British Journal of Psychiatry (1984), **144**, 508–512

Cognitive Vulnerability to Auditory Hallucination
Impaired Perception of Meaning

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Summary: Forty-four psychiatric patients were separated into four groups on the basis of presence/absence of hallucinations and reactive/process status. Reactive hallucinators were found to be singularly impaired in two aspects of cognitive processing: (1) tolerance of ambiguity; and (2) availability of alternative meanings. The perceptual errors produced by premature judgment and limited consideration of alternative meanings for misperceptions are discussed as factors predisposing to auditory hallucination.

While there is agreement that auditory and visual hallucinations are misrepresentations of words or images originating in thought which result in their being treated as having external reference (Horowitz, 1975), there is little consensus regarding their explanation. Theories suggested so far include proposals based upon psychoanalytic postulates (Arieti, 1955; Breuer and Freud, 1895; Cameron, 1963; Isakower, 1939), psychodynamic theories (Bender, 1970; Sherman and Beverly, 1924), hypotheses of the effects of deviant or ambiguous sensory input (Evarts, 1962; Feinberg, 1962; West, 1962) and theories involving heightened physiological arousal (Fish, 1961).

A different approach is suggested by Cromwell (1975) in his emphasis on the continuity between normal and abnormal behaviour. He proposes the concept of specific mechanisms, present in all of us and occasionally in some degree of disorder, that may subserve the more dramatic features of psychopathology. Pursuing this idea, our research efforts have been directed towards those cognitive attributes that would logically appear to increase the risk of auditory hallucination if they were functionally deficient.

Goldstone (1962) and Sarbin (1967) have already proposed one model for cognitive vulnerability to hallucination. Internal sensations interpreted in a non-preferred sensory mode may be misrepresented because the person is not accustomed to imagery in that mode: in such cases, the person is more likely to assume that the sensations originate at an outside source. Empirical support for this proposal has been reported by Heilbrun *et al* (1983), who found that auditory hallucinators displayed a reduced preference for auditory imagery compared with other psychiatric patients. Heilbrun (1980) also considered whether auditory hallucinations, which are most commonly experienced as misperceptions of lexical thought, would be more likely in those who were less familiar with the properties of their own thoughts. He found that auditory hallucinators were less capable than non-hallucinators of recognizing their own thoughts, recorded verbatim a week earlier.

Research has also sought specific cognitive deficits that may be relevant for some auditory hallucinators but not for others—deficits in the mechanisms of attention that assign meaning to ambiguous stimulation, and subsequently confirm or disconfirm that meaning. Excessive outward deployment of attention may create the risk of auditory hallucinations in some people; excessively inward-directed attention may do the same in others.

Several reviews of the literature on schizophrenia (DeWolfe, 1974; Silverman, 1964; Venables, 1964) have concluded that the premorbid status of the patient offers a reliable guide to how the attention is deployed. *Reactive* (i.e. good premorbid) and paranoid schizophrenics attend to the external environment to such an extent as to risk stimulus flooding, whereas *process* (poor premorbid) and non-paranoid schizophrenics drastically restrict their outward deployment of attention. An advantage of using premorbid status as an index of attention deployment is that the process-reactive distinction applies to all psychiatric patients, not just to schizophrenics (Klorman, Strauss and Kokes, 1977; Zigler and Levine, 1981). Thus Balogh *et al* (1979) have reported that problems with locating sounds in space are most prevalent among process patients. Going a step further, Heilbrun *et al* (1983) have found that auditory location is *particularly* impaired in process patients

with a history of auditory hallucinations: such patients presumably have problems in revising their perception that the auditory sensation in a hallucination has an external source.

The present study considers yet another set of cognitive variables that may influence the quality of perception and so contribute to hallucination in some patients. We may suppose that the initial phase of auditory hallucinations is characterized by a considerable degree of ambiguity in the meaning of a stimulus to the hallucinator. The ability of the percipient to reach a valid judgment on the meaning of the ambiguous stimulation obviously influences his liability to auditory hallucination. Tolerance of ambiguity, and the willingness or ability to defer the assignment of meaning in the case of unclear stimulation, would seem *prima facie* to be important to the judgment process: we would expect excessive quickness in reaching a conclusion to be associated with premature and erroneous perception.

Early assignment of meaning in the face of ambiguity would not necessarily increase liability to invalid perceptions, however, unless accompanied by subsequent failure to consider alternatives. Thus the present study considers also a second cognitive variable—the subject's ability to use alternative meanings in processing information.

Our survey of the literature revealed no direct empirical evidence of process-reactive differences in either tolerance of ambiguity or availability of alternative meanings. However, since both of these cognitive processes require inward deployment of attention, we hypothesized that the tendency of reactives to direct their attention outwards would be conducive to deficits in both; and if these deficits do contribute to auditory hallucinations, we would expect to find among reactive hallucinators a unique combination of intolerance of ambiguity and restricted ability to use alternative meanings.

