

# Validity and Reliability of the Auditory Consonant Trigrams Test in Multiple Sclerosis

M. Abu-AIHawa<sup>1,2</sup>, J.A. Berard<sup>2,3</sup>, L. Osman<sup>3</sup>, L. Gresham<sup>3</sup>, L.A.S. Walker<sup>1,2</sup>

<sup>1</sup>Carleton University, <sup>2</sup>Ottawa Hospital Research Institute, <sup>3</sup>University of Ottawa



## Introduction

- The Brief International Cognitive Assessment for MS (BICAMS) is a brief, cognitive monitoring tool developed for MS Clinics that can be administered by health care professionals who may not have neuropsychological training<sup>1,2</sup>.
- The BICAMS, however, fails to evaluate working memory; a common area of cognitive impairment in people with MS (PWMS)<sup>3</sup>.
- Auditory Consonant Trigrams (ACT) is a test of working memory under conditions of interference that only takes 5 minutes to administer.
- ACT can supplement the BICAMS assessment for a more comprehensive evaluation of cognition with little added time commitment.

## Objectives

- The goals of the present study are:
  - to determine if ACT can discriminate between people with MS and healthy controls
  - to establish the psychometric properties of ACT.

## Method

### Subjects

- 57 individuals with a confirmed diagnosis of MS
  - 16 males, 41 females
  - 44 RRMS, 9 SPMS, 4 PPMS
  - mean age 45.44 (9.93); mean education 15.44 (2.68)
  - mean disease duration in years 10.11 (7.72)
- 51 healthy controls
  - 7 males, 44 females
  - mean age 41.92 (10.78); mean education 16.31 (2.11)

