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Letter to the editor

Experiencing bird voices as auditory hallucinations - Phenomenological lessons from Phylogeny & Ethnography

Auditory hallucinations (AH) in psychoses are most often defined by Schneider's criteria, which define these, implicitly, as human voices (commenting, commanding) that communicate intent. However, the literature with respect to voices coming from non-human living (and sentient) beings is scant (Dening and West, 1990).

We report findings from a phenomenological investigation of AH in patients with a diagnosis of schizophrenia or bipolar disorder. Twenty-five patients experiencing AH were evaluated using the Mental Health Research Institute Unusual Perceptions Schedule (MUPS) (Carter et al., 1995), a semi structured questionnaire. We specifically examined non-verbal AH with the question "*During your last illness episode, did you ever hear sounds that you suspect others did not hear or report hearing, either together with the voices or at another time*?"

A third of the subjects (8/25; 33%) experienced non-verbal hallucinations and 5/25 (20%; 3 males and 2 females) reported hearing birds speaking to them, or being able to understand the language of birds. These experiences were not attributed to voices from other animals. One subject reported hearing "voice of pigeons calling me to come down" almost every day, especially during dawn; another reported she could "hear voices of birds talking to me saying Sambhu is a good person; and hearing a bird's voice in her native language saying "I am Lord *Mahadev*, and my daughter is the best"". One also reported that she frequently conversed with the birds in her garden and once, when she asked them whether they like rains or not, the birds replied that they did. Another patient reported crows asking him to come down to the ground floor. All patients reported birds conversing with them in their (the subjects') native language, and the voices were attributed to pigeons and crows.

The experience of AH in schizophrenia has a complex phenomenology, and is only partially understood. The AH are often perceived as coming from other humans, and patients can usually distinguish between hallucinations, and voices from inanimate sources (radio, TV etc.) or to originate from another sentient being (angels, devils etc.). The experience of AH may have subtle differences across populations, and may reflect the cultural symbolism attributed to the phenomenon (Luhrmann et al., 2015). Hearing voices from birds and animals has often been described in folktales, mythology and religious texts. However, parallel evolution between brains and communication behavior across species may offer some intriguing insights on the phylogenetic origins of psychiatric phenomenology.

Studies exploring the neural substrates of auditory hallucinations have identified the role of various cortical and sub-cortical language processing structures. The cortical structures include inferior frontal gyrus, superior temporal sulcus, anterior cingulate cortex, post central gyrus, and sub-cortical structures including, bilateral thalamus, ventral striatum and head of caudate (Powers et al., 2017; Zmigrod et al., 2016). The experience of AH thus seems to be contingent upon connectivity (and its dysfunction) in the cortico-thalamo-striatal circuit(s).

Interestingly, studies have found that the brain circuitry for song and speech in birds overlaps with that seen in humans. These include the cortico-striatal loop and direct connections from cortical motor areas in humans and Robust Nucleus of acro-pallidum in song learning birds, to brainstem vocal motor and respiratory neurons for phonation. These connections are more direct in avian species than in other vertebrates (Simonyan and Horwitz, 2011). The striatal region in the brain of songbirds has similarities with that part of the human striatum that gets activated during speech production. Neuroscientists have also suggested the role of basal ganglia in song learning (Pfenning et al., 2014).

The brain regions specialized for vocal learning in both humans and song-learning birds also seem to have a similar specialized expression of genes like the glutamate receptor genes (Pfenning et al., 2014). The gene encoding for parvalbumin shares specialized expression in brainstem vocal-oral nuclei between the two, and also the Forkhead box P2 gene (FOXP2) transcription factor which is required for vocal learning in both birds and humans (Pfenning et al., 2014).

The FOXP2 gene is involved in the development of neural systems that mediate speech and language (Liégeois et al., 2003), and is expressed in similar patterns in human brains as in the songbirds. Its expression in the thalamus, which is responsible for sensory integration and relaying of information, and the cerebellum and basal ganglia, which are involved in fine motor coordination (Shen, 2017) is necessary for language. Humans with mutations in FOXP2 have displayed severe speech disorder (Morgan et al., 1993-2019). It has been proposed that FOXP2 gene can be considered as a candidate gene for the vulnerability to syndromes that are characterized by thought and language impairments, such as schizophrenia and autism (Sanjuán et al., 2006).

These similarities – at structural, functional and molecular-levels, are especially remarkable given that humans and songbirds separated from a common ancestor nearly 300 million years ago. The shared neural landscape of speech and language processing between humans and songbirds – a possible byproduct of parallel evolution – might provide a mechanistic neural template based on which one could potentially understand how humans have a tendency to perceive "bird voices", in addition to "human voices" as internally generated (mis) perceptions.

We observe that a proportion of our subjects with psychoses experienced voices specifically from birds, and not other animals. Shared cultural and social symbolism may explain this intriguing phenomenology (Luhrmann et al., 2015). However, the fact that language processes in birds and humans show significant molecular and neural circuitry overlaps may provide a window to a broader understanding of AH, from a phenomenological through to a biological (even evolutionary) perspective. Our phenomenological observations, when seen in the light of cross-species convergent evolution of complex traits like

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communication behaviors, suggest the exploration of avian models to study cognitive functioning, which could throw some light on thought disorder and hallucinations in schizophrenia and related psychoses.

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