

# Detecting Declining Financial Skills in Preclinical Alzheimer’s Disease: The Financial Capacity Instrument--Short Form

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## Introduction

As currently conceptualized, functional impairment is the final and somewhat remote outcome of a cascade of preceding pathophysiological and clinical events characterizing AD: amyloid deposition, neurodegenerative cellular, metabolic and network pathway changes, structural atrophy, and cognitive decline.

The intriguing possibility that detectable functional change may occur in earlier phases of AD, including preclinical AD, has recently been suggested<sup>1,2</sup>. For example, prior research by our group<sup>3,4</sup> and others<sup>5,6</sup> has shown that higher-order functional skills are impaired in mild cognitive impairment (MCI) and decline over time. Financial capacity is a functional skill that is particularly sensitive and vulnerable to MCI and mild AD<sup>3,4</sup>, which raises the possibility that measurable financial decline may also occur in preclinical AD.

A critical factor is the sensitivity of the functional measure employed. Informant report measures commonly used to characterize functional decline in AD dementia likely lack sensitivity to detect very subtle functional decline in cognitively normal persons with preclinical AD. In contrast, performance based assessment measures can support finely grained measurement of function using performance and task completion time measures.

The present study used a new functional measure, the **Financial Capacity Instrument—Short Form (FCI-SF)**, to investigate possible declines in financial skills of persons with preclinical AD. The FCI-SF is a performance measure of financial skills developed specifically to be sensitive to financial skill declines associated with transition from MCI to AD type dementia. The FCI-SF was derived from the FCI long form used in clinical research<sup>3,4,7</sup>. The FCI-SF comprises 37 test items and measures constructs of financial conceptual knowledge, monetary calculation, use of a checkbook and register, and use of a bank statement. The FCI-SF also includes 6 timing variables measuring times to completion (in seconds) related to four FCI-SF tasks: a medical deductible problem, an income tax calculation, completion of a single-item checkbook/register task, and completion of a multi-item checkbook/register and deposit task.

The FCI-SF takes 15 minutes or less to administer to cognitively normal older adults. It has a well-operationalized scoring system for both performance and timing items. Performance scores on the measure range from 0-74 points. Maximum allowable time for completion of timed tasks is 720 seconds (12 minutes).

## Purpose and Hypotheses

This study examined whether a brief performance measure of financial skills (FCI-SF) could discriminate financial task performance and time to completion of cognitively normal older adults with abnormal amyloid deposition (A+) compared to cognitively normal adults without abnormal amyloid deposition (A-).

- We tested the following hypotheses:
  - 1) A+ older adults would perform below A- older adults on financial tasks; and
  - 2) A+ older adults would be slower completing financial tasks than A- older adults.

## Methods

- Participants:**
- We recruited 186 cognitively normal, community-dwelling older adults age 70+ who were participants in the Mayo Clinic Study of Aging (MCSA) in Olmsted County, Minnesota.
  - Demographic information about this sample is located in **Table 1**.
  - All participants were classified as cognitively normal controls based on MCSA diagnostic workup.
  - Participants underwent 11C PiB amyloid imaging and were administered the FCI-SF, a brief performance measure of financial skills that evaluates both task performance and time to completion.

- Measures:**
- As noted above, we developed a short-form version of the Financial Capacity Instrument (FCI-SF) using specific items from the long form FCI<sup>7</sup> that were sensitive to progression from MCI to AD type dementia.
  - The Mini Mental State Examination (MMSE) is a brief screening measure of general cognitive functioning. Total scores range from 0-30 with higher scores indicating better cognitive functioning.<sup>8</sup>
  - The Auditory Verbal Learning Test (AVLT) is a verbal memory measure used to assess a person’s ability to encode, consolidate, store and retrieve high load verbal information.
  - Trail Making Test (TMT) Part B from the Halstead-Reitan Neuropsychological Battery is an executive function measure of visuomotor processing speed and set-shifting.
  - Depression symptoms were assessed with the Beck Depression Inventory – 2<sup>nd</sup> edition (BDI-II). The BDI-II has 21 questions scored on a Likert scale of 0-3, with higher scores indicating greater depressive symptoms.<sup>9</sup>

- Statistical Analyses:**
- PiB imaging resulted in subsamples of amyloid positive (A+) (n=66) and amyloid negative (A-) (n=120) controls.
  - We used independent t and chi square tests to compare A+ and A- groups on FCI-SF performance and task completion time variables, on cognitive and depression screen variables, and on demographic factors.
  - We used backwards elimination binary logistic regression to develop a predictor model of participants’ amyloid status. Specifically, we examined how well FCI-SF performance and timing variables predicted amyloid status (positive/negative) in relation to demographic and cognitive variables.

