

SHORT REPORT

Online monitoring of financial capacity in older adults: Feasibility and initial findings

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Abstract

Introduction: Impairment in financial capacity places older adults at risk of fraud or abuse and can be a harbinger of loss of independence. Online automated monitoring of financial transactions offers an objective, unobtrusive, and continuous data collection strategy to minimize risk and to detect early changes in an important complex activity of daily living.

Methods: Ninety-three participants used an online financial activity monitoring platform that extracted metrics related to use and potential departures from established patterns of financial behavior. Standard neuropsychological assessments and a performance-based measure of financial capacity at baseline were compared using continuous monitoring metrics.

Results: Participants demonstrated a willingness to engage with an online financial activity monitoring system. Online metrics were not associated with performance in specific cognitive domains. Performance on an established test of financial capacity was negatively correlated with a ratio of alerts to transactions, that is, a higher likelihood of errors or deviations from previous activity.

Discussion: To our knowledge, this is the first reported study using secure online technology to link ongoing unobtrusively collected financial activity monitoring data with other objective measures of function and cognition in a cohort of independent living older adults.

KEYWORDS

aging, automated monitoring, digital biomarkers, financial capacity, technology

1 | BACKGROUND

The ability to maintain appropriate personal financial decision making is a critical capacity for independent living for older adults. Financial capacity, defined as financial decision making plus task execution con-

sistent with one's needs and values,¹ relies on a broad range of abilities, from basic skills such as conducting cash transactions, to more complex abilities like interpreting financial documents. Multiple studies have described an association between decline in financial capacity and progression of cognitive impairment.²⁻⁴

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Clearly, early detection of impairments in financial capacity is important, but present approaches use self- or proxy-reported missteps and brief, performance-based assessments. These have notable shortcomings. Self-reports typically underestimate the problem, while proxy informants may under- or overestimate abilities, either due to lack of adequate information or willful misrepresentation.²

A potential alternative to self-report or informant ratings to measure functional capacity is clinical assessments involving testing of financial task performance.⁵ Existing performance-based instruments have been validated in older adults and have established reliabilities.^{3,6} However, these performance-based assessments can be time consuming, rely on a small sample of behaviors some of which may be foreign to day-to-day experience, typically require administration by a trained assessor, and take place in an unfamiliar environment. Finally, as in all traditional methods of behavioral data collection, the use of findings based on normative data rather than individualized trends and fluctuations can result in either overprotection and premature loss of autonomy, or lack of adequate supervision for those in decline.

One promising approach to detecting changes in financial task performance is a monitoring system embedded in a person-specific, day-to-day setting. Real world functional metrics of “everyday cognition” have been shown to reflect the earliest harbingers of cognitive decline.⁷⁻¹³ Similarly, longitudinal, objective monitoring of changes in financial capacity may further the development of truly individualized, ecologically valid assessment methods.

The purpose of this study was to examine the relationships between online financial activity, an established measure of financial capacity, and cognitive abilities in a cohort of nondemented older adults. A novel aspect of the study was the use of EverSafe, a publicly available personal financial monitoring service designed to protect older adults from financial exploitation and unintentional irregular financial activity. Here we report on data obtained at baseline, and examine the relationships among a performance-based measure of financial capacity; standard cognitive measures; and on-line, real-time indicators of financial activity from each volunteer’s first month of monitoring.

2 | METHODS

2.1 | Participants

Inclusion criteria: men and women, 70 years or older, living independently, not demented (Montreal Cognitive Assessment [MoCA] score > 24;¹⁴ Clinical Dementia Rating less than or equal to 0.5), and current computer users. Exclusion criteria: poorly controlled medical illnesses, no broadband connection. While no previous experience with online banking was required, participants had to agree to perform some online banking activity during the 1-year study period.

Participants were recruited from multiple sources including cohorts of research volunteers that were already participating in ongoing in-home activity monitoring studies and from existing clinic and research registries, followed by recruitment via social media and community outreach. The study duration was 1 year.

