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Determinants of occurrence and recovery from hallucinations in daily life

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Abstract *Background* Data related to the dynamics of hallucinatory experiences of patients suffering from schizophrenia are scarce. Detecting antecedent conditions and coping strategies may aid development of targeted psychological interventions. *Method* We studied hallucinating and non-hallucinating patients suffering from schizophrenia spectrum disorder (n = 57), and non-schizophrenic severe mentally ill patients with depression (n = 37). Data were collected using the Experience Sampling Method (ESM) over a period of 1 week. Contingent on a randomly signalling beep, subjects filled in reports of ongoing hallucinations as well as thought, mood, current activity, social circumstances and places frequented. *Results* More subjects suffering from schizophrenia reported hallucinations, but for all hallucinating subjects the qualities of hallucination episodes were quite similar. More subjects reported visual hallucinations at least once. In contrast, the intensity of auditory hallucinations was higher. Anxiety was the most prominent emotion during hallucinations and reports of anxiety intensity exceeded baseline levels before the first report of auditory hallucinations. Context modified hallucination intensity over the course of an episode. Social withdrawal resulted in a decrease of hallucinatory intensity (AH > VH), while social engagement slightly raised intensity levels (VH > AH). Doing nothing (VH > AH) and work activities (AH > VH) led to decreases in intensity levels over time, while passive leisure activities (watching TV) resulted in increases in intensity levels of hallucinations (AH > VH). *Conclusion* The results suggest that hallucinating experiences are subject to a host of contextual influences. Understanding variation offers useful insights for therapy.

Key words Schizophrenia – hallucinations – Experience Sampling Method – coping – anxiety

Introduction

Auditory (AHs) and visual hallucinations (VHs) are common in schizophrenia, with reported prevalences of 63 % and 29 %, respectively (Owens et al. 1989). Although less frequently, hallucinations also occur in other psychiatric illnesses such as affective psychosis and personality or posttraumatic stress disorders (Asaad 1990). Finally, people who never received a psychiatric diagnosis also report hallucinatory experiences (Honig et al. 1998; van Os et al. 2000). Some researchers have argued that content complexity (Nayani and David 1996) and normalisation interpretations (Romme and Escher 1989) are related to outcome. Birchwood and Chadwick (1997) argued that beliefs about the power and meaning of voices was related to affect and coping. Knowledge about the psychological functions involved in the interpretation of mental phenomena such as hallucinations is accumulating (Bentall 1990; Leudar et al. 1994). New information on the processes related to hallucinations (Johns and McGuire 1999; Shergill et al. 2000; Johns et al. 2001) can be incorporated to assess

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theories on hallucinations proposed by Slade and Bentall (Slade and Bentall 1988; Slade 1994) and Frith (1992).

Specific interventions have been developed to control and minimise the burden related to such experiences (Tarrier et al. 1993; Bentall et al. 1994; Chadwick and Lowe 1994; Kingdon et al. 1994; Haddock and Tarrier 1998). Recently, meta-analyses have suggested their effectiveness (Jones et al. 2001; Rector and Beck 2001).

To assess these theories and improve interventions, additional knowledge about the context of auditory and visual hallucinations in terms of time of the day, places frequented, persons met and activities performed is needed (deVries and Delespaul 1989). Also needed is additional information on the concurrent experiences of hallucinatory moments as well as patients' strategies that alleviate their burden. Few studies have focussed on visual or auditory hallucinations as they develop under the circumstances of daily life. Assessments that generate this information are difficult to conduct because valuable data are often blurred by the person's own beliefs (Delespaul and deVries 1987; Delespaul 1995). However, this type of information is needed to increase knowledge about the aetiology of hallucinations and its neurobiological correlates and to facilitate the development of individualised psychological interventions.

In this article, data will be presented – collected using the Experience Sampling Method (ESM) – on hallucinatory experiences in real-life situations, in a comparison between patients with a diagnosis of non-affective psychosis, primarily schizophrenia, and a group of severe mental illness patients with affective psychosis diagnoses. In particular, the focus will be on: i) occurrence and frequency; ii) the concurrent mental state of hallucinatory moments, and iii) the dynamics of hallucinatory experiences over time in relation to accompanying emotions, social context and activities.

