



Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep



Mixing apples with oranges: Visual attention deficits in schizophrenia



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ARTICLE INFO

Article history:

Received 17 July 2014

Received in revised form

28 November 2014

Accepted 14 January 2015

Available online 26 January 2015

Keywords:

Schizophrenia

Attention

Visual perception

Garner paradigm

Positive symptomatology

ABSTRACT

Background & objectives: Patients with schizophrenia usually present cognitive deficits. We investigated possible anomalies at filtering out irrelevant visual information in this psychiatric disorder. Associations between these anomalies and positive and/or negative symptomatology were also addressed.

Methods: A group of individuals with schizophrenia and a control group of healthy adults performed a Garner task. In Experiment 1, participants had to rapidly classify visual stimuli according to their colour while ignoring their shape. These two perceptual dimensions are reported to be “separable” by visual selective attention. In Experiment 2, participants classified the width of other visual stimuli while trying to ignore their height. These two visual dimensions are considered as being “integral” and cannot be attended separately.

Results: While healthy perceivers were, in Experiment 1, able to exclusively respond to colour, an irrelevant variation in shape increased colour-based reaction times (RTs) in the group of patients. In Experiment 2, RTs when classifying width increased in both groups as a consequence of perceiving a variation in the irrelevant dimension (height). However, this interfering effect was larger in the group of schizophrenic patients than in the control group. Further analyses revealed that these alterations in filtering out irrelevant visual information correlated with positive symptoms in PANSS scale.

Limitations: A possible limitation of the study is the relatively small sample.

Conclusions: Our findings suggest the presence of attention deficits in filtering out irrelevant visual information in schizophrenia that could be related to positive symptomatology.

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1. Introduction

Visual attention can be compromised in schizophrenia (see Hemsley, 1976; Ravizza, Robertson, Carter, Nordahl, & Salo, 2007). Classic studies of attention in this mental disorder revealed deficits at selecting relevant information from their environment (McGhie, 1996; Payne, 1971, 1973). According to most of these studies, these anomalies may be specifically circumscribed to cases where the selection process is driven by top-down (or rule-guided; also known as “pigeonholing”) mechanisms (e.g., Stroop-like tasks). However, the possible presence, in schizophrenia, of alterations in

the bottom-up selection of visual information (i.e., “filtering” mechanisms) still remains unclear (see Hemsley, 1975; Hemsley & Richardson, 1980).

In the present preliminary study, we used the Garner paradigm to investigate possible dysfunctions in the early selection of visual information. Participants were instructed to classify, as fast as possible, distinctive features from a “relevant” dimension. The performance in this task was used to test the possible interfering influence of a variation introduced in another “non-relevant” dimension (see Garner & Felfoldy, 1970). Normally, when two visual dimensions are processed in a separable fashion, the perception of a variation in one of them (e.g., shape) does not affect a speeded classification of the other (e.g., colour). In contrast, when selective attention cannot filter out information from a task-irrelevant visual dimension (e.g., height), variations in this dimension slow down responses to a task-relevant dimension

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(e.g., width). Therefore, a clear distinction has been made between “separable” and “integral” visual dimensions, respectively (see Garner & Felfoldy, 1970). Note that the interference in the Garner paradigm occurs as the variation in visual dimensions accumulate (Boenke, Ohl, Nikolaev, Lachmann, & Leeuwen, 2009), and is not based on any incongruence (as in the Stroop effect), but rather on the impossibility to ignore the perceptual variation in one dimension when concentrating on another target dimension. There is no much evidence regarding how deficits at selecting sensory information interact with other symptoms (e.g., delusions) (Oertel et al., 2007).

The attention mechanisms that affect the processing of integral dimensions such as width and height have scarcely been investigated in schizophrenia. Frith and Done (1983) reported that both a group of patients with schizophrenia and a control group of healthy volunteers were equally unable to perform a speeded classification of one target dimension (e.g., width) without being influenced by a variation introduced in an irrelevant dimension (height). From our point of view, however, testing separable dimensions may also be relevant for the study of possible alterations of attention in schizophrenia. In addition, it may also be interesting to investigate any possible relation between this kind of deficits and other (more studied) symptoms such as delusions, etc. In a recent study by Baudouin, Martin, Tiberghien, Verlut, and Franck (2002) the Garner paradigm was used to investigate whether patients with schizophrenia show deficits in classifying one of two dimensions (‘face identity’ and ‘facial emotion’) while trying to ignore the other or not. A similar pattern of results was found in both a non-psychiatric control group and a group of schizophrenic patients. None of the 2 groups was able to selectively attend to the emotion of a face without having interference from its identity. In contrast, both groups were able to respond to the identity of a face regardless of its emotional content. These results represent an example of what has been referred to as “asymmetric Garner interference” (see Schweinberger, Burton, & Kelly, 1999). However, the classification of facial identities and emotions may not be the most appropriate task to assess possible deficits at filtering visual information because the interaction between these 2 dimensions still remains unclear and also because the ability to recognize faces has been found to be particularly damaged in schizophrenia (Etcoff, 1984; Schweinberger et al., 1999).

