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# Context-dependent information processing in patients with schizophrenia

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## Abstract

Thirty schizophrenic patients fulfilling the Diagnostic and Statistical Manual of Mental Disorders IV criteria for schizophrenia and 30 control participants were shown a set of incomplete sentences, and were asked to complete them with the first word(s) that came to mind. Target sentences included an ambiguous word, the ambiguity of which was not resolved within the clause. However, completion necessarily required participants to select one specific meaning. Each target sentence was preceded by another sentence playing the role of context, which was designed to prime the less frequent meaning of the ambiguous word. The results showed that schizophrenic patients, especially those with thought disorder [on the basis of their TLC scores (Thought, Language and Communication Scale; Andreasen, N.C., 1979. Thought, language and communication disorders. Clinical assessment, definition of terms and evaluation of their reliability. *Diagnostic significance. Arch. Gen. Psychiatry* 39, 778–782)], used the most common meaning of the ambiguous word more frequently than controls, thus revealing a specific deficit in context use. The deficit was observed whether or not the relation between context and target sentences was made explicit. These results are in line with the cognitive models of schizophrenia that postulate a decreased ability to use context information. However, when considered in the light of prior studies (e.g., Bazin, N., Perruchet, P., 1996. Implicit and explicit memory in patients with schizophrenia. *Schizophr. Res.* 22, 241–248), they suggest that the deficit in processing contextual information is limited to what Baddeley (Baddeley, A.D., 1982. Domains of recollection. *Psychol. Rev.* 98, 708–729) called the interactive context (which affects the meaning, or the interpretation, of the target event) in contrast to the independent context (which does not interfere with the meaning-based interpretation of the target event). © 2000 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

Deficits in schizophrenic patients do not extend to all cognitive abilities, but tend to be limited to

specific tasks. However, it is still difficult to interpret the pattern of impaired and spared abilities within an integrative framework. Although different integrative models have been proposed (e.g. Frith, 1987), several authors have claimed that most of the cognitive deficits observed in schizophrenia could be dependent on a specific impairment in the processing of contextual infor-

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mation. By contextual information, we mean the background or surrounding circumstances that can mediate a response to a target event, except the information conveyed by the target event itself. This may include, for instance, the general instructions given prior to the task, and the stimulus or the participant's response immediately preceding the target event. Cohen and Servan-Schreiber (1992) posit that many of the cognitive deficits in schizophrenia can be accounted for by the idea that schizophrenic patients have a degraded ability to construct and maintain internal representations of context. Other authors have reached similar conclusions on the basis of different paradigms. For instance, the fact that latent inhibition, which is commonly exhibited in normal subjects, is absent in schizophrenic patients (Lubow et al., 1987), has also been accounted for by the idea that contextual information processing is impaired in those patients (Hemsley, 1992). Along the same lines, Hardy-Bayle postulates that the inability to take account of contextual data is the source of other cognitive impairments (Hardy-Bayle, 1992; Widlocher and Hardy-Bayle, 1989).

In order to examine the role of context processing in schizophrenics' memory deficits, Bazin and Perruchet (1996) used an implicit memory task in which the use of context may improve performance. We were especially interested in implicit rather than explicit memory, because several authors have posited that only the controlled processes are impaired in schizophrenia, while more automatic processes are spared (e.g., Hardy-Bayle, 1994). As support for this hypothesis in the memory field, it has been shown that performance on recall and recognition tests is often altered, whereas performance in implicit memory tasks is the same as in controls (Danion et al., 1992; Goldberg et al., 1993a,b; Schwartz et al., 1993; Schmand et al., 1992; Clare et al., 1993). Implicit memory tests tap the automatic effects of a previously studied stimulus in subsequent identification or production tasks, the term 'automatic' here being intended to mean that the effects are not mediated by the explicit retrieval of these stimuli.