RESEARCH IN CONTEXT

1. **Systematic review:** The authors reviewed prior research on the merits and drawbacks of current methods of assessing financial capacity in older adults. The current investigation uses an innovative online monitoring technology to offer a novel approach to an important real-life predictor of independence.
2. **Interpretation:** Participant willingness to use a technology to monitor their financial transactions demonstrated the feasibility of this novel data collection strategy. There were no differences in baseline online financial metrics by sex or age. Performance on standard cognitive measures and an established test of financial capacity were compared to online activity.
3. **Future directions:** Online financial monitoring provides an objective measure of financial capacity that will be analyzed in relation to changes in cognition over the course of 1 year. Additional research will help clarify the sensitivity of this digital biomarker as a predictor of early and subtle cognitive decline.

2.2 | Measures

2.2.1 | Online financial activity

An online web-based platform (“EverSafe,” www.eversafe.com) was used to monitor financial transactions of participants for irregular activity and issues related to financial capacity. EverSafe uses software based on machine learning techniques to analyze activity across accounts and institutions, to identify irregularities with respect to spending, repetitive transactions, late/unpaid bills, and so on. Any such irregularities generated alerts, which were a key metric in this study. The second key measure from EverSafe was the number of transactions per participant per month. Free use of the EverSafe product was offered to all participants for the duration of the study.

2.2.2 | Financial Capacity Instrument-Short Form (FCI-SF)¹⁵

This performance-based instrument was derived from the original Financial Capacity Instrument (FCI)¹⁶ and has established age and education-based normative data. Unlike the full FCI, the short form was designed for use with all older adults, not just those with mild to severe dementia. The FCI-SF tests financial capacity across four constructs of financial activity including coin/currency knowledge, financial conceptual knowledge, understanding/using a checkbook, understanding/using a bank statement, and financial judgment. Component and total performance scores and completion times are calculated with higher scores indicating better financial skills. For the present report,

TABLE 1 Baseline FCI scores and month of online financial activity measures (n = 93)

Variable	Mean	SD	Minimum	Maximum
Total FCI score (0-74)	63.9	13.0	21	74
Total FCI seconds to completion(0-720)	315.6	108.7	150	631
Number of alerts	1.8	1.9	0	9
Number of transactions	39.9	66.5	0†	574*
Alerts-to-transactions ratio	0.21	0.37	0	1

*When one outlier was removed from analyses, the highest number of transactions was 134.

† Zero transactions in the first month does not indicate lack of online banking activity; all participants enrolled in and used the EverSafe system. Ten participants who had 0 transactions in the first month were coded as 0/0 alerts to transactions ratio.

Abbreviations: FCI, Financial Capacity Instrument; SD, standard deviation.

only FCI-SF total score and total completion time (measured in seconds) were included in analyses.

2.2.3 | Cognitive assessment

The neuropsychological assessment battery from the Uniform Data Set of the National Alzheimer's Coordinating Center¹⁷ was administered at baseline.

2.3 | Procedures

All participants provided written informed consent via in-home visits by study personnel as approved by the Oregon Health and Science University Institutional Review Board (IRB #19404). After consent, participants were administered a battery of tests including the FCI, and received a link with a "promo code" to identify them as research participants at the EverSafe website. EverSafe then analyzed historical financial transactions over the previous 90 days to construct the patterns and habits of each participant and create a personal financial profile against which future activity would be compared. Alerts are generated when irregularities are detected. Monthly summaries of anonymized individual activity, including number of accounts, transactions, and alerts were provided to the study staff by EverSafe.

3 | RESULTS

A total of 93 participants were enrolled and completed baseline clinical assessments; of these, 79 completed the full assessment while 14 were assessed remotely via telephone or video (due to the COVID pandemic) and administered an abbreviated battery, which did not include the FCI. Mean age at baseline was 77.3 years with an average of 16.5 years of education; 66% were female. Average MoCA score was 26.1 out of 30.

3.1 | Summary of on-line measure of financial behaviors

Participants varied widely in the number of online financial transactions in their baseline month (Table 1). Given the wide variability

in activity, a ratio of alerts to transactions was calculated to better describe participant-specific measure of potential irregularities in online financial behavior.

Online financial capacity metrics during the first month in study for each participant (number of transactions, number of alerts, ratio of alerts to transactions) were not correlated with education (years of school) and did not differ by sex. Older age was correlated with fewer transactions ($r = -0.26, P = .01$). When the 10 participants with 0 transactions in the first month were excluded from these analyses, older age was associated with a higher alert:transactions ratio; no other correlations were affected. Online metrics were not correlated with any neuropsychological test scores.

