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Review

Cognitive mechanisms of auditory verbal hallucinations in psychotic and non-psychotic groups

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ABSTRACT

The continuum model of psychosis has been extremely influential. It assumes that psychotic symptoms, such as auditory verbal hallucinations (AVH), are not limited to patients with psychosis but also occur in healthy, non-clinical individuals – suggesting similar mechanisms of origin. Recent debate surrounding this model has highlighted certain differences, as well as similarities, in the phenomenology of AVH in clinical and non-clinical populations. These findings imply that there may, in fact, be only partial overlap of the mechanism(s) involved in generating AVH in these groups. We review evidence of continuity or similarity, and dissimilarity, in cognitive, and related neural processes, underlying AVH in clinical and non-clinical samples. The results reveal some shared (intrusive cognitions, inhibitory deficits) and some distinct (aspects of source memory and cerebral lateralization) mechanisms in these groups. The evidence, therefore, supports both continuous and categorical models of positive psychotic symptoms. The review considers potential risks of uncritical acceptance of the continuum model and highlights some important methodological issues for future research.

Contents

1. Introduction

In recent years, a dimensional approach to understanding psychotic symptoms has become firmly established, commonly referred to as the continuum model of psychosis (Allardyce et al., 2007; Johns and van Os, 2001; van Os et al., 2009; Verdoux and van Os, 2002, for reviews). A wealth of empirical evidence now shows, for example, that auditory verbal hallucinations (AVH) are commonly reported by healthy individuals without mental illness, as well as those diagnosed with a psychotic disorder, such as schizophrenia (e.g. Sommer et al., 2010). Such findings suggest that the experience of hearing voices lies on a continuum with normality (Claridge, 1990, for a theoretical model; Choong et al., 2007; Pierre, 2010; Stip and Letourneau, 2009, for reviews). The rate of AVH reported in the general population varies, as a result of methodological and design factors, from 5.7–21.0% in children and adolescents (e.g. Bartels-Velthuis et al., 2010; McGee et al., 2000) to 10–15% of

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the adult population (Tien, 1991; Sommer et al., 2010). The majority of these hallucinatory experiences are transitory but some persist – increasing the risk of secondary delusional ideation and transition to psychosis (see De Loore et al., 2011; Dominguez et al., 2011; Smeets et al., 2010, for empirical evidence; van Os et al., 2009, for a review). Interestingly, Bartels-Velthuis et al. (2011) found better theory-of-mind skills in children hearing voices, a finding the authors suggested could mitigate the risk of secondary delusion formation.

The presence of a continuum of psychotic symptoms is often taken to imply fundamentally the same phenomenological experience which, though varying in severity depends upon the same cognitive and neural mechanisms in psychotic and non-psychotic populations (see Esterberg and Compton, 2009 as an example). Consequently, it is commonly stated that studying hallucinatory experiences in non-clinical samples is likely to unveil the essential cognitive and neural mechanisms underlying schizophrenic hallucinations, while avoiding confounding effects associated with medication, hospitalization and illness duration. The advantages associated with the continuum model have led some to call for a dimensional approach to the classification of psychotic disorders (Dutta et al., 2007; Peralta and Cuesta, 2007, for reviews and discussions). Nonetheless, several authors have called for a re-evaluation of the continuum concept (see discussion by David, 2010; and related commentaries by Kaymaz and van Os, 2010; Sommer, 2010) wherein AVH are assumed to be not inherently pathological, and yet at the core of psychosis.

One important and potentially revealing challenge to the continuum model emerges from phenomenological comparisons between clinical (psychotic) and non-clinical (healthy) AVH. Although these point to some similarities in the characteristic features of AVH in both groups (voices heard inside or outside the head, loudness, number of voices, and attribution of voices to a real or familiar person) and a continuum of disability, they also highlight significant differences, as first reported by Honig et al. (1998) and Romme and Escher (1989). In particular, recent data provided in separate studies by Daalman et al. (2011) and Lawrence et al. (2010) show that a cluster of features – the frequency, emotional valence of beliefs and content, experience of control, age of onset and preponderance of male voices – clearly distinguishes AVH heard by patients with schizophrenia from those experienced by healthy (non-psychotic) adults in the general community. These findings raise the possibility that there may be only partial overlap in AVH experiences and the underlying cognitive (and neural) mechanisms involved (Kaymaz and van Os, 2010), in these groups. Moreover, current cognitive models of AVH assume that more than one mechanism is likely to be involved in the development of hallucinations (see discussions and literature overviews by Hugdahl, 2009; Jones, 2008; Seal et al., 2004; Waters et al., 2006a). Such models also leave scope for the possibility that only some, but not all, cognitive mechanisms underpinning AVH occur on a continuum.

