



Functional Systems Organization of Multiple Sclerosis Living Disability Scale Items

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Abstract

Objectives: To organize living disability report items into domains of functional neurological systems and assess the interpretability of the resulting scores.

Methods: Retrospective chart review was conducted for multiple sclerosis (MS) patients with neuropsychological testing data ($N = 68$), including the Incapacity Status Scale (ISS) and measures across multiple physical and cognitive domains. The ISS was assessed for internal consistency, and a varimax-rotated principal component analysis was performed. Averages of the items comprising each extracted component were compared to physical and cognitive measures by means of Pearson product-moment correlations.

Results: Two ISS questions were excluded from analysis due to high non-response rates: medical problems (86.8%) and sexual function (64.5%). A third, vision, was excluded due to poor internal consistency (item-total correlation = .137). 13-item ISS showed strong internal consistency (Cronbach's $\alpha = .890$). Four components were extracted based on eigenvalues greater than 1.000, corresponding to pyramidal/cerebellar, bowel/bladder, brainstem, and cerebral functions. Averages of the items associated with extracted components correlated significantly with multiple external measures of function.

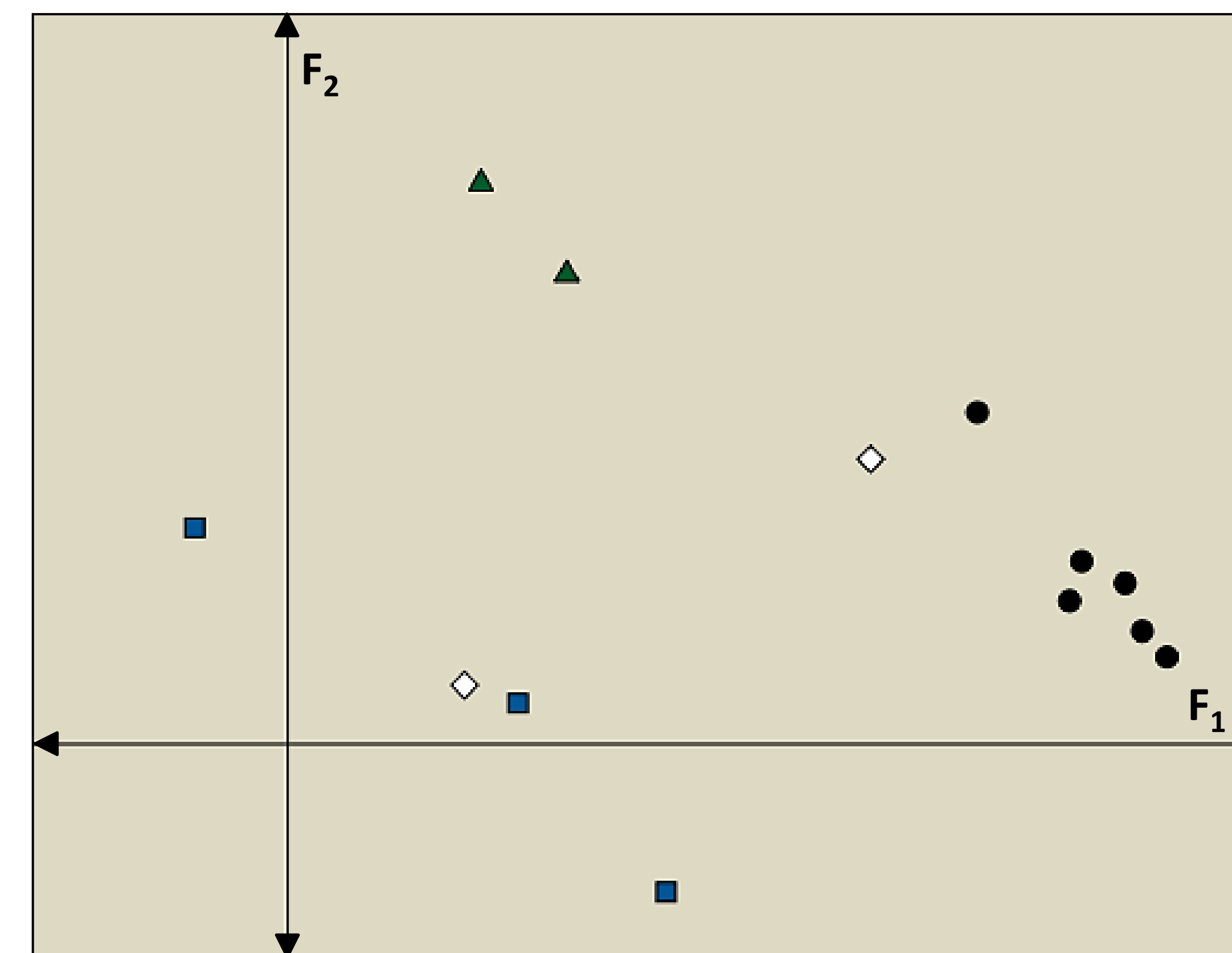
Conclusions: Living disability items map onto associated functional neurological systems as used in the Expanded Disability Status Scale (EDSS). Scores representing these functional systems, produced through ratings of subjective disability, relate strongly to external functional measures.

