

Virtual environment using the Virtual Reality Functional Capacity Assessment Tool (VRFCAT) for enhanced ecological validity in community functioning in individuals with schizophrenia

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BACKGROUND

- In schizophrenia, the process of social construction of reality is disturbed. Individuals with schizophrenia are unable to fulfill basic social roles (including work skills), have significant impairments in social relationships, and are often socially isolated. When they do interact with others, they often have difficulty navigating through their community, maintaining communication, and performing daily activities outside the home (e.g., paying, shopping).
- As opposed to studies in a laboratory setting, influencing and constraining a real-world environment for subjects with schizophrenia can be challenging. Potential factors in the real world that can be distracting for subjects with schizophrenia, such as number of people in the environment, and noise, are difficult to control.
- Virtual environments for functional or cognitive assessment engage subjects by allowing them to be involved in a task while being less focused on the fact that they are being tested. Relevant functional tasks, such as navigating a virtual community, or shopping and paying for groceries in a virtual supermarket, can be delivered with improved ecological validity compared to traditional questionnaires or performance-based assessments.

OBJECTIVE

The aim of this study was to assess whether participants' interactions with the social world in a controlled virtual reality environment were comparable to interactions in the real-world, specifically, related to their symptoms of poor interpersonal functioning, suspiciousness, social and emotional withdrawal.

VIRTUAL REALITY ASSESSMENT

- The Virtual Reality Functional Capacity Assessment Tool (VRFCAT) is a performance-based assessment of functioning that assesses a participant's ability to complete instrumental activities (called objectives) associated with a shopping trip.
- In previous studies, the VRFCAT has demonstrated high test-retest reliability and has shown strong relationships to cognition, sensitivity to declines in healthy aging adults, and sensitivity to pronounced functional deficits in schizophrenia (Atkins et al., 2015; Keefe et al., 2016).



Interactive Environment Consisting of 4 Scenes

- Exploring the kitchen and creating a shopping list
- Selecting and paying for the bus to a grocery store
- Shopping and paying for groceries on the shopping list
- Selecting and paying for the bus home

Objectives

- Pick up the recipe on the counter
- Look for ingredients in cabinets and refrigerator
- Cross off the ingredients already in kitchen and pick up bus schedule
- Pick up wallet
- Leave the apartment
- Wait for the correct bus to the grocery store and then board it when it arrives
- Pay required bus fare using exact change
- Select a grocery store aisle to begin shopping
- Shop for items on list in correct quantities
- Pay for groceries using exact change
- Wait for the correct bus home and then board it when it arrives
- Pay required bus fare using exact change



METHODS

- Participants** met criteria for DSM-IV TR schizophrenia and were recruited at : 1) The University of South; 2) The University of Miami Miller School of Medicine; and 3) The University of California, San Diego School of Medicine.
- Statistical Analysis:** Pearson r correlations were performed for the VRFCAT objectives (indoor/home objectives 1 – 5 and outdoor/community objectives 6 – 12), SLOF domains and the PANSS Prosocial, PANSS Experiential and Expressive deficits. Significant PANSS and SLOF domains were included as the latent trait to the best fitting regression model predicting outdoor/community functioning.
- PANSS Prosocial Deficit** includes : Active Social Avoidance, Emotional Withdrawal, Passive/Apathetic Social Withdrawal, Stereotyped Thinking, Hallucinatory Behavior, and suspiciousness/paranoia. (Purpine et al., 2000).
- PANSS Experiential Deficit** includes: Emotional Withdrawal, Passive Apathetic Social Withdrawal, Active Social Avoidance
- PANSS Expressive Deficit** includes Blunted Affect, Poor Rapport, Lack of Spontaneity, Motor Retardation.

DEMOGRAPHIC CHARACTERISTICS			
	N	%	
Male	88	56	
Unemployed	135	85	
Comfortable with Computer	140	89	
Hispanic	30	19	
English Primary Language	151	96	
Race			
Caucasian	75	47	
African American	76	48	
Other	7	4	
	N	Mean	SD
Age	158	43.6	11.85
Years of Education	157	12.8	1.99
Mother's Education	142	12.5	3.33

CLINICAL AND FUNCTIONAL CHARACTERISTICS			
	N	Mean	SD
VRFCAT Adjusted Total Time	158	32.5	16.59
VRFCAT Total Errors	158	37.7	22.4
VRFCAT Forced Progression	158	40.5	13.64
SLOF Interviewer Total Scored	158	11.1	1.64
PANSS Total scores	158	71.6	21.93

RESULTS

Significant positive correlations ($p \leq 0.01$) was observed only for Community Objectives (Adjusted Total Time - Paying for the bus to the supermarket, and Paying for the bus home).