The aim of this paper, therefore, was to review current evidence regarding similarities and dissimilarities in cognitive processes underlying AVH in psychosis and in healthy, non-clinical populations.

2. Overview of findings

We conducted a selective, theoretically guided review rather than a formal meta-analysis of the literature, focusing on four influential cognitive models of AVH in patients with schizophrenia (intrusive cognitions, source memory, inhibition and lateralization) followed by a search for comparable evidence in non-clinical samples. Within each of these four domains, all cognitive methods/paradigms were considered eligible for inclusion. The review also incorporated information regarding underling neural processes and networks relevant to each cognitive deficit. Other important and well supported cognitive models of AVH have been proposed, but were not included in this review. In particular the Inner Speech/Self Monitoring Model (Bentall, 1990) has been extensively studied but has recently been reviewed elsewhere (Asai et al., 2009; Waters et al., 2010). Literature searches began with Medline and Psycinfo, using relevant search terms, and then searching the associated reference lists and citation listings. The scope of the review was limited to papers published in English. For the sake of clarity, the references cited represent empirical studies, unless otherwise indicated.

2.1. Intrusive cognitions

By definition, AVH occur in the absence of a triggering, external sensory stimulus; consequently, they must arise as a result of dysfunctional activation of corresponding internal auditory representations (e.g. see discussion by Badcock, 2010). Current opinion is still divided over the question of whether hallucinatory experiences are an outcome of relatively autonomous or planned activation of core cognitive (e.g. perception and memory) and neural mechanisms (reviewed by Allen et al., 2008). However, all existing models of AVH assume that dysfunctional activation intrudes into ongoing neural and cognitive processing (Hugdahl et al., 2009; see Jones, 2008, for a critique of current models). Such a basis is in keeping with the 'unbidden, intrusive character' of the experience (Nayani and David, 1996) which patients find particularly helpful to distinguish hallucinated voices from ordinary verbal thought (Hoffman et al., 2008b). Aside from the conceptual similarity to intrusive cognitions, cognitive accounts of AVH differ in their explanation of the content (i.e. *what*) – namely thoughts, images or memories – and the processes (i.e. *how*) associated with intrusive cognitions in clinical and non-clinical populations.

One influential line of empirical studies and subsequent models developed by Morrison and colleagues, for example, has conceptualized both clinical and non-clinical AVH as a variant of normal, intrusive thoughts: all comprise unwanted, uncontrollable cognitions with similar themes and content that typically interrupts ongoing activity (see Morrison, 2001, 2005, for summaries of this line of work). In contrast, the authors propose that it is the process of appraising, interpreting and responding to intrusive thoughts that distinguishes psychotic from non-psychotic hallucinations. The assessment of intrusive thoughts relies largely on self-report via questionnaires which have shown that the frequency of intrusive thoughts is higher in schizophrenia patients with AVH compared to psychiatric or healthy controls (Morrison and Baker, 2000). Importantly, subsequent empirical studies have confirmed that healthy individuals predisposed to hallucinations also report more intrusive thoughts than those with low levels of hallucination proneness (Jones and Fernyhough, 2006). Statistical modelling of a variety of self-report measures also indicates that intrusive thoughts contribute significantly to hallucination predisposition (Jones and Fernyhough, 2009). While such findings appear to be compatible with Morrison's model – in which intrusive thoughts are cast as the 'raw material' for AVH – recent phenomenological evidence shows that clinical and non-clinical AVH differ significantly in emotional content, although not with regard to the perceived location (inside/outside of the head) or subjective reality (Daalman et al., 2011). A modified account, therefore, might be that clinical and non-clinical AVH have a common basis in frequent cognitive intrusions (grounded in neural over-activation) but differ in the content and thus the subsequent interpretation of, or response to, those intrusions.

A second line of studies links AVH with intrusive auditory imagery. Mental images are similar to hallucinatory experiences