

Predicting Changes in Employment Status using the Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS)



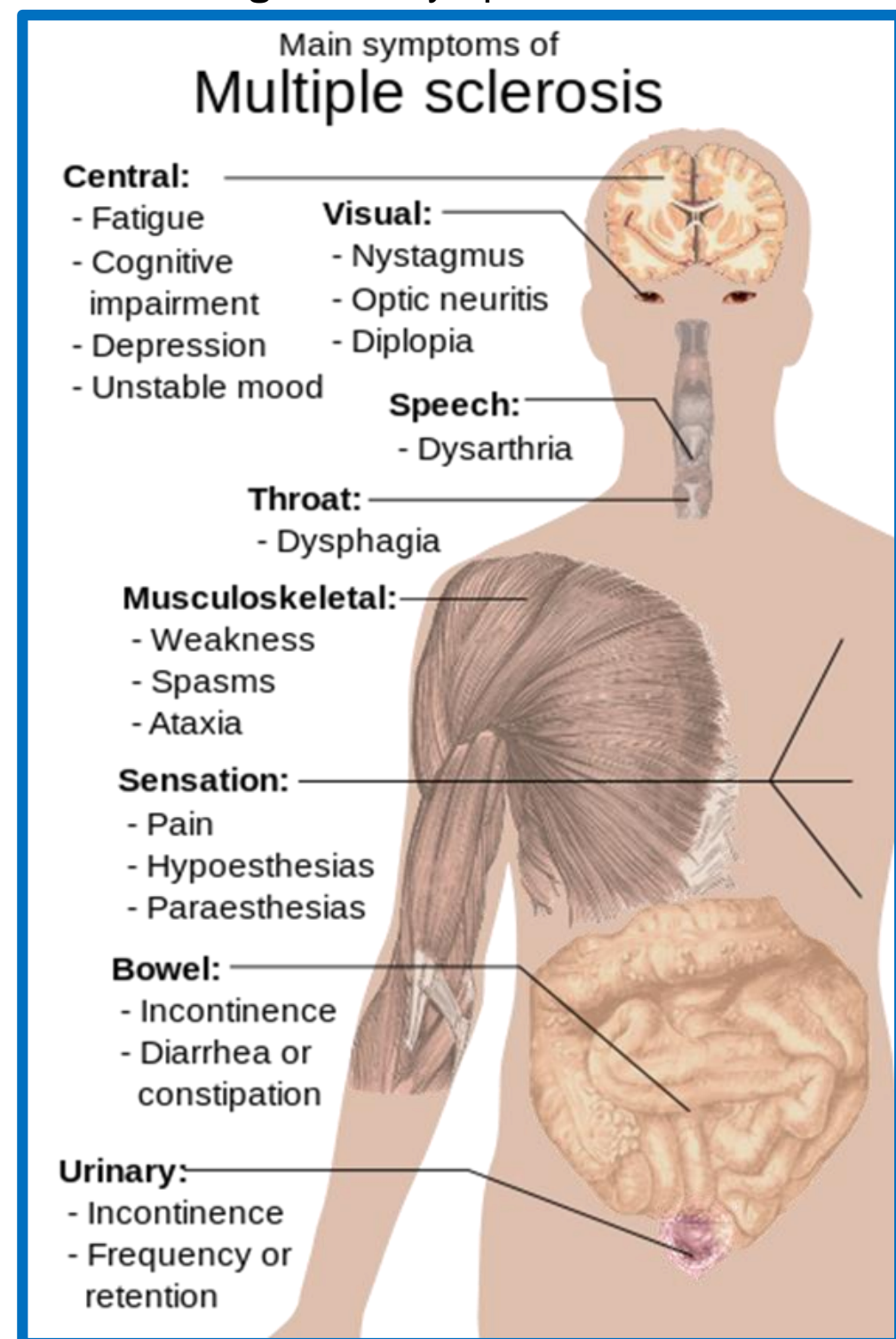
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Background

- Multiple Sclerosis (MS) is a chronic, progressive neurological disorder that presents with multiple disease courses and different symptoms.