Subjects and methods

Subjects

All patients were recruited from severe mental illness services in a catchment area serving a population of around 220,000. Patients were in remission but still suffering from residual symptoms that needed ambulatory or clinical professional mental health care. The average illness history was 13.9 years (sd 8.5 years) and the number of admissions 3.5 (sd 2.6).

One hundred and thirty-three patients were diagnosed with DSM-IV criteria by one of the authors (PD). Diagnostic accuracy was checked independently using case-note material and the OPCRIT computerised diagnostic procedure (McGuffin et al. 1991). This revealed no diagnostic discrepancies. Two groups were formed. The first group was a schizophrenia spectrum group of 81 subjects of which 57 subjects actually participated in the study (see ESM instrument). Of the second group of 52 affective disorder patients, 37 participated in the study (Table 1).

The patients under study matched the profiles of the regional affective and non-affective psychotic patients with regard to age, sex and marital status and education (Delespaul 1995). Subjects from these samples were previously described in analyses pertinent to delusions (Myin-Germeys et al. 2001) and to 'flat affect' (Myin-Germeys et al. 2000).

The Experience Sampling Method

Data were collected using the Experience Sampling Method (ESM), a random signal contingent sampling of mental states in context, collected in the natural flow of daily life (Csikszentmihalyi and Larson 1984; deVries 1992; Delespaul 1995). All subjects participated in ESM for a period of 6 days, being sampled ten times each day. We sampled between 7:30 and 22:30, with average intervals of 90 min. Contingent on a random signal, emitted by a SEIKO RC–1000 digital watch, subjects filled in Experience Sampling Forms (ESF) that were bundled by day in A5 size booklets. These forms included ESF modules for the assessment of ongoing thought, mood, psychopathology, activity appreciation, physical well-being, as well as descriptions and ratings of the social circumstances and places that a person frequented. Subjects reported all experiences on a 7-point Likert scale and coded open questions (Table 2). Subjects could participate in the study when they were able to hear the beeping signal, read and write, comply with the instructions and consent participation conform with local medical-ethical standards. This was ascertained during a briefing session and followed up by repeated checks in the course of the week. Reports are assumed valid when subjects respond to the beep within 15 min. This was ascertained by comparing the actual beeping time with the reported time of completion of the ESF. In order for a subject to be included in the analyses, they had to respond validly to at least one-third of the emitted beeps (Delespaul 1995). Fifty-seven (70.4%) schizophrenia spectrum subjects and 37 (71.2%) affective disorder patients remained (Table 1). There was no different attrition between the groups and no differences in the characteristics of the included samples.

Self-reports of hallucinations

Self-assessments of hallucinations, as well as of all other positive schizophrenic symptoms, may be problematic due to the assumed lack of insight of psychotic patients. However, insight has different gradations (David 1990; Birchwood et al. 1994) and recognising hal-

Table 1 Sample description and study attrition

Schizophrenia spectrum (n = 81) → n = 57			Affective disorders (n = 52) → n = 37		
Diagnosis			Diagnosis		
• Schizophrenia (295.xx)	n = 67	82.7%	• Major depression (296.xx)	n = 41	78.8%
• Delusional D. (297.10)	n = 3	3.7%	• Dysthymia (300.4x) with Type B PD (301.7/8)	n = 11	21.2%
• Psychotic D NAO (298.90)	n = 7	8.6%			
• Brief psychotic R (298.80)	n = 4	4.9%			
ESM-based attrition			ESM-based attrition		
• Able to participate and informed consent	n = 65	80.2%	• Able to participate and informed consent	n = 40	76.9%
• n after ESM validation exclusion	n = 57	70.4%	• n after ESM validation exclusion	n = 37	71.2%

