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INTRODUCTION: According to World Health Organization (2018), 21 milion people worldwide suffer from schizophrenia. Among them, 60-70% report auditory verbal hallucinations (AVH), typically of threatening and derogatory nature (Waters et. al., 2012). Despite pharmacotherapy, approximately 25% schizophrenia patients (SP) still suffer from psychotic symptoms (Aleman et. al., 2011). Novel treatment options are being investigated. To date, virtual reality (VR), enabling creation of a safe, controlled environment, has been effective in treatment of various mental disorders. AVATAR therapy, invented by J. Leff in 2008, uses this technology to engage patients in conversation with virtual image of the person, they believe, is talking to them.

OBJECTIVE AND METHODOLOGY: This article reviews currently available literature on the use of different forms of VR in therapy of persistent AVH in SP. PubMed, PMC, Scopus, ProQuest, Oxford Academic Journals database searches using the terms “Schizophrenia” AND “Hallucinations” AND “Virtual Reality” returned the total of 438 records. Included papers investigated clinical use of VR in treatment of refractory AVH in SP. All articles were available in English.

RESULTS: Presented below are 6 articles included in this review. All studies examined the use of therapist-controlled, 3-dimensional virtual AVATAR and voice transformer to closely resemble patients' hallucinations presented either on flat screen (non-immersive virtual reality), or using 3D goggles (immersive virtual reality). All studies reported improvement in AVH severity, advantage in using VR vs. treatment-as-usual and all but one reported improvement in depressive symptoms.

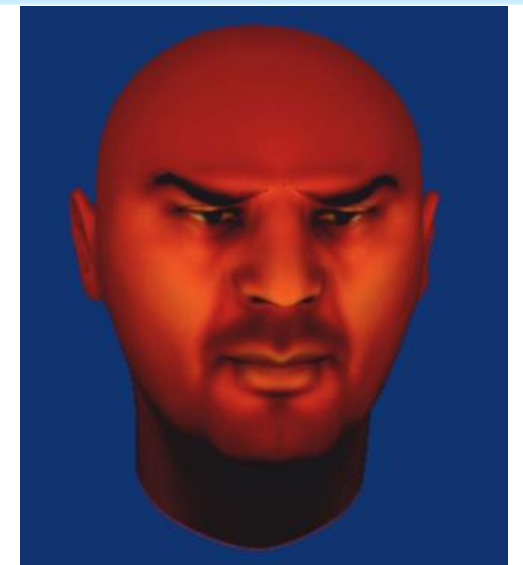


Image of an avatar used in therapy (Leff et. al 2013)

Study	Type of trial	Number of participants	Equipment used	Outcomes
Leff et al. (2013)	Randomized, single blind, partial crossover trial with follow-up	N=26 N=16 in 3-month follow-up	Non-immersive virtual reality	Significant improvement in frequency and quality of AVH measured with PSYRATS and BAVQ-R scales directly post-treatment and at follow-up. Significant improvement in depressive symptoms recorded at follow-up (vs. direct post-treatment assesment).
Stefaniak et al. (2017)	Case report	1 patient with 6-month follow-up	Non-immersive virtual reality	Observed reduction in AVH frequency. Patient reported improved mood and self-esteem and ability to better cope with AVH exacerbation.
du Sert et al. (2018)	Randomized, partial cross-over trial with follow-up	N=15 N=12 in 3-month follow-up	Immersive virtual reality	Significant reduction in AVH measured with PSYRATS and BAVQ-R scales. Improvement in depressive symptoms and general symptoms measured with PANSS scale. All improvements remained significant at follow-up.
Dellazizzo et al. (2018)	Case report	1 patient with 3-month follow-up	Immersive virtual reality	There was improvement in positive, negative and general symptoms of schizofrenia measured with PANSS scale, and in depressive symptoms measured with BDI-II, which persisted throughout the 3-month follow-up period. No improvement measured with PSYRATS scale.
Dellazizzo et al. (2018)	Randomized-controlled trial	N=28	Immersive virtual reality	Preliminary results show significant improvement in AVH severity, psychotic symptomatology, depressive symptoms and quality of life vs. standard CBT.
Craig et al. (2018)	Single-blind, randomized controlled trial with follow-up	N=150 N=115 in 24-week follow-up	Non-immersive virtual reality	Compared to standard supportive counselling, AVATAR therapy more significantly reduced AVH severity, measured with PSYRATS-AH, BAVQ and VASS scales in direct post-treatment assessment. No significant difference between both groups at follow-up.

CONCLUSIONS: Although limited, available sources propose promising new interventions for treatment of refractory AVH in schizophrenia. Researchers agree that further investigation is required in order to establish a new standard procedure.

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