Figure 1: Symptoms of MS



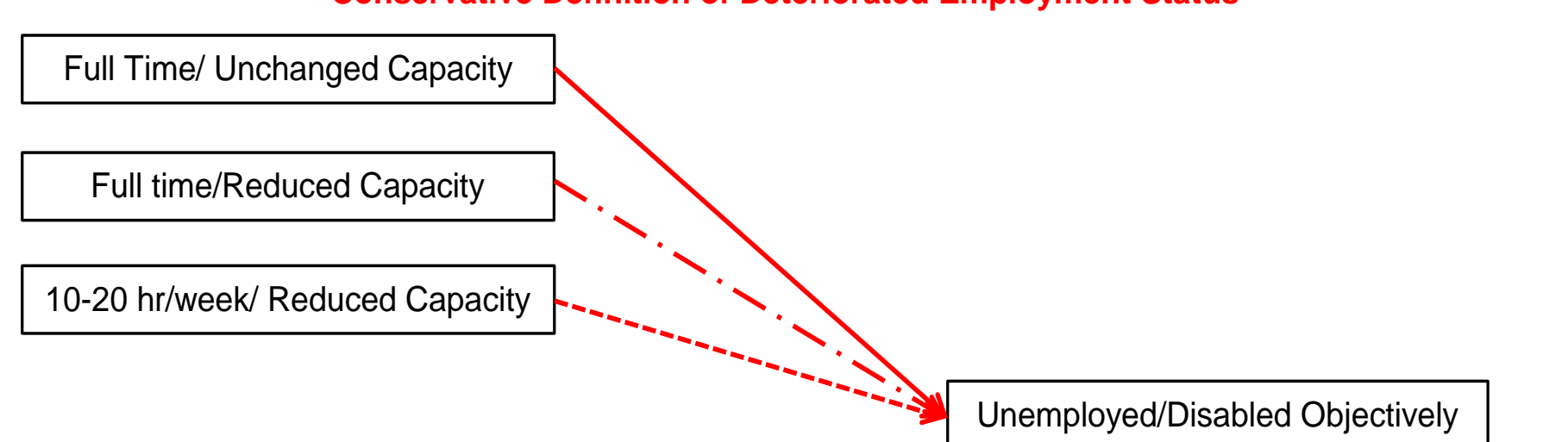
- As shown in Fig. 1, MS can affect multiple functional domains and has a variable symptom presentation and trajectory among people.
- Cognitive impairment affects 40-65% of patients and has been shown to significantly impact employment status.
- A consequence of MS could be potential job loss. Research has estimated about 50% of MS patients will lose their job within 5 years of diagnosis.
- Job loss is an important event due to the implications, including reduced social engagement, monetary issues, and quality of life changes that may occur due to it, therefore, it's important to study the relationship between employment loss and disease.
- In order to identify people at risk for employment loss, valid reliable measures of cognitive function over time are necessary.
- Currently, there is a need for a gold standard measure of the multiple cognitive domains most commonly influenced by MS.
- The BICAMS is a short Neuropsychological test battery, taking about 15 minutes to administer, that involves tests of verbal memory, visuospatial memory, and information processing.

Objectives

- To validate BICAMS as a method for detecting change in vocational status
- To evaluate cognitive function in employed and unemployed patients
- To characterize what constitutes a clinically meaningful change in cognition with respect to vocational status

Figure 2: DES Grouping Criteria

Conservative Definition of Deteriorated Employment Status



Design & Methods

- Retrospective longitudinal study design in which demographic, neuropsychological, and employment data were analyzed for 283 patients with MS. Demographic information is shown in Table 1.