Table 2 Variable description

Independent variables

- Hallucinations auditory (AH) 'I hear voices' 7-point Likert scale
  visual (VH) 'I see phenomena' 7-point Likert scale
  - Variable definition:
    - *occurrence:* 1 = no hallucination; score of 2 or more = hallucination moment
    - *intensity:* scores 2–7 (2 = in the background, can hardly be heard ± 7 = extremely disrupting, disabling, can't engage in any kind of activity)
    - *frequency:* count of valid reports of hallucination occurrence over the total of valid beeps; this figure can be considered a time budget of hallucination moments
    - *hallucinator:* subject with at least one report > 1 on a hallucination item over the course of the ESM week
    - *episode:* uninterrupted series of occurrence of hallucinations (nights, missing or invalid beeps, and scores of 1 are considered interruptions)
    - *episode duration:* period between first and last occurrence of hallucination within an episode

Dependent variables

- Hallucination episodes
  - *episode phases:* defined as the last report before the episode, the first report in the episode, reports in the middle, the last during and the first after the episode
- Experience modules
  - cognitions:
    - open ended: 'What were you thinking?'
    - 7-point Likert scales: pleasant, clear, normal, difficulty concentrating
  - concurrent mood:
    - 7-point Likert scales: cheerful, unsecure, lonely, relaxed, anxious, satisfied, irritated, sad, guilty
  - psychopathology (excluding hallucinations)
    - 7-point Likert scales: suspicion, thoughts difficult to express, can't get rid of, influenced by others, I feel unreal, fear to lose control
  - social context
    - 7-point Likert scales: pleasant company, prefer to be alone, acting together
  - activity
    - 7-point Likert scales: motivation, activity level, consumes energy, challenge, skills
- Context
  - Who 'I am alone' no/yes
    'Who am I with?' open question coded after debriefing info is collected; codes: alone; family; friends; colleagues; strangers
  - What 'What am I doing?' open question coded after debriefing info is collected; codes: doing nothing, self-care, work/study, leisure, health care, travel

lucinations is often possible outside of the most acute phases (Schwartz 1998; Peters et al. 1999; van Os et al. 1999). DeVries and Delespaul (1989) demonstrated that psychotic patients are able to self-monitor such experiences in ESM studies.

Visual and auditory hallucinations were assessed using 7-point Likert scales cued by definitions derived from group discussions with patients (see Table 2). During the ESM briefing, we ascertained that the subjects understood that the questions related to hallucinations and that responses on the Likert scales reflected symptom intensity (2 = 'can barely be heard' to 7 = 'disturbingly loud making normal functioning impossible'). Validity of momentary reports of hallucinations was assessed by comparing the average of the subjects' ratings to BPRS based assessments. We found correlations of 0.75 for auditory hallucinations and 0.64 for visual hallucination rates. Specificity was high: no other BPRS item had such a high correlation with the ESM hallucination scores (the highest was 0.52 for BPRS delusions) and no other ESM pathology item correlated that high with the BPRS hallucination score (the highest was 0.45 for ESM suspicion).

Analysis

ESM data sets contain repeated observations nested within subjects and are not independent. Two analyses strategies can be applied in this situation. The conservative approach was proposed by Larson and Delespaul (1992) and computes summary scores (frequency, proportion and averages) by subject for the appropriate parameters. Standard statistical group comparison techniques such as χ^2-tests and analyses of variance are used. Comparisons between mental states in hallucinatory and non-hallucinatory moments were assessed using repeated measures regression techniques on averages of subject values during hallucinatory and non-hallucinatory moments. Whenever the number of tests biased α-values, salient significances were weighted using meta-analytic techniques (Hunter 1990; Petitti 1994). Assuming statistical tests evaluated with a generous significance level of 10 %, substantially more than 10 % of independent tests should be significant. With sign tests (one condition greater than the other), significantly more than 50 % of the tests should be in the same predefined direction. Assessments on occurrence and frequency were done on both samples. Evaluation of the concurrent mental state of hallucinatory moments were done on hallucinating schizophrenia subjects who did not report hallucinations all the time. We used SPSS 6.1 for Apple Macintosh computers (SPSS Inc. 1990).

