

# VALIDATION OF A COMPUTERIZED ASSESSMENT OF FUNCTIONAL CAPACITY

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## ABSTRACT

### BACKGROUND

Assessment of functional capacity is critical to the treatment of cognitive impairments in schizophrenia. Current methods are highly correlated with performance on neuropsychological tests, but suffer from compromised ecological validity due to reliance on role playing exercises. Methods of assessment with improved ecological validity are acutely needed. In response, we have developed a computerized virtual reality assessment that contains the components of a shopping trip, including searching the pantry, making a list, taking the correct bus, shopping, paying for purchases, and getting home. Previous pilot studies indicated that the assessment of functional capacity with virtual reality methodology is feasible, and suggested such a tool may meet criteria for use as a co-primary measure. The primary aims of the current study were to extend our previous results to 1) assess the validity, sensitivity, and reliability of the Virtual Reality Functional Capacity Assessment Tool (VRFCAT) as a primary measure of functional capacity in schizophrenia; 2) examine the VRFCAT's ability to quantify changes in functional capacity by comparing it to the UCSD Performance-based Skills Assessment (UPSA-2-VIM); and 3) determine the association between performance on the VRFCAT and performance on the MATRICS Consensus Cognitive Battery (MCCB), which is the gold standard measure of cognition in pharmaceutical clinical trials regulated by the FDA.

### METHODS

Participants included 158 patients with schizophrenia (87 male, 71 female) and 166 healthy controls (88 male, 78 female). All subjects completed the VRFCAT, UPSA-2-VIM and the MCCB at Visit 1. The VRFCAT and UPSA-2-VIM were completed again at Visit 2. Key outcome measures for the VRFCAT included total time to complete all objectives as well as errors and forced progressions. A VRFCAT Performance Composite was created by standardizing the summation of the T-scores for the VRFCAT total time, total errors, and total progressions. Analyses examined test-retest reliability as well as performance differences and correlations between measures.

### RESULTS

High test-retest reliability was demonstrated for VRFCAT Total Completion Time in both Patient and Control groups (ICCs= 0.81 and 0.78 respectively). Test-retest reliability for the UPSA-2-VIM was also high for both groups (ICCs= 0.78 for both Patients and Controls). The test-retest reliability for the VRFCAT Performance Composite was slightly lower than the Total Completion Time and UPSA-2-VIM (ICCs = 0.77 and 0.76 for Patients and Controls, respectively).

VRFCAT Total Completion time was negatively correlated with both UPSA-2-VIM ( $r=-0.52$ ,  $p<0.001$  for patients and  $-0.66$ ,  $p<0.001$  for controls) and MCCB Composite ( $r=-0.47$ ,  $p<0.001$  for patients and  $-0.64$ ,  $p<0.001$  for controls). The VRFCAT Performance Composite was positively correlated with the UPSA-2-VIM ( $r=0.48$ ,  $p<0.001$  for patients and  $0.65$ ,  $p<0.001$  for controls) and the MCCB Composite ( $r=0.44$ ,  $p<0.001$  for patients and  $0.60$ ,  $p<0.001$  for controls).

### DISCUSSION

Findings extend previous results and indicate the VRFCAT is a highly reliable and sensitive measure of functional capacity with associations to the UPSA-2-VIM and MCCB. These results provide encouraging support for a computerized functional capacity assessment for use in schizophrenia.

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### VRFCAT SCREENSHOT EXAMPLES



