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Impaired action self-monitoring in schizophrenia patients with auditory hallucinations

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ABSTRACT

Background: It has been suggested that the process of discriminating between inner and outer experiences underlies auditory hallucinations (AHs). The aim of the present study was to investigate whether discrimination between imagined and performed action (i.e., action self monitoring) differed between schizophrenia patients with auditory hallucinations (AHs) and those without.
Method: Twenty-eight schizophrenia patients with AHs, twenty-six patients without AHs, and thirty-four healthy subjects were assessed with an action memory task. Simple actions were presented to the participant verbally (text) or non-verbally (icons). Some actions were physically performed and others were imagined. Following the learning phase, participants were presented with each action as well as new ones, were asked whether the action was presented verbally or non-verbally (action's presentation type discrimination), and whether the action was performed or imagined (self-monitoring). A confidence score related to self-monitoring responses was also obtained.
Results: Patients with AHs more often remembered imagined actions as performed than patients without AHs and healthy controls. Schizophrenia patients made significantly more incorrect responses in action presentation type discrimination than healthy controls. Self-monitoring errors were followed by high confidence ratings in the schizophrenia group. No differences between patients with and without AH in old/new recognition emerged.
Conclusions: Our study suggests that action self-monitoring deficits but not impairments in discriminating presentation type are related to AHs. In the schizophrenia group, action-self monitoring errors were associated with overconfidence.

1. Introduction

Schizophrenia is a severe psychiatric disorder characterized by prominent distortions in the sense of self and reality (e.g., Saas and Parnas, 2003). Important clinical manifestations are auditory hallucinations (AHs) occurring in approximately 60%–80% of affected subjects. Although the cognitive mechanisms underlying AHs are still unclear, theoretical models have shed some light on potential factors involved. One prominent cognitive model of AHs proposes that they share some cognitive operations with source monitoring (Bentall, 1990; for review see: Woodward and Menon, 2013; Waters et al., in press), that is to say, the process of discrimination between inner and outer experiences (e.g. "Did I say something or did someone else"?) and between fantasies and real perceptions (e.g. "Did I really perceive or just imagined something") (Johnson et al., 1993).

As indicated by phenomenological studies AHs are mostly experienced as a different kind of voice(s) speaking to the person (Nayani and David, 1996). Hence, abnormal inner-speech monitoring was hypothesised by the most influential source monitoring based cognitive approach (e.g. McGuire et al., 1995; Shergill et al., 2003) to underlie the AHs and its empirical verification is provided by administration of verbal material from different sources to the participants. For example, participants are required to generate words themselves, or words are provided by an external source (e.g. experimenter or computer). Later, the participant is asked to recollect the source of information. In support of the cognitive theories of AHs, it was found that patients with AHs, when comparing to those without AHs, exhibit a tendency to externalize internally generated events (Baker and Morrison, 1998; Franck et al., 2000; Brunelin et al., 2006; Anselmetti et al., 2007; Woodward et al., 2007; for review see: Ditman and Kuperberg, 2005; Woodward and Menon, 2013). Others have found that source monitoring deficits are correlated with delusions (Brébion et al., 2000, 2005; Costafreda et al., 2008), disorganization (Nienow and Docherty, 2004; Mammarella et al., 2010) or negative symptoms (Brébion et al., 2002;

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Moritz et al., 2003). In contrast to these findings, some authors have not found specific relationships between source monitoring and psychopathology (Vinogradov et al., 1997; Moritz et al., 2005; Gawęda et al., 2012). More recently, a meta-analysis conducted on thirty-two studies have confirmed the linkage between AHs and self recognition deficits (Waters et al., 2012).

Some authors have found that patients with schizophrenia misremembered covertly read words as overtly read (Franck et al., 2000; Henquet et al., 2005), that is, they present self-monitoring deficits more frequent than healthy controls. Interestingly, this bias was found to be exaggerated in patients with AHs comparing to those without AHs (Franck et al., 2000) suggesting that in addition to deficits in reality monitoring, self-monitoring may be involved in AHs as well. The finding is, however, inconsistent as Henquet et al. (2005) did not find an association between self-monitoring and schizophrenia symptoms. These studies are consistent with the 'over-perceptualization' account (Allen et al., 2008) that suggest that AHs and source monitoring deficits may arise as a consequence of neural over-activation of the brain regions that are involved in the processing of real percepts (e.g. speech perception) during imagination (e.g. thinking of hearing someone). The 'over-perceptualization' account was also confirmed by findings suggesting more vivid imagery in patients with schizophrenia (Mintz and Alpert, 1972; Böcker et al., 2000; Sack et al., 2005; Oertel et al., 2009). Importantly, self-monitoring biases have been observed not only for speech modality, but also for simple physical actions. It has been reported that patients with schizophrenia falsely remember imagined actions as perceived (Mammarella et al., 2010; Gawęda et al., 2012), suggesting that the 'over-perceptualization' may not operate exclusively in the speech modality. However, to date there is a lack of knowledge whether 'over-perceptualization' of imagined actions (i.e. imagined actions misremembered as performed) is associated with AHS.