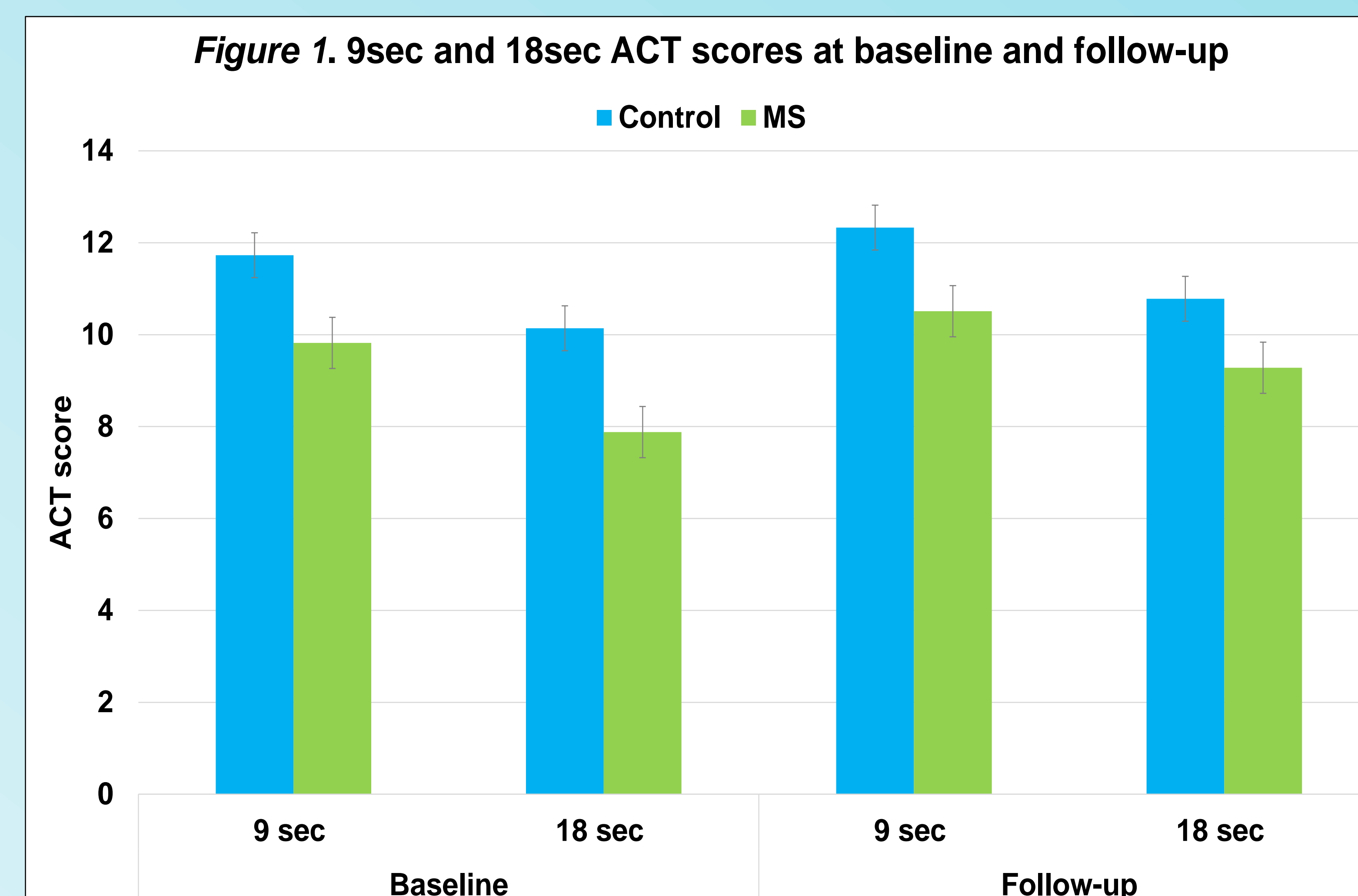
### Procedure

- Participants completed ACT (9sec and 18sec delay intervals) at baseline and after a two-weeks follow-up as part of a larger battery of tests which also included the BICAMS.

### Analyses

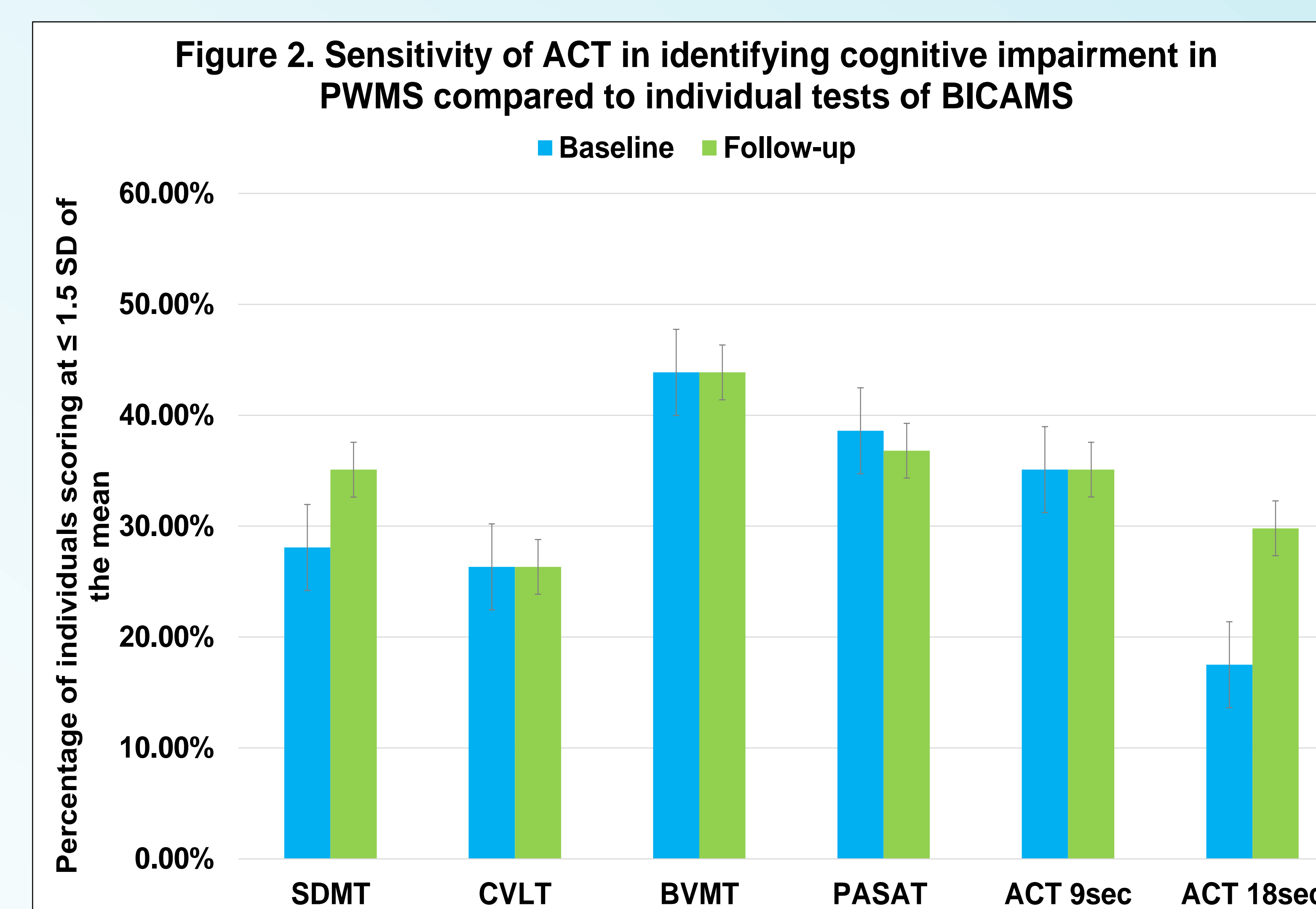
- After homogeneity of variance was established, one-way ANOVAs were performed to evaluate group differences
- Test-retest reliability was evaluated using Pearson correlational analyses
- Sensitivity of the various tests was established via the percentage of individuals scoring at or below 1.5 standard deviations below the mean

