Mobile Neuropsychological Assessment: Validation of a Test Battery Administered on an Android Tablet

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Neuropsychological Assessment on Mobile Devices

Tests of memory, attention, executive function and processing speed, are widely used to assess the impact of illness, physiological state or drug treatment on cognitive function. Portable devices allow assessments to be made in a wide range of settings for example in the context of everyday life (Tiplady et al. (2009), or practitioners may carry out tests when visiting patients. Touchscreen devices have been used for this purpose for some years (see, e.g. Tiplady 1994; Cameron et al., 2001), Smartphones and tablets are now becoming more widely available, making this an attractive mode of administration.

It important to assess the validity of assessments made on these devices, as the interface differs from that of conventional computer-based tests. Validation has a number of different aspects, and a three-level model is proposed.

The Validation Model

Level	Example of Tasks
Device Validation Establishing correct operation of device and software application	1, Scripted completion of tests with specified number of correct and incorrect response of different kinds, which are then compared to data file 2. Video recording of test completion to measure reaction times for comparison with values measured internally by test software
Intrinsic Validation Showing differences in test performance that reflect expected differences due to nature of test stimuli	1.Measuring differences in reaction times between stimuli of differing difficulty, for example depending on nature of distracting stimuli 2. Showing slowing of responses immediately following an incorrect response
Extrinsic Validation Evaluating the ability of a test to discriminate between states affecting cognition	1.Measuring the difference in performance due to influences known to affect performance within an individual, such as alcohol or sleep deprivation 2. Ability to detect differences between individuals, e.g. those with and without a particular diagnosis

The Android Test Battery

The test battery consists of the following assessments of attention, memory, processing speed and spatial and executive function:

Rapid Information Processing
Four-Choice Reaction Time
Memory Scanning
Sentence Verification
Symbol Digit
Word Number

Arrow Flankers
Little Man
Number Pairs
Serial Sevens
Trails A & B
Visual Search

The test battery runs on any Android tablet with a large enough touchscreen (≥ 5"). The version tested is set up on an MID X5A Tablet (7" screen).

The Visual Search Task

Each stimulus consists of a square array of letter shapes. There is a single target, which is an **L** shape, which can be in any orientation. The non-targets can be **T** or **X**, again in any orientation All the nontargets are the same for a block of stimuli. The arrays are of different sizes, from 4 (2X2) to 36 (6X6) shapes.

When **L** appears in an array of **X**s, the target appears to "pop out". Visual search is effectively in parallel, and is little affected by array size. **L** against **T** does not pop out. In this case, search is of elements in a serial fashion, and the time taken to detect a target increases proportionally with array size (see , e.g. Duncan & Humphreys, 1989; Troscianko & Calvert, 1993).

Here are examples of the two types of display. On the Android tablet application, the user taps with a stylus on the target as quickly as possible. Only one type of array appears on the screen at a time.
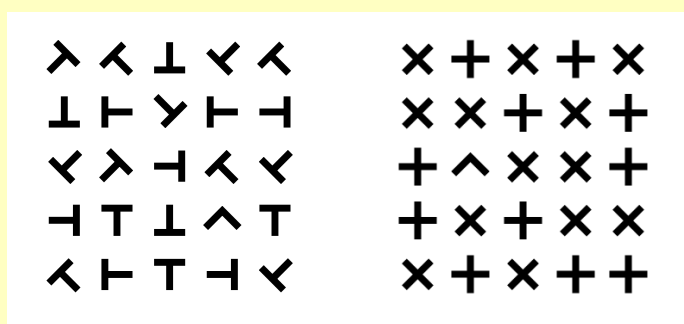
Intrinsic Validation

Users complete a set of test administrations in which they respond to blocks of arrays of increasing size, first **L** vs **X** then **L** vs **T** or vice versa. The mean response time (RT) for correct responses at each array size is recorded for each array type.

A typical run is shown below. There is a very substantial increase in RT with array size for the serial search condition, but a much smaller increase for the parallel search condition. This is in accordance with previous versions of the test, which has been implemented on other electronic platforms and using pencil,and paper. This provides supporting evidence that the test is functioning as intended.

Summary and Conclusions

The three level validation model provides a useful framework for planning, describing and analysing the validation of cognitive assessments
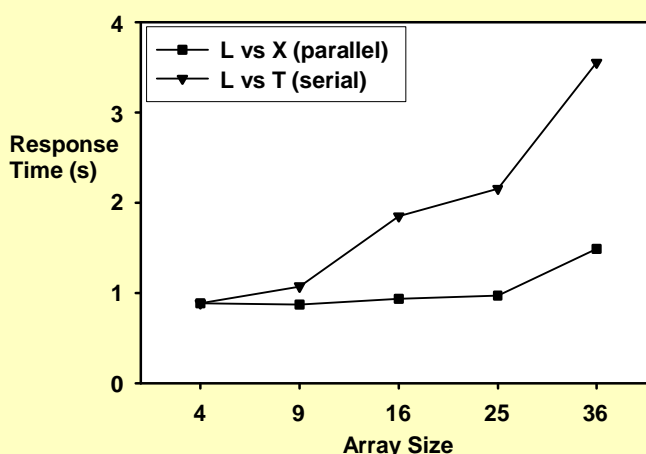
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