Does the Phenomenology of Auditory Hallucinations Differ Across Patients Having Severe Mental Illness With and Without Hearing Impairment?

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We compared the experience of auditory hallucinations, in persons who have normal (HN; N = 20), or impaired hearing (HI; N = 20), while experiencing psychoses. We assessed this experience across 42 domains and observed that irrespective of the hearing status, patients most often heard voices mainly in the language that they had learnt first ($\chi^2 = 5.584; P = .018$). However, a few experienced hallucinations in languages they “did not know” (3/20; 15%). The voices were most often attributed to both males and females (35/40; 87.5%). Those with hearing impairment heard voices closer to their ears, a hubbub of voices of crowds talking to them, and “as if” stuck or repetitive; often in the hearing-impaired ear. The hearing-impaired subjects also reported hearing nonverbal auditory hallucinations more frequently ($\chi^2 = 17.625; P = .001$), and the voices lacked emotional salience ($\chi^2 = 4.055; P = .044$). In contrast, the hallucinations were experienced in elaborate detail by the HN (20/20), while those with HI often heard only simple sentences (14/20, $P = .005$). The intensity of the hallucinatory voices remained the same on closing the affected ear or both of the ears in the HI group as compared to the HN group. Interestingly, the use of hearing aids attenuated the intensity of the hallucinations (6/7; 85%) in those with HI.

Key words: auditory hallucinations/severe mental illness/hearing impairment/phenomenology/hearing normal

Introduction

Hallucinations are defined as false perceptions that are not in any way distortions of real perceptions but spring up on their own as something quite new and occur simultaneously with and alongside real perception.1

Auditory verbal hallucinations (AVHs) occur frequently in schizophrenia and other psychotic illnesses, and are associated with significant amounts of distress and functional disability.1 Though they are believed to be one of the core symptoms of psychosis, they can also be experienced in other disorders, as well as in normal populations.3 The incidence of schizophrenia in prelingually profoundly deaf patients is found to be similar as in the hearing population,3 with broadly comparable symptoms.4 The interface between hearing impairment, and the presence of psychotic symptoms and disease, thus raises some intriguing issues. This question has become even more relevant, as hearing impairment is a common disability and ~16% of these individuals experience auditory hallucinations.5 A systematic review and meta-analysis done on all epidemiological evidence based on the association between hearing impairment and psychosis has hypothesized that hearing impairment, as opposed to visual impairment, may increase the risk of “state” psychosis.6

Over the past few years, there has been considerable interest and effort in understanding the phenomenology of auditory hallucinations present in severe mental illnesses (SMI), especially schizophrenia. Studies understanding the phenomenology of auditory hallucinations in people having SMI and classifying them into themes or clusters are sparse.7–11 However, there are a few studies that compare and understand the phenomenological differences in auditory hallucinations experienced in the hearing impaired and hearing normal individuals. Studying these may help in the identification of certain fundamental mechanisms12 in how the brain handles “real” voices, “distracting and intrusive” hallucinations (which are experienced as real), as well as ambient sounds; as also the boundaries between cognitive and perceptual dysfunction. Hence, we attempt to compare the phenomenology of auditory hallucinations in patients experiencing a psychotic episode, with and without hearing impairment.

Methods

Participants

Patients diagnosed to have schizophrenia/schizoaffective disorder/bipolar disorder (either mania or depression)
with psychotic symptoms and currently experiencing auditory hallucinations were invited to participate in the study, and were evaluated. Those who were likely to have any neurological or general medical illness that can present with auditory hallucinations were assessed clinically and excluded from the study. Those with substance dependence in the last 6 months (except nicotine) and intellectual developmental disorder (IDD) were also excluded. The patients were thus of either gender with SMI with normal hearing (HN) (N = 20) (group A); or with hearing impairment (HI) (N = 20) (group B). This was a case–control, cross-sectional, comparative study, and was approved by the Institute Ethics Committee, and all participants underwent systematic evaluation. Those with normal hearing were also clinically examined with a basic screening test, and a tuning fork test; while those with hearing impairment were evaluated using pure tone audiometry procedures. Sociodemographic details were collated and relevant symptom assessments were performed. In depth one-to-one interviews were conducted with each sample using these instruments:

