Psychology and Psychiatry: Open Access

Kenny, Psychol Psychiatry 2023, 7:1

Review Article Open Access

Visual Hallucinations are Psychotic Symptom Present in Numerous Clinical Conditions

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Abstract

Visual hallucinations (VH) are a common symptom in multiple clinical and non-clinical populations. Although structural and functional neuroimaging has informed the understanding of VH, temporal resolution is limited. Electrophysiological techniques provide a complementary perspective on dynamic and temporal aspects of neural functioning, offering greater insight into the mechanisms underlying their formation. In this review we examine and critically evaluate the emerging evidence base utilising electrophysiological approaches in the study of VH. Overall, increased visual system excitability, dysfunctional visual processing and network connectivity, and cholinergic dysfunction have been consistently observed in VH-prone pathologies. However, a major limitation is in the lack of robust experimental studies and the reliance on single case reports.

Keywords: Dementia; Hallucinations; Parkinson's disease

Introduction

We conclude that electrophysiology provides tentative evidence for the contribution of bottom-up, top-down, and network dysfunction in the aetiology of VH, supporting several existing VH models. Furthermore, we discuss how electrophysiology has been directly utilised in specific clinical interventions for VH. Further exploration utilising electrophysiology in combination with, for example, neuroimaging will help better understand VH aetiology while aiding in the development of novel therapeutic interventions for this difficult to treat symptom. Visual hallucinations are a psychotic symptom present in numerous clinical conditions such as eye disease, Parkinson Ian syndromes, neurodegenerative disorders and psychosis. Alteration of low level visual processing is a common feature in these clinical conditions, and various stages of processing from the retina to visual cortices are involved.

Discussion

We undertook a literature review of abnormalities of the retina and their potential link with the occurrence of VHs in these clinical conditions of interest. We found that structural and functional abnormalities of the retina are frequently present. In Parkinson disease and eye disease, VHs have been related to dysfunctions of the retina. By contrast, in neurodegenerative disorders and psychosis, possible links have yet not been explored. We show that structural or functional abnormalities of the retina are given little consideration in cognitive models of VHs, which primarily postulate an alteration of sensory visual processing and a top-down attention process. We conclude that contrast sensitivity measures and an exhaustive exploration of the retinal functions using the clinical electroretinography standards of the International Society for the Clinical Electrophysiology of Vision (ISCEV) are needed to explore retinal involvement in the occurrence of visual hallucinations. Models of hallucinations emphasize imbalance between sensory input and top-down influences over perception, as false perceptual inference can arise when top-down predictions are afforded too much precision (certainty) relative to sensory evidence. Visual hallucinations in Parkinson's disease (PD) are associated with lower-level visual and attention impairments, accompanied by over activity in higher-order association brain networks. PD therefore provides an attractive framework to explore contributions of bottom-up versus top-down disturbances in hallucinations. Visual hallucinations in dementia are distressing for both patients and carers and currently lack effective treatments. They also occur in eye disease (Charles Bonnet Syndrome - CBS) and Parkinson's disease (PD). If the brain dysfunction underlying visual hallucinations is the same across conditions, treatments used for CBS or PD hallucinations might also be used in dementia [1-4].

Here we compare the phenomenology of visual hallucinations and related symptoms in different conditions as a guide to similarities and differences in underlying brain dysfunction. Visual hallucinations (VH) represent a common symptom exhibited by patients with Lewy body disease (LBD). VH have been associated with cognitive and structural brain alterations. The Perception and Attention deficit (PAD) model suggests that VH result from the combination of deficits in attention and visual perception. Nevertheless, there is still insufficient evidence regarding the interplay between these deficits in LBD patients with VH. The aim of the present study was to investigate the neuroanatomical and neuropsychological characteristics associated with VH in dementia with Lewy bodies (DLB) and Parkinson's disease (PD). CBS becomes more prevalent as the population ages. CBS is characterized by the triad of impairment of vision, complex visual hallucinations with insight, mentally normal people. Although visual hallucinations in the elderly are often associated with dementia with Lewy body, Alzheimer's disease and delirium, they are excluded from the diagnosis of typical CBS. Here, we describe three typical CBS patients whose visual hallucinations developed after bilateral severe visual impairment due to diabetic retinopathy. The effectiveness of agomelatine adds to evidence implicating serotonergic and melatoninergic pathways in the pathogenesis of visual hallucinations. This case report offers rare insights into crossmodal responses to psychedelic drug use in a congenitally blind (CB) individual as a form of synthetic synaesthesia. BP's personal

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Received: 01-Feb-2023, Manuscript No. ppo-23-91580; **Editor assigned:** 03-Feb-2023, PreQC No. ppo-23-91580(PQ); **Reviewed:** 17-Feb-2023, QC No. ppo-23-91580; **Revised:** 24-Feb-2023, Manuscript No. ppo-23-91580(R); **Published:** 28-Feb-2023, DOI: 10.4172/ppo.1000135

Citation: Kenny G (2023) Visual Hallucinations are Psychotic Symptom Present in Numerous Clinical Conditions. Psychol Psychiatry 7: 135.