Table 1. Baseline demographic characteristics for MS patient groups

Variables	All (n=283)	SES (n=108)	DES (n=35)	Unemployed (n=140)
Age at Time 1 (years)	44.7 (8.8)	42.7 (9.1)	46.7 (9.2)	45.8 (8.1)
Gender (n, % female)	219 (77.4%)	89 (82.4%)	29 (82.9%)	101 (72.1%)
MS Duration at Time 1* (years)	10.0 (7.8)	7.5 (5.8)	11.64 (8.4)	11.5 (8.4)
MS Type* (n, %RRMS)	215 (77.3%)	97 (90.7%)	26 (78.8%)	92 (66.7%)
Time Between NP Time Points (years)	4.8 (2.9)	4.7 (2.8)	4.4 (2.8)	4.5 (2.6)

*For all that reported variable

- Participants were administered the BICAMS battery at two separate time points on average 4.8 (± 2.8) years apart.
 - The Brief Visuospatial Memory Test-Revised (BVMTR) is a test of visuospatial learning and memory where patients recall and recognize visual displays at different times. (Sample shown in Fig. 3)
 - The California Verbal Learning Test, second edition (CVLT-II) is a test of verbal learning and memory where patients listen to a list of words and are asked to recall and recognize them at different times. (Sample shown in Fig. 4)
 - The Symbol Digit Modalities Test (SDMT) is a test of processing speed and working memory where patients state numbers corresponding to matching symbols. (Sample shown in Fig. 5)

