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Quantitative Motor Performance is Indicative of Impairments in Specific Cognitive Domains Among Persons with Multiple Sclerosis

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BACKGROUND

- >85% of individuals with Multiple Sclerosis (MS) report walking dysfunction as a primary complaint.¹
- >65% of individuals with MS report specific cognitive impairment that interferes with daily life.²
- Not surprisingly, individuals with MS also present with impairments in dual-tasks, or simultaneous motor-cognitive tasks (i.e., walking while talking).³
- However, little is known about the specific relationships among motor and cognitive performance.

METHODS

- 18 persons with MS participated: mean (SD) age: 51.3 (10.5) years; BMI: 26.8 (8.0); symptom duration: 15.4 (10.8) years; 17 females. 89% of individuals were taking disease modifying therapies, 22% were taking dalfampridine.
- In a single session, individuals completed: quantitative measures of gait, dual-task, and cognitive performance. Participants also completed survey measures of pain and quality of life.

Motor Tests

Cognitive Tests

Simple Motor Measures

- Forward Walking (FW) on GaitRite
- Timed 25 Foot Walk (T25FW)
- Timed Up and Go (TUG)
- Two Minute Walk Test (2MWT)

Complex Motor Measures

- Backward Walking (BW) on GaitRite
- Six-Spot Step Test (SSST)

Dual-Task Measures

- TUG- Cognitive (TUG-Cog)
- Walking While Talking Test (WWTT)

- Brief Visuospatial Memory Test (BVMT)
- Controlled Oral Word Association Test (COWAT)
- California Verbal Learning Test (CVLT)
- Delis Kaplan Executive Function System-Sorting (DKEFS)
- Judgment of Line Orientation (JLO)
- Paced Auditory Serial Addition Test (PASAT)
- Symbol Digit Modalities Test (SDMT)

Survey Measures:

