Effect of Audio-Visio Hallucinations on Memory in healthy individuals: an Experimental Study

Research Project

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Abstract

Hallucinations can occur in the absence of sensory stimulation and manifest in a range of sensory modalities, producing vivid experiences of nonexistent occurrences. Experiments in cognitive and experimental psychology have made good use of the idea that associative learning events might trigger conditioning-induced hallucinations. Hallucinations may have an impact on memory. Semantic memory can be changed by hallucinations. Although almost all of human behavior is based on semantic memory, which encompasses all learned information about the outside world, its neurological underpinnings are still unclear. These convergences allow for new representations of perceptual experience that are increasingly abstract and support a range of conceptual activities such as language, social cognition, object recognition, and the amazing ability of humans to remember the past and imagine the future. We first conducted a trial without audio conditioning to ascertain users' cognitive functioning when exposed to generated hallucinations. The results showed that a person's memory may be impacted by particular situations. Subsequently, we designed an interactive scenario with the goal of eliciting mild to moderate negative auditory-visual hallucinations conditioned with positive audio and positive to moderate positive visual hallucinations conditioned with negative audio, followed by a combination of the two. In both visually produced and visually induced hallucinations conditioned by the audio, participants acted out the scenario. Higher degrees of absorption were observed by those who rehearsed the hallucinations conditioned with audio, and this in turn increased the intensity of their cognitive response to the event. Using an advanced program called Psychopy, the individuals' cognitive states were evaluated through the use of a Semantic Memory Scale and PANSS to measure both positive and negative symptoms. Following their exposure to conditionally triggered hallucinations, there was a notable impact on the subjects' semantic memory.

Keywords: Semantic memory, Conditioning, induced hallucination, cognitive function, memory, audio hallucinations, video hallucinations, PANSS

Introduction

Prior research on human semantic memory processes has been hindered by two factors: an experimental tradition that prioritizes stimulus-driven brain activity and a relatively narrow focus on object knowledge. The majority of the day is spent by human brains remembering, planning, and reasoning. This highly conceptual exercise can be completed, and typically is, in the solitude of one's own thoughts; it is not dependent upon external stimuli. A new anatomical model of the brain systems implicated in these processes is fast emerging from functional imaging data and fresh insights obtained from studying patients with semantic memory loss.

Hallucinations are perceptual experiences in which there is no supporting sensory input. It can range from simple mutterings to complex, fully developed voices and images. In addition to being present in a significant portion of the normative population, they are seen in several medical and psychiatric diseases. According to Johns et al. (2004), they might be comforting or upsetting. Though they most likely represent equifinal outcomes across (and within) these various populations - with different etiologies culminating in similar symptoms - establishing a common framework to understand hallucinations may prove to be a powerful way to shed light on their mechanisms and what might go wrong in more serious clinical manifestations (Corlett & Schoenbaum, 2021).

During auditory hallucinations (AH), the distinctions between speech production, internal thought, and external perception may become blurry. Patients with schizophrenia often describe AH, albeit they can also occur in other mental diseases (Andreasen & Flaum, 1991; Sartorius, Shapiro, & Jablensky, 1974). Cognitive impairment is another essential feature of schizophrenia that also predicts functional incapacity (Barch & Ceaser, 2012; Goldman-Rakic, 1999). Working memory impairment (WM) is one of the most serious mental illnesses. Nevertheless, AH and WM are still mostly studied as separate entities since science does not yet understand their joint mechanism.

Definitions of hallucinations vary among philosophical systems. In the clinical domain, visual hallucinations (VHs) are characterized as conscious visual impressions that are not triggered by external stimuli. It is not to be confused with a visual illusion, which is an external stimuli that appears differently than it normally does. Even in situations where no apparent illness is present, VHs can develop in a number of medical and psychological contexts. Compared to nonclinical populations, delirious states, and mental illnesses, VHs have gotten very little attention.

Even though the diagnostic guidelines for mental diseases list hallucinations as a primary characteristic sign of psychotic illnesses, doctors most often ask about auditory hallucinations as their symptoms. One explanation is the widely held belief that VHs are more common in organic states than in psychosis. Determining if all of the requirements for the existence of VHs have been satisfied can be difficult due to a number of other perceptual abnormalities.