## Results



**Table 1.**  
*Test-retest reliability of ACT scores at baseline and follow-up for PWMS and control groups.*

Delay	Control		MS	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
9 sec	.258	.067	.525	< .001
18 sec	.395	.004	.559	< .001



### Group Differences

- The MS group performed significantly worse than the HC group on ACT 9sec and 18sec delay intervals at both baseline and follow up
  - 9sec baseline:  $F(1,106) = 13.21, p < .001$
  - 9 sec follow-up:  $F(1,106) = 16.60, p < .001$
  - 18sec baseline:  $F(1,106) = 12.18, p = .001$
  - 18sec follow-up:  $F(1,106) = 7.214, p = .008$
- Figure 1 depicts performance in the ACT at baseline and follow-up

### Test-retest Reliability

- In the MS sample, test-retest reliability was moderate for the ACT 9sec and 18sec intervals (Table 1)
  - 9sec:  $r = .52, p < .001$
  - 18sec:  $r = .57, p < .001$

### Sensitivity

- Figure 2 represents the sensitivity of ACT compared to BICAMS.
- The 9sec ACT was more sensitive to cognitive impairment than the CVLT at both baseline and follow-up.

## Discussion

- The current findings demonstrate that ACT discriminated between people with MS and healthy controls
- ACT was able to identify impairment in a large portion of the sample to a similar degree as a previously validated measure (BICAMS)
- In conclusion, given that ACT assesses working memory, while BICAMS does not, clinicians may consider supplementing evaluations in the clinic with this measure.

## References

- Langdon, D.W., Amato, M.P., Boringa, J., Brochet, B., Foley, F., Fredrikson, S., Hämäläinen, P., Hartung, H-P, Krupp, L., Penner, I.K., Reder, A.T. & Benedict, R.H.B. (2012). Recommendations for a Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS). *Multiple Sclerosis Journal*, 18(6), 891-898.
- Benedict, R.H.B., Amato, M.P., Boringa, J., Brochet, B., Foley, F., Fredrikson, S., Hämäläinen, P., Hartung, H-P, Krupp, L., Penner, I.K., Reder, A.T., & Langdon, D.W. (2012). Brief International Cognitive Assessment for MS (BICAMS): international standards for validation. *BMC Neurology*, 12, 55.
- Parmenter, B.A., Shucard, J.L., Benedict, R.H., & Shucard, D.W. (2006). Working Memory deficits in multiple sclerosis: Comparison between the n-back task and the Paced Auditory Serial Addition Test. *Journal of the International Neuropsychological Society*, 12, 677-687. doi:10.1017/S1355617706060826.

## Acknowledgements

The authors would like to thank the research participants for their time and effort. Their contributions are invaluable. The authors would also like to thank the University of Ottawa Brain and Mind Research Institute for their financial support.