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Validity Study of the Western Psychological Services Finger-Tapping Test

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ABSTRACT

In 2004, the research department of Western Psychological Services (WPS) was conducting field trials on a series of developmental scales, one of which was investigating the measures of tapping speed with an electronic tapping device. WPS encouraged the researchers to do a validity study on this instrument. Forty-three individuals with a mean age of 20.3 years were evaluated with a mechanical tapper acquired from Reitan Laboratory and the electronic tapper provided by Western Psychological Services. The researchers counterbalanced the test administration to account for fatigue and practice effects. The results demonstrated individuals could tap slightly faster on the electronic tapper, but there was no significant difference in the relationship of speed of dominant versus non-dominant hand on either test. Use of the electronic tapper would offer a time and economic advantage in neuropsychological assessment.

INTRODUCTION

A foundation tenant of neurology is that sensory and motor abilities in the brain are contralateral; the right hemisphere sensory and motor strips controlling sensory and motor functioning of the left side of the body, and the left hemisphere sensory and motor strips controlling the right side of the body (Lezak, 1995; Pinel, 1997). Researchers have also well documented that the sensory and motor activities of both hemispheres are inverse, with the sensory and motor activities at the base of the body, such as feet, being managed at the superior portion of the sensory and motor strips, while activities of the head, face, and tongue are managed at the inferior position, bilaterally (Pinel, 1997). Given their position in the neocortex and their functional dynamics as they interact with other neurological systems, the motor and sensory strips are impacted by a wide range of neurological impairments (DeGroot, 1991). Perhaps the most noticeable problems are deficiencies in unilateral motor ability secondary to a

disturbance within the middle cerebral artery system (Beatty, 2001; Reitan & Wolfson, 1985). A cerebrovascular accident, commonly called a stroke, can be the most demonstrative. This condition often results in hemiplegia, apraxia and partial or total paralysis of contralateral motor ability (Beatty, 2001). Not all impairments, however, are so obvious or dramatic. Exposure to toxic chemicals, traumatic brain injuries, or neuronal deterioration due to aging may all result in unilateral or bilateral impairments (Banich, 1997).

A comprehensive neuropsychological test battery is composed of many instruments, which measure individual components of behavior related to brain functioning. The assessment of motor functioning is a fundamental component of modern assessment programs as it is diagnostic of laterally impairments. The degree of these impairments relates to the client's current condition, implicates etiology and history, and suggests the potential for recovery (Reitan & Wolfson, 1993). To achieve this goal, the Halsted-Reitan finger-tapping test was developed. The test requires a client to tap rapidly, with their index fingers, for a specific amount a time in repeated trials. Trials are summed and an average for each hand is calculated. A ten percent difference between the dominant and non-dominant hand is typical for the general population. The best known, and perhaps the most widely used, of all the finger-tapping tests is published by Reitan Laboratories (Reitan & Wolfson, 1993). The test, developed by Drs. Ward Halsted and Ralph Reitan, is a component instrument of the Halsted-Reitan neuropsychological test battery (Halstead, 1947). Its use is widespread throughout the United States and Canada. It is regarded as a foundation component of a comprehensive neuropsychological assessment procedure and has been the topic of considerable research regarding the functional integrity of the cerebral hemispheres (Finlayson & Reitan, 1976, 1980). For valid results, all trials of the tapping test should be within ten percent of the mean of each trial. The test is considered clinically significant when the mean score of either hand is beyond ten percent of the other. For example, a right-handed individual whose mean score was 50 for the dominant hand would be considered pathological if the left hand went above a mean score of 55. As the brain is contralateral, this would be suggestive of an impairment in the left hemisphere. The greatest utility of the test is gained when it is used in conjunction with other tests, especially instruments assessing sensory perceptual functioning (Bradford, 1992). Used in this fashion, inferences of impairment can be introduced pertaining to anterior verses posterior (Jarvis & Barth, 1994). Snow (1987) cautioned the use of electronic tapping devices and indicated scores might vary and then could not be used in calculating the impairment index with the same assurance as could those inferred from the test developed by the Reitan Laboratory.

In 2004, the research staff at Western Psychological Services considered the development of an electronic tapping test using an off-the-shelf calculator manufactured by Casio (MS-80TV). The researchers envisioned the electronic tapping test to be a component of a developmental test battery for children and adolescents. As part of their field studies, WPS encouraged the researchers to do a validity study on this instrument.

The purpose of this study was to compare the two tapping tests and investigate their similarities and differences. The hypothesis states that there may be differences in the rate of tapping between the mean scores of the mechanical tapping test and the electronic tapping test, but there will be no significant differences in the ability of these instruments to measure psychomotor integrity.

METHOD

Participants

The participants in this study consisted of 43 undergraduate students with a mean age of 20.3 years. Of these individuals, four were left hand dominant while thirty-nine were right hand dominant; none reported being ambidextrous. Individuals in this study reported no history of premorbid motor impairments or other neurological disorders.