The paradigm involved in the Bazin and Perruchet (1996) study was adapted from that used by Graf and Schacter (1985), who investi-

gated implicit memory for newly acquired associations (referred to as implicit associative memory below). The study context is a semantic one represented by words. The subjects were first presented with a set of pairs of normatively unrelated words. Within each pair, the first word formed the context for the second, target word. Because the associative memory effect appears only, or at least most clearly (Schacter and Graf, 1986), when a meaningful relation between the two words is formed during the encoding phase, the subjects either had to read a sentence including the two words or generate such a sentence themselves. The subjects were then given a word-stem completion test involving the target word of each pair. Some stems appeared in the same context as they had during the study phase, whereas other stems appeared in a different context. The result was that subjects completed stems more often when they appeared in the same context than when they appeared in a different context. However, contrary to the authors' hypothesis, normal subjects and schizophrenic patients were equally sensitive to the congruence of the context target relationship between the study phase and the test phase. In a second experiment, Bazin and Perruchet replicated these results, and extended their conclusions to an explicit associative memory task.

The discrepancy between Bazin and Perruchet's (1996) findings and the earlier results exhibiting impaired context processing highlights the need to explore the differences between our paradigm and earlier ones. Although the situations differ in several features, the specific role of context in dealing with target information may constitute a particularly pertinent difference. Baddeley (1982) distinguished between two categories of context. One, the interactive context, is defined by the fact that it affects the meaning, or the interpretation, of the target event. For instance, a semantic context which makes it possible to disambiguate the meaning of a homophone is undoubtedly interactive in nature. In contrast, independent context does not interfere with the meaning-based interpretation of the target event. A well-investigated independent context in studies on list memory is whether the words studied are shown in the context of 'on land' or 'under water' (e.g. Godden and Baddeley, 1975).

In this case, the environmental context is encoded independently of and in parallel with the target information. Note that Baddeley's distinction does not match the distinction between verbal and physical contexts, as the above examples might suggest. For instance, the ground of a picture can serve as an interactive context for the interpretation of an ambiguous figure. Similarly, the pairing of semantically unrelated context/target words instantiates independent context.

Baddeley's distinction appears relevant in several research domains. For instance, Ackerman (1986) showed that the allocation of attention varied in context-interactive and context-independent encoding situations, and that adults and children differ in the way they attend to context information when context is interactive. Likewise, a change in context has been shown to impair performance in a lexical decision task only when this change alters the perceived meaning of the target word (Bainbridge and Lewandowsky, 1993). The distinction between interactive and independent context can help to account for the discrepancy between studies involving schizophrenic patients. Indeed, the context used by Cohen and Servan-Schreiber (1992) and Chapman et al. (1964) was interactive, insofar as it dispelled the ambiguity of the meaning of the target word, whereas the context in Bazin and Perruchet's (1996) experiments was not.

The present study was intended to test the hypothesis that the deficit in context processing in schizophrenic patients can be revealed in a priming task in which context is interactive, irrespective of whether context processing is implicit or explicit. Participants were shown a set of incomplete clauses and were asked to complete them with the first word(s) that came to mind in order to form meaningful sentences. Half of the clauses for completion included a word with multiple meanings (an ambiguous word), the ambiguity of which was not removed within the clause. However, completion of the sentence necessarily required participants to select one specific meaning. For instance, one ambiguous clause was: *Chez eux, il s'assied, prend sa serviette et commenceà ...* (At their house, he sits down, takes his *serviette* and begins to ...; The word *serviette* in French is ambiguous: its

common meaning is napkin, its less frequent meaning is briefcase). Each ambiguous clause was preceded by a context clause that primed the less frequent meaning of the word with multiple meanings of the ambiguous clause. The context clause that primed the less frequent meaning of *serviette* (briefcase) at the expense of its more frequent meaning (napkin) was: *Ce médecin ... va chez ses patients avec ses ordonnances*. (This doctor ... goes to his patients' homes with his prescriptions). In order to examine the role of intentionality in the exploitation of the context, the context clause and the ambiguous clause were either presented as two separate sentences or linked with "and" within a same sentence: *Ce médecin consciencieux va chez ses patients avec ses ordonnances et chez eux, il s'assied, prend sa serviette et commenceà ...* (This conscientious doctor goes to his patients' homes with his prescriptions and at their house, he sits down, takes his *serviette* and begins to ...). Because participants were asked to generate meaningful sentences, this procedure meant that the use of context was implicit in the former case, and explicit in the latter.