This study was designed to fill some of the aforementioned gaps by using an action memory task (Moritz et al., 2009) aimed to assess action self-monitoring (kinesthetic modality). First, we state that if the 'over-perceptualization' operates in AHs, one should expect that patients with AHs would misremember imagined actions as perceived, but not the reverse, compared to patients without AHs. Thus, we contrasted patients with and without AHs on action self-monitoring performance. Furthermore, by administration of the action memory task we were able to manipulate the way the action is presented (verbal vs. non-verbal) and thus two types of discrimination were provided in one experiment (self-monitoring and action presentation type discrimination). Hence, the question of whether there is a deficit in a specific source monitoring type in AHs was targeted. Given that different source monitoring deficits may be linked to different symptoms, in addition to the group comparisons, we also performed correlational analyses between investigated cognitive processes and symptomatology. Finally, following past work suggesting that in addition to source monitoring deficits, overconfidence (e.g. errors committed with strong conviction) may be involved in schizophrenia (Moritz and Woodward, 2002; Moritz et al., 2005), we also measured confidence in responses in the study.

2. Methods

2.1. Participants

Fifty-four in- and outpatients took part in the study. They were recruited from the II Department of Psychiatry, Medical University of Warsaw and from collaborative Clinics from Warsaw. All patients fulfilled schizophrenia or schizoffective disorder diagnostic criteria according to DSM-IV as determined by a consensus of the current treating psychiatry team. All patients were clinically stabilized (e.g. exhibit no agitation or aggressive behaviour) and were at a stable dosage of medication with the vast majority on atypical antipsychotics. Patients with equivocal diagnosis, current alcohol or any other substance dependence and neurological diseases were excluded from the study. Patients were divided into two separated groups regarding the presence of auditory hallucinations (AHs) by the P3 item from PANSS (see paragraph 2.2) referring to hallucinatory behaviours. Twenty-eight patients (nineteen males) that scored ≥ 3 on the PANSS item P3 were included in the auditory hallucinations group. Twenty-six patients (twenty males) scoring 2 or below on the PANSS P3 item were included in the group of patients without auditory hallucinations. Ten patients that had taken part in a previous study (Gawęda et al., 2012) were included into the present study (eight were included into the group with AHs and two without AHs). All participants in the groups were matched on demographic variables. Regarding clinical groups all patients were matched in terms of number of hospitalization, duration of psychosis and symptomatology (except of the presence of AHs). The healthy comparison group consisted of thirty-four people (eighteen males) with no history of any psychiatric and neurological disorders. They were recruited by word-of-mouth. Demographic and clinical characteristics of patients and controls are presented in Table 1. This study was approved by a local bioethical committee.

2.2. Psychopathology assessment

All patients were assessed with the Positive and Negative Syndrome Scale (PANSS, Kay et al., 1986) following a structured clinical interview for schizophrenia symptom severity. We calculated the following syndrome-based five factor solution of PANSS derived from van der Gaag et al. (2006): positive symptoms, negative symptoms, disorganized symptoms, excitement, and emotional distress.

2.3. Action memory task

We utilized an action memory task that was previously used in investigations of OCD (Moritz et al., 2009) and schizophrenia (Gawęda et al., 2012). Participants were presented with either verbal instructions or non-verbal pictograms cuing actions in the learning phase. Instructions set in a green frame had to be performed by the participant (actions involving one extremity could be performed with either the left or right arm/leg/hand/foot), whereas action instructions set in a red frame had to be imagined but not performed. Before the experiment, participants were instructed that they would be required to later recollect the presented actions, and to distinguish whether the action was imagined or performed by them.

A short practice trial acquainted participants with the task requirements. In the main phase, 18 verbal and 18 non-verbal action instructions were presented, with each part (9 items each) requiring the participant to either perform or imagine each item. A computer screen displayed each instruction once for exactly 10 s. Before recognition, a filler task was administered that took 10 min. Then, 36 verbal instructions for the studied items were presented along with 20 new action instructions (the recognition items were presented in a different font than the encoding items to prevent physical matching). Participants were required to respond to indicate whether the corresponding instruction had appeared either as text (verbal), pictogram (non-verbal), or was new (presentation type differentiation) and whether or not action was performed or imagined (self-monitoring) and graded for confidence (binary scale — unsure vs. sure). All items were randomized both in the learning and recognition phase.

2.4. Data analysis strategy

We contrasted patients with and without AHs and healthy subjects utilizing ANOVA. For computation of source monitoring biases, only incorrect responses were analyzed and error types classified. For old/new recognition both correct (i.e. hits) and