1. MHRI Unusual Perception Schedule\textsuperscript{13}. The Mental Health Research Institute Unusual Perceptions Schedule (MUPS) is a descriptive, hypothesis-generating instrument developed to record subjects’ experiences of auditory hallucinations as thoroughly as possible. The schedule comprises a semistructured interview, which lasts about 2 h, and contains approximately 365 questions clustered in 42 variables (could not mention the variables due to copyright issues) documenting the physical characteristics of auditory hallucinations such as their onset and course, number, volume, tone, location, as well as other phenomena associated with them such as delusions. In addition, other aspects of hallucinations, such as coping strategies, contributing factors and subjects’ personal views and reactions were also explored.

2. Psychotic Symptom Rating Scale (PSYRATS) (11 items, total score 44)\textsuperscript{14}

3. Auditory Hallucination Rating Scale (AHRS) (8 items, total score 36)\textsuperscript{15}

4. Scale for the Assessment of Positive Symptoms (SAPS) (4 items, total score 30)\textsuperscript{16}

5. Young Mania Rating Scale (YMRS) (11 items, total score 60)\textsuperscript{17}

6. Hamilton Depression Rating Scale (HDRS) (21 items, total score 67)\textsuperscript{18}

7. Audiological assessment: Pure tone audiometry was done for the hearing-impaired group. The threshold assessment for octave frequencies was between 250 and 8000 Hz for air conduction and between 250 and 4000 Hz for bone conduction. The testing was done using calibrated audiometer (Maico Audiometer MA-53) in a sound-treated room using standard test procedures.

\textit{Statistical Analysis}. After streamlining of data, quantitative inferential statistics (chi-square test) were performed to compare rates of specific phenomena between HN and HI individuals using SPSS version 21 IBM (IBM SPSS Statistics for Windows, Version 21.0). Independent samples \textit{t} tests or analysis of variance were employed to compare continuous sociodemographic data. The variables which received adequate responses are reported in the findings; and the rest were excluded from the analysis.

\textbf{Results}

\textbf{Sociodemographic and Clinical Data}

Mean age of those with normal hearing (HN) was 31.5 ± 8.7 years, and in those with impaired hearing (HI) was 44.8 ± 12.7 years. The male:female ratio in groups 1 and 2 was 12:8 and 7:13, respectively. The hearing-impaired group were older, and had more females (\textit{table 1}). Seventy-five percent in HN group (group 1) and 85% in HI group (group 2) were diagnosed with schizophrenia (\textit{table 1}). Rest of the diagnosis was bipolar disorder (5% in HN and 0% in HI), persistent delusional disorder (PDD) (0% in HN and 5% in HI), and others (20% in HN and 10% in HI). Age of onset of illness was 26.3 ± 11.3 years and 38.6 ± 15.3 in HN and HI groups, respectively. Duration of illness was 5.3 ± 6.3 years and 6.4 ± 9.1 in HN and HI groups, respectively (\textit{table 1}). In HI group, 75% (15/20) had bilateral symmetrical sensorineural hearing impairment (SNHL); and 25% had bilateral asymmetrical SNHL. The two groups did not differ on most of the measurement scales. The details are provided in \textit{table 2}.

\textbf{Phenomenology of Auditory Hallucinations in Hearing Normal}. All the 20 patients with normal hearing were right-handed, and their hallucinations are described below.

\textit{Degree of Volume}

Thirteen patients (13/20, 65\%) reported that the degree of the volume of auditory hallucinations was neither loud nor soft. Only one patient (1/20, 5\%) reported the voices as soft, and the rest reported varied responses.

\textit{Number of the Voices}

Twelve patients (12/20, 60\%) reported that they heard more than two voices, however, several (4/20, 20\%) reported hearing only a crowd, and four patients (4/20, 20\%) reported hearing a single voice (talking about the patient).