We expected schizophrenic patients to complete the ambiguous sentence using the more frequent meaning of the ambiguous word more often than normal subjects, thus providing evidence that they fail to use contextual information, irrespective of the fact that use of contextual information was a part of the explicit task demands.

Because of the well-known heterogeneity of schizophrenic patients, we studied several subtypes of patients individually depending on their TLC score (Thought, Language and Communication Scale, Andreasen, 1979). This scale seems to be the one best suited for discriminating between schizophrenic patient groups (Besche et al., 1997; Passerieux et al., 1997; Sarfati et al., 1998).

## 2. Method

### 2.1. Participants

Sixty participants, half patients and half control subjects, took part in the study. The patient group included 30 schizophrenic inpatients (8 females

and 22 males) fulfilling the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV, American Psychiatric Association, 1987) criteria for schizophrenia. They were of mean age  $32.4 \pm 11.03$  years. All were under neuroleptic treatment and clinically stable (mean on PANSS (Kay et al., 1987):  $76.5 \pm 17.4$ ).

The control group comprised 30 subjects (15 females and 15 males) with no history of illness, somatic or psychiatric symptoms (mean age:  $28.5 \pm 8.05$  years). The control subjects were younger than the schizophrenic subjects, although not significantly [ $F(1, 58) = 2.36, p = 0.13$ ].

All the subjects were native speakers of French; their vocabulary level was assessed through a specially designed test (Binois and Pichot Vocabulary Test): schizophrenic patients' average level =  $24.03 \pm 6.17$  and control subjects' level =  $24.4 \pm 5.04$ ;  $F < 1$ . Educational levels were identical in the two groups of subjects.

Two groups of schizophrenic patients were formed on the basis of their TLC scores (Thought, Language and Communication Scale, Andreasen, 1979). Patients without thought disorder (non-thought-disorder patients,  $N = 13$ ) obtained a TLC score  $\leq 6$  (mean  $4.3 \pm 2.0$ ), and patients with thought disorder (thought-disorder patients,  $N = 15$ ) obtained a TLC score  $> 6$  (mean  $17.0 \pm 6.7$ ). These two groups of patients were equivalent with regard to sex ratio (10 males in both group), and vocabulary level (25.2 and 23.3, respectively, in the Binois Pichot test). The patients in the thought-disorder group were older than those in the non-thought-disorder group ( $35.2 \pm 12.4$  vs  $27.9 \pm 8.3$  years;  $F(1, 26) = 3.2, p = 0.08$ ).

## 2.2. Material

The material included 45 ambiguous sentences and 45 associated context sentences. Thirty distractor sentences were added to mask the aim of the experiment. All the sentences included a blank to be filled in.

From The Homonym Dictionary (Bertrand, 1990) we selected ambiguous words (words with multiple meanings) that had one strongly common meaning. The ambiguous sentences were generated

in such a way that the sentence did not indicate the ambiguity of the word with multiple meanings, and completion of the sentence necessarily required participants to select one specific meaning for the ambiguous word. The context sentences were unambiguous, and each context sentence primed the less frequent meaning of the ambiguous word of the corresponding ambiguous sentence. The material as a whole was tested in a pilot study with 15 voluntary participants. This allowed us to gradually adjust the definitive material to fulfil the above requirements.

Each sentence was displayed on its own in a booklet. The typographical presentation in no way emphasized the ambiguous word.

## 2.3. Procedure

The participants were tested individually. They were informed that they would be shown a set of sentences, each including a blank, and that they had to fill in the blank with the first word(s) that came to mind. They were asked to respond quickly, and their response times were ostensibly measured, in order to minimize the potential influence of an intentional response strategy. All the subjects were unaware of the purpose of the study.

