

Quantifying short-term changes in daily functioning: Development of change scores

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Background

- Daily functioning is critical to distinguish mild cognitive impairment from dementia.
- Subtle functional changes likely occur before frank functional impairment.
- Performance-based functional measures may help objectively capture these early, subtle changes.
- Standardized regression-based (SRB) change scores quantify changes in test scores.
- This study used SRBs to quantify one-week change on a performance-based measure of daily functioning, the Independent Living Scales (ILS).

Methods

Participants

- 186 cognitively unimpaired older adults (Table 1).

Procedures

- Administered the ILS at baseline (Time 1) and 1 week later (Time 2).
- Five subscales and the Full Scale score were examined (Table 1).

Analyses

- Time 1 ILS scores and age, education, sex, retest interval, and Wide Range Achievement Test (WRAT) Reading were regressed to predict Time 2 ILS scores (Hammers et al., 2021).

Table 1. Participants and ILS scores		
Female %	70%	
Age (years)	74.85 (5.75)	
Education (years)	16.90 (2.00)	
Retest interval (days)	7.79 (3.00)	
WRAT Reading (std score)	109.96 (9.00)	
ILS scores	Time 1	Time 2
Full Scale score (FSS)	109.24 (6.33)	111.61 (6.19)
Memory and Orientation (M&O)	15.03 (1.06)	15.42 (0.78)
Managing Money (MM)	32.08 (2.14)	32.34 (1.88)
Home and Transportation (H&T)	28.04 (1.54)	28.34 (1.55)
Health and Safety (H&S)	36.97 (2.08)	37.50 (2.00)
Social Adjustment (SA)	19.09 (1.31)	19.19 (1.29)

Raw scores for ILS except FSS, which is a std score (M=100. SD=15).

Predicting change on a functional scale

Table 2. SRB prediction equations from cognitively unimpaired participants that predict Time 2 ILS scores.

ILS Score	R ²	Equation	SEE
FSS	0.49	36.78+(T1×0.69)	4.44
M&O	0.18	10.78+(T1×0.23)–(Gender×0.36)+(WRAT×0.01)	0.71
MM	0.30	20.72+(T1×0.46)–(Age×0.04)	1.59
H&T	0.11	19.07+(T1×0.33)	1.47
H&S	0.44	12.89+(T1×0.57)+(WRAT×0.04)–(Retest×0.08)	1.52
SA	0.50	5.94+(T1×0.70)	0.92

Note: Full Scale scores are age-corrected standard scores, and subscale scores are raw scores. Age is in years. Gender is coded as 0 for Females and 1 for Males, Retest = Retest interval is in days. SEE=Standard Error of the Estimate. T1= Observed Time 1 score, WRAT=Wide Range Achievement Test Standard Score.

$$\text{SRB z- score} = \frac{\text{Observed T2} - \text{Predicted T2}}{\text{SEE}}$$

Proof-of-concept for improving accuracy of functional change

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Results

- Across the ILS, one-week retest scores were significantly ($p<0.001$) predicted from their respective baseline scores, with regression models approximately accounting for 11-50% of the variance (see Table 2).
- While baseline performance was the strongest predictor, demographic and other variables contributed additional variance (2%-7%) in 3 of 8 models.

Example of calculating FSS if T1 = 100 and T2 = 90

FSS Predicted T2 =
 $36.78 + (100 \times .69) = 105.78$

SRB z-score =
 $90 - 105.78 / 4.44 = -3.55$

Discussion

- SRB z-scores on the ILS provide a systematic method for quantifying change in daily functioning.
- Time 1 ILS scores were the strongest predictors of Time 2 scores across all regression models.
- Results preliminarily support SRB methodology as a proof-of-concept for examining change on other functional scales across longer retest intervals.
- However, validation in cognitively impaired samples is needed.

Reference

Hammers, D. B., Suhrie, K. R., Dixon, A., Porter, S., & Duff, K. (2021a). Reliable change in cognition over 1 week in community-dwelling older adults: a validation and extension study. Archives of Clinical Neuropsychology, 36(3), 347–358.