Figure 3: Sample BVMTR Stimulus

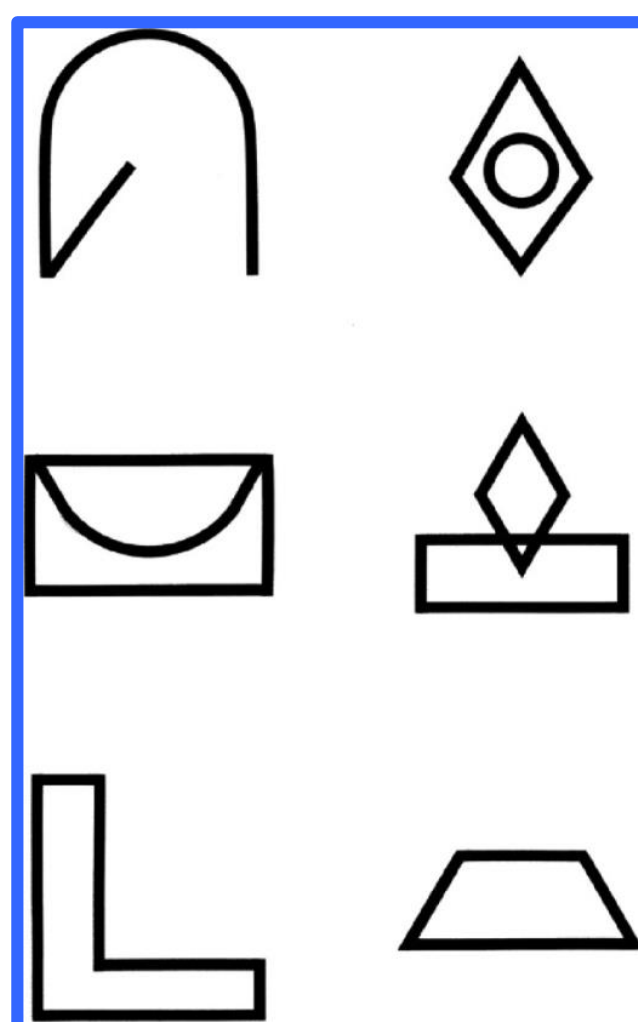


Figure 4: Sample CVLT-II Stimulus

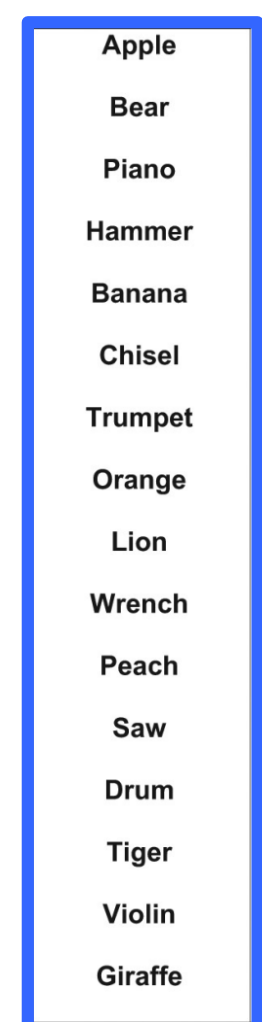


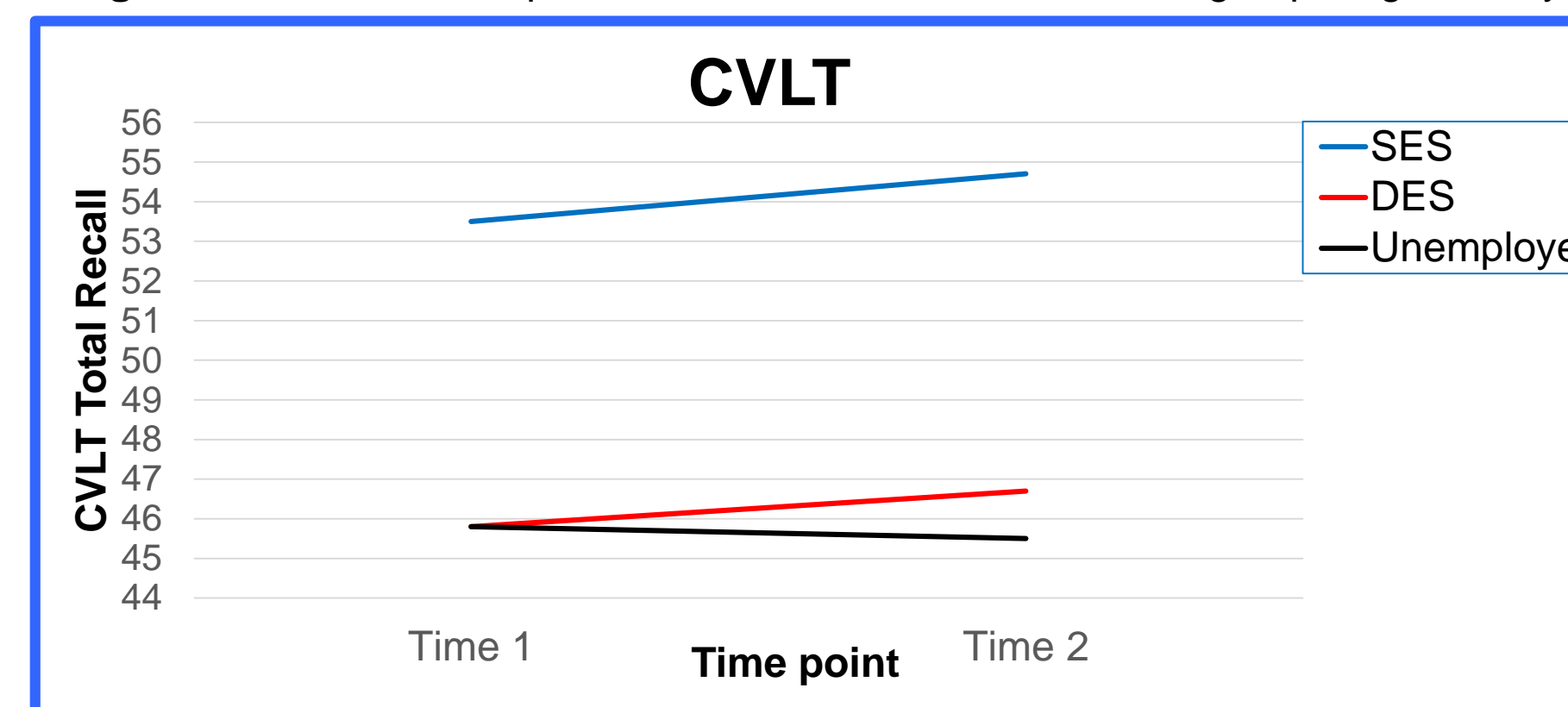
Figure 5: Sample SDMT Stimulus



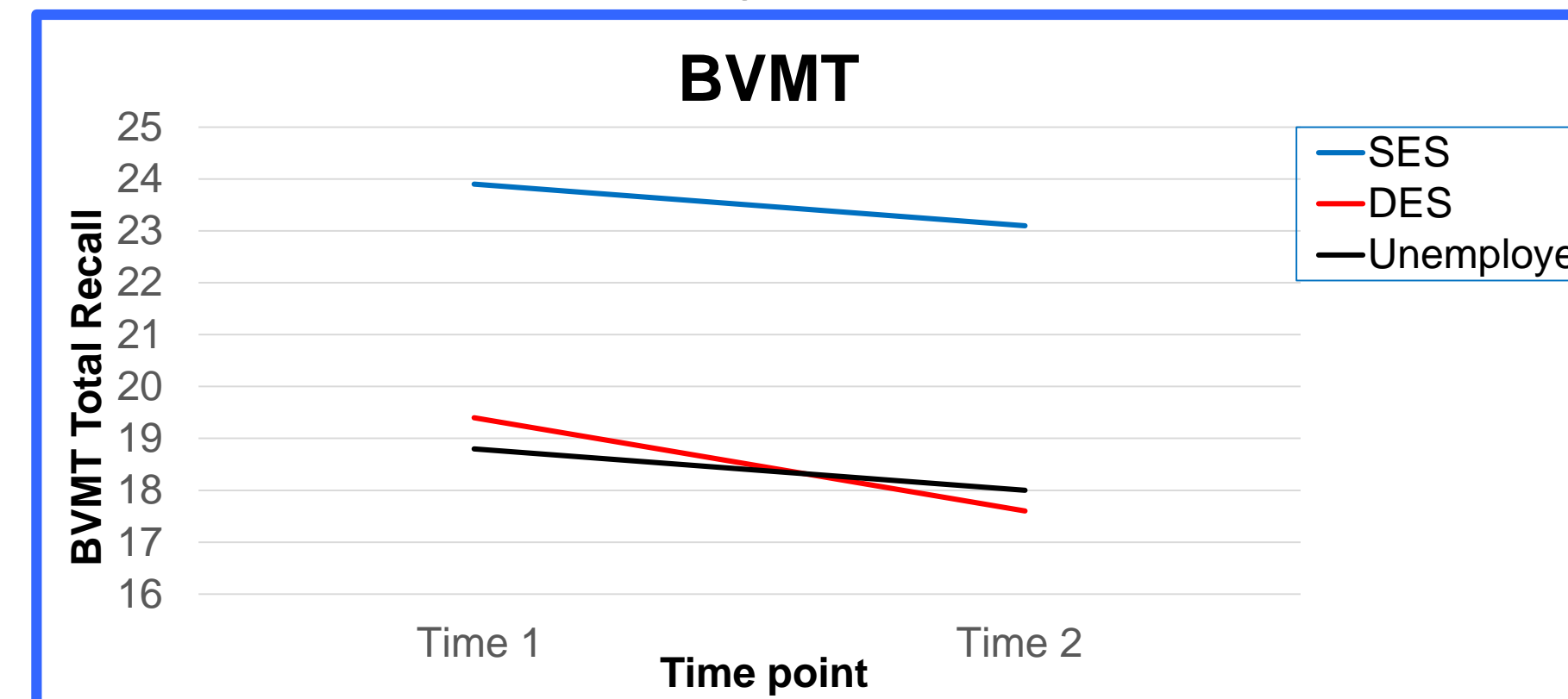
- Participants were categorized into three groups based on their employment status:
 - Stable Employment Status (SES) refers to no reported change in work responsibilities between time points.
 - Deteriorated Employment Status (DES) refers to reported reduction in work responsibilities from the first to second time point, specifically a deterioration from working to becoming unemployed and receiving Social Security Disability. (Shown in Fig. 2)
 - Participants that were unemployed at both time points were placed in an Unemployed group.
- Data were analyzed using SPSS 22.0
- The differences in performance on BICAMS measures among employment groups were examined using a two-way mixed-model ANOVA with employment status (DES, SES, and unemployment) as between-subjects factors and time as a within-subjects factors.
- Further mixed-model ANOVAs were performed using a sub-sample of participants with EDSS, T25FW and BDI-FS data, respectively.