\textit{Type and Gender of Voices}

Sixteen patients (16/20, 80\%) reported that the voices were adult voices, whereas four patients (3/20, 20\%)}
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Fifteen patients (15/20, 75%) (7 females) reported that the voices were of either gender, but predominantly males; whereas four patients (4/20, 20%) (1 female reported the voices to be exclusively male voices). Only one patient (a male) heard only female voices.

**Anonymity of the Voices**

Nine patients (9/20, 45%) reported that the voices were identifiable, six patients (6/20, 30%) reported that they were anonymous, and five patients (5/20, 25%) reported both. Out of nine patients who reported the voices to be identifiable, three patients (3/8, 37%) reported that the voices were of significant others.

**Repetitiveness**

Six patients (6/20, 30%) reported that the voices were often repetitive, another six patients (6/20, 30%) informed that the voices were sometimes repetitive; whereas rest said the voices were rarely or never repetitive.

### Table 1. Sociodemographic Data & Clinical Data

| Variables                        | Group 1 (Hearing Normal) (N = 20) Mean ± SD (Range) /Frequency (%) | Group 2 (Hearing Impaired) (N = 20) Mean ± SD (Range) /Frequency (%) | Pearson Chi-Square Value or Fisher’s Exact Test Value | df | P Value |
|----------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------|----|---------|
| Age (in years)                   | 31.5 ± 8.7                                                          | 44.8 ± 12.7                                                         | −3.826                                               | 38 | .073    |
| Gender                           | Male 12 (60%) Female 8 (40%)                                        | Male 7 (35%) Female 13 (65%)                                       | 2.506                                               | 1  | .113    |
| Socioeconomic Status             | Upper 4 (20%) Middle 14 (70%)                                       | Upper 0 (0%) Middle 13 (65%)                                       | 6.815                                               | 2  | .033    |
| Status                           | Lower 2 (10%)                                                       | Lower 7 (35%)                                                       |                                                      |    |         |
| Total number of years of education | 14 ± 2.4                                                           | 9.6 ± 3.18                                                          | 4.897                                               | 38 | .055    |
| Occupation                       | Professional 5 (25%) Skilled 0 (0%) Unskilled 4 (20%) Unemployed 11 (55%) | Professional 2 (10%) Skilled 7 (35%) Unskilled 5 (25%) Unemployed 6 (30%) | 9.867                                               | 3  | .020    |
| Marital status                   | Single 11 (55%) Married 6 (30%) Separated 2 (10%) Divorced 1 (5%) Widowed 0 (0%) | Single 4 (20%) Married 15 (75%) Separated 1 (5%) Divorced 0 (0%) Widowed 0 (0%) | 8.457                                               | 3  | .037    |
| Diagnosis                        | Schizophrenia 15 (75%) Bipolar Disorder 1 (5%) PDD* 0 (0%) Others** 4 (20%) | Schizophrenia 17 (85%) Bipolar Disorder 1 (5%) PDD* 1 (5%) Others** 2 (10%) | 4.667                                               | 4  | .323    |
| Age of onset of illness (in years) | 26.3 ± 11.3                                                        | 38.6 ± 15.3                                                         | −2.875                                               | 38 | <0.05   |
| Duration of illness (in years)   | 5.3 ± 6.3                                                           | 6.4 ± 9.1                                                           | −4.54                                               | 38 | .652    |
| AHRS scores                      | 34 ± 5.8                                                            | 31.9 ± 8.1                                                          | −3.940                                               | 38 | .353    |
| PSYRATS scores                   | 46.5 ± 9.5                                                         | 42.3 ± 10.8                                                         | 1.314                                               | 38 | .197    |
| SAPS scores                      | 29.7 ± 10.7                                                        | 27.4 ± 14.9                                                         | −0.572                                               | 38 | .570    |
| HAM D scores                     | 7.5 ± 8.4                                                           | 2.1 ± 3.4                                                           | 2.61                                                | 38 | .045    |
| YMRS scores                      | 0.85 ± 3.8                                                          | 0.10 ± 0.44                                                         | .876                                                | 38 | .386    |

*PDD = persistent delusion disorder; ** others = Schizoaffective disorder, Schizo-obsessive disorder, psychosis NOS.

reported that the voices belonged to both adults and children.