3.2 | Performance on FCI

There were no differences in financial capacity (FCI) scores by sex or education. Age was negatively correlated with total scores ($r = -0.27, P = .02$), and positively correlated with total time to completion ($r = 0.37, P = .0009$). A higher FCI total score was correlated with a lower alert:transaction ratio ($r = -0.27, P = .03$). FCI total score and seconds to completion (of timed items) were positively correlated with neuropsychological test scores and are presented in Table 2. Animal fluency, Benson Complex Figure Recall, and Trail Making Test Parts A and B were all significantly correlated with total FCI scores, while time to completion was additionally correlated with digit span backward, immediate and delayed verbal recall (Craft Story) but not Trail Making Test Part A.

4 | DISCUSSION

This study assessed the feasibility of enrolling older adults in a study that gathers information considered quite personal and sensitive. To our knowledge, this is the first reported study using secure online technology to link ongoing unobtrusively collected financial activity monitoring data with other objective measures of function and cognition in a cohort of independent living older adults.

Both the FCI total score and total completion time in this study were well within the average range of published norms for the test.¹⁵

TABLE 2 Correlations between cognitive test scores and total financial capacity score and FCI completion time

	Total FCI score	Total FCI seconds
Unified MoCA	r = 0.04 P = .74	r = -0.12 P = .32
Animal Fluency	r = 0.35 P = .002	r = -0.32 P = .005
Digits Forward	r = 0.03 P = .75	r = -0.18 P = .12
Digits Backward	r = 0.09 P = .44	r = -0.34 P = .003
Benson Copy	r = 0.33 P = .005	r = -0.02 P = .89
Benson Recall	r = 0.33 P = .005	r = -0.32 P = .007
Craft Story Immediate Recall	r = 0.09 P = .45	r = -0.42 P = .0006
Craft Story Delayed Recall	r = 0.07 P = .57	r = -0.34 P = .006
FL Letter Fluency	r = -0.05 P = .69	r = -0.14 P = .22
MINT	r = 0.16 P = .21	r = -0.04 P = .74
Trail Making Test A	r = -0.34 P = .003	r = 0.20 P = .09
Trail Making Test B	r = -0.51 P < .0001	r = 0.28 P = .02

Abbreviations: FCI, Financial Capacity Instrument; MINT, Multilingual Naming Test; MoCA, Montreal Cognitive Assessment. Significant correlations are in bold.

However, performance in this cohort did range from 1st to 98th percentile in norms for age-matched healthy older adults, providing evidence that a decline in a functional domain critical for independent living can occur in cognitively intact older adults. Given the consistent finding that financial capacity is an early harbinger of subsequent cognitive decline,^{2,3} these results highlight the importance of the clinician's role in assessing financial capacity in all their older patients.

4.1 | Limitations

An initial concern in embarking on a study of online financial activity monitoring was the willingness of older adults to participate. Ubiquitous headlines regarding data breaches and identity theft likely contribute to a general reluctance to provide personal financial information via Internet transactions. While we found some hesitation during our enrollment process, most older adults we approached expressed interest, often describing personal knowledge of financial exploitation

among friends or family. Nevertheless, it is possible that this group is not representative of the general older population, as we initially recruited from our existing cohort of actively online research participants. However, additional enrollees were obtained from informational talks open to the public and local media coverage, neither of which assume pre-existing experience with online banking.

The unexpected outbreak of the COVID-19 pandemic forced a revision of the study protocol, such that a number of baseline, and all 12-month assessments, were restricted to virtual visits, either by telephone or computer-based video communication. Of necessity some measures were eliminated, resulting in missing data and reduced statistical power from initial estimates. Fortunately, the enforced quarantine of the pandemic did not affect our online monitoring; indeed, this kind of research is ideally suited to continuous remote data acquisition. Our ability to collect 12 months of uninterrupted financial activity metrics will provide a basis for detailed analysis of changes in financial behavior over time as they relate to relevant cognitive domains.

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CONFLICTS OF INTEREST

The authors have no relationships, activities, or interests to disclose related to the content of this submission.

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