



Short Communication

A linguistic comparison between auditory verbal hallucinations in patients with a psychotic disorder and in nonpsychotic individuals: Not just what the voices say, but how they say it



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ARTICLE INFO

Article history:

Received 18 December 2015

Revised 10 June 2016

Accepted 29 July 2016

Keywords:

Auditory verbal hallucinations
 Psychosis
 Language
 Lateralization
 Syntax
 Hemisphere
 Voice hearing
 Linguistics
 Emotional valence
 Verbal abuses

ABSTRACT

Background: Auditory verbal hallucinations (AVH) in psychotic patients are associated with activation of right hemisphere language areas, although this hemisphere is non-dominant in most people. Language generated in the right hemisphere can be observed in aphasia patients with left hemisphere damage. It is called “automatic speech”, characterized by low syntactic complexity and negative emotional valence. AVH in nonpsychotic individuals, by contrast, predominantly have a neutral or positive emotional content and may be less dependent on right hemisphere activity. We hypothesize that right hemisphere language characteristics can be observed in the language of AVH, differentiating psychotic from nonpsychotic individuals.

Method: 17 patients with a psychotic disorder and 19 nonpsychotic individuals were instructed to repeat their AVH verbatim directly upon hearing them. Responses were recorded, transcribed and analyzed for total words, mean length of utterance, proportion of grammatical utterances, proportion of negations, literal and thematic perseverations, abuses, type-token ratio, embeddings, verb complexity, noun-verb ratio, and open-closed class ratio.

Results: Linguistic features of AVH overall differed between groups $F(13,24) = 3.920$, $p = 0.002$; Pillai's Trace 0.680. AVH of psychotic patients compared with AVH of nonpsychotic individuals had a shorter mean length of utterance, lower verb complexity, and more verbal abuses and perseverations (all $p < 0.05$). Other features were similar between groups.

Conclusion: AVH of psychotic patients showed lower syntactic complexity and higher levels of repetition and abuses than AVH of nonpsychotic individuals. These differences are in line with a stronger involvement of the right hemisphere in the origination of AVH in patients than in nonpsychotic voice hearers.

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1. Introduction

Auditory verbal hallucinations (AVH), hearing voices, is a cardinal feature of psychosis (David, 1999). AVH are the most common positive symptom in schizophrenia, with a one-year prevalence between 64 and 83 percent (Bauer et al., 2011; Thomas et al., 2007). They also occur in individuals who do not experience any psychiatric or neurological disorder, with reported prevalences ranging from 0.6% to 84% (median: 13.2%), depending on the

method of investigation (Johns et al., 2014). AVH in nonpsychotic and psychotic individuals are similar in terms of loudness, personification and number of voices heard, but the emotional content differs with a preponderance towards negative valence content in patients (Daalman et al., 2011).

To gain insight into the pathophysiology of AVH, the language component of this symptom is a rich source of information. Both hemispheres are capable of producing language, but in most people language production largely stems from left hemisphere activation (Kuperberg et al., 2000). This is most likely the result of active inhibition of right hemisphere language areas (Karbe, Herholz, Halber, & Heiss, 1998). Reduced language lateralization may be a result of decreased inhibition and is observed in patients with schizophrenia and is associated with AVH (Sommer et al., 2008). In these patients, increased activation in language-related areas

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of the right hemisphere may be related to the generation of AVH. Neuroimaging studies have established that neural activation is lateralized to the right hemisphere during AVH in psychotic patients. This was first reported by Woodruff and colleagues, who found activity in the right inferior frontal and temporoparietal areas in a patient with schizophrenia who experienced hallucinations during functional magnetic resonance imaging (fMRI) (Woodruff et al., 1995). This finding was replicated in a large sample by our group (Sommer et al., 2008). It has been suggested that activation of right hemisphere language areas is specific to psychotic AVH, whereas right hemisphere language areas may be less involved during AVH in non-psychotic individuals (Diederer, De Weijer, et al., 2010). However, a direct comparison of activation during AVH between 21 people with a psychotic disorder and 21 nonpsychotic individuals, showed no significant differences (Diederer et al., 2011). This does not preclude the presence of more subtle differences which could be detectable in fairly large samples.

Contribution of right hemisphere language areas in patients with schizophrenia may be reflected in the form and content of their AVH. Right hemisphere language is distinctive, as the right hemisphere is involved in some semantic processing, but not in syntactic processing (Menenti, Segaert, & Hagoort, 2012). The left hemisphere dominates syntactic functions, and, to a lesser extent, sentence-level and word-level semantic processing (Friederici, 2011; Grodzinsky, 2000). In split-brain patients, the right hemisphere was only capable of recognizing object names, but incapable of processing tenses, singularity versus plurality, or the relations between subject, verb and object (Gazzaniga & Hillyard, 1971). Likewise, patients with left hemisphere stroke were capable of semantics but were impaired in their syntactic functions (Tyler et al., 2011; Wright, Stamatakis, & Tyler, 2012). In aphasic patients with left hemisphere lesions, familiar phrases or automatic speech are relatively preserved (Van Lancker & Kempler, 1987) and thematic perseverations are common (Sandson & Albert, 1984). These findings explain why speech produced in right hemisphere language areas is characterized by low linguistic complexity and high levels of repetition (Code, 1982; Kuperberg et al., 2000).