Fifteen patients (15/20, 75%) (7 females) reported that the voices were of either gender, but predominantly males; whereas four patients (4/20, 20%) (1 female reported the voices to be exclusively male voices). Only one patient (a male) heard only female voices.

**Nonverbal Auditory Hallucinations**

Seven patients (7/20, 35%) reported hearing nonverbal hallucinations, and three patients (3/7, 42%) reported hearing birds speaking to them, or them understanding the language of birds. They reported “I hear voice of pigeons calling me to come down,” another reported that “I used to hear voices of birds talking to me saying sambhu acha hai” (sambhu is good; sambhu iz gʊd/). One reported hearing birds voice in her native language saying “hum mahadev hain, humari beti sabse achi hai” (I am Mahadev..my daughter is the best; /aɪ ˈæm (Mahadev)/.. /maɪ ‘dɔːtər iz ðə best/). One person also reported that she used to talk to the birds and once, when she asked them whether they like rains or not, the birds told they like it. Another one reported that a crow asked the patient to come down on the ground floor.

**Relationship to the Voices**

Five patients (5/20, 25%) reported that they have developed some relationship with the voices; eg, “I have developed a student-teacher relationship,” “I have developed good relations with Basanti,” “Yes, they are my children”; but most
(14 patients (14/20, 70%) reported no relationship at all. Interestingly, a few (three patients (3/20, 15%)) reported that they would miss the voices if they were to ever stop.

**Language**

Only three patients (3/20, 15%) used only one language, and they heard voices in the same language. Most (17/20) were familiar with two or more languages. Almost half the subjects (9/20, 45%) heard voices only in their “first” language, whereas five patients (5/20, 25%) heard voices in all the languages that they were familiar with, but mainly in the first learnt language. Three patients (3/20, 15%) knew multiple languages, and heard voices in other languages or non-native language more often as compared to the first learnt language. Surprisingly, three patients (3/20, 15%) reported hearing voices in languages they did not know at all.

The hallucinations were experienced in elaborate detail by all 20 patients (20/20).

**Distance of the Voices**

Eight patients (8/20, 40%) reported that voices were heard as if from meters away, and six patients (6/20, 30%) reported that voices were coming from far-off. One patient reported “I can hear voices coming from my family in the USA.”

**Coping Mechanism**

Five patients (5/20, 25%) reported coping by distraction including listening to music, songs, relaxation, and talking to other people, or sometimes stuffing a pillow over their ears.

**Phenomenology of Auditory Hallucinations in Hearing Impaired.** In the 20 subjects with impaired hearing, the disability had occurred before the onset of psychoses, and subjects had experienced normal hearing in early life (table 1). All the subjects were right-handed. For hearing assessment, pure tone audiometry was performed and all patients were diagnosed to have bilateral sensory-neural hearing loss (SNHL) [air conduction (AC) threshold > 25 Db, bone conduction (BC) threshold > 25 Db, A–B gap < 10 Db, AC and BC threshold below normal and similar, no air-borne gap (ABG)]. Fifteen patients (15/20, 75%) were found to have bilateral symmetric SNHL and five patients (5/20, 25%) were found to have bilateral asymmetric SNHL (table 2).

**Degree of Volume.** Six patients (6/20, 30%) reported the voices to be loud and 1 patient (1/20, 5 %) reported hearing voices as soft.

**Number of Voices**

Four patients (4/20, 20%) reported that they heard more than two voices, however, a large proportion (10/20, 50%) reported hearing a crowd. Two patients (2/20, 10%) reported hearing a single voice, and four patients (4/20, 20%) reported hearing only elementary voices.

**Gender and Type**

Fourteen (14/20, 70%) patients reported hearing only adult voices, out of which six (6/14, 42%) patients (three were males and three were females) reported hearing only male voices and rest (58%) could hear both male and female voices. None reported hearing female voices.

**Anonymity of the Voices**

Five patients (5/20, 25%) reported that the voices were identifiable. Five patients (5/20, 25%) reported that
they were anonymous and three patients (3/20, ie, 15%) reported both.

Repetitiveness. Ten patients (10/20, 50%) reported that the words or phrases appear “stuck”; out of which eight reported it as (5/8) very repetitive, while one patient reported it to be rarely repetitive, and the rest could not comment.