A second strategy uses multilevel random regression techniques (Goldstein 1987) to model hallucinatory intensity. These statistical methods adequately control for the lack of independence between observations. In the models presented in this study, we controlled for autoregressive factors and modelled subjects as random effects and events as fixed. We used MIXREG and MIXOR (Hedeker 1993a; Hedeker 1993b) to assess the dynamics of hallucinatory experiences over time in relation to accompanying emotions, social context and activities for the different phases related to hallucinatory episodes (the last moment before, the first and last report during a hallucinatory episode and the first report after). We compared these observations with assessments made at moments unrelated to hallucinations (baseline ratings) (see formula below). The improved fit of complex models above baseline models was evaluated using $\Delta\chi^2$ algorithm (Hedeker 1993).

$$
\begin{aligned}
\text{Hallucinatory intensity} = {} & \beta_0 + && \text{: overall constant term} \\
& \beta_1 \text{ Hallucinatory event} + && \text{: 0 = no; 1 = yes} \\
& \textstyle\sum_{i=1 \dots n} \beta_{2i} \text{ Hallucinatory phase (i)} + && \text{: 0 = no; 1 = yes for phases last before, first during, last during, first after} \\
& \textstyle\sum_{j=1 \dots n'} \beta_{3j} \text{ Concurrent mental state (j)} + && \text{: 7-point Likert scale for anxiety, depression demotivation, activation, \dots} \\
& \textstyle\sum_{k=1 \dots n''} \beta_{4k} \text{ Concurrent context (k)} + && \text{: 0 = no; 1 = yes for alone, work, leisure, \dots} \\
& \textstyle\sum_{i=1 \dots n} \sum_{j=1 \dots n'} \beta_{5ij} \text{ Phase (i)} \times \text{Mental State (j)} + && \text{: interaction phase} \times \text{mental state} \\
& \textstyle\sum_{i=1 \dots n} \sum_{k=1 \dots n''} \beta_{6ik} \text{ Phase (i)} \times \text{Context (k)} + && \text{: interaction phase} \times \text{context} \\
& \beta_n \text{ Hallucinatory intensity [\_ n}-1] + && \text{: autoregressive factor (lag 1)} \\
& r_c && \text{: random term at subject level}
\end{aligned}
$$

Results

Sampled hallucinatory experiences: occurrence and frequency

Compared to severely ill affective disorder patients, more patients suffering from schizophrenia reported hallucinations (VH: 10.5% and 62.5%, respectively, $z = 3.46$; $p < 0.001$; AH: 17.1% and 49.1%, respectively, $z = 3.09$; $p < 0.001$). An equal number of subjects had auditory hallucinations but no visual ones, or visual but no auditory ones (18% each).

Subjects who did report hallucinations, reported hallucinations the same amount of time (±30%) in both groups (AH: $F(1,33) = 0.96$ n. s.; VH: $F(1,15) = 0.00$ n. s). We also found no differences in the number and duration of episodes, and the intensity and moment-to-moment variability of either visual or auditory hallucinations between both groups. Due to the fact that no differences were found and the frequency of hallucinating experiences was relatively low in affective disorder patients, the assessment of episodes was restricted to schizophrenia patients only.

From the schizophrenia patients with AHs, three (11%) hallucinated on each reported beep – one of them constantly at the maximum intensity level. Ten patients (36%) heard voices more than half of the time. For VHs, one patient hallucinated all the time and five (14%) more than 50% of the time. Excluding subjects who hallucinated continually, VHs occurred 26.32% and AHs 33.20% of the time. This difference was not significant. With a sampling window between 7:30 and 22:30 – 900 min each day – the cumulative amount of hallucination time is 3 h and 57 min a day for VHs and 4 h and 59 min for AHs. By combining repeated uninterrupted series of hallucination reports, we got some indication of episode duration. The difference between VHs and AHs was non-significant (episodes lasting 144 vs 190 min).

Concurrent mental state of hallucinatory moments

We used a meta-analytic strategy to assess the significance of the proportion of significant tests for each of the ESF modules (assessment of concurrent mood, cognitions, social context and activity). Assessments were made for the hallucinating schizophrenic subjects.