## ANALYSIS & RESULTS

### DISCRIMINATION BETWEEN SCHIZOPHRENIA PATIENTS & HEALTHY CONTROLS

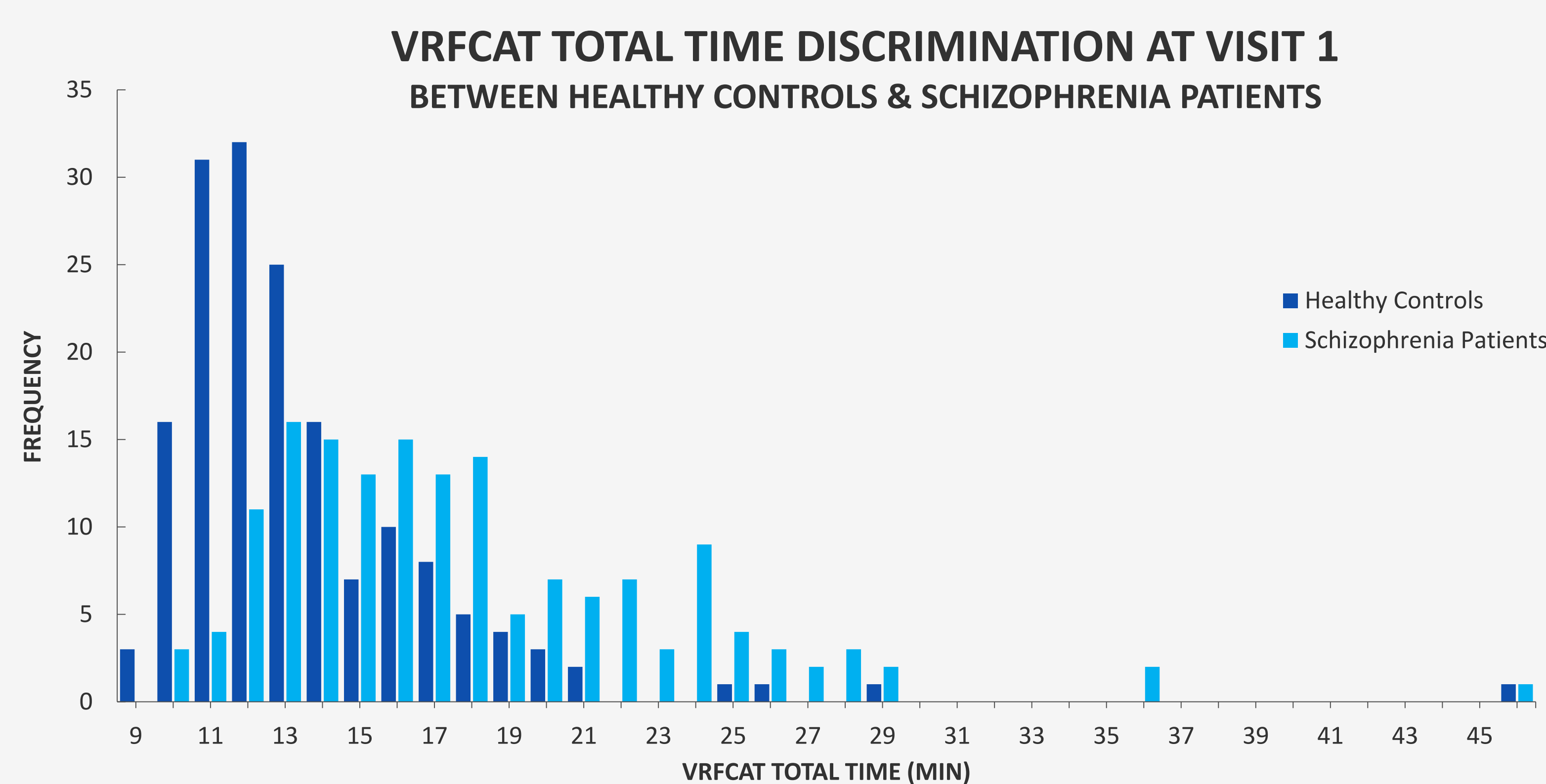
The VRFCAT Total Time, VRFCAT Performance Composite, UPSA-2-VIM, and MCCB Composite Score all demonstrated significant differences between healthy controls and schizophrenia patients at the first visit.

### TEST-RETEST RELIABILITY & PRACTICE EFFECTS

VRFCAT Total Time demonstrated strong test-retest reliability in both Patients (ICC=0.81) and Healthy Controls (ICC=0.78). The VRFCAT Performance Composite also showed strong test-retest reliability (ICC = 0.77 for Patients; ICC = 0.76 for Healthy Controls). ICCs were similar for the VRFCAT Total Time, VRFCAT Performance Composite, and the UPSA-2-VIM. The VRFCAT Total Time and VRFCAT Performance Composite showed minimal, non-significant practice effects between Visit 1 and Visit 2.

### RELATIONSHIP TO MCCB & UPSA-2-VIM

VRFCAT Total Completion time was negatively correlated with the UPSA-2-VIM ( $r=-0.52$ ,  $p<0.001$  for patients and  $-0.66$ ,  $p<0.001$  for controls) and MCCB Composite ( $r=-0.47$ ,  $p<0.001$  for patients and  $-0.64$ ,  $p<0.001$  for controls). The VRFCAT Performance Composite was positively correlated with the UPSA-2-VIM ( $r=0.48$ ,  $p<0.001$  for patients and  $0.65$ ,  $p<0.001$  for controls) and the MCCB Composite ( $r=0.44$ ,  $p<0.001$  for patients and  $0.60$ ,  $p<0.001$  for controls).