Background

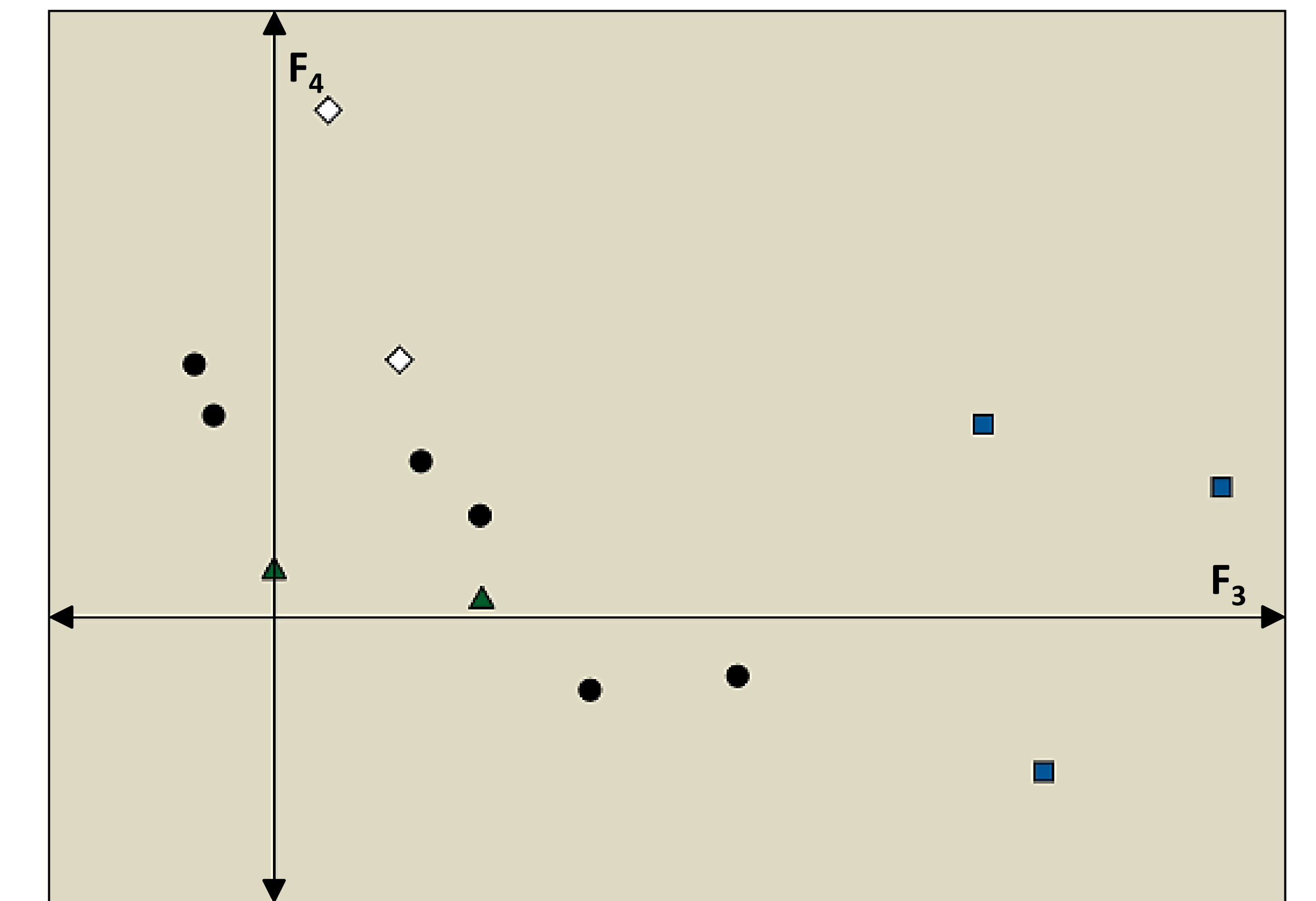
Multiple scales are capable of measuring elements of living disability and disease severity in MS. The Incapacity Status Scale (ISS) and Expanded Disability Status Scale (EDSS) are two such measures, with the former assessing disability and the latter assessing neurological function based on functional systems scores.¹ While there is a face-valid association between these constructs, prior research has not established a method of interpreting them in a joint context.²