Aims & Objectives

This study sought to investigate the effect of induced visual hallucinations paired with auditory hallucinations on Semantic Memory in healthy individuals.

The main hypotheses of this study are as follows:

Hypothesis 1: Induced hallucinations may temporarily impair Semantic Memory.

Hypothesis 2: Induced positive visual hallucinations conditioned with positive audio mildly improve Semantic Memory.

Hypothesis 3: Induced positive visual hallucinations conditioned with negative audio moderately impair Semantic Memory.

Hypothesis 4: Induced negative visual hallucinations conditioned with positive audio mildly improve Semantic Memory.

Methods

Research Design

This was a temporal, randomized, controlled trial with a block design that was double blinded. After presenting each stimulus, such as a positive video, negative video, positive audio, and negative video at T0, memory was first evaluated using the Semantic Memory Scale in conjunction with the PANNS Scale to measure Positive and Negative symptoms. Next, Positive Visual Hallucination conditioned with Positive Audio was induced, and evaluation was repeated at T1. Semantic memory was evaluated and positive visual hallucinations conditioned with the negative audio were produced during the T2 phase. To evaluate the semantic memory, negative visual hallucinations conditioned with negative audio were created in the T3 phase. In order to evaluate the participants' semantic memory along with positive and negative symptoms, negative hallucinations conditioned with positive audio were created in the final stage T4.

Temporal Study

Learning about the actual amount of time that passes between occurrences is referred to as temporal learning. The occurrences could be reactions or stimuli. Beyond only perceiving time, temporal learning also includes temporal memory, or the psychological time that is remembered, and temporal decision-making that is predicated on contrasting temporal perception and temporal memory, Church, R.M. (2012)

Double Blind Study

A study in which neither the subject nor the researcher is blind to the type of treatment they are receiving is referred to as a double-blinded study. In a double-blind study, neither

the participants nor the investigators are aware of who is in the experimental and control groups, Padhi, A., Fineberg, N. (2010).

Randomized Controlled Trial

Design of the study: a comparison of the intervention and control groups' results. To reduce selection effects, participants are randomized to either the intervention or control group, Kirch, W. (2008)

Block Design

An experimental design in which the experimental units are arranged into groups known as blocks is known as a randomized block design. Within each block, the experimental units are assigned treatments at random. We have a fully randomized block design when each block has at least one instance of each treatment. In the absence of such, our randomized block design is not complete. The Concise Encyclopedia of Statistics (2008)

Sample and Sampling Procedure

A sample of young individuals, ages 18 to 30, was included in the current investigation. Students from universities provided the experiment data. Students from FUI Islamabad's Foundation University School of Science and Technology served as the study's sample.

The study took four months to complete, during which time data from the target group was gathered, analyzed, and results were presented.

Inclusion Criteria & Exclusion Criteria

Using QR code scanning and flyer distribution throughout the campus, 30 participants were selected from among the Foundation University School of Science and Technology students. To be eligible for the study, individuals had to meet three criteria: (1) they had to be between the ages of 18 and 30; (2) they had to be free from significant visual impairment, which meant that all of them had normal or corrected-to-normal visual acuity; and (3) they had to be free from psychological problems.

Before they began, all participants received written information about the study, and they had to give written informed consent in order to be included. The study received ethical approval from both the department head and Mr. Muhammad Aqeel, the supervisor.

Psychometric Assessment

Demographics: Participants were requested to provide their age, education, and gender (male or female).

Procedure

First, participants had to complete the informed permission form and follow the guidelines set forth by the lab. We first conducted an experiment in which users were exposed to produce hallucinations in order to assess their semantic memory without acoustic conditioning. The findings raised the possibility that certain circumstances could affect semantic memory. To elicit mild to moderate positive visual hallucinations conditioned with negative audio and negative visual hallucinations conditioned with positive audio, as well as a combination of positive and negative auditory-visual hallucinations, an interactive scenario was subsequently created for the experimental group. When assessed on the PANSS and Semantic Memory Scale while they played out the scenario, the participants reported experiencing both visually- and audio-induced hallucinations.