In addition, right hemispheric activation is associated with swearing and threats (Copolov et al., 2003; Pell, 1999). In a previous study we found that the level of right hemisphere activation while experiencing AVH was associated with the negative emotional valence of the hallucinations (Sommer et al., 2008). This may imply that the predominant activation of right hemisphere language areas during AVH in psychotic patients underlies the distinct negative emotional content of the AVH. Furthermore, it has been hypothesized that a lack of synchronization between right hemisphere language areas leads to patients erroneously interpreting this emotional speech activity as coming from an external source (Curcic-Blake et al., 2013). By contrast, in nonpsychotic individuals, AVH rarely have a negative emotional content, being mostly neutral or positive (Daalman et al., 2011).

Since the right hemisphere areas are suggested to play an important role in producing AVH in psychotic patients (Jardri, Pouchet, Pins, & Thomas, 2011), the syntactic characteristics of the AVH are expected to be limited. The linguistic features may therefore differ from AVH in nonpsychotic persons. The aim of the current study is to investigate the phenomenological reflections of right hemisphere language, by comparing the content and linguistic properties of AVH between psychotic and nonpsychotic subjects. For this purpose, we recorded “shadows” of AVH, which are verbatim reproductions of the AVH as uttered by the individuals directly upon experiencing them (Hoffman, Oates, Hafner, Hustig, & McGlashan, 1994; Hoffman, Varanko, Gilmore, & Mishara, 2008). We hypothesize that AVH in psychotic patients are characterized by more negative emotional content and reduced

syntax, but a similar use of nouns, compared to AVH in nonpsychotic persons.

2. Methods

2.1. Participants

A total of 36 participants with AVH were included, 17 patients with a psychotic disorder and 19 nonpsychotic persons. All participants were native Dutch speakers and did not have any known hearing or speech deficits. Patients with a psychotic disorder were outpatients from the University Medical Center Utrecht and were referred by their psychiatrist. Ten patients had a diagnosis of schizophrenia (56%), four had schizoaffective disorder (24%), three psychosis not otherwise specified (18%). The nonpsychotic individuals with AVH were recruited and selected through a Dutch website (www.verkenuwgeest.nl) (Sommer et al., 2010). The questionnaire on the website was based on the Launay and Slade Hallucinations Scale (LSHS) (Larøi, Marczewski, & Van Der Linden, 2004), a self-report questionnaire designed to quantify the tendency to hallucinate in healthy individuals. Subjects with high scores on items 8 (“In the past, I have had the experience of hearing a person’s voice and then found that no-one was there”) and 12 (“I have been troubled by voices in my head”) of the LSHS were selected. They did not meet criteria for a DSM-IV diagnosis, as defined by a psychiatrist using the Comprehensive Assessment of Symptoms and History (CASH) interview (Andreasen, Flaum, & Arndt, 1992) and the Structured Clinical Interview for Personality Disorder (SCID-II) (First, Spitzer, Gibbon, & Williams, 1995). For more details about selection and assessment procedure see previous studies by our group (Daalman et al., 2011; Sommer et al., 2010). All participants experienced AVH at least once every day.

All participants gave written informed consent. The study was approved by the medical ethics committee of the University Medical Center Utrecht and was performed in accordance with the Declaration of Helsinki.

2.2. Shadow procedure

The participants were instructed to literally repeat their AVH directly upon hearing them during one minute, with the same intonation, loudness, and pronunciation as the voice they perceive. The verbatim responses were recorded using a voice recorder. This shadow procedure was repeated three times per participant, for three different AVH episodes. This resulted in three separate minutes of shadowed AVH. Voice recording was started with the onset of the AVH and was stopped after one minute. Some participants experience AVH almost continuously, while others had less frequent AVH. On average, the shadow procedure lasted between ten and thirty minutes. One patient was excluded due to the infrequency of his AVH. All other participants experienced AVH during three full minutes. The recorded utterances were transcribed manually by a neuropsychologist and verified by JB. The transcriptions were used for analyses.

2.3. Linguistic features

The recordings were analyzed with respect to content and linguistic complexity. All recordings were scored by the same person who was blinded for the diagnosis of the individual. The content was scored for literal and thematic perseverations and invectives. Furthermore, verbal abuses were counted. Linguistic complexity was examined by scoring the following characteristics: total words produced, type-token ratio, mean length of utterance, proportion of grammatical utterances, mean number of embeddings, verb

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