- Short-Form 36 Quality of Life
- Brief Pain Inventory
- MS Walking Scale 12

RESULTS

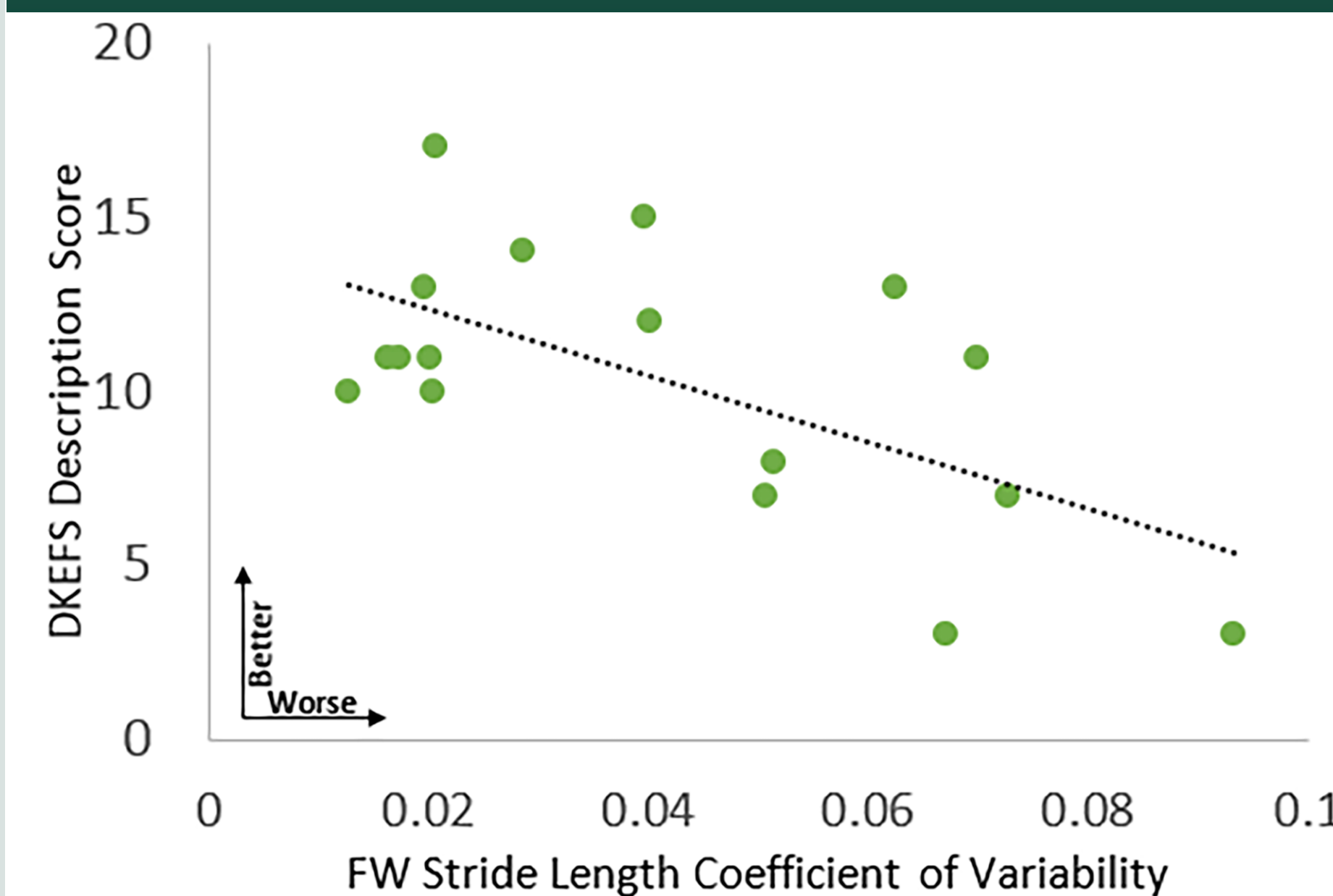
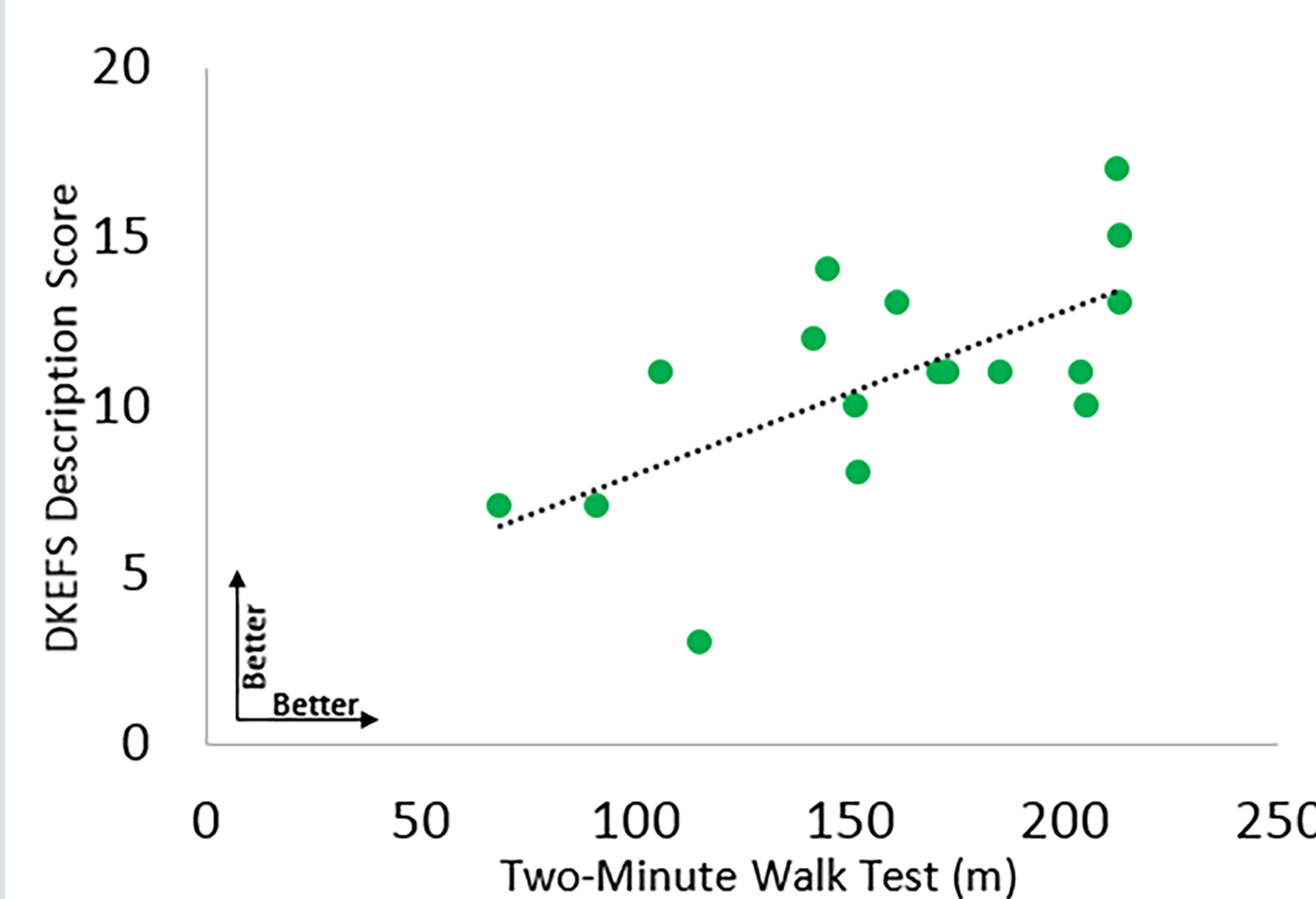