The ability to filter out irrelevant visual information was investigated, in the current study, in a group of schizophrenic patients after an acute psychotic episode, using both integral and separable dimensions. In Experiment 1, a group of patients with schizophrenia and a control group of healthy participants performed a Garner task where two separable dimensions (colour and shape) were manipulated. If the attention-mediated mechanisms of visual selection are compromised in schizophrenia, an anomalous integration of these two dimensions and a consequent increase in reaction times (RTs) was expected only in the group of schizophrenic patients. In Experiment 2, the same method was used to compare the two groups of participants when responding to integral dimensions (height and width). Although a slow-down could be expected in both groups, an anomalous processing of these two dimensions would lead, in the patient group, to larger RTs.

In order to further clarify a possible relation between visual attention deficits and positive and/or negative symptoms in schizophrenia, we also assessed possible correlations between these symptoms and the performance in our Garner task (Experiment 1; separable dimensions). Recent theories of psychosis have related positive symptoms such as delusions and hallucinations to a failure of selective attention (see Morris, Griffiths, Le Pelley, & Weickert, 2013), which leads us to hypothesize a possible association between anomalies in Garner interference (e.g., larger RTs

when categorizing separable dimensions) and positive symptomatology in the tested group of patients.

2. Material & methods

2.1. Participants

The patient group included 14 right-handed patients (4 female) with ages ranging between 17 and 60 years (mean = 39.35, SD = 8.75), diagnosed with schizophrenia (paranoid type [DSM IV]; years of illness average = 7.64; SD = 5.32). The patients were recruited after a 2–3-week hospitalization at Parc Sanitari Sant Joan de Déu as consequence of an acute psychotic episode. Patients were stable at the moment of the study, and left the unit a few days after the study.

The Control group included 14 healthy control participants that were equivalent, in terms of gender, age (± 2 years; mean = 37.50; SD = 8.42), and academic level (primary, secondary school or university) to the group of patients with schizophrenia. Normal or corrected-to-normal vision was necessary for participation in the study.

Experiments 1 and 2 were non-invasive, were conducted in accordance with the Declaration of Helsinki, and had ethical approval from the Parc Sanitari Sant Joan de Déu's ethics Committee. The participants provided a written informed consent to participate in the study.

2.2. Exclusion criteria

2.2.1. Patient group

The exclusion criteria were the presence of any other diagnosis on axis I or II of DSM-IV (at least two weeks before participating in the study), a rating in the YMRS (Young, Biggs, Ziegler, & Meyer, 1978) above 7 and above 12 in the MADRS (Montgomery & Asberg, 1979), the presence of any other medical or neurological disorder that may affect cognitive functions severely, and the inability to provide informed consent. Stable medication (type and dose) was required for at least 2 weeks before the Experimental session.

2.2.2. Control group

The exclusion criteria were the presence of any declared mental disorder, a previous history of mental or neurological disorders that could affect cognitive functioning, and/or a history of several mental/neurological disorders in first degree relatives.

2.3. Experiments

The visual stimuli were always presented at the centre of the screen (Asus A55V; refresh rate = 60 Hz). The participant sat at a distance of approximately 50 cm from the display monitor in a dimly-lit and sound-proof room at Hospital Sant Joan de Déu. The presentation of all the stimuli was controlled by a program running in E-prime 2.0 (Psychology Software Tools, Inc.).

2.3.1. Experiment 1. Separable dimensions (colour and shape)

Visual targets (4 × 6 cm) that could vary in terms of shape (rounded vs. jagged) and colour (purple vs. orange) were presented to participants (see Fig. 1). The experiment included 2 Homogeneous and 2 Orthogonal blocks. In the Homogeneous blocks, the target dimension (colour) varied but the irrelevant dimension (shape) was kept constant. In the Orthogonal blocks, both colour and shape could vary randomly within each experimental block (see Fig. 1).

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