Method

Subjects

The subjects in this study were in-patients at a short-term psychiatric unit at the Georgia Mental Health Institute, Atlanta, Georgia. We selected 22 patients (14 male, 8 female) who had been observed by hospital staff to have auditory hallucinations among their current symptoms, and 22 (10 male, 12 female) for whom no auditory hallucinations had either been observed or admitted by the patient. These 44 patients included 26 who met the DSM-III criteria for schizophrenia (21 of these had hallucinations, 5 did not); another 12 with affective disorders; and 6 diagnosed as personality/adjustment disorders.

The hallucinating and non-hallucinating groups were closely matched for length of education (means of 11.64 years and 12.14 years respectively), proportion representing first admission (4/22 and 6/22 respectively), and daily dosage of neuroleptic or antidepressant drugs.

Matching for age was less successful: the hallucinating patients were mostly younger (mean age 31.55 years) than the non-hallucinators (mean age 39.27 years). However, the correlations between age and the two dependent variables in the present study were small (r = .00, .23) and non-significant; and even the larger of these two coefficients for tolerance of ambiguity could not have introduced bias into the results, since reactive hallucinators were actually older (mean age 33.85 years) than their process counterparts (mean age 29.92 years), which would tend to nullify the expected outcome of lower tolerance scores for reactive hallucinators.

Cognitive tests

Tolerance of ambiguity

The tolerance of ambiguity task was based upon procedures initially described by Frederikson (1966). Fourteen polysyllabic words (e.g. commerce, graceful), selected from Frederiksen's list and spoken by a female experimenter, were recorded on tape along with masking noise created by two other voices reading different magazine passages. Each stimulus word was repeated nine times, at the same volume, before the next word appeared. The masking noise started at the same volume as the stimulus word on the word's first occurrence, but was then reduced by one decibel with each repetition of the same stimulus word, so that recognition of the word became progressively easier over the nine repetitions.

The nature of the task was described to the subjects beforehand, and they were told to guess the word as soon as they were 'reasonably sure' of it. They were also told that they could repeat that guess or change their minds after the next presentation of the word, but that they would receive no feedback regarding their accuracy. If a subject achieved three consecutive correct identifications prior to the final presentation of a given word, the tape was moved ahead to the next word, without explanation but with the warning 'New word'.

A tolerance-of-ambiguity score was obtained from the total number of word presentations on which the subject withheld a guess: higher scores therefore indicate greater tolerance of ambiguity. The possible range of scores was from 0 (a guess on each trial) to 126 (no guess on any trial): the actual range of scores obtained in this study was from 8 to 106.

The tolerance-of-ambiguity task has been found to be of heuristic value in a number of previous studies

using normal subjects (Heilbrun, 1972a, 1983 (in press)).

Alternative meanings

The Willner Unusual Meanings Vocabulary Test (Willner, 1965) was used to measure the subject's familiarity with unfamiliar meanings of words. This instrument includes 42 items, each offering a key-word and five alternatives from which the subject must choose one that represents an unusual meaning of the key-word (e.g. shoot—rifle, *sprout,* cap, duck, door). The task is self-paced, and the subject is encouraged to guess if in doubt. Scores may range from 0 to 42: the actual range of scores obtained in the present study was 5–40.

Willner (1965) has reported a split-half reliability for his test of 0.92, and correlations with the WAIS (dominant-meaning) vocabulary test between 0.64 and 0.72. However, schizophrenics matched with hospitalized controls on the WAIS vocabulary score were inferior to controls on the unusual-meanings task. Heilbrun (1972b), investigating differences in internal scanning behaviours among normals, found the predicted difference using the Willner instrument but no difference on a standard vocabulary test. *Post hoc* analysis of the Willner scores verified a significant correlation with a free-association task: subjects who scored low on alternative meanings tended also to give popular rather than remote associations. Both suggest limited scanning of information.

Process-reactive status

Process or reactive status was determined by the Ullmann-Giovannoni self-report scale (1964). Evidence for the validity of this scale has been reported by Johnson and Ries (1967), McCreary (1974), and Meichenbaum (1969). A median split of the distribution of Ullmann-Giovannoni scores for the whole sample was used to define reactive (>12) and process (<13) status in the present study.

Procedure

Subjects were seen individually in a private room by a female experimenter. The order of administration of the measures was (1) Ullmann-Giovannoni, (2) the Willner test, (3) the tolerance-of-ambiguity task.

Results

Tolerance of ambiguity

The Table (top row) presents the tolerance-of-ambiguity scores for the four groups—process/reactive×hallucinating/non-hallucinating. Two-factor factorial analysis of variance for unequal cell frequencies (Winer, 1962) revealed a significant main effect of premorbid status ($F = 5.82$; d.f. = 1,40; $P < 0.025$): reactive patients were less tolerant of ambiguity than process patients. Although the mean for the reactive hallucinating group was, as expected, lower than those of the remaining three groups, the interaction effect did not achieve significance ($F = 1.66$; d.f. = 1,40; $P > 0.10$).