Verbal and Nonverbal Auditory Hallucinations

Ten patients (10/20, 50%) reported that they hear voices from a crowd of people.

Out of 20 patients, a substantial majority (14/20, 70%) reported that they experienced nonverbal auditory hallucinations. They reported “I hear buzzing sound constantly (/əɪ hɪrˈbaɪzŋ sɔːnd ‘kærntəntlɪ/)”, “I hear music in my ears (/əɪ hɪrˈmjuzɪk in maɪ ɪərɪ/)”, “I hear temples bell (/əɪ hɪrˈtɛmpəlz bel/)”, “I hear sounds of goats (/əɪ hɪr sɔːndz əv goʊts/)”, “I hear sounds of airplane gushing into the ear which was initially far, now, right into my ears (/əɪ hɪr sɔːndz əv ərˌplɛm ‘ɡɑːrɪŋ ˈɪntuː ˈdiː iz hwɪf wɔz ˈɪntʃəl fər nɑːs ræt ˈɪntuː maɪ ɪərɪ/)”. A few (5/20, 25%) denied hearing nonverbal auditory hallucinations and one person could not comment.

Relation and Whether Would Miss Them. Out of 13 responses, no one reported developing any sort of relationship with the voices, and the only one said they would miss the experience, if it were to stop.

Language

Ten patients (10/20, 50%) used/knew only one language, and heard voices in the same language, whereas two (2/20, 10%) used/knew multiple languages, but heard voices only in the first language. Three patients (3/20, 15%) used/knew multiple languages and heard voices in all the languages that they were familiar with, but mainly in the first learnt language, whereas two patients (2/20, 10%) used/knew multiple languages and heard voices in the other languages or nonnative language more often as compared to the first learnt language. In terms of complexity, those with HI often heard voices speak only in simple sentences, like, “I will come,” “She is angry,” “You are bad,” “You walk” (14/20, P < .005).

Distance of the Voices

Two patients (2/20, 10%) reported hearing voices few meters away; five patients (5/20, 25%) reported voices coming from far; six (6/20, 30%) patients reported voices coming very close to their ears; two patients (2/20, 10%) reported varying distances; and five patients (5/20, 25%) could not identify the distance.

Hearing Aids

Out of 20 patients, seven patients (7/20, 35%) reported using hearing aids out of which six patients (6/7, 85%) reported that the intensity of the hallucinations have decreased after they have started using aids. One patient reported no change in the intensity of auditory hallucinations after a year of use.

Shared and Unique Findings Between the Two Groups

Shared Findings (table 3): Both the groups reported the voices to be coming from an objective space (outside) initially (P = .638); belonging to adult (P = .091); not preferring any gender (P = .207).

Unique Findings (table 4): The hearing impaired group reported the voices to be louder (P = .033); multitudinous (P = .011); buzzing in quality (P = .001); having less emotional salience to the voices (P = .044) and closer to the ears (P = .025).

Discussion

We describe the experience of hallucinations in subjects with mental illness, with or without hearing impairment.

Physical Aspects of AVH

Most of the patients in both the groups located these voices to located outside the head, initially. Over the course of the illness, more patients in HN group reported them to be “inside” the head. However, the patients in HI group continued to attribute them from outside. This perhaps reflects an inability to attribute the voices as inner speech in hearing-impaired population, or difficulty in developing insight in this group.

The voices in both the groups were more often those of adults rather than of children, and less often exclusively female. The voices did not show a preference for either gender, confirming what was also observed by the two other studies. The voices thus did have enough texture and characterization to be identified as gendered.