The ambiguous sentences were displayed in one of three conditions. Fifteen sentences ('No Context') were not preceded by their associated context sentence, in order to provide a baseline for evaluating the effect of context on completion. Fifteen sentences ('Implicit Context') were immediately preceded by their associated context sentence. Finally, 15 sentences ('Explicit Context') were displayed as the second part of a composite sentence, the first part of the sentence being the associated context (without blank). Both parts of the composite sentence were linked by "and".

For example, one of the ambiguous sentence was:

- *Chez eux, il s'assied, prend sa serviette et commenceà ....* (At their house, he sits down, takes his *serviette* and begins to ....).

The word *serviette* in French is ambiguous. Its common meaning is *napkin*; its less frequent meaning is *briefcase*.

This sentence was presented alone in the ‘No Context’ condition. In the ‘Implicit Context’ situation, the immediately preceding sentence was:

- *Ce médecin ... va chez ses patients avec ses ordonnances.* (This doctor ... goes to his patients’ homes with his prescriptions.).

In the ‘Explicit Context’ situation, participants were shown:

- *Ce médecin consciencieux va chez ses patients avec ses ordonnances et chez eux, il s’assied, prend sa serviette et commence à ...* (This conscientious doctor goes to his patients’ homes with his prescriptions and at their house, he sits down, takes his *serviette* and begins to ...).

Scores were defined by the number of sentences completed in line with the less frequent meaning of the ambiguous word in each of the three context situations.

In order to minimize the probability of participants discovering the nature of the manipulation and developing controlled response strategies, the ambiguous sentences were intermixed with 10 distractor sentences that also included a blank, but had no semantic ambiguity. Moreover, the ‘Explicit Context’ sentences, in which the nature of the manipulation was most salient, were presented after the others. To summarize, participants were shown 15 ‘No Context’, 15 ‘Implicit Context’ ambiguous sentences and 10 distractor sentences. These sentences were mixed and their order of presentation was randomized. The participants were then shown 15 ‘Explicit Context’ sentences.

Participants were randomly assigned to one of three groups, and the 45 ambiguous sentences were randomly assigned to one of three lists for each subject. Groups, lists of sentences and contexts

were combined using a Latin square design. Thus, any given subject saw a given sentence in only one context condition, but overall each sentence was displayed in the three context conditions.

### 3. Results

An ANOVA was performed with Group (control vs. schizophrenic subjects) as a between-subjects factor, and Context (no context, implicit context and explicit context) as a repeated-measure factor. This analysis indicated a reliable main effect of context [ $F(2, 116) = 728.9, p < 0.0001$ ]. Planned pairwise comparisons revealed that subjects completed the sentence in line with the less frequent meaning of the ambiguous word more often in the ‘Explicit Context’ situation ( $14.2 \pm 1.07$ ) than in the ‘Implicit Context’ situation [ $7.2 \pm 2.3; F(1, 58) = 545.2, p = 0.0001$ ], and more often in the ‘Implicit Context’ than in the ‘No Context’ situation [ $3.8 \pm 1.4; F(1, 58) = 111.7, p = 0.0001$ ].

There was also a main effect of Group [ $F(1, 58) = 14.10, p = 0.0004$ ], with control subjects having higher scores than schizophrenic patients. In addition, the effect of context differed in strength for control and schizophrenic subjects, as shown by the significant interaction between Context and Group [ $F(2, 58) = 3.38; p = 0.037$ ]. As shown in Table 1, in the ‘No Context’ situation, there was no significant difference between schizophrenic patients and control subjects. In contrast, in the ‘Implicit context’ and ‘Explicit Context’ situations, the results showed a significant difference between schizophrenic patients and control subjects: schizophrenic patients used the common

Table 1  
Schizophrenic patients’ and control subjects’ results in the three situations (‘No Context’, ‘Implicit Context’ and ‘Explicit Context’)<sup>a</sup>