Results

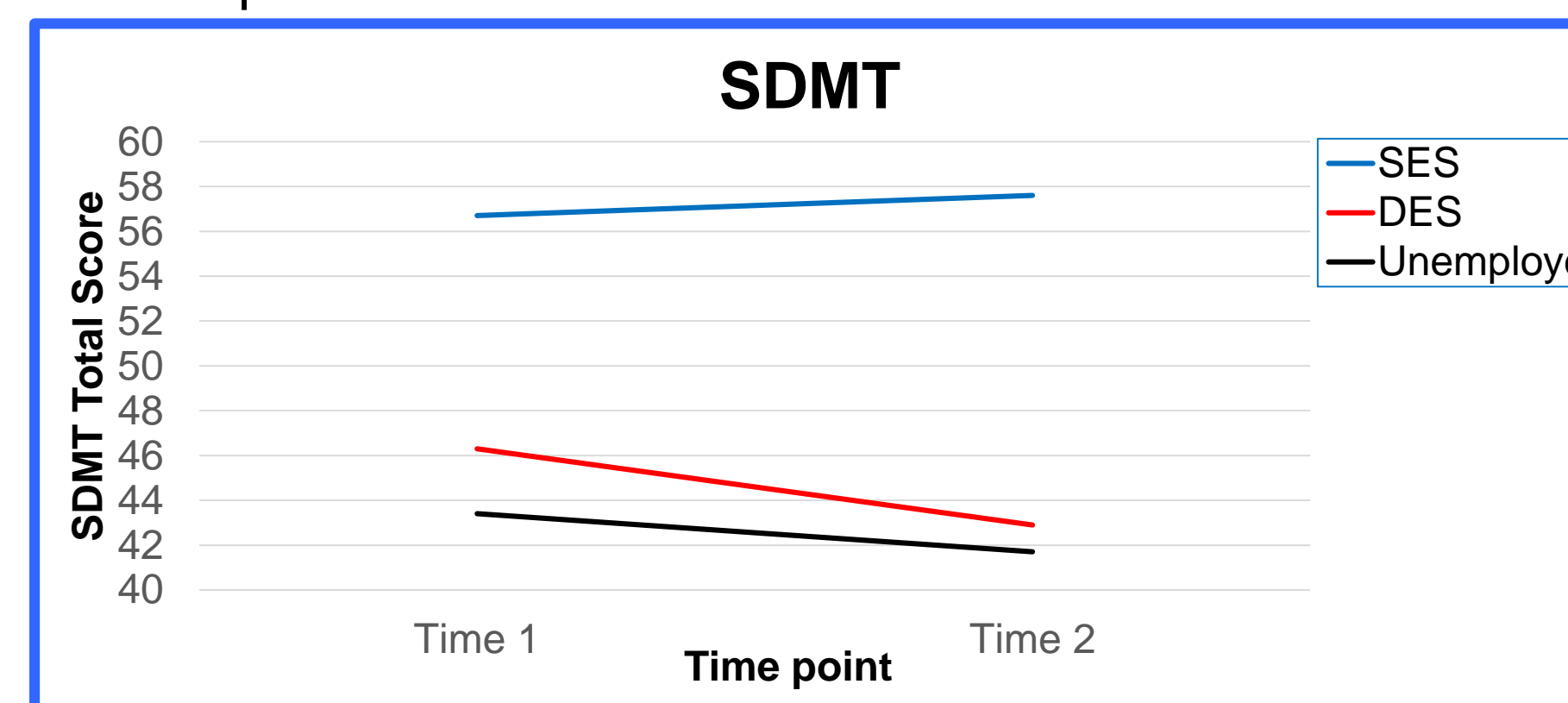
Figures 6, 7, and 8: Graphs of the mean test scores for each group longitudinally



