



## Temporal dynamics of visual and auditory hallucinations in psychosis

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### ABSTRACT

**Background:** Hallucinations are a core feature of psychosis, often causing considerable distress. Reported prevalence ranges from 70% for auditory hallucinations (AHs) to 30% for visual hallucinations (VHs) and 4% for hallucinations in the tactile domain. AHs have been studied extensively but studies on VHs are scarce. The current study investigated the phenomenology of VHs and AHs in the realm of daily life, by analyzing their prevalence, course and co-occurrence over a 6-day period and their temporal relation to emotions and delusions.

**Methods:** The ESM, a structured diary technique, was used to investigate hallucinatory experiences in the context of daily life in a pooled data-set of 184 participants (71% males) with psychosis spectrum disorders, which were recruited from mental health facilities in the south of the Netherlands and Belgium. All self-assessments were rated on 7-point Likert scales. VHs were defined using participants' scores on the item "I see phenomena". AHs were measured using the item "I hear voices".

**Results:** Overall, 73 participants (40%) reported hallucinations. Ten participants reported VHs only, 38 reported both VHs and AHs, and 25 participants reported AHs only. AHs co-occurred with VHs in 40% of the hallucinatory moments. Patients with both VHs and AHs reported higher levels of negative affect, lower levels of positive affect and higher delusional intensity than non-hallucinatory patients. Increased delusional intensity preceded the onset of hallucinatory episodes, whereas increases in positive or negative affect did not.

**Discussion:** These results show that VHs are common in patients with psychosis spectrum disorders and often co-occur with AHs in time. Furthermore delusional ideation may precede hallucinatory episodes in the realm of daily life, rather than result from a hallucination and affective dysregulation might not play a primary role in hallucination onset.

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### 1. Introduction

Hallucinations are considered core symptoms of psychosis spectrum disorders and can appear in all sensory modalities (e.g. olfactory, tactile), but are in patients most frequently experienced in the auditory and visual modalities. Auditory hallucinations (AHs) in psychosis typically involve voices, ranging from single words or short phrases to multiple voices conversing or commenting on the voice hearer, and affect about 70% of schizophrenia patients during the illness course (WHO, 1973; Baethge et al., 2005). Visual hallucinations (VHs) also

involve a wide range of experiences, such as seeing dots, figures or people, with lifetime prevalence rates up to 56% (Bracha et al., 1989; Baethge et al., 2005). Despite the many patients with a psychotic disorder being affected by hallucinations, we know disappointingly little about the prevalence of AHs and VHs and information on the regulation of these experiences is limited. Questions such as 'What is the real life prevalence rate of AH and VH and how often do they co-occur?', 'Do hallucinations fluctuate in intensity and what drives these fluctuations?' seem crucially important from a clinical point of view; still they remain largely unanswered.

One study, using the Experience Sampling Method (a structured daily diary method), found that 65% of patients with schizophrenia reported unusual visual phenomena and 49% reported auditory phenomena during the course of a week (Delespaul et al., 2002). This study also showed marked variability in hallucinatory intensity over periods of hours and days, both in AHs and VHs. An interview study found significant comorbidity of AHs and VHs, with 70% of patients

*Abbreviations:* AH, auditory hallucination; VH, visual hallucination; ESM, Experience Sampling Method; PANSS, Positive and Negative Syndrome Scale; NA, negative affect; PA, positive affect.

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suffering from VHs also reporting AHs (Gauntlett-Gilbert and Kuipers, 2003).

It is possible that affective processes play a role in triggering hallucinatory phenomena. Patients retrospectively recall affect to be a relevant factor in the onset of a hallucination (Gauntlett-Gilbert and Kuipers, 2005) and report elevated levels of distress and anxiety while hallucinating (Honig et al., 1998; Delespaul et al., 2002). It remains unclear, however, whether changes in emotion precede the onset of hallucinatory experiences in everyday life and if so, whether this is equally true for auditory and visual hallucinations.

It is also possible that delusional thinking plays a role in the onset of hallucinations. Early theorists argued that delusions are rational attempts to interpret anomalous experiences, hence that hallucinations drive delusional thinking (Maher, 1974). Indeed, the presence of delusions has found to be strongly associated to the presence of hallucinations (Liddle and Barnes, 1990; van Os et al., 2000). Furthermore, several epidemiological studies have shown that hallucinatory experiences followed by a delusional interpretation increase the risk to develop a clinical psychosis (Krabbendam and van Os, 2005; Smeets et al., 2010). However, alternatively, delusional beliefs may affect the salience of inner experiences (Kapur, 2003) and the source-monitoring mechanisms involved in the development of a hallucination (Bentall, 1990; Morrison and Haddock, 1997; van 't Wout et al., 2004).

