



# Instrumental measurements of spontaneous dyskinesia and schizotypy in subjects with auditory verbal hallucinations and healthy controls



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## ABSTRACT

Spontaneous dyskinesia is associated with non-affective psychosis. Few studies investigated dyskinesia in individuals with subclinical psychotic experiences. We examined dyskinesia using instrumental measurements of force variability in 34 individuals with frequent auditory verbal hallucinations but without a clinical psychotic disorder and 31 matched healthy controls. Schizotypy was assessed using the Schizotypal Personality Questionnaire. We found a positive correlation between dyskinesia and schizotypy in the total group. In addition, when using a cut-off point based on the 95th percentile of force variability in the control group, we found a greater proportion of subjects with dyskinesia in the group with auditory verbal hallucinations than in the control subjects. Current findings are in agreement with the concept of psychosis as a continuous phenomenon and with movement disorders being an integral part of psychosis.

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## 1. Introduction

Psychotic symptoms occur along a continuum, ranging from mild and subclinical to severe and associated with dysfunction. Furthermore, the continuum theory implies that psychotic symptoms can occur in the absence of a psychotic disorder, and are more prevalent than psychotic disorders themselves (Kelleher et al., 2010; van Os et al., 2000, 2009). One way to study the validity of the continuum concept is to investigate if similar correlations between symptom dimensions are present for the subclinical manifestation as are known to exist in psychotic disorders (van Os et al., 2000, 2009). Indeed, correlations between the positive dimension and negative and affective dimensions have been

found (Stefanis et al., 2002; van Os et al., 2000).

Movement disorders are also known to be part of the clinical picture of psychosis (van Harten and Tenback, 2009), however, not much research has been done on movement disorders in relation to subclinical psychotic experiences.

The relationship between movement disorders and schizophrenia has been well established (van Harten and Tenback, 2009). Movement abnormalities are prevalent in antipsychotic naive patients with schizophrenia (Koning et al., 2010), adolescents with schizotypal personality disorder (Saczawa et al., 2008) and non-affected siblings of schizophrenia patients, who have a heightened genetic risk to develop a psychotic disorder (Koning et al., 2011a, 2011b, 2010). Movement disorders have even been suggested as a core symptom of schizophrenia (van Harten and Tenback, 2009). One of these motor symptoms is dyskinesia, which is a hyperkinetic movement disorder characterized by involuntary writhing and purposeless, irregular choreatiform movements (Koning, 2011). In schizophrenia, these movements frequently occur in the orofacial region and the distal extremities (Walther, 2015). Research suggests that dyskinesia is related to aberrant striatopallidal activity giving rise to reduced output in the globus pallidus interna and disinhibition of thalamocortical pathways (Obeso et al., 2014). It has been hypothesized that both dyskinesia and psychotic symptoms depend on dysfunction in striatal

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dopaminergic transmission (DeLong, 2007; Mittal et al., 2010; Perez-Costas et al., 2010). Dyskinesia ranges in severity from subtle to severe and more subtle forms can only be measured mechanically (Koning et al., 2011a).

Persons who experience auditory verbal hallucinations in the absence of a clinically relevant psychotic disorder can be considered a population with (at least one) non-clinical psychotic symptom. A sample of these persons has been brought together by Sommer et al. (2010b). Sommer and colleagues found more schizotypy, a heightened delusional tendency, more disorganized speech (Sommer et al., 2010a) and a lower global level of functioning in individuals with auditory verbal hallucinations compared to matched healthy controls (Sommer et al., 2010a). They suggested that the hallucinations in these individuals are part of a general vulnerability to psychosis (Sommer et al., 2010b). Following this line of reasoning, we regard these individuals as a group with a generally heightened expression of the psychosis phenotype.

In the present study we examined instrumentally measured dyskinesia as a sign of non-affective psychosis in a subset of these subjects with auditory verbal hallucinations and a healthy control group. We hypothesized that:

1. In the group with auditory verbal hallucinations and the control group together, dyskinesia and schizotypy are positively correlated.
2. Individuals with auditory verbal hallucinations show more dyskinesia than healthy controls.

