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Original article

Affectively salient signal to random noise might be used to identify psychosis vulnerability in severe mental disorders

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ABSTRACT

Background: Subclinical psychotic symptoms are present in the general population. Furthermore, they are quite common in diagnostic categories beyond psychosis, such as BPD patients.
Methods: We want to assess the differences between 3 groups: BPD (n = 68), FEP (n = 83) and controls (n = 203) in an experimental paradigm measuring the presence of speech illusions in white noise. The Positive and Negative Syndrome Scale was administered in the patient group, the Structured Interview for Schizotypy-Revised, and the Community Assessment of Psychic Experiences in the control and BPD group. The white noise task was also analysed within a signal detection theory (SDT) framework. Logistic regression analyses and the general linear models were used to analyse the adjusted differences between groups.
Results: Differences were more prevalent in signals that were perceived as affectively salient in patients groups (9.6% in FEP vs 5.9% in BPD and 1% in controls; OR: 10.7; 95%CI: 2.2–51.6, p = 0.003 in FEP; OR: 6.3; 95%CI: 1.1–35.0, p = 0.036 in BPD). Besides, we found a worse general performance and more false alarms in the task for FEP group using SDT framework.
Conclusions: Experimental paradigms indexing the tendency to detect affectively salient signals in noise may be used to identify liability to psychosis in people with vulnerability. Its predictable value in other diagnostic categories and general population requires further research.

1. Introduction

Aberrant salience is the incorrect assignment of importance to neutral stimuli [1]. Contemporary models of psychosis [2] propose that the inappropriate processing of stimuli that would normally be considered irrelevant, due to "aberrant salience", drives the development of psychotic symptoms, such as delusions and hallucinations. In the context of this model, "salience" refers to the motivational properties of a stimulus, which can cause it to attract attention and drive behaviour [3]. This aberrant salience is thought to generate a distorted model of the environment founded on erroneous inference [4]. Data from experimental animals suggest that aberrant motivational salience attribution results from out-of-context dopamine signalling in the ventral striatum [5], which may in turn be driven by abnormal regulation of subcortical dopamine transmission by the prefrontal cortex [4] and hippocampus [6].

First rank psychotic symptoms may be more common in schizophrenia than in other categories but their diagnostic value is too low to be of diagnostic importance [7]. Indeed, psychotic-like experiences are also common in the general population and in severe mental disorders such as, borderline personality disorder (BPD) [8,9]. Recent studies support the idea that the difference in psychotic experiences between BPD and schizophrenia are unclear and these experiences are quite similar in both groups of patients [10,11].

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These “subtle expressions of psychotic experiences” (common in clinical and non-clinical populations) offer clinicians a new way of understanding psychotic experience [12]. A recent study has found that hallucinations in healthy controls (HC) and patients only differ in the fact that patients have them with increased frequency, distress, negative content and less control perceived over them [13]. In trying to explain the underpinning mechanism of auditory hallucinations from a cognitive point of view, several mechanisms have been suggested, such as monitoring deficits and misattributions [14]. A dysregulation in top-down processing has been proposed to explain this mechanism [15,16].

Two recent studies have found that the tendency to identify affectively salient speech illusions in random noise was more prevalent in patients with a psychotic disorder than in HC independent of measures of neurocognition [17,18]. These results therefore suggest that white noise speech illusion could reflect individual differences in the risk of developing psychotic symptoms.

Several approaches toward experimental assessment of speech illusions have been reported [15,19]. It may be hypothesized that stable differences in the tendency to attribute meaning and emotional value to experience—varying from aberrant to adaptive—are associated with the tendency to express psychotic experiences and thus represent an indicator of liability for psychotic disorder.

In the current investigation, an extension of the ‘false-positive meaning’ approach was used as described in a previous paper introducing the ‘white noise test’ [17]. We wanted to evaluate the relation between psychotic-like experiences (speech illusions) in patients with first episode psychosis (FEP), patients at risk of developing psychosis (BPD) and HC.

The aim of the current study, therefore, was to measure (1) the variation in detecting affectively salient speech in neutral random signals (white noise) in three groups (BPD, FEP and controls), hypothesizing that affectively salient meaning attributed to white noise would be associated with mainly FEP patient status, and (2) the relation between speech illusion and psychometric vulnerability status in the form of positive psychotic experiences (schizotypy) in controls and BPD, and with positive symptoms in FEP.