### DEMOGRAPHICS & BASELINE CHARACTERISTICS

	HC (N = 166)	SZ (N = 158)	p-value <sup>1</sup>
Age, Mean (SD)	42.7 (13.98)	43.6 (11.84)	0.246
Caucasian, N (%)	92 (55)	75 (47)	0.151
Male, N (%)	88 (53)	87 (55)	0.711
Comfortable with PC, N (%)	161 (97)	140 (89)	0.003
VRFCAT Total Time in minutes, Mean (SD)	13.6 (4.08)	17.9 (5.48)	< 0.001
VRFCAT Performance Composite, Mean (SD)	50.0 (10.03)	39.7 (16.10)	< 0.001
UPSA-2-VIM, Mean (SD)	82.9 (9.70)	71.0 (11.85)	< 0.001
MCCB Composite Score, Mean (SD)	43.7 (13.53)	28.1 (12.91)	< 0.001
Clinician SCoRS Total, Mean (SD)	-	38.2 (9.88)	-
PANSS Total, Mean (SD)	-	71.6 (21.93)	-
Clinician SLOF Total, Mean (SD)	-	120.8 (14.42)	-

Data presented are from Visit 1. The SCoRS, PANSS, and SLOF were only administered to the SZ group.

### PEARSON CORRELATION COEFFICIENTS BETWEEN THE VRFCAT, UPSA-2-VIM & MCCB

Assessment	1	2	3	4	5	6
1 VRFCAT Total Time	---	0.78	0.86	-0.94	-0.66	-0.64
2 VRFCAT Total Errors	0.67	---	0.84	-0.93	-0.59	-0.58
3 VRFCAT Total Progressions	0.89	0.85	---	-0.96	-0.60	-0.49
4 VRFCAT Performance Composite	-0.90	-0.91	-0.98	---	0.65	0.60
5 UPSA-2-VIM	-0.52	-0.40	-0.45	0.48	---	0.75
6 MCCB Composite Score	-0.47	-0.37	-0.42	0.44	0.70	---

Data presented are from Visit 1. Correlations highlighted below the diagonal are for the schizophrenia patients; those above the diagonal are for the healthy controls. All correlations were significant at the 0.001 significance level.

### TEST-RETEST RELIABILITY & PRACTICE EFFECTS FOR THE VRFCAT & UPSA-2-VIM FOR SCHIZOPHRENIA PATIENTS (HIGHLIGHTED) & HEALTHY CONTROLS

Assessment	Visit 1 Mean (SD)	Visit 2 Mean (SD)	Difference Mean (SD)	Paired t-test p-value	Cohen's d <sup>2</sup>	ICC <sup>3</sup>						
VRFCAT Total Time	13.5 (3.95)	18.0 (5.54)	13.2 (3.41)	18.3 (6.04)	0.2 (2.44)	-0.3 (3.58)	0.244	0.347	0.1	-0.1	0.78	0.81
VRFCAT Total Errors	2.2 (3.25)	5.5 (5.87)	2.2 (3.79)	5.6 (5.68)	0.0 (3.05)	-0.1 (4.80)	0.938	0.787	0.0	0.0	0.63	0.66
VRFCAT Total Progressions	0.3 (0.77)	1.1 (1.41)	0.3 (0.73)	1.1 (1.43)	0.0 (0.55)	0.0 (1.0)	0.477	0.807	0.0	0.0	0.73	0.75
VRFCAT Performance Composite	50.3 (9.74)	39.3 (16.32)	50.6 (9.90)	38.9 (16.71)	0.3 (6.81)	-0.4 (11.35)	0.540	0.657	0.0	0.0	0.76	0.77
UPSA-2-VIM	83.1 (9.75)	70.7 (11.83)	86.4 (9.68)	74.5 (12.07)	3.4 (5.69)	3.8 (7.15)	< 0.001	< 0.001	0.3	0.3	0.78	0.78

Positive differences and Cohen's d values indicate improvement from Visit 1 to Visit 2. For HC, N = 160 except for UPSA-2-VIM where N = 159; for SZ, N = 151.

## CONCLUSIONS

### THE VRFCAT DEMONSTRATES:

- Good test-retest reliability
- Strong correlations with the MCCB and UPSA-2-VIM
- Minimal practice effects
- Strong discrimination between patients and healthy controls.

Findings suggest the VRFCAT is a highly reliable and sensitive measure with associations to the UPSA-2-VIM and MCCB.

Results provide support for the VRFCAT as a co-primary outcome measure of functional capacity assessment for use in schizophrenia trials.

## NOTES & ACKNOWLEDGEMENTS

### DATA ANALYSIS NOTES

- <sup>1</sup> A Wilcoxon Two-Sample Test was used to test for significant differences between HC and SZ
- <sup>2</sup> Cohen's d is the mean difference divided by the pooled SD from Visit 1 and Visit 2. The sign of the effect size has been changed for the VRFCAT measures such that a positive effect size denotes improvement in performance between screening and baseline.
- <sup>3</sup> The intraclass correlation coefficient (ICC) is defined as the proportion of total variance attributed to between-subject variance:  $\sigma^2_b / (\sigma^2_b + \sigma^2_e)$ .

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