Results

One-Way ANOVA:

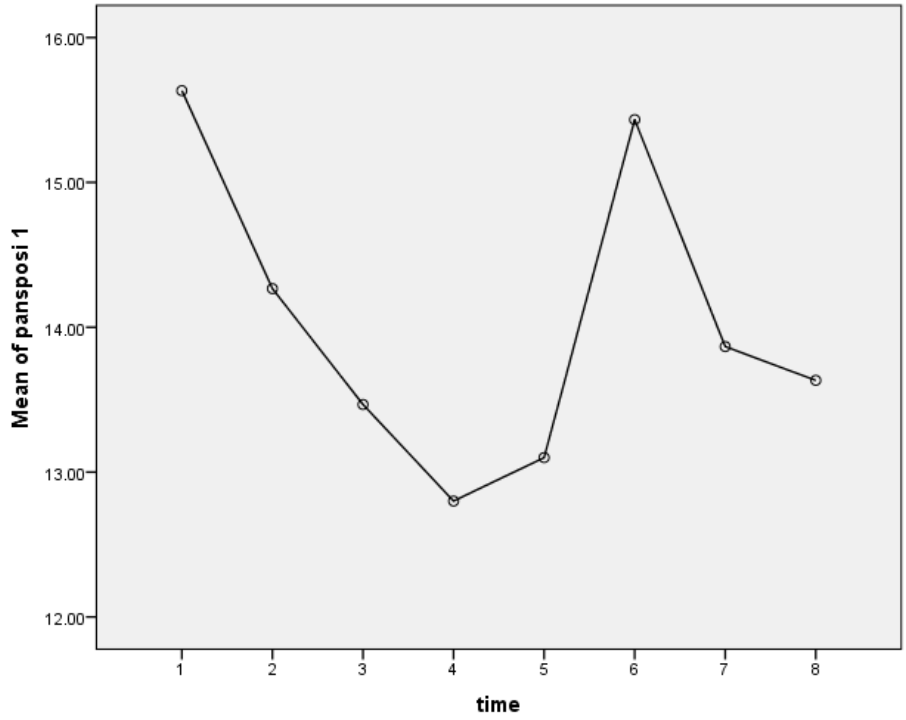
Table 1: To Study mean wise differences on Semantic Memory of PANSS positive and Negative items in healthy individuals (N=30)

	PANSS POS (n=30)		PANSS NEG (n=30)			
Variables	Mean	SD	Mean	SD	F	P
PANSS POS	15.63	3.02	13.37	3.11	2.69	0.01
PANSS NEG	14.27	4.22	15.70	0.47	4.95	0.00
	13.47	2.91	13.67	2.37		
	12.80	1.35	13.17	1.29		
	13.10	1.24	15.40	3.02		
	15.43	4.97	12.90	3.00		
	13.87	4.48	14.83	4.32		
	13.63	3.43	12.50	4.07		
	14.03	3.53	13.94	3.14		

Note:- *PANSS=Positive & Negative Syndrome Scale* **p<0.05, **p<0.01, ***p<0.00*

In the Table no 1, the findings of the One-Way ANOVA revealed that the desired direction of hypothesis are obtained by assessing Semantic Memory on PANSS Positive and Negative items for healthy individuals thus proving our hypothesis true. Similarly the value of p is highly significant for both Negative items & Positive Items (p=0.00, 0.01) which revealed that both have equal significance. Hence our hypothesis is supported by the findings.

