



Letter to the Editor

Multimodal hallucinations are associated with poor mental health and negatively impact auditory hallucinations in the general population: Results from an epidemiological study



Keywords:

Psychosis
Multi-modal hallucination
Visual hallucination
Tactile hallucination
Olfactory hallucination
Auditory hallucination

Dear editor,

Hallucinations are very common in psychotic disorders but can also be found in other psychopathologies and in a minority of the healthy general population (van Os et al., 2009). To date, the vast majority of studies have examined hallucinations in one modality, namely the auditory modality. In contrast, a few studies have reported that multimodal hallucinations are highly prevalent in some clinical populations. For example, 36% to 81% of schizophrenia patients experience hallucinations in more than one modality (Lim et al., 2016; Llorca et al., 2016; McCarthy-Jones et al., 2017) and up to 80% of patients with Parkinson's disease (Llorca et al., 2016). However, these studies did not examine important issues such as potential differences between having multimodal hallucinations compared to having unimodal hallucinations in terms of mental health and other variables. In addition, multimodal hallucinations in the general population have never been previously examined. The aim of the present study was to explore, in the general population, any potential differences between people who experience only AH and people who also experience hallucinations in other modalities in terms of mental health, negative impacts, and AH characteristics.

The data from the present study are issued from an epidemiological study exploring the prevalence of AH in the Norwegian general population (Kråkvik et al., 2015). The original sample constitutes 2461 individuals. For the present study, subgroups of the above sample were created based on their responses on an extended version of the Launay-Slade Hallucination Scale (LSHS; Larøi and Van Der Linden, 2005). Participants who answered affirmatively to at least one of the three AH items were included (e.g., “In the past I have had the experience of hearing a person's voice and then found that there was no-one there”). The same procedure was then used to determine the presence or absence of hallucinations in the other modalities: visual (e.g., “Sometimes I have seen things or animals when nothing was in fact there”); olfactory (“In the past, I have smelt a particular odor when there was nothing there”); and tactile (“I have had the feeling of touching something or being touched and then found that nothing or no one was there”). Three subgroups were created: (1) participants who only reported AH ($N=48$); (2) participants who reported AH and hallucinations in one

or two additional modalities ($N=79$); (3) participants who reported hallucinations in all four modalities ($N=46$). Participants were also asked to complete the Hospital Anxiety and Depression scale (HAD; Zigmond and Snaith, 1983) and to answer questions assessing: AH valence; AH frequency; the influence of AH on everyday life decisions; the level of interference of AH with social interactions; the number of experienced adverse life events; subjective mental and physical health; whether there was any contact with a mental health professional due to difficulties related to the AH; any use of medication for the AH; alcohol consumption; and the level of childhood happiness.

The three groups were equivalent in terms of age [ANOVA: $F(3, 169) = 1.54, p > 0.05$; overall mean age = 42.15, $SD = 15.59$, Min-Max = 19–85] and gender proportion [$\chi^2(2) = 1.19, p > 0.05$; overall proportion = 40.3% of male and 59.7% of female]. Thereafter, groups were compared in terms of anxiety, depression and number of adverse life events using ANOVA and Fisher's least significant difference tests. With a corrected α set at 0.027 (Hommel, 1983, 1988), results (Table 1) revealed a main group effect on anxiety, depression, and on the number of adverse life events. Post-hoc tests (α was set at 0.017, Hommel, 1983, 1988) showed that multimodal hallucinations were associated with a higher level of depression and anxiety, and more adverse life events. Chi square tests were then used to compare the groups in terms of AH characteristics, health and childhood (α was set at 0.015, Hommel, 1983, 1988). Results revealed that the groups were not equivalent in terms of the proportion of neutral AH, frequency of the AH, influence of the AH on everyday life decisions, impact of the AH on social interactions, and mental health. In particular, Chi-squared post-hoc tests with Bonferroni correction showed that multimodal hallucinations were associated with less neutral AH, a higher frequency of AH and a more severe impact of the AH on both daily life and social interactions, and poorer subjective mental health.