## 2. Methods

### 2.1. Participants

The current study was part of a larger study on subjects experiencing auditory verbal hallucinations without a diagnosis of a psychotic disorder (Sommer et al., 2010b). Subjects with auditory verbal hallucinations and healthy controls were recruited using a website with information about hearing voices.

Inclusion criteria for subjects with auditory verbal hallucinations were: 1) voices were distinct from thoughts with a '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 remission, 4) no alcohol or drug abuse for at least 3 months, 5) no chronic somatic disorder, 6) 18 years of age or older, 7) 4 Dutch-born grandparents 8) no current use of psychotropic medication. Healthy control subjects had to fulfill criteria 3–8. The procedure of selection of nonpsychotic individuals with auditory verbal hallucinations and healthy controls is described in more detail elsewhere (Sommer et al., 2010b).

### 2.2. Demographic and psychiatric assessments

Relevant demographic variables for all participants for the present study were gender, age, and total years of education. DSM IV axis I disorders were assessed in all subjects by independent psychiatrist using the Comprehensive Assessment of Symptoms and History (CASH) interview (Andreasen et al., 1992). The subjects with auditory verbal hallucinations were additionally assessed for personality disorders with the Structured Clinical Interview for Personality Disorder (SCID II) (First et al., 1995). Urine samples were taken to screen for use of cannabis, amphetamine, cocaine, heroine and methadone. A positive screen of one or more of these substances would lead to exclusion.

### 2.3. Measurement of dyskinesia and schizotypy

Mean force variability was taken as a proxy for upper extremity dyskinesia and measured with a mechanical instrument designed by Koning et al. (2011a) based on a similar instrument developed by Caligiuri and Lohr (1990).

The task for subjects consisted of pressing a button with constant pressure, first with the index finger of their dominant hand and then with the index finger of their non-dominant hand. The button was connected to a load cell attached to a monitor showing a graph indicating the pressure exerted, providing participants with immediate feedback. The target force was set at an equivalent of 3 N. The force generated was measured continuously (12 bit sampling at 2.5 kHz, digital low pass filtering, storage, and further analysis at 100 Hz). The task was performed 3 times per hand for a duration of 20 s each, separated by 5-second rest periods. The first trial was used to accustom subjects to the test. Data of the two subsequent tests for both hands, regardless of handedness, were used for analysis. The average pressure was calculated for each 20-second test period. This mean was subtracted from the signal and then Fourier transformed. Total power in the 0–3 Hz range was determined and converted to calculate the standard deviation for the 0–3 Hz signal components. The standard deviation was presented as the percentage of error (standard deviation divided by mean force). Force in the 0–3 Hz frequency range was used as this measures dyskinesia best and is unaffected by resting tremor which manifests itself in the 4–6 Hz frequency band (Koning et al., 2011a). This procedure has been used and validated earlier (Koning et al., 2011a; Lohr and Caligiuri, 1992). Dyskinesia was defined as a force variability score higher than the 95th percentile of the control group (Cortese et al., 2005; Koning et al., 2011a).

Schizotypal tendency was assessed by means of the Schizotypal Personality Questionnaire (Raine, 1991), a self-report questionnaire containing 74 questions.

### 2.4. Analyses

Depending on the type and distribution of the data, *t*-tests, Mann Whitney U, Chi-square and Fisher's exact tests were used to test for differences between groups. Spearman's rho was calculated to assess the correlation between force variability and schizotypy.

## 3. Results

### 3.1. Demographic and psychiatric characteristics

Data were collected for 34 individuals with auditory verbal hallucinations and 31 healthy control subjects. Participants with auditory verbal hallucinations and healthy controls did not differ with regard to gender, age or total years of education which was to be expected because both groups were matched on these variables (Table 1). There were no personality disorders in the hallucinating

**Table 1**  
Demographic characteristics.

	Control group (n=31)	AVH group (n=34)	Statistic	P value
Gender % man	48.4	38.2	Chi square (1)=0.68	0.41
Age in years mean (sd)	45.9 (15.0)	45.4 (11.9)	t(63)=0.137	0.89
Total years of education mean (sd)	13.0 (2.6)	13.8 (1.9)	t(53)= -1.45	0.15

AVH: auditory verbal hallucinations

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