



## Formal thought disorder in non-clinical individuals with auditory verbal hallucinations

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### ABSTRACT

**Background:** Auditory verbal hallucinations (AVH) and formal thought disorder (FTD) may originate from the same aberration in the language system. The hypothesis of a shared neurobiological basis would be strengthened by the presence of FTD in individuals who frequently experience AVH, but do not meet DSM-IV criteria for a psychotic disorder.

**Methods:** In this study, FTD was quantified in 40 non-clinical subjects with AVH, in 50 healthy subjects without AVH and in 40 schizophrenia patients with AVH. Recorded speech samples were analysed by one rater who was blind to the presence/absence of AVH and to diagnosis, using the Thought and Language Index.

**Results:** Negative FTD was barely present in non-clinical subjects with AVH and in healthy controls without AVH. Positive FTD, however, was significantly higher in both groups experiencing AVH than in controls without AVH. Severity of positive FTD did not differ significantly between non-clinical subjects with AVH and schizophrenia patients with AVH.

**Conclusion:** Negative FTD (alogia) appears not to be associated with AVH. However, the fact that positive FTD (disorganised speech) in schizophrenia patients with AVH is equally high in non-clinical subjects with AVH indicates that these two symptoms tend to co-occur, which may be suggestive of a shared neurobiological substrate.

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### 1. Introduction

Schizophrenia is a complex syndrome consisting of a variable combination of psychotic, negative and disorganised symptoms (Andreasen et al., 1995). It is suspected, but as yet unclear, whether specific symptoms, or symptom clusters, of this disorder have a shared neurobiological basis. Two characteristic symptoms of schizophrenia, auditory verbal hallucinations (AVH) and positive FTD (i.e. disorganised speech), are particularly likely to have a shared neurobiological basis, as these symptoms may both result from a

malfunctioning language system (Hoffman 1986; Strik and Dierks 2008; Kuperberg 2008; Horn et al., 2009). As Hoffman (1986) put it: while FTD is disorganised overt speech, AVH can be viewed as disorganised covert speech. Indeed, several structural and functional deviations of language-related areas have been demonstrated in subgroups of schizophrenia patients, who either have prominent AVH or severe formal thought disorder. A rather consistent finding is the volume decrease of the left Superior Temporal Gyrus (STG) in thought disordered schizophrenia patients (Shenton et al., 2001; Vita et al. 1995; Subotnik et al. 2003; Horn et al., 2009) as well as in schizophrenia patient with AVH (reviewed in Sun et al., 2009). One hypothesis is that insufficient functioning of the left temporo-parietal language area gives rise to both FTD and AVH (Horn et al., 2009; Sun et al., 2009). Another possibility for a shared neurobiological substrate for FTD and AVH is increased activity of the right sided homologues of the

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language areas (Sommer and Dieren 2009). This hypothesis is supported by functional MRI studies, which showed AVH to be associated with activity in inferior frontal and temporo-parietal areas, with a lateralization to the right hemisphere (Woodruff et al., 1995; Shergill et al., 2000; Hoffman et al. 2007; Sommer et al., 2008a). In a similar fashion, cerebral activation during speech in patients with severe positive FTD also showed lateralization towards the right hemisphere language areas (Kircher et al., 2002).

An argument against a shared biological substrate for AVH and FTD is that factor analyses of symptom clusters in schizophrenia usually place AVH in the cluster “positive symptoms” or “reality distortion” and FTD in another (usually termed “disorganisation”) (Andreasen et al., 1995; Ruggieri et al., 2005, but see Demjaha et al., 2009). More precisely, negative FTD, i.e. the lack of spontaneous speech, clusters into the group of negative symptoms (Grube et al., 1998), while positive FTD, i.e. disorganised speech, is usually classified into the disorganised dimension (Andreasen et al., 1995).

This indicates that AVH and FTD may not tend to co-occur in the same patients *at the same time*. However, this does not exclude the possibility that patients with AVH are at increased risk to experience FTD *at another phase* in their illness. For example, AVH may be most prominent in first episode psychosis, while FTD may develop at a later stage of the disease. Another possibility may be that AVH tend to be more responsive to medication than FTD, which thwarts research into the predisposition for FTD and AVH in this patient group.