In general, the results revealed that among people from the general population presenting AH, the vast majority of them (i.e., 72%) also experience hallucinations in at least one additional modality. Such results are in agreement with previous studies, albeit studies including clinical populations, showing that multimodal hallucinations are highly prevalent (Lim et al., 2016; Llorca et al., 2016; McCarthy-Jones et al., 2017). These results are coherent with the continuum hypothesis of psychosis that claims that phenomena experienced by psychotic patients and by individuals in the general population share similar characteristics (van Os et al., 2009).

For the first time in the literature, the present study revealed that multimodal hallucinations are associated with a higher level of depression and anxiety, poorer subjective mental health, and more adverse life events. This suggests that a greater number of hallucination modalities may be a risk factor for the development of a psychopathology. Multimodal hallucinations were also shown to negatively affect AH. More specifically, multimodal hallucinations were associated with less neutral AH, a higher AH frequency, and a more severe impact of the AH on everyday life. That is, someone who experiences multimodal hallucinations will most probably also experience more frequent, disturbing,

Table 1

Group comparisons for anxiety, depression, and adverse life events, AH characteristics, health and childhood.

1. ANOVAs				
	Only Auditory Mean (SD)	Several Modalities Mean (SD)	All Modalities Mean (SD)	F
HAD - Anxiety	12.65 (2.84)	13.78 (4.24)	16.36 (4.51) ^{a,b}	F(2, 167)=10.57, $p < 0.0001$
HAD - Depression	10.23 (2.85)	11.13 (3.77)	12.42 (4.80) ^a	F(2, 167)=3.74, $p < 0.026$
Number of adverse life events	1.43 (1.01)	1.94 (1.24) ^a	2.24 (1.18) ^a	F(2, 168)=6.04, $P < 0.003$
2. Chi-squared tests				
	Only Auditory % (N)	Several Modalities % (N)	All Modalities % (N)	χ^2
AH characteristics				
<i>Valence of AH</i>				
<i>Positive</i>				
Yes	15.6 (7)	24.6 (17)	21.4 (9)	$\chi^2(2)=1.35, p > 0.05$
No	84.4 (38)	75.4 (52)	78.6 (33)	
<i>Negative</i>				
Yes	6.7 (3)	8.7 (6)	21.4 (9)	$\chi^2(2)=5.62, p > 0.05$
No	93.3 (42)	91.3 (63)	88.5 (33)	
<i>Positive and Negative</i>				
Yes	26.7 (12)	34.8 (24)	40.5 (17)	$\chi^2(2)=1.83, p > 0.05$
No	(33)73.3	65.2 (45)	59.5 (25)	
<i>Neutral</i>				
Yes	51.1 (23) ^a	27.5 (19) ^b	23.8 (10) ^b	$\chi^2(2)=9.16, p < 0.015$
No	48.9 (22) ^a	72.5 (50) ^b	76.2 (32) ^b	
<i>Other¹</i>				
Yes	6.7 (3)	14.5 (10)	11.9 (5)	$\chi^2(2)=1.64, p > 0.05$
No	93.3 (42)	58.5 (59)	88.1 (37)	
<i>AH frequency</i>				
At least once per month	31.1 (14) ^a	28.4 (19) ^a	61.9 (26) ^b	$\chi^2(2)=13.68, p < 0.001$
Less than once per month	68.9 (31) ^a	71.6 (48) ^a	38.1 (16) ^b	
<i>AH influence everyday life decisions</i>				
Yes	36.4 (16) ^a	47.8 (32) ^a	73.2 (30) ^b	$\chi^2(2)=12.11, p < 0.002$
No	63.6 (28) ^a	52.2 (35) ^a	26.8 (11) ^b	
<i>AH interfere with social interactions</i>				