Figure 1. Lower coefficient of variability in forward walking ($r=0.621$; $p=0.008$) and greater distance walked on the 2MWT ($r=0.588$; $p=0.013$) was associated with better performance on the DKEFS test of executive function.



Higher scores on the DKEFS were also associated with better performance on the T25FW ($r=-0.626$; $p=0.005$), TUG ($r=-0.502$; $p=0.034$), FW lower double support % ($r=-0.638$; $p=0.006$) and lower FW stance time ($r=-0.619$; $p=0.008$).

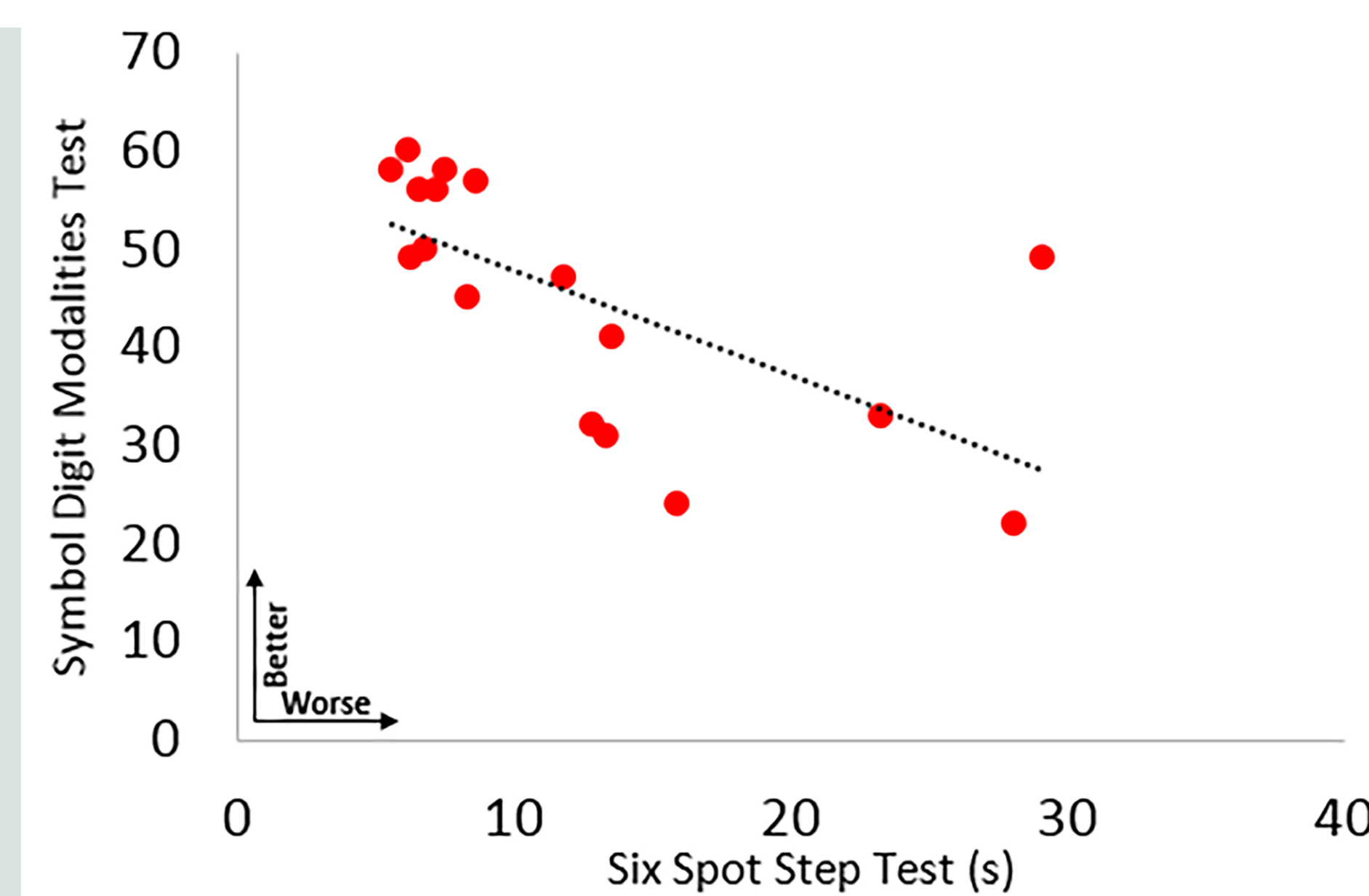


Figure 2. Better performance on the SSST ($r=-0.762$; $p=0.001$) and less time spent in BW double support ($r=-0.738$; $p=0.001$) was associated with better performance on a test of processing speed (SDMT).

Higher scores on the SDMT were also associated with better performance spatiotemporal measures of BW and lower BW coefficients of variability ($r>0.516$; $p<0.041$ for all).

