

Cognitive & Behavioral Assessment

Computer simulations for assessing cognitively intensive instrumental activities of daily living in older adults

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Abstract

Introduction: Aim is to evaluate validity, reliability, diagnostic precision, and user acceptability of computer simulations of cognitively demanding tasks when administered to older adults with and without cognitive impairment.

Methods: Five simulation modules were administered to 161 individuals aged ≥ 60 years with no cognitive impairment ($N = 81$), mild cognitive impairment ($N = 52$), or dementia ($N = 28$). Groups were compared on total accuracy and time to complete the tasks (seconds). Receiver operating characteristics were evaluated. Reliability was assessed over one month. Participants rated face validity and acceptability.

Results: Total accuracy ($P < .0001$) and time ($P = .0015$) differed between groups. Test-retest correlations were excellent (0.79 and 0.88, respectively). Area under the curve ranged from good (0.77) to excellent (0.97). User ratings supported their face validity and acceptability.

Discussion: Brief computer simulations can be useful in assessing cognitive functional abilities of older adults and distinguishing varying degrees of impairment.

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The prevalence of cognitive impairment is increasing markedly as the number of older Americans increases. Diagnoses of mild cognitive impairment (MCI) and dementia (DM) require the assessment of functional performance in ecologically relevant activities such as managing money, taking medications, navigating social interactions, and self-care [1].

Assessing functional status and decline can be challenging. Self-reports can be unreliable, especially if cognitive abilities are compromised plus individuals may for various reasons choose to conceal or underreport deficits. Reports by proxies are also subject to biases and thus can

be inaccurate [2]. Probably the best method, direct observation of an individual performing relevant activities in their natural environment, is prohibitively expensive. Clinic-based behavioral simulations are useful but often require referrals, therefore adding delays, expense, and inconvenience for patients and families. An optimal assessment strategy would be one that quickly provides relevant information to providers, patients, and families about functional impairments and proficiencies; that is brief and easy-to-administer in a busy clinic; and that has demonstrated reliability, validity, and diagnostic accuracy.

The present study describes an innovative approach to measuring performance in cognitively intensive everyday activities. The SIMulation-Based Assessment of Cognition (SIMBAC) consists of computer tablet-based simulations of

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five common, cognitively demanding activities—recognizing faces, remembering names, filling a pillbox, using an automated teller machine (ATM), and renewing a medication prescription over the phone. The aim of this study was to assess the validity, reliability, diagnostic precision, ecological relevance, and user acceptability of the SIMBAC modules when administered to older adults with and without independently adjudicated cognitive impairment (MCI, DM).

1. Methods

1.1. Development of SIMBAC modules

Two board-certified geriatricians (K.S. and V.W.) and a clinical geropsychologist (S.R.) identified five instrumental abilities from their clinical experience that were cognitively demanding, relevant to everyday life for most older Americans and could be simulated on a computer. They were as follows: recognizing faces, remembering names, filling a pillbox, using an ATM, and refilling a prescription over the phone. A computer programmer then (R.B.) developed each module to be administered on a computer tablet. The SIMBAC modules are as follows:

Orientation to the computer: An initial orientation module provides written instructions on the use of the com-

puter tablet and exercises using touch and “dragging” features of the tablet. A trained examiner assists the respondent, as needed, and repeats the training trials until the participant can complete them without error.

FACES: Respondents view a digital photo of a human face (varied by gender, age, and race/ethnicity) for 5 seconds. Next, a series of gender-, age-, and race-matched novel facial images [3] are presented together with the target image, and respondents are asked to touch the target image. A practice trial is followed by three successive trials in which the target image is presented with 1, 2, or 3 distractor images.

FACES AND NAMES: Respondents view a series of digital facial images each paired with a unique name for 5 seconds. The next screen presents all the viewed faces but only one name (Fig. 1A). The individual must touch the face that was paired with that name. Six trials are presented with 2, 3, or 4 name-face pairs. As with the FACES module, facial images vary by gender, age, and race/ethnicity (whites, African-Americans, and Hispanic).