Yes	6.8 (3) ^a	19.4 (13) ^a	47.5 (19) ^b	$\chi^2(2)=20.43, p < 0.0001$
No	93.2 (41) ^a	80.6 (54) ^a	52.5 (21) ^b	
Health				
<i>Mental Health</i>				
Good	93.8 (45) ^a	71.8 (56) ^b	62.2 (28) ^b	$\chi^2(2)=13.48, p < 0.001$
Not good	6.3 (3) ^a	28.2 (22) ^b	37.8 (17) ^b	
<i>Physical health</i>				
Good	79.2 (38)	68.4 (54)	64.4 (29)	$\chi^2(2)=2.69, p > 0.05$
Not good	20.8 (10)	31.6 (25)	35.6 (16)	
<i>Help-seeking for AH</i>				
Yes	20.6 (7)	22.2 (14)	27 (10)	$\chi^2(2)=0.46, p > 0.05$
No	79.4 (27)	77.8 (49)	73 (27)	
<i>Medication for AH</i>				
Yes	6.5 (2)	14.3 (8)	11.8 (4)	$\chi^2(2)=1.19, p > 0.05$
No	93.5 (29)	85.7 (48)	88.2 (30)	
<i>Alcohol consumption</i>				
Once per month or less	33.3 (16)	46.8 (37)	46.7 (21)	$\chi^2(4)=2.63, p > 0.05$
2-4 times per month	47.9 (23)	36.7 (29)	37.8 (17)	
Several times per week	18.8 (9)	16.5 (13)	15.6 (7)	
Other				
<i>Happy childhood</i>				
Yes	89.4 (42)	81 (64)	73.3 (33)	$\chi^2(2)=3.89, P > 0.05$
No	10.6 (5)	19 (15)	26.7 (12)	

Note for the ANOVAs: ^a Statistically significant compared to "Only Auditory"; ^b Statistically significant compared to "Several Modalities".

¹ The category "Other" included specific examples of AH content, which could be positive, negative or neutral.

Note for the Chi-squared tests: Each subscript letter denotes a group whose column proportions do not differ significantly from each other at 0.05 (adjusted with Bonferroni correction).

Each subscript letter denotes a group whose column proportions do not differ significantly from each other at 0.05 (adjusted with Bonferroni correction).

and emotional AH. The specific reason why multimodal hallucinations are associated with more impacting AH is, however, unclear but may be related to the fact that co-occurring hallucinations increase the perceived veracity of AH thus rendering them more difficult to cope with.

The present results have theoretical and clinical implications. The high prevalence rate of multimodal hallucinations indicates that it is likely that hallucinations in the different modalities share some common underpinning mechanisms. Moreover, the fact that multimodal hallucinations were found to negatively impact AH suggest that the different modalities interact with each other. Consequently, future studies need to take into account multimodal hallucinations and their interactions. From a clinical perspective, the present results underline the need for assessing hallucinations in the different modalities.

Contributors

Julien Laloyaux, Frank Larøi, and Josef Bless contributed to the design of the present study. Frank Larøi, Bodil Kråkvik, Kenneth Hugdahl, Einar Vedul-Kjelsås, and Anne Martha Kalhovde designed the original epidemiological study. Julien Laloyaux conducted the statistical analyses and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Role of the funding source

The study was partly funded by an ERC Advanced Grant #249519, and by a grant from Western Norway Health Authorities (Helse-Vest #912045) to Kenneth Hugdahl. The study was partly funded by Central Norway Regional Health Authority (RHA) and by St. Olavs hospital, Nidaros DPS and Department of research and development (AFFU).

Declaration of Competing Interest

None of the authors have a conflict of interest.

Acknowledgements

None.