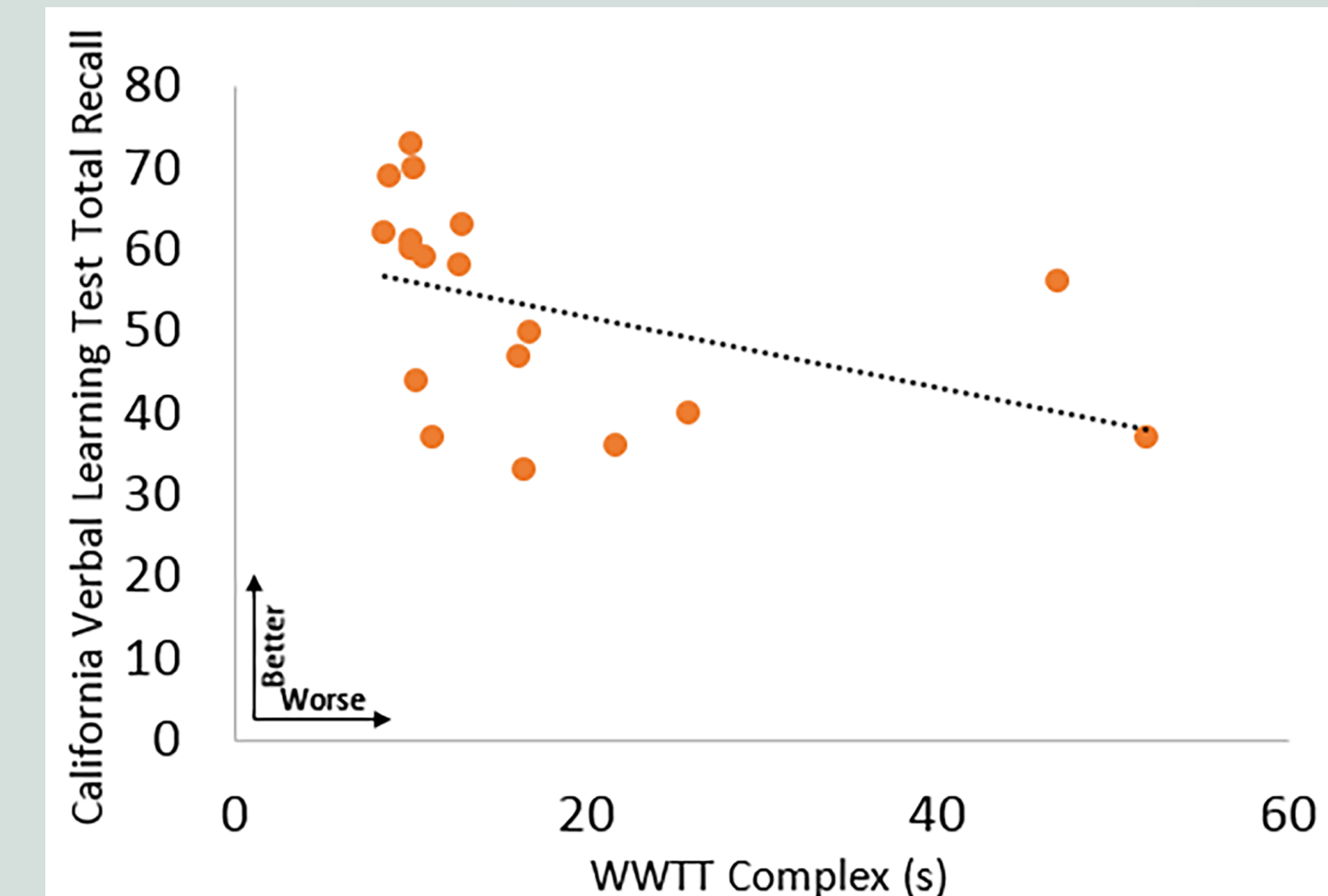
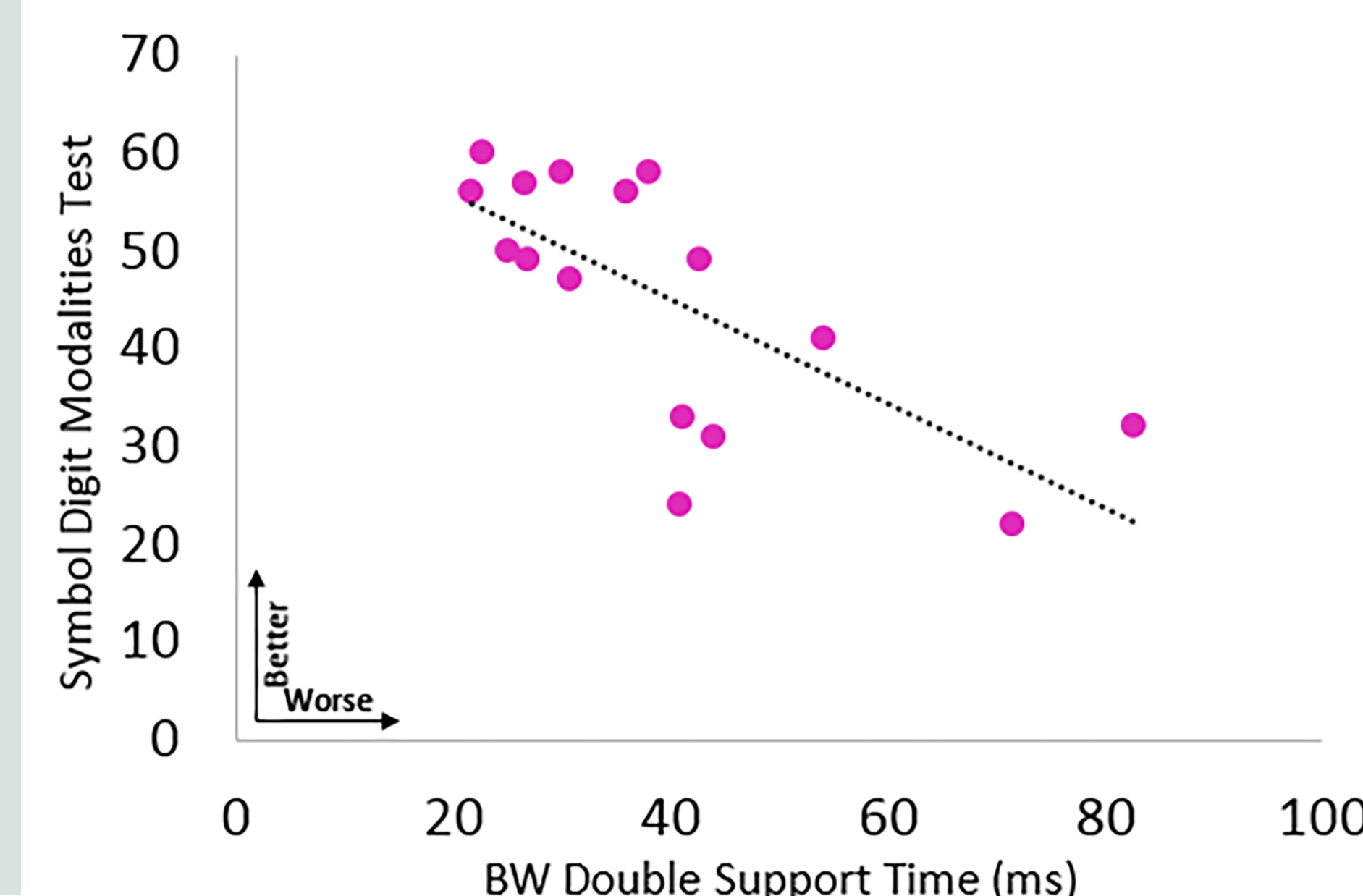


