Validating the Mobile Toolbox: A Remote Assessment for Measuring Cognitive Change

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What is the Methodological Question Being Addressed? To date, there are few sensitive assessment tools to detect cognitive impairment that can be easily and widely deployed in diverse research designs and populations. An even greater challenge is that it can be difficult for clinicians and researchers to reach certain populations to conduct assessments in the first place. Here we present the Mobile Toolbox, an app-based assessment tool allowing for a completely remote cognitive assessment experience; thereby addressing challenges in conducting longitudinal cognitive assessments over the adult life course.

Introduction Cognitive Impairment (CI) – the inability to remember, learn new things, concentrate, or make decisions – is estimated to affect more than 16 million people, the majority of whom are 65 and older (Centers for Disease Control and Prevention, 2011). Moreover, there are about 5.8 million Americans currently living with the most common type of dementia, Alzheimer's Disease, which is projected to increase to 13.8 million people by 2050 (Alzheimer's Association, 2020). Clearly, the ability to detect early indicators of and/or risk factors for brain disease AND differentiate these from typical cognitive aging is crucial to supporting healthy aging. To that end, we introduce the Mobile Toolbox (MTB). MTB includes an expandable library of cognitive assessments for at-home smartphone administration, ideal for collecting data on cognitive functioning from robust samples remotely, safely, and effectively.

Methods The current study describes the initial results evaluating the reliability and construct validity of eight remotely administered MTB tests. In this study, ninety-four English-speaking participants between the ages of 18-85 were recruited by a market research company. Our sample skewed predominately female (n = 61, 65%). Participant age (Mage= 51; SD = 17) was distributed across six age brackets: 18-30 (n = 16), 31-40 (n = 12), 41-50 (n = 14), 51-60 (n = 22), 61-70 (n = 18), and 71 and over (n = 12). All participants completed the NIH Toolbox® Cognition Battery, other cognitive validation measures, and the MTB (pre-loaded on a study device), in that order. See table for list of measures and associated domains.

The primary goal of analyses is to consider the reliability and validity of the MTB measures. To evaluate internal consistency, measure appropriate statistical indices will be used. For Spelling and Vocabulary (the two MTB measures that are CAT-administered), empirical reliability derived from the respective IRT model will be evaluated. For DCCS, PSM, Flanker, and FNAME (the measures in

which all participants receive identical item sets), Cronbach's alpha will be calculated. For MFS and Number Match (tasks in which items are administered based on participant ability), even-odd split half reliability with Spearman Brown correction will be calculated.

Results Completion time for MTB averaged around 57 minutes (+/- 9). Reliability estimates (IRT-based reliability, split-half reliability, or Cronbach's alpha) suggests acceptable reliability for remote, large-scale assessments (rxx>0.65). Split-half reliability was particularly high for working memory (rxx=0.90). Scores were highly correlated with NIH Toolbox and external validity measures of comparable domains. Some validity coefficients were particularly strong; for example, MTB Vocabulary was correlated 0.78 with the PPVT5, and MTB Spelling was correlated 0.86 with the WIAT-4 Spelling.

Conclusion It is more important than ever that researchers have access to well-designed cognitive assessments that can be administered entirely remotely. Initial results from this study show satisfactory internal consistency and convergent validity that supports the use of MTB for this purpose. We are excited to share data on this validation study so that researchers will be able to do exactly that.

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Keywords

Keywords
Technology
Cognitive Functioning
Remote Assessment

Guidelines I have read and understand the Poster Guidelines

Disclosures This work is funded by National Institutes of Health (NIH) Award Number 5U2CAG060426-03. The authors report no conflicts of interest for this work.

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