Visual hallucinations

The number of significant tests comparing hallucinatory and non-hallucinatory moments for modules that assessed cognitions, moods, activity appreciation or characteristics of the social interactions did not exceed chance levels for VHs. However, understandably, the psychopathology module did (four out of seven tests were significant at $\alpha = 0.10$ level; $z = 1.87$; $p < 0.03$). The subjects rated themselves more obsessive ($F(1,10) = 4.08$; $p < 0.07$), more "de-realised" ($F(1,10) = 10.58$; $p < 0.09$), had more "fear of losing control" ($F(1,14) = 7.48$; $p < 0.02$) and were "hearing voices" more often ($F(1,14) = 5.42$; $p < 0.04$).

Auditory hallucinations

The same pattern was found for AHs. Some individual tests were significant but the modules never passed the meta-analytic test criterion. Although subjects experienced more "thought control" ($F(1,26) = 7.71$; $p < 0.01$), and "visual hallucinations" ($F(1,14) = 7.19$; $p < 0.02$) during AHs, a total of two significant tests out of a possible seven is insufficient to interpret individual tests in the pathology module ($z = 0.90$; n. s).

Dynamic analysis of hallucinations over time

In the final set of analyses, the dynamic process of hallucination episodes in daily life was examined. What is the context of a hallucinatory moment and how do patients respond emotionally before, during and after a hallucinatory experience? We assessed the intensity of AHs and VHs at specific moments in time using multilevel random regression techniques on the data pertaining to patients with schizophrenia who showed variability in their reports of hallucinations.

Pattern of hallucination intensity

Overall, the intensity of VHs ($\bar{x} = 3.37$) was lower than AHs ($\bar{x} = 4.21$). Over the course of the episode, the intensity of AHs increased to a peak and dropped at the end. In contrast, the intensity of modelled VHs was unaffected by the episode's phase. Both models were used as baseline models. The presented elaborations of these baseline models yield significantly better predictions of the empirical data.

Concurrent emotions

The baseline models were extended by adding different concurrent emotions – such as "anxiety", "cheerfulness", "loneliness", "satisfaction" and "de-motivation". The fit improved significantly for both AH and (more pronounced) for VHs (Table 3).

Overall, compared to other mental states, anxiety was the strongest predictor of hallucination intensity. The effect was marginal for AH irrespective of phase ($\Delta\chi^2(1) = 14.28$, $p < 0.001$) but increased significantly when interaction terms for the different phases of the AH episode were included ($\Delta\chi^2(5) = 48.00$, $p < 0.001$). Interestingly, anxiety levels were already elevated at the last non-hallucination report, before the first report of an AH (Fig. 1).

The effect was even more dramatic for VHs. The prediction of hallucination intensity improved by including anxiety levels and their interaction with the phases in the equation ($\Delta\chi^2(5) = 158.34$, $p < 0.001$). Anxiety levels co-varied with hallucinatory intensity, primarily for the first and last beep of the episode. In contrast to AH, no anticipatory anxiety was found for VH (Fig. 1).

Concurrent context

In the next set of analyses the influence of contextual factors – "being alone", "doing nothing" and "being involved in work or leisure" – on the intensity of hallucinatory experiences in daily life was assessed.

Social context. The concurrent social context did not result in differences in the intensity of hallucinatory experiences (AH: $\chi^2(1) = 3.53$, $p < 0.07$; VH: $\chi^2(1) = 0.53$, n. s). Specific interaction terms between social context and phases of the hallucinatory episodes improved the estimation of the original data for AH ($\chi^2(5) = 20.70$, $p < 0.001$) but not for VH ($\chi^2(5) = 7.55$, n. s) (Fig. 2). The absolute effect was marginal for AH. Hallucinatory intensity was higher at the beginning of an episode when a subject was alone and dropped at the last hallucination report of an episode that was spent alone. When subjects remained in a social situation, the hallucinatory intensity tended to remain the same.