Scores	Schizophrenic patients ( $n = 30$ )	Control subjects ( $n = 30$ )	$F/p$
Explicit Context	$13.86 \pm 1.30$	$14.63 \pm 0.55$	$F(1, 58) = 7.14, p = 0.009$
Implicit Context	$6.3 \pm 2.26$	$8.07 \pm 1.99$	$F(1, 58) = 10.28, p = 0.002$
No Context	$3.7 \pm 1.42$	$4.07 \pm 1.44$	$F < 1$

<sup>a</sup> Scores were defined by the number of sentences completed in line with the less frequent meaning of the ambiguous word in each of the three context situations.

meaning of the ambiguous words more often than control subjects, hence providing evidence that they tend to neglect context.

In order to examine whether the fact that the use of context was implicitly driven or explicitly induced by the instructions had different effects on schizophrenic and control subjects, a new ANOVA was performed with Group as a between-subjects factor, and Context (implicit context vs explicit context) as a repeated-measure factor. The Group by Context interaction was non-significant [ $F(1, 58) = 2.7, p = 0.1$ ], thus indicating that the nature, implicit or explicit, of the context manipulation exerted the same effects on schizophrenic and control subjects.

Additional analyses were performed in order to examine whether performance differed for subgroups of schizophrenic patients. The performances of thought-disordered schizophrenic patients were significantly different from those of non-thought-disordered patients [ $F(1, 26) = 5.06, p = 0.03$ ]. It appeared that thought-disordered schizophrenic patients were responsible for the significant differences between patients and control

subjects. Indeed, fine-grained analyses contrasting controls and each group of patients, showed that only thought-disordered patients exhibited significantly lower performances than controls, while non-thought-disordered patients performed like controls (see Tables 2 and 3). When thought-disordered schizophrenic patients, on the one hand, and non-thought-disordered patients on the other, were contrasted with normal subjects in separate ANOVAs, the interaction between Context (No Context, Implicit Context and Explicit Context) and Groups was significant only for the former group [ $F(2, 43) = 4.80; p = 0.01$ ].

The analyses contrasting control and schizophrenic subjects were replicated for other subgroups of schizophrenic patients, formed on the basis of their performance in BPRS (Positive vs Negative schizophrenic patients) on the one hand, and the criteria of DSMIV (Paranoid, Undifferentiated, Disorganized Schizophrenic patients) on the other, in order to examine whether the results were the same for different subtypes of schizophrenic patients. None of these exploratory analyses revealed reliable differences.

Table 2

Non-thought-disorder schizophrenic patients' and control subjects' results in the three situations ('No Context', 'Implicit Context' and 'Explicit Context')<sup>a</sup>

Scores	Non-thought-disorder patients ( $n = 13$ )	Control subjects ( $n = 30$ )	$F/p$
Explicit Context	$14.23 \pm 1.42$	$14.63 \pm 0.56$	$F(1, 41) = 1.81, p = 0.18$ NS
Implicit Context	$7.23 \pm 1.92$	$8.06 \pm 1.99$	$F(1, 41) = 1.62, p = 0.21$ NS
No Context	$3.85 \pm 1.34$	$4.06 \pm 1.44$	$F < 1$

<sup>a</sup> Scores were defined by the number of sentences completed in line with the less frequent meaning of the ambiguous word in each of the three context situations.

Table 3

Thought-disorder schizophrenic patients' and control subjects' results in the three situations ('No Context', 'Implicit Context' and 'Explicit Context')<sup>a</sup>

Scores	Thought-disorder patients ( $n = 15$ )	Control subjects ( $n = 30$ )	$F/p$
Explicit Context	$13.66 \pm 1.17$	$14.63 \pm .56$	$F(1,43) = 14.1, p = 0.0005^{**}$
Implicit Context	$5.6 \pm 2.06$	$8.06 \pm 1.99$	$F(1,43) = 14.9, p = 0.0004^{**}$
No Context	$3.53 \pm 1.59$	$4.06 \pm 1.44$	$F(1,43) = 1.27, p = 0.26$ NS

<sup>a</sup> Scores were defined by the number of sentences completed in line with the less frequent meaning of the ambiguous word in each of the three context situations.