2. Material and methods

2.1. Sample

Data were collected in a convenience sample of patients with a diagnosis of FEP and BPD, admitted consecutively to the inpatient unit of Basurto University Hospital (HUB) from January 2011 to December 2016. BPD patients were also collected from Day Hospital Units of HUB and AMSA clinic. Controls were recruited from the general population in the same catchment area as the patients, through advertisements and announcements. Controls did not report psychotic first-degree relatives. Patients were examined when the psychiatrist in charge considered that they were stable and were able to provide written informed consent. Inclusion criteria were the following (for the three groups): age between 18 and 65 years, sufficient mastery of the Spanish language, IQ >70; for FEP patients: exposure to antipsychotic medication <1 year. The psychotic episode fulfilled DSM-IV-TR criteria for affective or non-affective psychotic disorder; for BPD patients fulfilled DSM-IV-TR criteria for BPD, in the absence of any current psychotic disorder comorbidity. Exclusion criteria for FEP patients were: psychotic episode was the consequence of a somatic disorder and for all three groups: unwillingness to participate.

Two of the BPD had a history of psychotic symptoms. Sociodemographic variables were collected including age, sex, employment status, marital status and living arrangements. In the patient group, clinical scales such as the PANSS (Positive and Negative Syndrome Scale) [20] and GAF (Global Assessment of Functioning) [21] were used to assess functional impact of psychopathology. The Operational Criteria Checklist for Psychosis [22] was completed, based on clinical instruments and relevant data in the medical history, and used to establish the diagnosis of the patients using the associated OPCRIT computer programme [23].

2.2. Instruments

2.2.1. White noise

This task has been described previously [17,18]. Subjects wore earphones and were presented 1 of 3 different types of stimuli: (1) white noise only, (2) white noise + clearly audible neutral speech, and (3) white noise + barely audible neutral speech. Participants were presented 25 fragments of each, in random order, and were asked to respond to each by pressing 1 of 5 buttons hereafter referred to as 1: positive speech illusion (endorsed hearing positive voice), 2: negative speech illusion (endorsed hearing negative voice), 3: neutral speech illusion (endorsed hearing neutral voice), 4: no speech heard, and 5: heard speech but uncertain whether voice was positive, negative or neutral. The rate of hearing a voice in the white noise–only condition (25 trials) was the variable of interest in the analyses. A dichotomous variable was created (speech illusion present versus not present) in which a speech illusion was considered a positive result. When a participant gave affective value to the speech illusion (negative or positive speech illusion), affectively salient speech illusion was considered. Two or more conditions were necessary for a positive result when the answer in the white noise task was 5.

2.2.2. SIS-R

The Structured Interview for Schizotypy–Revised [24] was used to determine a broad range of schizotypal symptoms and signs. Items can be scored on a 4-point scale from absent to severe (0–3). Positive schizotypy covers the symptoms referential thinking (2 items), magical ideation, illusions, psychotic symptoms, and suspiciousness (6 items). Negative schizotypy covers the symptoms of social isolation, introversion, restricted affect, and poverty of speech (4 items). Mean schizotypy scores for these dimensions were calculated, resulting in a positive schizotypy and a negative schizotypy score. In the analyses, SIS-R positive symptom score was used, divided by its median value, creating median groups.

2.2.3. CAPE

Community Assessment of Psychic Experiences [25] was used to assess the lifetime prevalence of positive and negative and depressive symptoms. This self-reporting scale measures positive and negative and depressive symptoms on both a frequency scale (0 = never to 4 = nearly always) and a distress scale (1 = not distressed to 4 = very distressed). In the analyses, CAPE positive symptom score was used, divided by its median value, creating median groups.

2.2.4. IQ

The short form of the Wechsler Adult Intelligence Scale – III [26] was assessed for an indication of intellectual functioning (IQ)

2.3. Signal detection theory (SDT)

The white noise task was also analysed within a signal detection theory (SDT) framework. SDT describes the probabilistic processes of decision-making under conditions of uncertainty [27,28]. In a SDT-based task, subjects are required to detect the presence of a