Figure 3. Faster time to complete the WWTT complex condition, which requires the participant to recite every other letter of the alphabet while walking was associated with better performance on the CVLT, a test of new learning and memory ($r=-0.697$; $p=0.001$).

- Better performance on simple walking measures (T25FW, TUG, 2MWT, FW) was significantly associated with executive function (PASAT: $r>|0.595|$; $p<0.015$ and DKEFS) tasks. (Figure 1).
- Better performance on complex walking tasks (SSST, BW) was strongly associated with better performance on processing speed (SDMT) tasks. (Figure 2).
- Better performance on dual-tasks (Tug-Cog and WWTT) was strongly associated with better performance on tasks of visuospatial memory (BVMT: $r>0.582$; $p<0.011$) and new learning and memory (CVLT: $r>0.564$; $p<0.015$). (Figure 3).

CONCLUSIONS

- Specific cognitive domains are associated with complex motor performance; dual-task and cognitive performance strongly relate to retrospective reports of falls and near-falls in individuals with MS.
- Assessment of objective motor and cognitive measures may improve the classification of individuals with MS and provide insight into targeted goals for rehabilitation.
- Future analysis will include inclusion of demographic confounders and prediction modeling from longitudinal data collection to determine potential biomarkers of long-term function.

1. Kelleher KJ et al., 2010; *Disabil Rehabil*. Doi: 10.3109/09638280903464497
2. Patti F et al., 2009; *Mult Scler*. Doi: 10.1177/1352458509105544
3. Hamilton F et al., 2009; *Mult Scler*. Doi: 10.1177/1352458509106712