PILLBOX: A 7-day pillbox with a.m. and p.m. compartments is presented next to images of three pill containers, each with unique instructions printed on the label (e.g., “Take one tablet with a glass of water daily in the evening.”). Images of three uniquely shaped or colored tablets/capsules are shown next to each bottle. Participants are

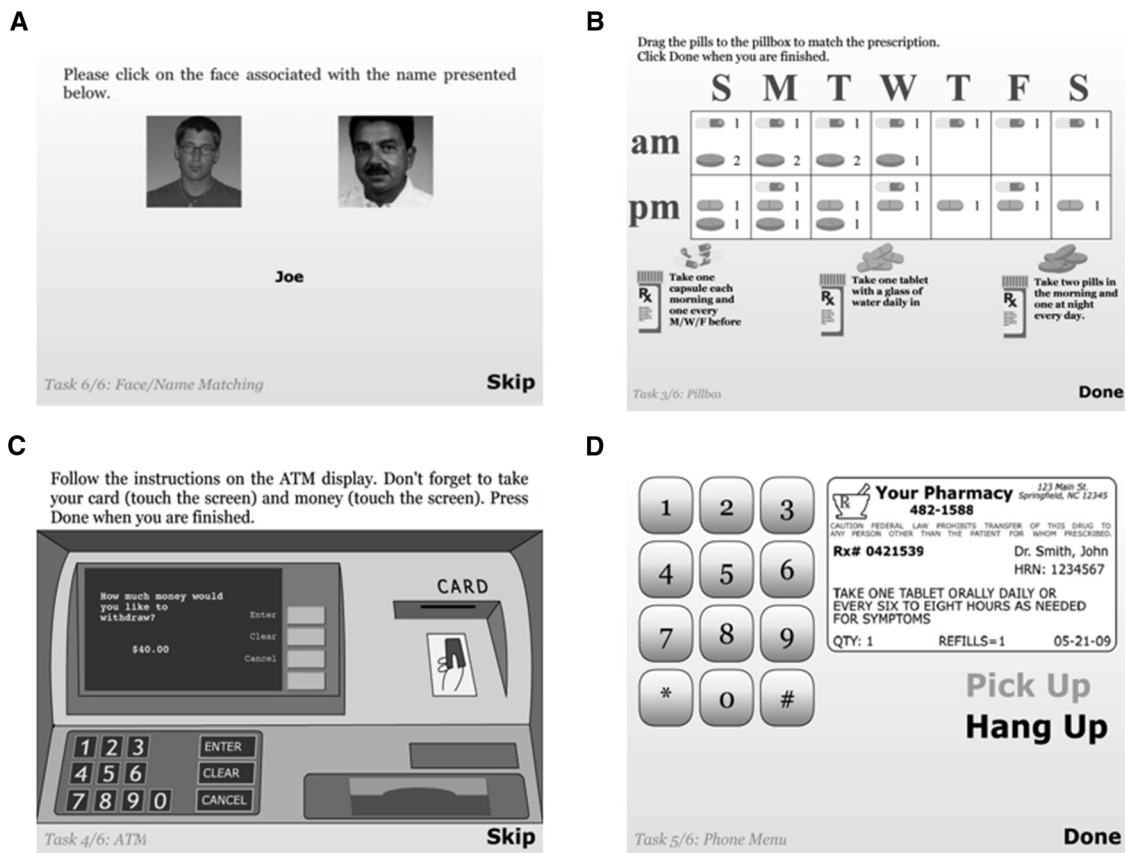


Fig. 1. Screenshots of SIMBAC modules. Module: (A) FACES & NAMES, (B) PILLBOX, (C) ATM, (D) PHONE. Abbreviation: SIMBAC, SIMulation-Based Assessment of Cognition.

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