



Commentary

Are Neuroanatomical Abnormalities Underlying Hallucinations Modality-specific?

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In this issue of EClinicalMedicine, Rollins and colleagues [1] report that hallucinations in psychiatric and neurological patients have neuroanatomically distinct signatures. This conclusion followed a careful and systematic meta-analysis and review of the *existing* structural neuro-anatomical literature on hallucinations, across sensory modalities and diagnoses. We emphasize “existing” to underscore that fact that Rollins and colleagues are constrained by what has already appeared in the literature: By necessity, most of the papers in their analysis involve primarily auditory hallucinations in psychiatric patients (for example, schizophrenia), and mostly visual hallucinations in neurological patients (for example, Parkinson’s and Alzheimer’s Disease). As the field becomes increasingly aware that voices are experienced by other diagnostic groups [2], more papers should be appearing soon that include neuro-structural correlates of hallucinations in these patients, as well. But, for now, the literature is limited.

Similarly, although non-clinical populations can also experience hallucinations, there is only one study of neuroanatomical correlates of hallucinations in healthy people, as Rollins et al. point out. This is an important growth area for the field: If the voices healthy young adults experience were the same as those experienced by neurological and psychiatric patients, we could study their neural basis without the confounds of aging, cognitive decline, and functional deterioration. To this point, Rollins et al. argue for more neuroimaging and cognitive research in non-clinical groups.

Rollins and colleagues required that studies included in their analysis compared patients who experienced hallucinations to patients who did not. Studies that compare patients who hear voices to healthy controls pose a tough interpretative problem: Are the effects reported due to the diagnosis or specifically to the presence of hallucinations? Rollins

and colleagues’ analysis allowed them to isolate the effects of hallucinations from the broader diagnosis. For example, in studies that simply report neuroanatomical differences between healthy controls and patients with schizophrenia who hallucinate, we cannot know if those differences were due to the tendency to hallucinate or to other features of the illness itself, including delusions, thought disorder, or cognitive deficits. Any neuroanatomical differences between them and healthy controls could be due to any, or all, of those features. Although this reduced the number of studies included in their meta-analysis, it was essential for firm conclusions to be drawn.

Despite the problems in the existing literature, the current analysis makes significant contributions to both the clinical and scientific communities. To clinicians, this paper offers scientific validation of patients’ hallucinatory experience. To patients, it offers a clear message: “The voices you hear are happening because of your neuroanatomy—it is not your fault.” This counters the remaining arguments of adherents to the anti-psychiatry movement of the 1960s, who believed that schizophrenia and its symptoms were a choice and a reasonable response to an insane world [3].

To the scientific community, this paper confirms what some might have expected: Populations who principally experience visual hallucinations have structural deficits in visual areas (visual cortex); populations who principally experience auditory verbal hallucinations have deficits in speech-language areas (frontal-temporal lobes). In this regard, it is worth mentioning that modality-specific deafferentation can promote hyper-sensitivity in that modality. Hoffman [4] proposed the “social deafferentation” hypothesis of auditory verbal hallucinations. Analogous to visual hallucinations produced by visual deafferentation in Charles Bonnet syndrome [5], the social deafferentation hypothesis proposes that high levels of social isolation in individuals with vulnerability to schizophrenia produce spurious social meaning in the form of complex, emotionally compelling hallucinations representing other persons or agents. He notes that significant social withdrawal commonly occurs prior to the first onset of voices, and auditory verbal hallucinations were made worse by social isolation [6]. There is a clear therapeutic message for patients and their families: Efforts could, and should, be made to decrease social isolation in people who suffer with auditory verbal hallucinations.

Although the authors did not highlight this in their discussion, we noticed that deficits in cerebellum were noted in Table 5, where details were provided for individual studies [7,8]. The cerebellum is becoming

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increasingly noted for the role it may play in distinguishing perceptual experiences that result from sources inside self from sensations coming from external sources [9,10]. The failure to make this distinction is likely to underpin hallucinations. More work should focus on this often-neglected area of the brain, which, nevertheless, contains roughly half of the brain's neurons [9].

Finally, we echo the authors' call for a more granular examination of the phenomenology we are all trying to understand. Acquiring structural images is not cheap, and detailed analysis of regional brain gray matter is not simple. It makes sense to balance the time and energy spent on the imaging side of the equation with careful assessment of the symptoms on the clinical side. We have highly precise tools for imaging; let's match that with precision of our clinical tools. We can then ask if the neuroanatomy that supports 'voices commanding' is different from 'voices conversing', or the difference between dangerous voices and voices that may be just good company.

Conflict of Interest Statement

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