Of course, quick accurate identification of the stimulus words would give a low score which could be misinterpreted as low tolerance of ambiguity. However, intolerance implies premature and inaccurate judgements: subjects' errors were therefore analyzed. The second row of Table I indicates the number of presentations for which a subject made an incorrect guess. Factorial ANOVA revealed a main effect of premorbid status: reactives made more errors than process patients ($F = 7.28$; d.f. = 1,40; $P < 0.025$), which is consistent with an interpretation of low tolerance of ambiguity. However, a significant interaction effect ($F = 5.89$; d.f. = 1,40; $P < 0.025$) confirmed that reactive hallucinators made more mistakes than any of the other groups ($P < 0.05$).

TABLE

Tolerance of ambiguity and recognition of unusual meanings in process and reactive auditory hallucinators and non-hallucinators. Figures represent mean test scores ±SD

	Hallucinators		Non-hallucinators	
	Process (n = 13)	Reactive (n = 9)	Process (n = 9)	Reactive (n = 13)
Tolerance of ambiguity				
Raw score[a]	63.80±29.23	31.71±19.20	61.00±21.51	51.25±24.02
Error score[b]	28.07±22.07	58.86±13.15	35.50±13.31	37.19±14.95
Unusual meanings[c]	13.40± 7.26	12.29± 7.39	18.83±10.47	24.31±10.65
Combined score	2408.13±565.95	1803.71±452.77	2595.17±340.44	2638.56±292.30

[a] Raw score = number of trials upon which subject withheld a guess as to word: high score = >high tolerance of ambiguity.
[b] Error score = number of trials upon which subject identified a word incorrectly.
[c] High score = >familiarity with unusual meanings of words (Willner, 1965).

https://doi.org/10.1192/bjp.144.5.508 Published online by Cambridge University Press

Interestingly enough, all groups eventually reached the criterion of 'three consecutive correct guesses' on about the same number of the 14 words (mean for reactive hallucinators 5.86; process hallucinators 6.07; reactive non-hallucinators 6.25; process non-hallucinators 6.67).

Alternative meanings

Mean scores on the Willner measure are reported in the third row of Table I. Factorial ANOVA revealed one significant effect: a main effect of hallucinatory status ($F = 7.79$; d.f. = 1,40; $P < 0.01$) indicated that hallucinators (process or reactive) were less familiar with the unusual meanings of words than non-hallucinators.

Combining the scores

To check for the expected combination of low tolerance of ambiguity and low availability of alternative meanings in reactive hallucinators, scores on both measures were standardized to a mean of 50 and SD of 10, and then the two standard scores for each subject were multiplied together. Row 4 of Table I contains the four mean values thus obtained.

Factorial ANOVA of these means revealed a main effect for hallucinatory status ($F = 11.46$; d.f. = 1,40; $P < 0.005$): hallucinators presented lower combined scores than non-hallucinators. However, there was an interaction effect ($F = 4.61$, d.f. = 1,40; $P < 0.05$) resulting from the difference between the reactive hallucinators and the remaining three groups. Comparisons with each of the other groups confirmed that the reactive hallucinating group had the lowest combined score (compared with process hallucinators, $t_{20} = 2.90$, $P < 0.01$; with reactive non-hallucinators, $t_{20} = 4.04$, $P < 0.01$; with process non-hallucinators, $t_{16} = 3.12$, $P < 0.01$).

In case our method of obtaining a combined score should seem excessively arbitrary, we should point out that the same sort of pattern emerged when the scores for 'tolerance of ambiguity' and 'unusual meanings' were added rather than multiplied. It is also interesting to note that reactive hallucinators obtained low scores on both variables despite an overall *negative* correlation ($r = -0.25$) between the variables.

Discussion

The results of this investigation, like those of earlier studies, are consistent with the hypothesis that particular cognitive attributes, probably acting in concert, place the individual at risk for auditory hallucinations. In the present study, reactive hallucinators displayed singular cognitive impairment in their ability to delay assignment of meaning to ambiguous stimuli and in availability of alternative meanings. This combination would be expected to reduce the quality of their perception by introducing errors of premature judgment, without the safeguard of subsequently considered alternatives.

A possible criticism of the method employed in the present study is that by using general psychiatric inpatients as the basis for sampling we have confounded diagnosis with symptom, thereby creating problems of inference; specifically, the presence of auditory hallucinations is almost exclusively associated with a diagnosis of schizophrenia, whereas the absence of this symptom is primarily associated with diagnoses other than schizophrenia. This criticism is valid only if the effects we found to be related to auditory hallucinations could more parsimoniously be understood as being associated with schizophrenia in general.

The only result in the present study that would be vulnerable to such a criticism is the statistical main effect for alternative meanings: hallucinators (21 out of 22 were schizophrenic) presented lower scores than non-hallucinators (only 5 schizophrenics in a group of 22). As for our other findings, the main effect of premorbid status on ambiguity tolerance was obtained with a roughly even distribution of schizophrenics and non-schizophrenics in the process and reactive groups. The singular effects found for errors of recognition and for the combined score among the reactive hallucinators, who were all schizophrenics, involved direct comparison with process hallucinators, all but one of whom were schizophrenics.

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(Received 2 June; revised 17 August 1983)