Activities. Doing nothing, working or being involved

Table 3 Multilevel random regression results for hallucinatory episodes (χ^2-tests)

	Model	Auditory hallucinations χ^2	Auditory hallucinations $\Delta\chi^2$	Visual hallucinations χ^2	Visual hallucinations $\Delta\chi^2$
Baseline model					
Intercept (fixed)	1F	11808.43	–	3938.55	–
Intercept (random)	1R	8098.10	3710.33[d]	3392.02	546.53[d]
+ Hallucinatory event	1R 1F	5190.97	2907.13[d]	1883.88	1508.14[d]
+ Periods (before, first in, in, last in, after) (reference model)	1R 5F	5165.38	25.59[d]	1882.99	0.89 n. s.
Mood (including interactions)					
Anxiety	1R 11F	5103.10	62.28[d]	1724.65	158.34[d]
Cheerful	1R 11F	5123.63	41.75[d]	1783.43	99.56[d]
Lonely	1R 11F	5135.31	30.07[d]	1848.69	34.30[d]
Satisfied	1R 11F	–	–	1871.84	11.15[a]
Demotivation	1R 11F	5145.10	20.28[c]	1861.25	21.74[d]
Context (including interactions)					
Activities (nothing/work/leisure)	1R 17F	5032.14	133.24[d]	1769.33	113.66[d]
Persons (alone/not alone)	1R 11F	5144.68	20.70[c]	1875.44	7.55 n. s.
	(subjects: 78; beeps: 3232)			(subjects: 38; beeps: 1654)	

[a] $p < 0.10$; [b] $p < 0.05$; [c] $p < 0.01$; [d] $p < 0.001$

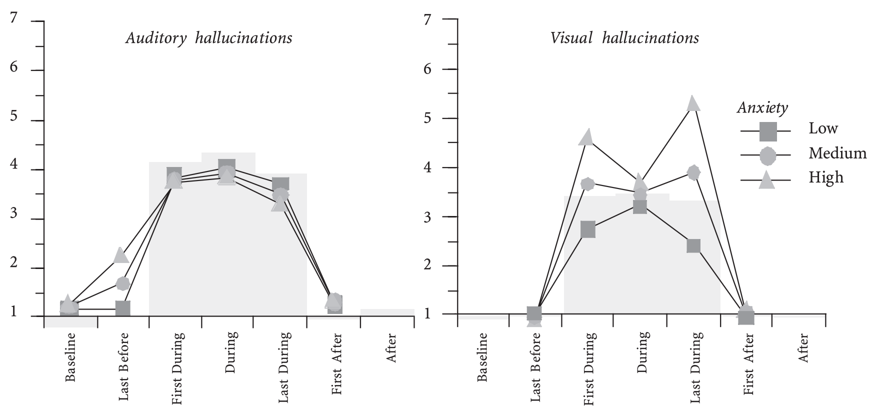

Fig. 1 Auditory and visual hallucinations modelled over the course of an episode: prediction of hallucination intensity by anxiety levels.

in leisure activities had no relation to the intensity of AHs (χ^2 (2) = 3.74, n. s) but a marginal effect was found for VHs (χ^2 (2) = 6.24, $p < 0.05$). When we controlled for activities in different phases of the hallucination episode the estimation of the models improved significantly (AH: χ^2 (4) = 90.25, $p < 0.001$; VH: χ^2 (4) = 81.35, $p < 0.001$). Subjects who were not engaged in an activity (AH: $\Delta = +0.31$; VH: $\Delta = +0.29$) hallucinated more intensively. This was, to a lesser extent, also the case during leisure moments including watching TV (AH: $\Delta = +0.18$; VH: $\Delta = +0.08$). In contrast, work reduced the hallucination intensity (AH: $\Delta = -0.49$; VH: $\Delta = -0.37$). In all situations, the effects were smaller for VHs compared to AHs but, of course, the overall intensity of VHs was also lower. The final models were highly significant (AH: χ^2 (8) = 42.83, $p < 0.001$; VH: χ^2 (8) = 32.32, $p < 0.001$) (Fig. 3). Once again the fit of the model for AHs was higher than for VHs. When subjects did nothing, the intensity of hallucinations dropped slightly over the phases of the episode. Under leisure activity conditions – 70 % of which is watching TV and less than 1 % active sports – the overall intensity of hallucinations was similar to the "doing nothing" condition. However, in contrast to idling, the intensity of hallucinations worsened over the phases of the episode. Finally, while working, the hallucinatory intensity decreased. As for anxiety, the first and last reports of the hallucination episode were most reactive.