#### 4. Discussion

This study indicates that schizophrenic patients fail in tasks involving interactive context processing. These results are in accordance with other experiments (Cohen and Servan-Schreiber, 1992; Chapman et al., 1964) which also reveal a deficit with interactive contexts. Because earlier studies (Bazin and Perruchet, 1996) have shown that context processing in tasks involving no interactive context is preserved, a tentative conclusion is that schizophrenic patients' impairment in context processing concerns only tasks involving interactive context.

The concept of interactive context seems particularly pertinent with regard to the results obtained for the clinical subgroups of schizophrenic patients with and without thought disorder (groups formed on the basis of their performance on Andreasen's Thought Language and Communication scale). Indeed, the results are significantly different for patients with thought disorders and for patients with no thought disorders. Only thought-disordered schizophrenic patients are affected by this deficit in interactive context processing. This result emphasizes the cognitive heterogeneity of schizophrenic patients (Harvey, 1987; Liddle, 1987) and coincides with recent data from the literature reporting cognitive deficits in thought-disordered patients (Manschreck et al., 1988; Kwapil et al., 1990; Spitzer, 1993; Henick et al., 1992; Besche et al., 1997; Passerieux et al., 1997; Sarfati et al., 1997). This dichotomy seems to be particularly pertinent, and needs to be explored more thoroughly. As a case in point, all these studies investigated semantic contexts using words or sentences. The influence of other types of contexts (graphic, auditory ...) should be explored to confirm and generalize these results.

Another aspect of our study related to the differences between the explicit and implicit use of context. In half of the cases, the help the preceding sentence could provide in completing the target sentence was left implicit. In the other cases, the link between the context cue and the target information was made explicit through their integration within a single, composed sentence. This variable was manipulated, because several earlier studies

(e.g. Schwartz et al., 1993) suggest that schizophrenics have selective deficits in the explicit processing of information, while implicit processing is spared. The results indicated that our manipulation had major effects on performance. Overall, completions occurred about twice as frequently in the direction induced by the sentence context in the explicit than in the implicit conditions. However, this effect turned out to be the same for schizophrenic patients and control subjects. In an earlier study (Bazin and Perruchet, 1996), we also failed to obtain a dissociation between schizophrenic patients and controls as a function of the nature, explicit or implicit, of the tasks.

The discrepancy between the lack of relevance of the explicit/implicit dimension our studies revealed and the earlier claim for the relevance of the distinction can be interpreted in at least two different ways. One initial possibility is that, beyond the use of identical terms, the explicit/implicit distinction refers to different concepts in different domains. For instance, it is worth noting that most of the papers highlighting the importance of the distinction in schizophrenia research deal with priming or memory tasks, while the present report involved another category of tasks. However, there is another possible account. The experimental conditions, the purpose of which is to manipulate the explicit/implicit dimension, often introduce changes in other dimensions of the tasks. For instance, Roediger and collaborators (e.g., Roediger et al., 1989) have convincingly argued that most explicit tasks have been conceptually driven and most implicit tasks have been data-driven. When both dimensions are teased apart in specially designed experiments, it turns out that some dissociations that were thought to be due to the explicit or implicit character of the tasks are, in fact, due to their prevalently conceptual or perceptual orientation. Moreover, Gras-Vincendon et al. (1994) have suggested that the role of context differs between nominally implicit and explicit tasks, and that differences in performance primarily construed as dependent on implicitness could be more easily interpreted in terms of the function of context. Thus it is possible that earlier studies emphasizing the relevance of the distinction between explicit and implicit processing

in the understanding of schizophrenic symptoms could be revisited in order to detect a potential confound between variables. This possibility deserves to be more thoroughly investigated.

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