Patients in the HI group experienced the voices as being “unnaturally” loud. As more patients in HI group reported the degree of volume as loud, we attribute this to lack of proper auditory feedback. The HI group also reported voices often as if those of a multitude or a crowd and less distinguishable as individuals. Those in the HI group reported hearing them as if very close to their ears, sometimes far, and occasionally found it difficult in identifying the distance. In contrast, the HN group often located the voices at meters away, or far away, or at a varying distance (sometimes far and sometimes near). Thus, in those with normal hearing, voices had a dynamic spatial representation (like normal auditory experience), while in those with impaired hearing, this was relatively fixed.
It is believed that there is only one behavioral space and only one egocentric space. Egocentric term specifies the position of perceptions with respect to the human body. The spatial content of the perceptions interacts with the complex connections in the brain to derive the meaning of it. However, in psychosis, there is a severe “disconnect/schism.” The experience of auditory hallucinations may be accompanied by a violation in the organization of gestalt space, as it also has been found in a study looking for the missing-stimulus mismatch negativity (MMN) in psychosis. It was observed that MMN amplitude reductions were correlated with positive symptomatology, ie, auditory hallucinations. It is also proposed that there is a misinterpretation of noise in HI group, hence leading to difficulty in attributing a distance to it. As more patients in HI group reported hearing voices of a crowd talking to them, it is proposed that whether the voices as if of a crowd is a misinterpretation of (white) noise that they heard due to their compromised hearing state, or is actually the hallucination of “white” noise of crowds, that may have a specific neurobiological correlate.

The HI group reported hearing nonverbal auditory hallucinations consisting of a buzzing sound or having musical quality. Hence, more incidences of elementary hallucinations in this population confirm partially the findings of increased prevalence of musical hallucinations in previous studies.

### Quantitative Aspects of AVH

The voices also appeared more stuck and repetitive in those with HI hearing-impaired group. Whether this could be linked to the fact that the lack of real stimuli limits the normal variability (since hearing is reduced to a fraction of the bandwidth) and thus a reduced complexity. In contrast, the hallucinations were experienced in elaborate detail by the HN (20/20), while those with HI often heard only simple sentences (14/20, \( P = 0.05 \)). It can be explained due to the lack of internal speech processing due to lack of proper feedback in HI group.

### Linguistic and Biological Aspects of AVH

Both the groups reported hearing the voices in the language first learnt by the patient. Most of the patients themselves reported hearing voices in a language that was their native language, despite the fact that this quite often was not the language that was being spoken around them. Even when the person knew multiple languages, or multiple languages were being spoken in the environment, both groups reported hearing voices mainly in the language they had first learnt. Esquirol, in his classical definition, described hallucinations as “if a man has the intimate conviction of actually perceiving a sensation for which there is no external object, he is in a hallucinated state.” Whether hallucinations are a top-down cognitive

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### Table 3. Comparing Auditory Hallucination Phenomenology Between Hearing Impaired and Hearing Normal Individuals With Psychotic Illness—Shared Findings

| Variables                     | Location (initially) | Adult/child | Gender | Anonymous | Do the voices appear stuck | Replays of memories |
|-------------------------------|----------------------|-------------|--------|-----------|----------------------------|--------------------|
|                               | Group 1 (\( N = 20 \)) | Group 2 (\( N = 20 \)) |        |           |                            |                    |
|                               | \( n \) (% )         | \( n \) (% ) |        | \( n \) (% ) | \( n \) (% )                | \( n \) (% )        |
| Location (initially)          |                      |             |        |           |                            |                    |
| Inside                        | 2 (10)               | 1 (5)       |        |           |                            |                    |
| Outside                       | 16 (80)              | 17 (85)     |        |           |                            |                    |
| Both                          | 1 (5)                | 0 (0)       |        |           |                            |                    |
| Can’t identify                | 1 (5)                | 2 (10)      |        |           |                            |                    |
| One                           | 4 (20)               | 2 (10)      |        |           |                            |                    |
| More than two, nominate       | 12 (60)              | 4 (20)      |        |           |                            |                    |
| Uncountable                   | 4 (20)               | 10 (50)     |        |           |                            |                    |
| Adult                         | 16 (80)              | 14 (70)     |        |           |                            |                    |
| Both                          | 4 (20)               | 2 (10)      |        |           |                            |                    |
| Neither                       | 0 (0)                | 4 (20)      |        |           |                            |                    |
| Gender                        |                      |             |        |           |                            |                    |
| Female                        | 1 (5)                | 0 (0)       |        |           |                            |                    |
| Male                          | 4 (20)               | 7 (35)      |        |           |                            |                    |
| Difficult to identify         | 0 (0)                | 1 (5)       |        |           |                            |                    |
| Both                          | 15 (75)              | 8 (50)      |        |           |                            |                    |
| Anonymous                     |                      |             |        |           |                            |                    |
| No                            | 9 (45)               | 5 (25)      |        |           |                            |                    |
| Yes                           | 6 (30)               | 5 (25)      |        |           |                            |                    |
| Mixed                         | 5 (25)               | 3 (15)      |        |           |                            |                    |
| Do the voices appear stuck    |                      |             |        |           |                            |                    |
| Never                         | 5 (25)               | 0 (0)       |        |           |                            |                    |
| Rarely                        | 2 (10)               | 2 (10)      |        |           |                            |                    |
| Sometimes                     | 6 (30)               | 3 (15)      |        |           |                            |                    |
| Often                         | 6 (30)               | 8 (40)      |        |           |                            |                    |
| Varies                        | 1 (5)                | 0 (0)       |        |           |                            |                    |
| Replays of memories           |                      |             |        |           |                            |                    |
| No                            | 16 (80)              | 12 (60)     |        |           |                            |                    |
| Yes                           | 3 (15)               | 0 (0)       |        |           |                            |                    |