experience provides us with a unique report on the psychological and sensory alterations induced by hallucinogenic drugs, including an account of the absence of visual hallucinations, and a compelling look at the relationship between LSD induced synaesthesia and cross modal correspondences. The hallucinatory experiences reported by BP are of particular interest in light of the observation that rates of psychosis within the CB population are extremely low. The phenomenology of the induced hallucinations suggests that experiences acquired through other means, might not give rise to "visual" experiences in the phenomenological sense, but instead gives rise to novel experiences in the other functioning senses. A hallucination is a subjective sensory experience that occurs in the absence of any external stimulation of the relevant sensory organ, and has a sufficient sense of reality to resemble a real perception. Hallucinations may occur in otherwise healthy people exposed to exceptional stress or as a consequence of neurological or psychiatric illness. Four potential pathophysiological mechanisms of hallucinations have been proposed including sensory deafferentiation, dysfunctional subcortical processing, cortical stimulation or inhibition, and dysfunctional top-down control. This chapter reviews the pathophysiology of hallucinations and discusses potential treatments. Learning-based face hallucination methods have received much attention and progress in past few decades. Specially, position-patch based approaches have been proposed to replace the probabilistic graph-based or manifold learning-based ones. As opposed to the existing patch based methods, where the input image patch matrix is converted into vectors before combination coefficients calculation, in this paper, we propose to directly use the image matrix based regression model for combination coefficients computation to preserve the essential structural information of the input patch matrix. For each input low-resolution (LR) patch matrix, its combination coefficients over the training image patch matrices at the same position can be computed. Then the corresponding high-resolution (HR) patch matrix can be obtained with the LR training patches replaced by the corresponding HR ones. The nonlocal self-similarities are finally utilized to further improve the hallucination performance. Various experimental results on standard face databases indicate that our proposed method outperforms some state-of-the-art algorithms in terms of both visual quantity and objective metrics. Understanding what happens at first onset of auditory verbal hallucinations (AVHs) is extremely important on a clinical and theoretical level. Previous studies have only focused on age with regard to first onset of AVHs. In the current epidemiological study, we examined a number of aspects relating to first onset of AVHs, such as the role of adverse life events at first onset of AVHs on symptom severity and general mental health. For this purpose, we compared participants who reported adverse life events at first onset of AHVs (adverse-trigger group; N = 76) to those that did not report any specific events at first onset of AVHs (no-adverse-trigger group; N = 59) on a large array of variables. Results showed that AVHs in the adverse-trigger group were experienced as more emotional compared to the no-adverse-trigger group. In addition, the adverse-trigger group more often reported hallucinations in other (non-auditory) sensory modalities (e.g. visual) compared to the no-adverse-trigger group. Furthermore, the adverse-trigger group reported poorer general mental health, reported having contact with mental health professionals more often, and also reported more frequently taking medication for psychological problems in general. The implications of these findings are discussed. Auditory verbal hallucinations (AVHs) are a cardinal characteristic of psychosis [5-7].

Recent research on the neuropsychological mechanism of AVHs has focused on source monitoring failure, but a few studies have suggested the involvement of attention, working memory, processing speed, verbal learning, memory, and executive functions. In this study we examined the neuropsychological profile of patients with AVHs, assuming that the mechanism underlying this symptom could be a dysfunction of specific cognitive domains. The distinction between the body schema and the body image has become the stock in trade of much recent work in cognitive neuroscience and philosophy. Yet little is known about the interactions between these two types of body representations. We need to account not only for their dissociations in rare cases, but also for their convergence most of the time. Indeed in our everyday life the body we perceive does not conflict with the body we act with. Are the body image and the body schema then somehow reshaping each other or are they relatively independent and do they only happen to be congruent? On the basis of the study of bodily hallucinations, we consider which model can best account for the body schema/body image interactions. In order to identify causes and triggers of hallucinations that can inform therapy, reliable, valid, and change-sensitive instruments to assess hallucinatory experiences in the subclinical and clinical range are needed. We developed and validated a novel scale, the Continuum of Auditory Hallucinations - State Assessment (CAHSA), to be used for repeated assessment of the subclinical factors vivid imagination, intrusive thoughts, and perceptual sensitivity as well as auditory hallucinations. After selecting items for the four factors in a first test sample (n=84), we tested factorial validity using CFA and criterion validity with self-reported psychosis-like experiences (n=534). Finally, within-subject variation of CAHSA scores over 14 days and time-lagged associations between its factors were explored (n=85). A 9-item CAHSA was selected that showed good factorial validity, criterion validity, and substantial, valid within-subject variation. Time-lagged regression showed that vivid imagination, perceptual sensitivity, and intrusive thought precede auditory hallucinations. In sum, the CAHSA validly measures fluctuation along the continuum of auditory hallucinations, is sensitive to change, and well suited for experimental studies, repeated measurement, and longitudinal research. The various models proposed for the mediation of auditory verbal hallucinations (AVH) implicate a considerable number of brain areas and mechanisms [8-10].

Conclusion

To establish which of those mechanisms are actually involved in the mediation of AVH, we developed a novel method to analyze functional MRI data, which allows for the detection of the full network of mutually interacting brain states, and the identification of those states that are relevant to the mediation of AVH, while applying a minimum number of preconceived assumptions. This method is comparable to the draining of a pond to lay bare the full ecosystem that affects the presence of a particular fish species. We used this model to analyze the fMRI data of 85 psychotic patients experiencing AVH. The data were decomposed into 98 independent components (ICs) representing all major functions active in the brain during scanning.

Acknowledgement

None

Conflict of Interest

None

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