- Significant difference in CVLT scores between at least one employment status group



- Significant difference in BVMTR scores between at least one employment status group
- Significant difference in BVMTR scores between testing time points



- Significant difference in SDMT scores between at least one employment status group
- Significant difference in SDMT scores between testing time points
- SDMT Scores are influenced by both the time point and employment status group

Table 2: Mean Scores for each group on BICAMS Measures

	Time Point	SES Mean Score	DES Mean Score	Unemployed Mean Score
CVLT-2	1	53.54	45.80	45.82
	2	54.74	46.74	45.53
BVMTR	1	23.89	19.40	18.76
	2	23.13	17.63	17.99
SDMT	1	56.69	46.29	43.44
	2	57.62	42.91	41.68

- Other Findings:
 - Significant difference in EDSS scores between at least one employment status group
 - Significant difference in EDSS scores between testing time points
 - Significant difference in Timed 25-ft Walk scores between at least one employment status group
 - Significant difference in BDI-FS scores between at least one employment status group
 - Significant difference in BDI-FS scores between testing time points

Discussion

Table 3: F and p values of the General Linear Model, with significant p-values in red

Test	Time	Employment Status	Time x Employment Status
CVLT-2	F	0.58	21.57
	p	0.447	< 0.001*
BVMTR	F	7.74	20.09
	p	0.006*	< 0.001*
SDMT	F	7.58	49.73
	p	0.006*	< 0.001*
EDSS	F	47.88	25.38
	p	< 0.001*	< 0.001*
T25FW	F	3.67	7.35
	p	0.057	0.001*
BDIFS	F	0.77	15.08
	p	0.380	< 0.001*

* Statistical Significance at p < 0.05

- F and p-values from the General Linear Model can be found in Table 3
- Our preliminary findings suggest the SES group significantly differs from the DES and unemployed groups on all BICAMS measures at both time points.
- This evidence suggests that subjects who deteriorate in status perform like unemployed patients, even before job loss, distinguishing between the SES and DES groups at the initial time point.
- This shows that performance at one time point could predict job loss/deterioration in work status before it occurs.
- To validate these claims, Post Hoc analyses should be completed.
- Patients' performance on BICAMS measures potentially could be used to identify risk for unemployment. This would provide a place to intervene or implement accommodations in order to prevent job loss.
 - Results on BICAMS measures can inform as to what types of accommodations are necessary for each individual.
- Subject groups not matched on all demographic variables, indicating different starting points among them
- Supports the utility of the BICAMS measures to detect and monitor clinically meaningful change in cognition

Future Research

- Future studies examining cognitive function in patients with MS and their implications on employment are warranted
- Apply this model to other measures of mood, fatigue, and motor function, which are other clinically relevant variables
- Apply this model to a more liberal definition of Deterioration in employment status, allowing for any reduction in hours or responsibilities to be considered DES

References

- Johnson et al. *Arch Phys Med Rehabil*; 85(2): 201-9
- Langdon et al. *Multiple Sclerosis Journal*; 0(0):1-8.
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