Another method to test the hypothesis of a shared neurobiological substrate for AVH and FTD is to measure the co-occurrence of FTD in individuals who frequently experience AVH, but do not meet DSM-IV criteria for a psychotic disorder.

The University Medical Centre Utrecht recently collected data on a group of healthy individuals experiencing AVH. These subjects are free of delusions and negative symptoms and function within the normal range (Sommer et al., 2008b). In this study, we tested if sub-clinical levels of FTD are higher in non-clinical individuals with AVH than in matched subjects without AVH. For reference, a group of schizophrenia patients with AVH was also included. Recorded speech samples were analysed blind to the presence/absence of AVH and to diagnosis. Levels of FTD were quantified using a validated scale (the Thought and Language Index, Liddle et al., 2002). Increased levels of FTD in hallucinating individuals as compared to non-hallucinating subjects will be interpreted to support the hypothesis of a shared neurobiology of these two language-related symptoms.

## 2. Method

### 2.1. Subjects

A website providing information about hearing voices was designed ([www.verkenuwgeest.nl](http://www.verkenuwgeest.nl)) and advertised by interviews on radio, television and newspapers. Visitors of this website were invited to fill out a questionnaire on hallucinations, based on a modified version of the Launay and Slade Hallucination Scale (LSHS), a self-report questionnaire

designed to quantify the tendency to hallucinate in healthy individuals (Larøi et al., 2004).

Between March 2006 and March 2008, 15,538 subjects visited this website, of whom 4135 completed the questionnaire. Subjects with high scores on item 4 and 9 of the LSHS (item 4: “In the past I have had the experience of hearing a person’s voice and then found that there was no-one there”, item 9: “I have been troubled by hearing voices in my head”) were selected. Trained psychologists interviewed these subjects by telephone. Subjects were included if they met the following inclusion criteria: (1.) voices were distinct from thoughts and had a perceptual, i.e. “hearing” quality (2.) voices were experienced at least once a month (3.) no diagnosis or treatment for psychiatric disorders other than depressive or anxiety disorders in complete remission (4.) no alcohol or drug abuse for at least 3 months (5.) no chronic somatic disorder (6.) 18 years of age or older.

477 subjects had a summed score of at least 7 on the items 4 and 9. From these, 83 could not be reached by telephone and another 94 were not interested in participation. Several subjects were found unsuitable for inclusion: 98 did not fulfill criterion 1, 18 did not meet criterion 2, 60 did not meet criterion 3 and 9 did not meet criterion 4. The selection procedure is illustrated in Fig. 1. 115 individuals fulfilled all

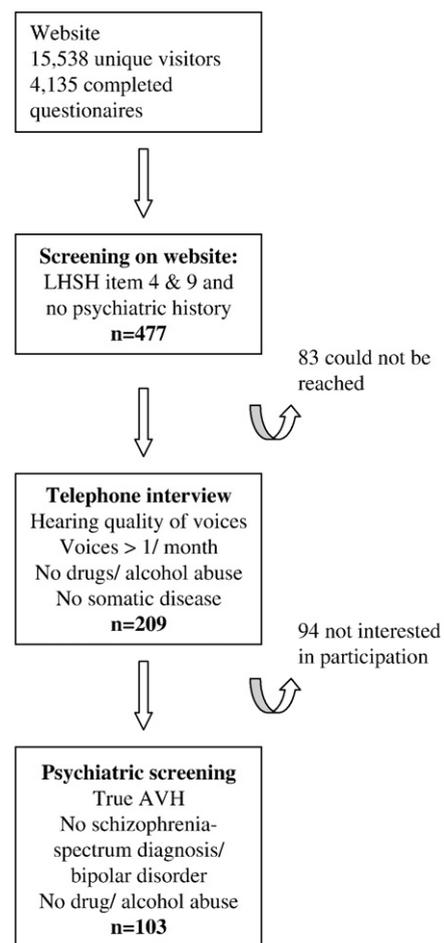


Fig. 1. Flow diagram of the selection procedure.

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