Materials

The materials in this study consisted of included the Halsted-Reitan finger-tapping test produced by Reitan Laboratories and the WPS Casio MS-80TV finger-tapping test. Researchers used both instruments as provided by the manufacture and they made no modifications. The Halsted-Reitan test uses a six by six inch fiberboard platform with a mechanical counter attached with four screws. Test administrators instructed the client to tap consecutive trials alternating the right and left hands, beginning with the dominant hand. Trials lasted 10 seconds each, and the researchers instructed the client to tap as rapidly as possible. The electronic tapping test manufactured by Casio has administration procedures very similar to those of the Halsted-Reitan test. The only difference between the mechanical and electronic variation was the nature of the lever. The mechanical tapping lever must recoil approximately 3/4 inch, while the electronic tapping lever recoils only 1/16 inch.

The researchers developed a tapping test record form to record participant responses. This form included participant number, dominant hand (left, right, ambidextrous), a recording section for the Halsted-Reitan test with columns for the left and right hand lever presses to be recorded across five trials, and a recording section for the WPS test with columns for the left and right hand lever presses to be recorded across five trials.

Procedure

Participants completed a consent form prior to testing. Upon signing their consent, participants identified their dominant hand by choosing left, right, or both. There were two stations set up, one administering the Halsted-Reitan tapping test and one administering the WPS electronic tapping test. Researchers instructed the test administrators to begin the trials with the participant's dominant hand, while counterbalancing the administration with 50% of research participants completing the WPS instrument first and later completing the Halsted-Reitan tapping test. Test administrators provided a brief resting period between the completions of each test. At the end of the procedure, the researchers answered questions and acknowledged the participants' contributions. Test administrators gave written verification of participation to those participating as part of extra credit in their psychology class.

RESULTS

To test the validity of the WPS electronic tapping test, we constructed a correlation matrix comparing the left and right hand trials, as well as the means for the WPS and the Halsted-Reitan tapping tests. There was a moderate correlation between all trials of the Halsted-

Reitan and the WPS tapping tests (see Table 1). In addition, the left hand means and the right hand means were strongly correlated for the Halsted-Reitan and WPS tapping tests (see Table 2). This supports the WPS electronic test being a valid test.

Table 1

Correlations Between the WPS Electronic and Halsted-Reitan Mechanical Tapping Test Trials

		WPS				
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Halsted-Reitan				(n=43)		
Trial 1	Left	0.592				
	Right	0.571				
Trial 2	Left		0.492			
	Right		0.591			
Trial 3	Left			0.489		
	Right			0.546		
Trial 4	Left				0.492	
	Right				0.407	
Trial 5	Left					0.564
	Right					0.462

* All correlations significant at the 0.01 level.

Table 2

Correlations of Left and Right Hand Means on the WPS and Halsted-Reitan Tapping Tests

	WPS	
	Left - mean	Right - mean
	(n=43)	
Halsted-Reitan		
Left - mean	0.78	
Right - mean		0.71

* All correlations significant at the 0.01 level.

In order to determine if the WPS electronic tapping test could be a substitute for the standard Halsted-Reitan tapping test, researchers performed independent samples t-tests to identify any significant differences between the tests. On the right hand trials, the WPS electronic tapping test (M = 66.22, SD = 7.57) had significantly higher mean scores than the Halsted-Reitan tapping test (M = 56.25, SD = 9.32), $t(84) = -5.443$, $p = .001$. Also, the WPS

electronic test (M = 58.68, SD = 6.64) had higher mean scores than the Halsted-Reitan (M = 51.75, SD = 7.37) on the left hand trials, $t(84) = -4.58$, $p = .001$. These results indicate participants can make more responses on the WPS electronic tapping test.

DISCUSSION

There appears to be a significant consistency for individuals within trials and between trials for both the electronic and mechanical tests. Thus, the WPS electronic tapping test is a valid test in measuring the same sensory and motor ability that can be detected in the well-established Halsted-Reitan tapping test.

Although the WPS tapping test is a valid measure, it may not be able to be used in place of the Halsted-Reitan. Because the electronic test yielded higher tapping speeds, causing a higher number of responses, these tests cannot be used interchangeably. This supports Snow's (1987) concerns about using electronic tapping tests. Although the WPS tapping test cannot be used in calculating the impairment index with the same assurance as could those inferred from the test developed by the Reitan Laboratory, there are still benefits to using the test. Cost, size, and replacement ease favor the electronic tapping test. The item is "off the shelf," smaller, and can be purchased at numerous outlet stores.

The mechanical test has a longer research heritage and enjoys broader acceptance with neuropsychologists. There are limitations in this study. For example, the participants were all college students of similar age and all were in excellent health. Future investigations with a clinical, non-college, younger, or older population might offer different results.

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