**Note:** Missing values are unsure or cannot tell responses. These responses have not been analyzed.
process akin to delusions, as suggested by Esquirol; or a sensory processing dysfunction has been debated for a long time. The ambiguity between the central and periphery raises an argument as to whether this phenomenon arises from cognitive or perceptual anomalies. The fact that most persons heard voices in their first (“private”) language, suggests that a cognitive basis is more likely rather than sensory misattribution. However, the fact that the bilingual subjects also heard voices in languages other than the first language, suggests that the “gestalt” experience of hallucinations is plastic enough to incorporate linguistic rules and lexicon of another language. The disorder is thus likely to be at a “higher” level, then sensory processing per se.

At a psychological level, those with normal hearing reported developing some sort of relationship between them and the voices, as compared to the HI group. The subjects with HI did not develop any relationship with the voices, nor did they report that they would “miss them,” as compared to those with normal hearing. None of this group reported the voices as replays of their memories, which suggests that this population have less emotional reactivity with respect to their auditory hallucinations. Due to lack of information clarity, the HI patients lack salience or emotionality because of which they are not able to develop a relationship with the voices.

Table 4. Comparing Auditory Hallucination Phenomenology Between Hearing Impaired and Hearing Normal Individuals with Psychotic Illness—Unique Findings

| Variables | Group 1 (n = 40) | Group 2 (n = 20) | Chi-Square | df | P |
|-----------|-----------------|-----------------|------------|----|---|
| **Degree of volume** | Whisper | 1 (5) | 0 (0) | 8.709 | 3 | .033 |
| | Soft | 1 (5) | 1 (5) | | | |
| | Normal | 13 (65) | 4 (20) | | | |
| | Loud | 1 (5) | 6 (30) | | | |
| **Location (later)** | Inside | 10 (50) | 2 (10) | 9.333 | 3 | .025 |
| | Outside | 8 (40) | 16 (80) | | | |
| | Both | 1 (5) | 0 (0) | | | |
| | Can’t identify | 1 (5) | 2 (10) | | | |
| **Number of voices** | Only elementary | 0 (0) | 4 (20) | 11.238 | 3 | .011 |
| | One | 4 (20) | 2 (10) | | | |
| | More than two, nominate | 12 (60) | 4 (20) | | | |
| | Uncountable | 4 (20) | 10 (50) | | | |
| **Nonverbal auditory hallucinations** | Buzzes/music | 0 (0) | 13 (65) | 17.625 | 3 | .001 |
| | Animals/birds | 3 (15) | 1 (5) | | | |
| | Others | 4 (20) | 0 (0) | | | |
| **Relation to the voices/ emotional salience with the voices** | Yes | 5 (25) | 0 (0) | 4.055 | 1 | .044 |
| **Language of the voices** | Patients used/ knew only one language & heard voices in the same language | 3 (15) | 10 (50) | 5.584 | – | .018 |
| | Patients used/ knew multiple languages & heard voices only in the first learnt language | 9 (45) | 2 (10) | 6.144 | – | .013 |
| | Patients used/knew multiple languages & heard voices in all the languages they were familiar with, but mainly in the first learnt language | 5 (25) | 3 (15) | 0.625 | – | .429 |
| | Patients used/knew multiple languages & heard voices in other languages more often as compared to the first learnt language | 3 (15) | 2 (10) | .229 | – | .633 |
| **Distance of the voices** | Meters away | 8 (40) | 2 (10) | 11.124 | 4 | .025 |
| | Far | 5 (25) | 5 (25) | | | |
| | Varies as both | 5 (25) | 2 (10) | | | |
| | Very close to ears | 1 (5) | 6 (30) | | | |
| | Can’t identify the distance | 1 (5) | 5 (25) | | | |