References

- Hommel, G., 1983. Tests of the overall hypothesis for arbitrary dependence structures. *Biom. J.* 25, 423–430.
- Hommel, G., 1988. A stagewise rejective multiple test procedure based on a modified Bonferroni test. *Biometrika* 75 (2), 383–386.
- Kråkvik, B., Larøi, F., Kalhovde, A.M., Hugdahl, K., Kompus, K., Salvesen, Ø., Stiles, T.C., Vedul-Kjelsås, E., 2015. Prevalence of auditory verbal hallucinations in a general population: a group comparison study. *Scand. J. Psychol.* 56 (5), 508–515.
- Larøi, F., Van Der Linden, M., 2005. Nonclinical participants' reports of hallucinatory experiences. *Can. J. Behav. Science.* 37 (1), 33–43.
- Lim, A., Hoek, H.W., Deen, M.L., Blom, J.D., 2016. Prevalence and classification of hallucinations in multiple sensory modalities in schizophrenia spectrum disorders. *Schizophr. Res.* 176 (2–3), 493–499.
- Llorca, P.M., Pereira, B., Jardri, R., Chereau-Boudet, I., Brousse, G., Misdrahi, D., Fenelon, G., Tronche, A.M., Schwan, R., Lancon, C., Marques, A., Ulla, M., Derost, P., Debilly, B., Durif, F., de Chazeron, I., 2016. Hallucinations in schizophrenia and Parkinson's disease: an analysis of sensory modalities involved and the repercussion on patients. *Sci. Rep.* 6, 38152.
- McCarthy-Jones, S., Smailes, D., Corvin, A., Gill, M., Morris, D.W., Dinan, T.G., Murphy, K.C., Anthony O'Neill, F., Waddington, J.L., Australian Schizophrenia Research, B., Donohoe, G., Dudley, R., 2017. Occurrence and co-occurrence of hallucinations by modality in schizophrenia-spectrum disorders. *Psychiatry Res.* 252, 154–160.
- van Os, J., Linscott, R.J., Myin-Germeys, I., Delespaul, P., Krabbendam, L., 2009. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis

proneness-persistence-impairment model of psychotic disorder. *Psychol. Med.* 39 (2), 179–195.

Zigmond, A.S., Snaith, R.P., 1983. The hospital anxiety and depression scale. *Acta Psychiatr. Scand.* 67 (6), 361–370.

Julien Laloyaux*

*Department of Biological and Medical Psychology, University of Bergen,
Norway*

*NORMENT – Norwegian Center of Excellence for Mental Disorders Research,
University of Oslo, Norway*

*Psychology and Neuroscience of Cognition Research Unit, University of
Liège, Liège, Belgium*

*Corresponding author at: University of Bergen, Department of
Biological and Medical Psychology, Jonas Lies vei 91, 5009 Bergen,
Norway.

E-mail address: julien.laloyaux@uib.no.

Josef J. Bless

*Department of Biological and Medical Psychology, University of Bergen,
Norway*

*NORMENT – Norwegian Center of Excellence for Mental Disorders Research,
University of Oslo, Norway*

Kenneth Hugdahl

*Department of Biological and Medical Psychology, University of Bergen,
Norway*

*NORMENT – Norwegian Center of Excellence for Mental Disorders Research,
University of Oslo, Norway*

Division of Psychiatry, Haukeland University Hospital, Bergen, Norway

Bodil Kråkvik

*St. Olavs University Hospital, Division of Psychiatry, Nidaros District
Psychiatric Center, Trondheim, Norway*

Einar Vedul-Kjelsås

*Department of Mental Health, Faculty of Medicine and Health Sciences,
NTNU, Trondheim, Norway*

*Department of Research and Development, Division of Psychiatry, St. Olavs
University Hospital, Trondheim, Norway*

Anne Martha Kalhovde

Jaeren District Psychiatric Center, Bryne, Norway

Frank Larøi

*Department of Biological and Medical Psychology, University of Bergen,
Norway*

*NORMENT – Norwegian Center of Excellence for Mental Disorders Research,
University of Oslo, Norway*

*Psychology and Neuroscience of Cognition Research Unit, University of
Liège, Liège, Belgium*

11 June 2019