Discussion

Methodological issues

Hallucinations were assessed by self-reports. No external concurrent check can validate these moment-to-moment reports. However, subjects who reported hallucinations were also assessed as hallucinators by trained clinicians using the BPRS.

Episode duration and phase definitions were coded by making assumptions about the continuity of the codings over time. In the ESM time sampling procedure, events are not monitored continually. Due to the random sampling, the assessment of frequency (and time budgets) gives good estimates. However, episode duration may be underestimated because the episodes were

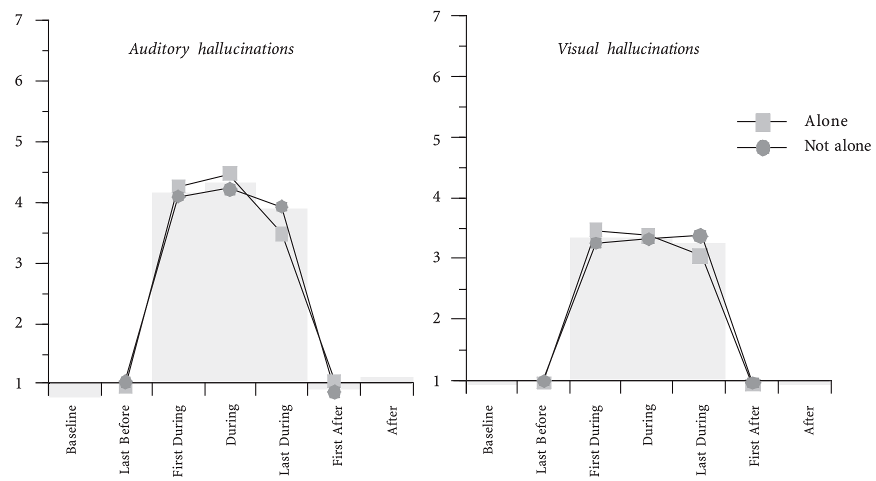

Fig. 2 Auditory and visual hallucinations modelled over time: prediction of hallucination intensity by social context.

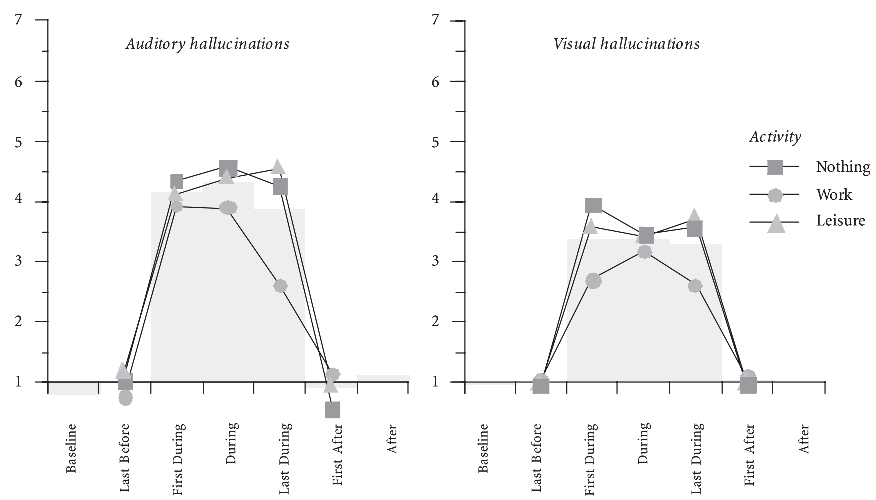

Fig. 3 Auditory and visual hallucinations modelled over time: prediction of hallucination intensity by activities.

assumed to start at the first symptom level report of a day or after a missed beep. In contrast, intervals between consecutive symptom level reports last from 15 min to 3 h. Symptom-free moment can occur resulting in overestimations. The same discussion applies to the definition of episode phases. However, results on differential prediction of hallucinatory intensity over the episodes gives credibility to the definitions.