VRFCAT Objectives (Adjusted Time)	PANSS Prosocial
Indoor (Home) Activities	
Pick-up the Recipe	0.169*
Search for Ingredients	-0.034
Cross Off Correct Ingredients & Pick-up Bus Schedule	0.169*
Pick-up the Billfold	0.048
Exit the Apartment	0.032
Outdoor (Community) Activities	
Get on the Bus to the Grocery Store	0.038
Pay for the Bus to the Supermarket	0.212**
Select an Aisle	0.093
Shop for Groceries	0.173*
Pay for Groceries	0.160*
Get on the Bus to go Home	0.152
Pay for the Bus to get home	0.222**
VRFCAT Total Adjusted Time	0.232**

*Significant at $p = 0.05$; **Significant at $p = 0.01$

Significant negative correlations ($p \leq 0.01$) was observed only for VRFCAT Community Objectives (Adjusted Total Time) and Specific Level of Functioning Total Score and Work Skills.

Functional and Psychopathology Measures	Adjusted Total Time on VRFCAT	
	VRFCAT - Indoor (Home) Objectives	Outdoor (Community) Objectives
SLOF Total Score	-0.028	-.181**
SLOF: Interpersonal Relationships	0.028	-0.068
SLOF: Social Acceptability	0.083	-0.106
SLOF: Activities	-0.052	-0.127
SLOF: Work Skills	-0.106	-.227**
PANSS Experiential Deficit	0.039	0.176*
PANSS Expressive Deficit	0.115	0.044
PANSS Prosocial	0.123	.232**

Stepwise regression showed that activities in the community was significantly predicted by SLOF Work Skills and the PANSS Prosocial factor.

Regression Model including all significant correlates of Community Activities as measured by the VRFCAT	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	728.960	98.584		7.394	.000
Experiential Deficit	-13.135	10.987	-.213	-1.196	.234
SLOF: Work Skills	-9.785	3.703	-.204	-2.643	.009
PANSS Prosocial	14.958	6.725	.396	2.224	.028

Dependent Variable: Community Activities on VRFCAT (Objectives 6 – 12)

CONCLUSIONS

- Virtual Reality, suitably applied with the VRFCAT, holds great promise to enhance the understanding and treatment of psychosis.
- Participants' social interactions in a controlled virtual reality environment were influenced by symptoms of suspiciousness, emotional and social withdrawal in a virtual community setting (outside the home), as opposed to virtual at-home activities.
- These findings indicate that symptoms that influence virtual social interactions are similar to symptoms that affect community social interactions in the real world.
- Findings also demonstrate enhanced ecological validity for the VRFCAT to simulate social interactions while providing standardized visual and auditory experiences during testing.
- Knowledge of these factors has significant clinical implications and could aid in treatment and prevention strategies in schizophrenia.

DISCLOSURES AND CONTACT INFORMATION

P. Harvey has served as a consultant to AbbVie, Allergan, Akli, Boehringer Ingelheim, Forum Pharmaceuticals, Genentech, Lundbeck Pharmaceuticals, Otsuka Digital Health, Roche Pharma, Sanofi, Sunovion, and Takeda Pharmaceutical for the past 3 years. A. Khan is an employee of NeuroCog Trials, Durham, NC, USA, and currently or in the past 3 years has received support from National Institute of Mental Health, Celgene, Two Pharmaceuticals, and Stanley Medical Research Foundation. AS Atkins is a full-time employee of NeuroCog Trials, Durham, NC, USA, and has received support from National Institute of Mental Health. H Snyder, C Sanchez and D Ulshen are full-time employees of NeuroCog Trials, Durham, NC, USA. RSE Keefe currently or in the past 3 years has received investigator-initiated research funding support from the Department of Veterans Affairs, Feinstein Institute for Medical Research, GlaxoSmithKline, National Institute of Mental Health, Novartis, Psychogenics, Research Foundation for Mental Hygiene, Inc, and the Singapore National Medical Research Council. He currently or in the past 3 years has received honoraria, served as a consultant, or advisory board member for AbbVie, Abbvie, Amgen, Abbvie, AvNeuro/ChemStar, BiolineRx, Biogen Idec, Biomarin, Boehringer Ingelheim, Eli Lilly, EndoPharm, GW Pharmaceuticals, Janssen, Lundbeck, Merck, Minerva Neurosciences, Inc., Mitsubishi, Novartis, NY State Office of Mental Health, Otsuka, Pfizer, Roche, Sanofi/Aventis, Shire, Sunovion, Takeda, Targacept, and the University of Texas South West Medical Center. Dr. Keefe receives royalties from the BACS testing battery, the MATRICS Battery (BACS Symbol Coding) and the Virtual Reality Functional Capacity Assessment Tool (VRFCAT). He is also a shareholder in NeuroCog Trials and Senegenix.

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