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Are conceptual abilities impaired in schizophrenia?

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ABSTRACT

Whereas semantic processing deficits are well-documented in schizophrenia, conceptual abilities have been poorly explored. This study aims at specifically exploring conceptualization abilities in 34 adults fulfilling schizophrenia according to DSM-IV and 34 healthy controls with similar socio-demographic characteristics. The 2 groups were assessed on the WAIS-R similarities test and the concept generation test (Raoux et al., 2014) consisting of free-sorting 6 cards of pictures of animals and geometric shapes to be separated in two groups or categories based on common attributes. After each sorting, the participant is asked to explain his/her sorting. Whereas the schizophrenic patients performed significantly poorer than the control participants in the semantic knowledge and lexico-semantic tests, there was no difference neither in the WAIS-R similarities test nor in the concept generation test, which supports the hypothesis of preserved high level conceptualization abilities in schizophrenia. However, qualitative differences in performing the concept generation test were evidenced. The patients used more often mixed criteria leading them to compare two different hierarchical levels (e.g., low-level physical attributes vs. high-level semantic criteria). Furthermore, the qualitative analysis based on the explanations provided by the participants shows that the categorizations achieved by schizophrenic patients are more often based on unexpected criteria.

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1. Introduction

Among memory disorders, semantic memory deficits are considered to be one of the most frequent in schizophrenia (McKenna et al., 1990; Saykin et al., 1991; McKay et al., 1996). According to Doughty's review, semantic deficits in schizophrenia are due to both a degraded semantic store and difficulty in accessing concepts (Doughty and Done, 2009). However, the respective contribution of these two aspects to the semantic deficit is often difficult to evaluate (Goldberg et al., 1988; Liddle and Morris, 1991; Allen et al., 1993; Gourovitch et al., 1996; Laws et al., 2000; Zalla et al., 2001; Rossell and David, 2006; Doughty et al., 2008).

As emphasized in Doughty's review, conceptual capacity in schizophrenia has been poorly explored. Different paradigms can be used to evaluate the ability to categorize and form concepts (Doughty and Done, 2009). The simplest one is a classification task which requires the subject to determine whether or not an object belongs to a designated category. An intermediate-level method devised by Hodges and Patterson (1996) requires matching a picture to two or more levels of semantic classification. Finally the tasks referred as 'concept generation' tasks (Green et al., 2004)

assess the ability to form high-level concepts based on the Rosh and Mervis taxonomic hierarchical classification (Doughty et al., 2008) by requiring the subject to classify items into a category using his/her own criteria.

Among the 227 studies included in Doughty's meta-analysis, only 12 studies deal specifically with conceptualization. According to some studies, high-level conceptual capacity is preserved in schizophrenic patients (McKay et al., 1996; Doughty et al., 2008) while others report a significant impairment (Kerns and Berenbaum, 2002; Barrera et al., 2005; Rossell and David, 2006). Lawrence et al. (2007) for example found a categorization deficit in schizophrenic patients who completed a concept generation test (Green et al., 2004; Lawrence et al., 2007) requiring the subject to sort 45 pictures of objects into 5 semantic categories. The results showed that schizophrenic patients made significantly more errors of inclusions (overinclusions, i.e. when items from two or more superordinate categories are sorted together or underinclusions, i.e. when items from the same category are sorted in two or more piles). Such errors suggest that the patients activated irrelevant characteristics leading the author to conclude that categorization deficits were caused by degraded links between concepts.

In the absence of consensus regarding conceptual ability in schizophrenia, the present study was designed to investigate such capacity in schizophrenic patients by means of two high-level

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categorization tests. The first task used is probably one of the most widely used categorization task in clinical practice: the WAIS-R similarities test (Wechsler, 1981). The second task chosen relies on the categorization procedure considered by Doughty and Done (2009) as the most complex one, a free concept generation task. This procedure requires the subject to classify items without being guided. In other words, the subject has to generate a concept by using his/her own criteria. The task used is a concept generation test (Raoux et al., 2014), a task recently adapted from the Rosch and Mervis' paradigm (1975). The subject is instructed to sort 6 pictures displaying animals and geometric shapes into 2 categories of his/her choice. After each classification, the participant is asked to explain his/her classification criteria and a qualitative analysis of the answers is undertaken in order to identify the strategies that have led to form the sorting and potential causes of errors.

In the hierarchical categorization approach, Doughty's meta-analyse concluded a preserved performance on superordinate level of sorting task but relatively worse performance on intermediate and basic levels of the tasks when more detailed knowledge is required (Doughty and Done, 2009). In the same vein, we hypothesized that schizophrenic patients would be able to produce conceptual entities in both tasks requiring self-initiated concept formation without constrained order or context guidance.