Interpretation of findings

Hallucinations in daily life were most often observed in severely ill chronic patients with schizophrenia and in a lower frequency in the chronically depressed subjects. The latter group of patients were also less ill. Compared to AH, more subjects reported at least one occurrence of VH during the sampling week. This finding was unexpected and may be related to the formulation of the VH item, facilitating perhaps reports of illusions. However, validity of the question on VHs comes from clinical assessments using the BPRS. Moreover, VHs were most disturbing (high anxiety) giving credibility to the pathognostic value of our definition. Finally, the predominance of subjects with auditory hallucinations is rather exceptional in other conditions. Normal people, but also persons addicted to drugs, have more VHs. Our data, if replicated, could indicate that the predominance of auditory hallucinations in subjects suffering from schizophrenia is a methodological artefact and no assessment of real experience. It might be caused by a content-based tradition in psychiatry that is more relevant in schizophrenia than in compound induced hallucinations.

Fluctuations in mood co-varied with hallucinatory severity – more for VHs than for AHs. The most prominent emotion was "anxiety". Overall, the prediction of hallucinatory episodes using antecedent conditions was poor. There was one exception: the antecedent "anxiety" level was increased above baseline (for AHs). Possibly, AHs act as a response to reduce the cognitive dissonance created by increased anxiety levels.

Context influences the course of a hallucinatory episode. Social withdrawal decreased hallucinatory intensity (AH > VH). Engaging in work activities (AH > VH) and, to a lesser extent, doing nothing (VH > AH) led to decreases in hallucinatory intensity over time. In contrast, passive leisure activities increased intensity of hallucinations (AH > VH). Unfortunately, due to low frequencies of active leisure reports, we could not assess the differential effects of activation in leisure. As discussed previously, we found no contextual triggers for hallucinations. The occurrence of AHs and VHs cannot be controlled by environmental selection. However, engaging in different situations during a hallucination episode can alter the overall burden. Our data indicate that – in daily life – both maximal engagement (work) and maximal disengagement (being alone and doing nothing) are coping situations for hallucinatory intensity. Being in the company of other persons or engaging in passive leisure activities were not. This conclusion might be of only marginal clinical relevance since persons who use disengagement as a coping strategy do not learn to habituate to hallucinations.

Attempt at integration: the Slade and Bentall model

Slade and Bentall (Slade 1976; Slade and Bentall 1988) have presented a model for AHs. Their central argument was that (1) stressful events lead to (2) a disturbed mood (internal arousal) that is evaluated against a predisposition resulting – or not – in sufficient power to raise the hallucinatory tendency above a critical threshold. In this study, we did not assess the effect of stressful events in the antecedents of hallucinatory experiences. We did, however, assess the antecedent and concurrent emotions of hallucinatory experiences and found that raised anxiety (internal arousal) was found in the antecedence of a hallucinatory report. As a general indication, the internal arousal hypothesis of the Slade and Bentall model was supported by our data.

Slade and Bentall argued that hallucinations gain access to consciousness when no external sources of stimulation exist or are detected by the individual. In our data, environmental cues did not trigger hallucinations. They did, however, influence duration and intensity. We found that "work" was the most powerful coping strategy. Slade and Bentall predicted this. We also found that "doing nothing" and "withdrawal" – but not "passive leisure activities" – decreased hallucination intensity over time. The model did not predict this. Our data point to a u-shaped relation between coping effect and the "focussed/unfocussed" or "concentrated/unconcentrated" activity dimension.

Another element from the Slade and Bentall model – (4) the "limited capacity channel" of consciousness – could not be assessed. However, we were able to assess the emotions after the hallucinatory experience. Therefore, we can assess the final step in the model – (5) reinforcement through mood state reduction. Our data indicate that anxiety is raised before the first reports of AH and returns to baseline after the hallucination episode. So, after hallucinations, anxiety levels are reduced. According to Slade and Bentall this mood state reduction is experienced as rewarding and increases the frequency of hallucinations. Alternatively, hallucinations may also act as an effective means of coping with negative emotional states.

Conclusion

ESM data may offer stimulating insights for intervention strategies that reduce the burden of psychotic symptoms in subjects suffering from schizophrenia. Both intra-psychic factors and dynamic contextual triggers should be monitored in parallel to appreciate the effect of coping in daily life.

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