Mean Plots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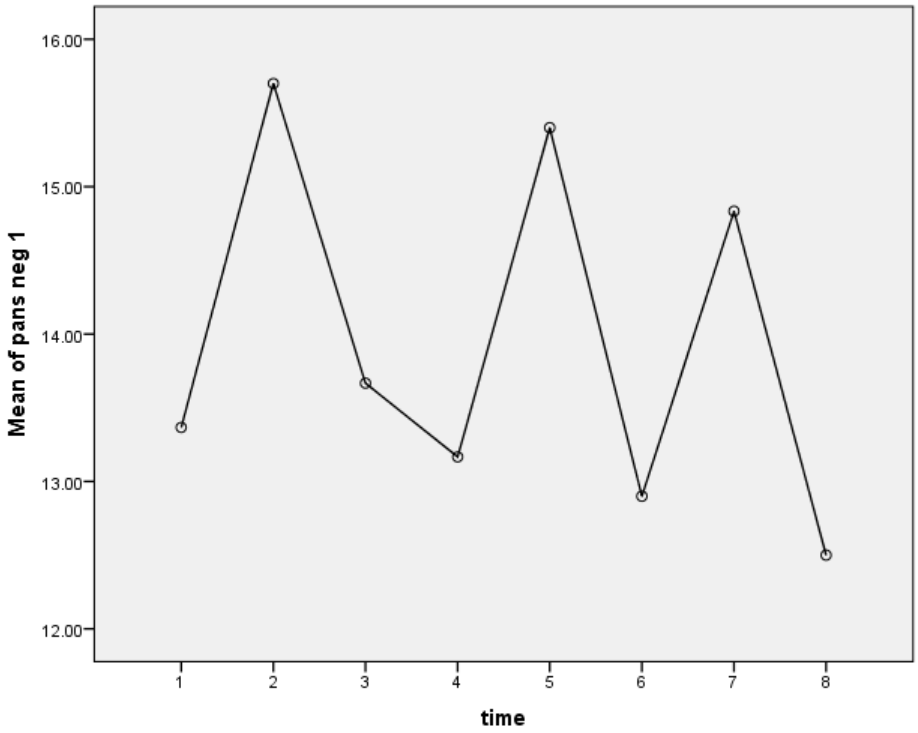
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Discussion

An essential part of the human memory system is semantic memory, which retains facts, ideas, and general information about the world without reference to particular personal experiences. In contrast, episodic memory refers to the recollection of individual experiences and occurrences. People with semantic memory are able to comprehend language, identify objects, and understand the meanings of words and concepts. The temporal lobe, particularly the hippocampus and its environs, is one of the brain regions involved in the neurological basis of semantic memory. Semantic memory disruptions can arise from a variety of neurological disorders. In the clinical domain, visual hallucinations (VHs) are characterized as conscious visual impressions that are not triggered by external stimuli. It is not to be confused with a visual illusion, which is an external stimuli that appears differently than it normally does. During auditory hallucinations (AH), the distinctions between speech production, internal thought, and external perception may become blurry. Patients with schizophrenia often describe AH, albeit they can also occur in other mental diseases (Andreasen & Flaum, 1991; Sartorius, Shapiro, & Jablensky, 1974). Cognitive impairment is another essential feature of schizophrenia that also predicts functional incapacity (Barch & Ceaser, 2012; Goldman-Rakic, 1999). Seldom have research on semantic memory and the brain regions involved in its functioning after experiencing hallucinations been conducted. Our study can act as a basis for more sophisticated MRI and other brain scan research in the future. In this study, we conducted our experiment in a controlled laboratory environment using sophisticated software psychopy. Our preliminary notion was validated by our highly significant results. We discovered that when individuals saw a negative hallucinatory movie with a negative sound, their response on the PANSS scale decreased, but when they saw a positive film with a positive sound, their response improved. Future researchers can utilize this experimental work as a resource to identify the specific brain regions that are involved in the processing of various emotions.

Limitations and Future Recommendations

There exist several limitations to this study. The age range of university students who met our population criterion was 18 to 30. This was an experiment that we ran for a month. Better tools, such as MRI and fMRI, were not available to determine which brain

regions are engaged. We could have gathered more information, carried out our experiment on a larger scale, and discovered more effects of positive and negative stimuli in enhancing or degrading semantic memory if we had a larger lab and no time constraints.

Conclusion

In conventional mental health treatment settings as well as with healthy persons, the induction of positive stimuli can be used to improve memory, cognitive functioning, and mood regulation. On the other hand, a negative stimulus can exacerbate or worsen mood and memory. In other words, in order for entertainment to be a useful instrument for enhancing people's general mental wellness, it must be improved to a good degree.

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