 2012](#)). In their recent meta-analysis, [Libby et al. \(2013\)](#) concluded that reanalysis of

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the data from 19 different studies, using the same metric and taking into account potential confounds such as response bias and non-independence, also revealed that schizophrenia affects both retrieval processes.

One possible reason for the discrepancies between studies could be the nature of the stimuli used (words, pictures, faces, etc.): the degree to which perceptual or conceptual codes support memory performance differs between unfamiliar faces and words, for example, semantic and perceptual priming usually enhance familiarity and bias decision processes toward endorsing stimuli as “old”. Recent investigations suggest that associative binding and conceptual priming may contribute to familiarity (Rhodes and Donaldson, 2007; Harlow et al., 2010; Wang and Yonelinas, 2012), and some models treat familiarity as separate from episodic and semantic memories, grouping it with long-term priming (e.g., Henke, 2010). On the other hand, recent work suggests failures to process the semantic relations between items, semantic broadening and overinclusive thinking in schizophrenia (e.g., Brébion et al., 2013). Similarly, the inability to implement semantic processing strategies has been reported in a false memory paradigm, whereas the patients' implicit retrieval of meanings from their semantic lexicon was spared (Paz-Alonso et al., 2013). This type of functioning may account for the visual object recognition deficit observed in patients (Calkins et al., 2005) but the exact nature of these deficits and their links with familiarity and recollection remain to be understood.

The dissociation between priming and explicit memories could be critical in schizophrenia (Gras-Vincendon et al., 1994) where study–test perceptual mismatch disturbs patients' recognition to a greater extent than controls (Guillaume et al., 2012a, 2012b). Impaired inhibition of irrelevant information has been associated with disorganization symptoms such as thought disorders (Baxter and Liddle, 1998; Bazin et al., 2000; Guillem et al., 2003; Guillaume et al., 2012a), whereas the source memory impairment is thought to be a key determinant of hallucinations and delusions, i.e., the most common symptoms of schizophrenia (Bentall, 1990). It has been suggested that reduced integration of contextual information into episodic representations is one of the main causes of episodic memory impairment in schizophrenia (Clare et al., 1993; Danion et al., 1999; Titone et al., 2004; Talamini et al., 2010). This reduced integration could be a bias toward perceptual priming because patients with schizophrenia suffer from a degraded ability to construct and maintain an internal representation of context (Schwartz et al., 1991; Cohen and Servan-Schreiber, 1992; Amoroso et al., 2012). Consequently, patients would present a familiarity deficit in tasks that rely on associative and conceptual familiarity (Waters et al., 2004; Talamini and Meeter, 2009) and the recollection deficit can be understood in terms of the contextual account (Bazin and Perruchet, 1996; Bazin et al., 2000; Meissner et al., 2001; Guillaume et al., 2007).

Taken together, these recent developments raise the possibility of a relational memory deficit in patients with schizophrenia that may affect both recollection and familiarity. This possibility has been discussed recently in relation to the abnormality of the event-related potential (ERP) correlates of familiarity in schizophrenia (Amoroso et al., 2012; Guillaume et al., 2013). In spite of the evidence that the contributions of recollection and familiarity can be affected by contextual variations, the influence of the semantic properties of the items on recognition processes has been largely neglected in schizophrenia. One question of interest is whether there are performance differences between tasks based on associative familiarity and tasks based on intra-item familiarity in schizophrenia.

In order to better understand the role of the semantic properties on visual object recognition and corresponding memory deficits in schizophrenia, the present study manipulated perceptual and conceptual

study–test matching. To jointly manipulate these variables, we used the process-dissociation procedure (PDP; Jacoby, 1991) in a long-term visual object recognition task in 30 patients with chronic schizophrenia and 30 matched healthy controls. We used the PDP to investigate how conceptual and perceptual features interact with recognition processes depending on the task at hand. In the inclusion task, participants had to recognize objects from daily life regardless of whether or not the exemplar presented at test was the same as the one presented at study. The exclusion task, in contrast, requires participants to accept only a physically identical picture as old and reject an unstudied exemplar as new. In this way, conceptual and perceptual features were opposed depending on the task at hand. The inclusion situation requires subjects to generalize the recognition decision at the semantic level of the object's conceptual identity, regardless of any perceptual mismatch, whereas the exclusion task requires them to focus on any perceptual mismatch, regardless of the object's conceptual identity. In one case, subjects had to inhibit the perceptual mismatch and base their recognition on conceptual priming. In the other case, they had to check for change in the perceptual exemplar and inhibit conceptual matching.

Our hypothesis was that we would replicate the findings of previous studies that manipulated study–test mismatch and found familiarity deficit in patients with schizophrenia (Martin et al., 2004, 2011; Guillaume et al., 2007), this time in the domain of object recognition. If patients with schizophrenia base their recognition mainly on perceptual feature matching, they should be more likely to reject different exemplars of a given object category than controls in the inclusion task. Conversely, no between-group difference should be observed in the exclusion task, where the recognition decision is based on perceptual matching. Hence, we expected a between-group difference in the inclusion task but not in the exclusion task, revealing a deficit in associative familiarity and conceptually driven recognitions, but not in perceptually driven recognition.

## 2. Method

### 2.1. Participants

Thirty patients fulfilling the DSM-IV criteria for schizophrenia participated in this study. All were clinically stable and had been receiving antipsychotic medication at fixed doses for at least 2 months at the time of testing. Five dimensions (negative, positive, excitation, depression and cognition) were assessed with the PANSS (Kay et al., 1987) in order to account for the various clinical aspects of schizophrenia (Lançon et al., 2000). No correlation was observed between performance and age at onset or antipsychotic dose. Thirty healthy subjects paired on an individual basis with the patients for age, sex, and parental socio-educational status (SES) were also recruited. Parents' socio-educational level was defined on the basis of the occupation of the head of household (usually the father) according to the Canadian National Occupational Classification. In this classification, occupations are assigned to five categories on the basis of skill level: I=Management; II=Professional; III=Technical, paraprofessional and skilled occupations; IV=Intermediate occupations; V=Unskilled laborers. Written informed consent was obtained from every subject. Information concerning their socio-demographic and clinical characteristics is presented in Table 1. The protocol was approved by the local ethics committee.

### 2.2. Stimuli

The stimuli consisted of two lists of 220 high-resolution (600 × 600 pixels) color photographs of objects in daily use (Lexique 3 mean frequency=25.7; S.D.=12.1) superposed on a medium-grey background (50% black). In some cases, an image of a different exemplar of the same object category was presented at test (see Fig. 1). Four experimental conditions were tested during each recognition task, with 44 trials in each: (1) same object (i.e., physically identical picture); (2) different exemplar of the same object category; (3) different object from a different, semantically associated category; and (4) different object from a different, semantically unassociated category. We ensured that there was no association between distractors and any item in the list. Object associations were pre-tested by

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