## Table 1: Demographic/Clinical Variables by PiB Status

	Amyloid Negative N=120	Amyloid Positive N=66	<i>p</i>
<b>Age (years)</b>			
Mean (SD, range)	79.4 (4.8, 71-94)	80.9 (4.1, 72-92)	0.033
<b>Education (years)</b>			
Mean (SD, range)	14.7 (2.8, 8-20)	14.5 (3.0, 8-20)	0.649
<b>Gender, n (%)</b>			
Female	50 (41.7%)	30 (45.5%)	0.645
Male	70 (58.3%)	36 (54.6%)	
<b>Cognition</b>			
MMSE	28.1 (1.4, 22-30)	28.0 (1.3, 23-30)	0.588
AVLT Delay	8.3 (3.4, 0-15)	8.3 (3.8, 0-15)	0.606
Category Fluency	42.4 (8.6, 23-63)	42.9 (9.8, 19-81)	0.964
TMT-B (sec)	96.0 (36.5, 45-230)	101.1 (38.5, 49-254)	0.372
<b>Depression</b>			
BDI-II	3.7 (4.2, 0-28)	4.4 (4.4, 0-27)	0.281

## Table 2: FCI-SF Performance Scores by PiB Status

	Max Score	Amyloid Negative N = 120	Amyloid Positive N = 66	<i>p</i>
<b>Total Score</b>				
FCI-SF Total Score	0-74	64.2 (8.3, 33-74)	62.1 (7.9, 44-74)	.094
<b>Component Performance Scores</b>				
Bank Statement Management	0-14	11.0 (2.2, 2-13)	10.4 (2.5, 3-13)	.080
Mental calculation problems	0-4	3.6 (0.9, 0-4)	3.4 (0.9, 2-4)	.125
Check/Register/Deposit Transactions	0-28	23.1 (4.9, 4-28)	22.2 (5.3, 8-28)	.230
Financial Conceptual Knowledge	0-8	7.0 (1.3, 1-8)	6.8 (1.4, 4-8)	.319
Single Check Transactions/Register	0-20	18.8 (1.9, 10-20)	18.8 (1.7, 14-20)	.987
<b>Select FCI-SF Test Items</b>				
How many quarters in \$	0 or 2	1.9 (0.4)	1.7 (0.7)	.011
Correct amount of deposit	0 or 2	1.6 (0.8)	1.3 (1.0)	.022
Checks cleared in bank statement	0 or 2	1.3 (1.0)	1.0 (1.0)	.028

## Table 3: FCI-SF Task Completion Times by PiB Status

	Max score/time	Amyloid Negative N = 120	Amyloid Positive N = 66	<i>p</i>
<b>Time Variables</b>				
Medical deductible problem (sec)	90 sec	17.2 (23.4)	18.9 (24.4)	.637
Income tax problem (sec)	90 sec	7.1 (10.1)	10.2 (11.0)	.062
Check/register task (sec)	240 sec	112.4 (34.6)	125.4 (36.2)	.017
Check/register/deposit task (sec)	300 sec	225.1 (62.8)	250.1 (54.9)	.007
2 check tasks composite time (sec)	540 sec	337.7 (87.1)	375.5 (77.4)	.004
Overall composite time (sec)	720 sec	359.6 (95.6)	404.6 (87.2)	.002

## Results

- Demographic and clinical variables are reported in **Table 1**. The groups differed only on age ( $p=.033$ ).
- FCI-SF performance scores and task completion times are listed in **Table 2** and **Table 3**. The FCI-SF detected both performance and time to completion differences between the A+ and A- groups.
- A+ participants performed below A- participants on three test items tapping specific complex financial skills: a difficult coin/currency calculation ( $p=0.011$ ), entering the correct amount of a deposit ( $p=0.022$ ), and rapidly scanning a bank statement for information to answer an account question ( $p=0.028$ ). FCI-SF total score ( $p=0.094$ ) and bank statement management score ( $p=.080$ ) showed trends for lower A+ group performance.
- A+ participants were slower completing each of the two checkbook/register tasks, slower on composite time for the 2 checkbook tasks ( $p=0.004$ ), and slower on total composite time ( $p=0.002$ ). Time to complete the tax problem showed a trend ( $p=.062$ ) for slower A+ group performance.

## Logistic Regression Model of Amyloid Status

- Using backwards elimination logistic regression, we developed a predictor model of participant amyloid status using study demographic, FCI-SF, cognitive, and depression screen variables.
- In our analysis, we first included age and those FCI-SF performance and timing variables that differed between the A+ and A- groups. A three variable predictor model emerged that was significant at  $p < .001$  and achieved a pseudo- $R^2$  of 12%. The three predictors were FCI-SF total composite time, a mental calculation problem, and a bank statement scanning problem. Age was not a predictor and was eliminated from the model in step one.
- In subsequent analyses, we forced entry of study cognitive and depression screen variables, but these variables were also not retained in the model. Only the three FCI-SF variables were retained as model predictors of amyloid status.**

## Discussion

- Functional change in the form of subtle financial skill decline occurs in preclinical AD and is detectable using a brief performance measure of financial skills.** Both slower financial task completion times, and diminished performance of complex financial tasks, characterized the A+ group and represent measurable very early functional changes in preclinical AD.
- Performance measures of complex everyday function may outperform cognition variables as predictors of preclinical AD.** In a logistic model of participant amyloid status, only FCI-SF predictors (composite time and two complex performance items) entered the model. Age and cognitive variables were not retained in the model.
- Brief performance based measures of complex everyday function like the FCI-SF represent a promising new addition to AD clinical trial outcomes.** Such measures appear to be sensitive to early functional changes across preclinical, prodromal, and clinical dementia stages of AD, and have face and ecological validity for consumers, families, and clinicians and researchers. Future studies will be needed to confirm our present findings.
- Measures like the FCI-SF should be considered for AD prevention and clinical trials.**

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