In order to advance our knowledge of factors triggering the emergence of hallucinations and about the relationships between hallucinations, emotions and delusional thoughts, we used the Experience Sampling Method (ESM) to study VHs and AHs in a large group of patients with a psychotic disorder. ESM is a structured self-assessment technique in which participants are prompted at random intervals throughout the day to report their current experiences (Myin-Germeys et al., 2009). This method allows the investigation of hallucinations, delusions and emotional experience in the moment, in the context of the normal daily life of patients without making a strong appeal to memory. ESM has been proven to be valid and feasible to study positive psychotic symptoms and their association with emotions and daily life stress (for a review see Oorschot et al., 2009). In a sample of 184 patients with psychotic disorder, we examined (i) the prevalence and course of VHs and AHs over a 6-day period, (ii) the co-occurrence of VHs and AHs in normal daily life, and (iii) the temporal association between VHs/AHs and emotional and delusional experiences.

## 2. Methods

### 2.1. Sample

The current sample comprised 184 participants (71% males). All patients were recruited from mental health facilities in the south of the Netherlands and Belgium. Hallucinations were reported by 40% of participants during the course of the 6-day ESM period. All participants were diagnosed with schizophrenia-spectrum disorders. Inclusion criteria were i) age 18–65 years, and ii) sufficient command of the Dutch language. Exclusion criteria were i) self-reported brain disease, and ii) history of head injury with loss of consciousness. Data for the current study were pooled from three previous ESM-studies investigating: 1) stress-reactivity (Myin-Germeys et al., 2000), 2) paranoia (Thewissen et al., 2008), and 3) stress-reactivity (Lataster et al., 2010). ESM-questionnaires were set up identically in terms of mood and symptoms in order to enable data pooling. Interview data and clinical record data were used to complete the Operational Criteria Checklist for Psychotic Illness (OCCPI) yielding DSM-III-R and DSM-IV diagnoses through the OPCRIT computer program (McGuffin et al., 1991) in two of the study samples (Myin-Germeys et al., 2000; Thewissen et al., 2008) or the CASH (Andreasen et al., 1992), yielding DSM-IV diagnoses in one study sample (Lataster et al., 2010). The diagnostic interviews

were conducted by psychologists or highly trained research assistants (at the level of assistant psychologist or psychiatric nurse). They were all extensively trained at the beginning of the study and then received a booster session at least once a year. Written informed consent, conforming to local ethics committee guidelines, was obtained from all participants. Participants were compensated with a 25 Euro voucher.

### 2.2. Experience Sampling Method

Data on daily life experience were collected using the ESM; a structured self-assessment technique, collecting data in the natural flow of daily life (Csikszentmihalyi and Larson, 1987; Myin-Germeys et al., 2009). Previous studies have demonstrated the feasibility, validity, and reliability of ESM in general and patient populations (Myin-Germeys et al., 2009; Oorschot et al., 2009). Participants received a pre-programmed digital wristwatch and 10 pocket size assessment forms collated in a booklet for each day. Ten times a day on 6 consecutive days, the watch emitted a signal at randomly selected time points between 7.30 AM and 10.30 PM, with average intervals of 90 min (range: 15 min to 3 h). After each “beep”, participants were asked to fill out the ESM self-assessment forms, collecting reports of emotions, psychopathology and context on 7-point Likert scales and open-ended questions. The ESM procedure was explained in a briefing session and all participants completed a practice form in order to confirm that they understood the procedure. Participants were instructed to complete their reports immediately after the beep and to register the time at which they completed the questionnaire. During the sampling period, research staff contacted participants regularly by phone or visited them to assess compliance with the instructions. During a debriefing session, participants were interviewed to be sure that they had complied with the instructions. Reports were assumed valid when subjects responded to the beep within 15 min (Delespaul, 1995; Myin-Germeys et al., 2001; Delespaul et al., 2002). Participants were only included in the analyses when they responded validly to at least one-third of the emitted beeps (Delespaul, 1995).

### 2.3. ESM measures

#### 2.3.1. Hallucinatory intensity

AHs were defined using participants' score on the item “I hear voices” and VHs using participants' score on the item “I see phenomena” (rated on 7-point Likert scales, ranging from 1 *not at all* to 7 *very*).

#### 2.3.2. Hallucinatory episodes

An AH episode consisted of one or more consecutive moments with a score of  $\geq 3$  on the item “I hear voices”. A VH episode consisted of one or more consecutive moments with a score of  $\geq 3$  on the item “I see phenomena”. We took a liberal approach to missing data, since this is a naturalistic study, and allowed a maximum of one missing data point per episode. In order to analyze temporal dynamics and relation to emotions and delusions, moments were categorized as either the last moment before an episode, the first moment in an episode, a moment during an episode (not first or last moment), the last moment during an episode, the first moment after an episode and unrelated to an episode (i.e., all the other moments; see Figs. 1 and 2).

#### 2.3.3. Delusional intensity

Delusional intensity was measured using three items (“I'm suspicious”, “I can't get rid of my thoughts” and “I fear losing control”) rated on 7-point Likert scales. The items had a good internal consistency (Cronbach's  $\alpha = .74$ ) and their validity was previously demonstrated (Myin-Germeys et al., 2005). All analyses were conducted

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