Patients with hearing impairment have been found to have a hypersensitive dopamine system\textsuperscript{31} and also, other deficits in cortical organization and function,\textsuperscript{32} that may have a significant effect on plasticity and cognitive function.\textsuperscript{33} Alterations in attribution to ambiguous stimuli, or even a mismatch between expectation and actual stimuli, which is normally mediated by dopamine-related mechanisms, may be responsible for hallucinatory experiences. Imaging techniques like fMRI can be employed to study psychosis with preexisting sensory deficits,\textsuperscript{34–36} to explore the pathoplastic and perhaps two-way interactions between these conditions.\textsuperscript{37} Studying the areas implicated in hearing deficits and hallucinations like inferior colliculus, Heschl’s gyrus etc. may also be useful\textsuperscript{38,41} because hallucinations in the hearing impaired could be a consequence of deafferentiation.\textsuperscript{42}

**Clinical Implications**

At the bedside and the community, poor detection, unmet needs, and poor service delivery for mentally ill within the deaf population suggest that there is a high need for adequate and specialized service delivery in this group.\textsuperscript{43} As it is often observed that the auditory hallucinations in hearing-impaired population are attenuated with the use of hearing aids over the period of time, hearing aids can be tried as a therapeutic intervention to attenuate verbal or nonverbal auditory hallucinations in this group. Also, the use of a masking or a white noise to improve perceptual clarity or shifting to and strengthening other sensory modes of communication, like sign language can be tried.

The multiplicity of languages, with different phonetics, grammar, lexicon, and gestural components in India makes it difficult to construct universal sign language. Those who have hearing impairment thus have multiple disadvantages, both of the impairment in hearing, as well as being unable to participate in a polyglot social space. Those who develop a mental illness, on the background of sensory impairments, thus need special assistance, both for accurate assessments, and planning interventions. These may not only improve the quality of life, but also prevent a decline in social functioning and cognitive abilities.\textsuperscript{33}

The need for adequate mental health care services (appropriate use of sign language training, psychometric tests) to provide a disability-friendly environment for these patients should also be encouraged.

**Limitation of the Study**

This was a clinic-based sampling of individuals accessing care, in a psychiatric facility. One would need to do the systematic screen of individuals with hearing deficits alone, and those who do have concomitant psychoses, as well as normal hearing (with and without psychoses); using a number of measures, from genetics to imaging, to understand these interactions in detail. We need to systematically assess, understand, intervene, and assist those with sensory impairments and psychosis at a larger level.

**Conclusion**

We suggest that in the hearing impaired, misinterpretation of auditory stimuli that happens due to the hearing deficits or the ambiguity in the stimulus leads to a lack of emotional salience. In addition, the restricted frequency range of auditory experience in the hearing impaired is not congruent with the wide range in the normal hearing group; and the hallucinations thus have a “stuck” or “repetitive” quality. How the brain locates events and sensations in space and time may be a fundamental defect, underlying the experience of psychoses. Understanding this from inside-out (phenomenology); as well as outside-in (using imaging, models etc.) may be essential for further insights into these complex phenomena. In any case, the use of sensory distraction techniques or other methods of multisensory communication in these patients may benefit subjects who have a hearing impairment and psychoses.

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