Methods and Results

- Charts of 68 patients at an outpatient MS clinic were examined retrospectively.
- Principal component analysis with varimax rotation was performed to extract factors from the ISS, with a total of four components yielding eigenvalues greater than 1.000, and explaining 74.68% of the variance in the scale.



- Pyramidal/Cerebellar (Stair Climbing; Ambulation; Transfers; Bathing; Dressing; Grooming)
- ▲ Bowel/Bladder
- ◇ Brainstem (Speech/Hearing; Feeding)
- Cerebral (Mood; Cognition; Fatigue)



- ISS items were assigned to components based on highest factor loadings with one exception (Feeding, discussed in Limitations).
- Average scores from the items comprising each factor were calculated and compared to available neuropsychological data.
- Pyramidal/cerebellar score was predictive of 9-hole peg test performance, averaged across three trials, for both dominant ($r = .629, p < .001$) and non-dominant hands ($r = .560, p < .001$), as well as timed 25-foot walk ($r = .446, p = .001$).
- Brainstem score predicted phonemic ($r = -.346, p = .002$) and semantic fluency ($r = -.370, p = .002$) on the Controlled Oral Word Association Test, 3-second ($r = -.343, p = .006$) but not 2-second Paced Auditory Serial Addition Test ($r = -.182, p = .188$), Symbol Digit Modalities Test ($r = -.436, p < .001$) and Stroop Color and Word Test ($r = -.319, p = .009$).
- Cerebral score predicted Hospital Anxiety and Depression Scale (A: $r = .284, p = .034$; D: $r = .263, p = .049$), Patient Health Questionnaire ($r = .280, p = .039$), Beck Depression Inventory ($r = .319, p = .005$), Fatigue Scale for Motor and Cognitive Functions (C: $r = .419, p = .006$; M: $r = .449, p = .003$; T: $r = .453, p = .003$), and Fatigue Severity Scale ($r = .285, p = .037$).

Conclusions and Limitations

- For weighting, and conceptually to reflect brainstem-mediated dysphagia, Feeding was assigned to the extracted brainstem component. Likely due to its motoric demands, feeding loaded more strongly onto pyramidal/cerebellar (.581) than brainstem functions (.424). Other loadings ranged .598 to .876. Average loading strength was .676.
- Living disability items load onto expected functional systems domains, and are strongly predictive of objective and subjective external measures of function.
- Disability instruments can be related conceptually and statistically to functional neurological system scores, as used in the EDSS, to provide a viable means of estimating disease severity from reported disability.

References

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2. Cohen, R. A., Kessler, H. R., & Fischer, M. (1993). The extended disability status scale (EDSS) as a predictor of impairments of functional activities of daily living in multiple sclerosis. *Journal of the Neurological Sciences*, 115(2), 132-135.