2. Method

2.1. Participants

This was a monocentric study in which 34 outpatients meeting DSM-IV criteria for schizophrenia (APA, 1994) were included. All the patients were chronic outpatients living at home. They were followed-up in the community mental health center, a care center under the public psychiatric hospital responsibility. All were clinically stabilized with drugs. Some of them were taking conventional neuroleptics (Haldol, $n=2$, Fluanxol, $n=3$, Piportil, $n=1$, Modecate, $n=3$, Clopixol, $n=3$). Two patients had Clozapine. The others were taking atypical antipsychotics (Risperdal, $n=11$, Zyprexa, $n=5$, Abilify, $n=3$, Solian, $n=1$). All dosages (mg per day) have been transformed in a quantifiable measure of chlorpromazine medication equivalence (Calanca, 1988; Patel et al., 2013; Woods, 2003). According to this classification, the mean medication was 274.3 (SD=172.1) (see Table 1). The average illness duration was 15.3 years (SD=9). Patients with addictions, neurological conditions or antecedent of head trauma were excluded. Schizo-affective disorders were also excluded. The control group was composed of 34 adults with no psychiatric or neurological conditions selected from paramedical or psycho-social staff from a medical department which was not involved in the care of the selected patients. They were matched to schizophrenic patients according to age, sex and education. All participants gave their informed consent.

2.2. Clinical and cognitive measures

Positive and negative symptoms were assessed respectively on the SAPS and SANS scales (Andreasen and Olsen, 1982). The formal thought disorder was measured on the SAPS subscale.

Premorbid verbal Intelligence Quotient (IQ) of the participants (patients and controls) was assessed using the French version of NART test (Nelson, 1982).

Two tasks assessing semantic knowledge were administered: verbal fluency tasks and the semantic knowledge subtest of the BECS. For verbal fluency, semantic (Isaacs set test with 4 semantic categories; Isaacs and Kennie, 1973) and phonemic (letter P)

Table 1

Demographic characteristics of participants and clinical information on the schizophrenic patients.

	Schizophrenic patients ($n=34$) Mean (SD)	Controls ($n=34$) Mean (SD)	<i>p</i> -Value
Age, years	41.4 (11.2)	38.1 (12.3)	0.30
Sex (n (%))			0.38
Male	28 (82.4)	25 (73.5)	
Female	6 (17.7)	9 (26.5)	
Education level (n (%))			0.08
No diploma	10 (29.4)	3 (8.8)	
< 12 years	16 (47.1)	18 (52.9)	
≥ 12 years	8 (23.5)	13 (38.2)	
Pre-morbid IQ (NART test score)	20.0 (6.8)	18.7 (6.4)	0.37
SAPS score ^a	40.6 (19.0)		
SANS score ^b	58.5 (18.2)		
Chlorpromazine dose equivalence (mg/day)	274.3 (172.1)		
Length of illness	15.3 (9.0)		

^a Schedule assessment of positive symptoms.

^b Schedule assessment of negative symptoms.

fluency tasks were used. The score recorded is the number of words belonging to each category generated in 15 and 60 s. The BECS battery (Kremin et al., 1999; Merck et al., 2011) is a standard battery in French language assessing semantic knowledge about the same set of items presented in different input modalities. The semantic knowledge subtest consists of 40 pictures of objects or animals successively presented to the participant. For each picture, 2 'yes' or 'no' questions are asked on perceptual attributes and 2 questions on associative attributes (e.g., for the picture showing a 'grape': 1 – 'Does it have a salty taste?'; 2 – 'Does it contain seeds?'; 3 – 'Does it grow in the desert?'; 4 – 'Is it used for making wine?'). Perceptual and associative sub-scores (maximum 80) and the total score are calculated (maximum 160).

Two tasks specifically assessing conceptual abilities were then administered. First, the WAIS-R version of the similarities subtest was used. The test consists of 14 pairs of items for which the subject has to say in what way the items are alike. The score ranges from 0 to 28. The second test was the concept generation test (Raoux et al., 2014) adapted from Rosch and Mervis' paradigm (Rosch and Mervis, 1975) for people with cognitive disorders. The material used was derived from that of Levine's test (Levine et al., 1995). Words stimuli referring to animals have been replaced by pictures to minimize intrinsic bias due to the linguistic material. The test consists of a set of 6 cards. Each one displays a picture of an animal (hamster, canary, eagle, lion, vulture, dog) and a geometric shape (small or large circle or square in white or blue). The cards are placed in front of the participant always in the same order. The participant is required to sort the cards in 2 groups of 3 cards according to self-generated criteria. The participant can sort the cards according to perceptual attributes the animals have in common (e.g., animals with feathers or animals with fur) or abstract attributes (e.g., domestic animals vs. wild animals). The participant can also use figurative criteria related to the geometric shape (shape, size, color of the geometric shape). Once the categorization has been made, the participant is asked by the examiner about the criterion he/she used to make the classification. The explanation is then provided by the participant and the verbatim is recorded by the examiner. The procedure is repeated 5 times with the same set of cards. At each trial, 3 scores are

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