“Excuse me, do you have the time?” To answer my question, would you check the time on your phone or laptop? Or would you check a watch or clock? Would the time have been represented in analog or digital form? Advances in timekeeping technology have changed the way we keep time. A look back in history shows early time estimations were based on the position of the sun and stars, replaced by sundials, water clocks, hour glasses, and pendulum clocks, then spring-driven timepieces and quartz crystal-regulated watches and clocks, now with digital displays (Andrewes, 2002).

We are well along in the transition from analog to digital time representation. Today’s older adults grew up in a world of analog time representations, but tomorrow’s older adults will not have done so. The analog time representation by hands on a dial have not been the next generation’s only or even primary source of information about time. Digital displays have been the primary representation of time to which they are exposed daily. Today, there are few clocks on our walls and watches have become far more than simple timepieces. They can be telephones, fitness trackers, sleep monitors, blood pressure monitors, connections to home security systems, calorie counters, internet portals, or bracelets. Their faces can be customized and can be either analog or digital (Whitwam, 2018; Williams, 2016).

THE CLOCK DRAWING TEST

Clocks and watches were much simpler, and their displays were analog when the Clock Drawing Test (CDT) was first developed in 1915 and became established as a component of screening and assessment tools for dementia in the 1980s (Hazan, Frankenburg, Brenkel, & Shulman, 2018). Strauss, Sherman, and Spreen (2006) described a standard approach to administration of the CDT:

Given a plain sheet of paper (alternatively a printed empty circle, 7-10 cm in diameter), the individual is directed to draw the face of a clock, write the numbers on it and then draw the hands for a given time such as “10 after 11.” (p. 972)

Other common time settings are “20 to 4” and “20 after 8” (Freedman et al., 1994). Although the freely drawn clock under command is the most common, there is also the copy condition. Scoring systems range from 3 to 10 discrete points, such as placement of the numbers or hands for the correct time, with lower scores indicating impairment.

The CDT is a short (5 minute) test that is relatively simple to administer and score. It is embedded in several cognitive tests and batteries, including but not limited to the 7 Minute Screen, Cambridge Cognition Examination, and Boston Diagnostic Aphasia Examination. The CDT has been described as “one of the most widely used neuropsychological assessment instruments” (Hazan et al., 2018, p. e29). Scores distinguish normal from cognitively impaired individuals and mild from severe impairment but are less useful in identifying the type of dementia (Strauss et al., 2006). Test–retest reliability coefficient was 0.78 for individuals with Alzheimer’s disease; reported interrater reliabilities are generally good (0.80 to 0.94) (Strauss et al., 2006). No gender differences are reported in children, but men have scored higher than women in the older adult population. Ethnic group differences are generally small. However, age, educational achievement, and literacy status impact scores (Kim & Chey, 2010; Strauss et al., 2006).

Visuospatial (placement of numbers), constructional (drawing the clock), conceptual (placement of the hands for a given time), memory (remembering where the numbers are placed), and executive function (organizing the information) abilities are needed to complete the CDT. The copy condition also relies on intact perceptual skills (Freedman et al., 1994). Educated adults are expected to
have the capabilities necessary to complete the test if unimpaired. Ability to complete the task successfully draws upon clock knowledge that is typically taught in grades one through three in the United States (Tillman & Barner, 2015). Most children can read both analog and digital time displays by ages 8 to 16 (Labrell, Mikaeloff, Perdry, & Dellatolas, 2016). This ability includes reading clock time, understanding the referents (i.e., the meaning of 12 noon vs 12 midnight or the duration of a 2-hour versus 2-minute interval), and calculating the interval between two time points (e.g., between 3:45 and 11:20) (Friedman & Laycock, 1989). The CDT draws primarily on the first component of clock knowledge, ability to read clock times. The need for this basic clock knowledge more than likely contributes to the education-based test bias that has been noted in the CDT.

Another less often considered type of test bias imminent for the CDT is generation bias. The CDT requires drawing an analog clock face and hands. Neither clock face nor hands are part of the digital time display that is becoming the most common time representation.

TEST BIAS

Test score bias is an important psychometric concept. Bias is concerned with the relationship of observed score to true score and evidenced when a systematic difference is found between groups that is not due to a true difference (Furr, 2018). The significance of test bias is related to the use of scores. Neuropsychological test scores are an essential component of the diagnosis of dementia. The scores are also used to estimate an individual’s ability to remain independent, continue to drive, continue to manage finances, and so on. They may also be used as a predictor of future decline. A misdiagnosis is a serious matter: test bias of any kind in neuropsychological measures increases the potential for misdiagnosis. Generation bias in the CDT will increase as the analog clock face and hands that are the foundation of the CDT lose their integral position in everyday life.

WHY NOW?

It is time to prepare for the next generation of older adults for whom analog clocks and watches do not have the integrality/ubiquity they did for previous generations. It is time to develop new neuropsychological assessment procedures more in accordance with 21st century living conditions (Ardila, 2013)

Test development, evaluation, and incorporation into practice is a lengthy process. Criteria for an adequate replacement include a virtually universal task that:

- is integral to daily function in individuals from most cultures;
- requires a multiplicity of cognitive abilities (visuospatial, constructional, etc.);
- all unimpaired adults could be expected to perform without error;
- is not education dependent; and
- has little or no age, education, gender, culture, or generation bias.

There are few everyday tasks that meet these criteria; therefore, the first step in developing a new test will be brainstorming to identify a replacement task. Development of the new measure should include: (a) articulation of the conceptual framework upon which the new test is based; (b) review of the literature; (c) observation of task completion in individuals with intact and impaired cognition; (d) creation of items; (e) review by a panel of experts; (f) trial of the items using “think aloud” to understand the processes participants are using to complete the task; (g) pilot testing; and (h) testing on a large sample for reliability, validity, sensitivity, and specificity and potential test bias related to age, education, gender, culture, and generation. Once complex development and evaluation are completed, dissemination and translation into practice must be performed. Completion of this work could take many years and require adequate funding. The CDT was a brilliantly conceived test. It will be a challenge to find an equally valuable replacement test.

REFERENCES


Guest Editorial


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