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An Examination of the Effects of Mode of Access on the *Computerized Revised Token Test*

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Abstract

The purpose of this study was to investigate normal young participants' performance on subtest and overall scores obtained from touchscreen versus mouse on the *Computerized Revised Token Test* (CRTT). The study also examined CRTT test-retest reliability for both input devices and for user preference. Forty young, healthy adults participated in this study. All were native English speakers, without a history of speech, language, or learning disability. The participants completed the survey and both versions of the CRTT during one session, and the retest during the following session. Participants used their non-dominant hand for all CRTT tasks. The results revealed a significant touchscreen preference. Overall, and six of the ten subtest scores were significantly higher for the touchscreen. Test-retest reliability was equivalent for both versions. We speculate that non-dominant hand use was more challenging and less preferred for the mouse due to greater fine motor control requirements.

Research Description

The *Computerized Revised Token Test* (CRTT) was recently developed to improve the reliability and accessibility of the *Revised Token Test* (McNeil & Prescott, 1978). The CRTT was standardized with the use of a touchscreen. This study investigated similarities and differences between participants' performance on subtest and overall scores obtained from touchscreen versus mouse on the CRTT. The following research questions were asked:

1. Is there a significant ($p \leq .05$) difference in subtest and overall scores derived from the initial administration of the touchscreen and mouse access versions of the CRTT in normal, healthy, young adults?
2. Are the preference judgments derived from initial administration of the touchscreen access version significantly ($p \leq .05$) higher than those derived from the initial administration of the mouse version?
3. Is the difference between overall and subtest scores derived from the test-retest for the touchscreen administration significantly ($p \leq .05$) different from the those same calculations derived from the mouse version?
4. Is there a significant ($p \leq .05$) difference between the test-retest correlation coefficients derived from the mean overall scores for the touchscreen version than those derived from the mouse?

Methods

Forty participants ($M = 23.23$ years) completed a biographical survey and passed a story retell language screening (McNeil, Doyle, Park, Fossett, & Brodsky, 2002). The order of administration of the two versions of the CRTT (mouse vs. touchscreen) was counterbalanced across participants. One-half of the participants were administered both versions of the CRTT a second time. The participants used their self-reported non-dominant hand during all CRTT data collection. All participants answered a preference questionnaire.

Results

Group means and standard deviations for subtest and overall test scores for both experimental conditions are presented in Figure 1.

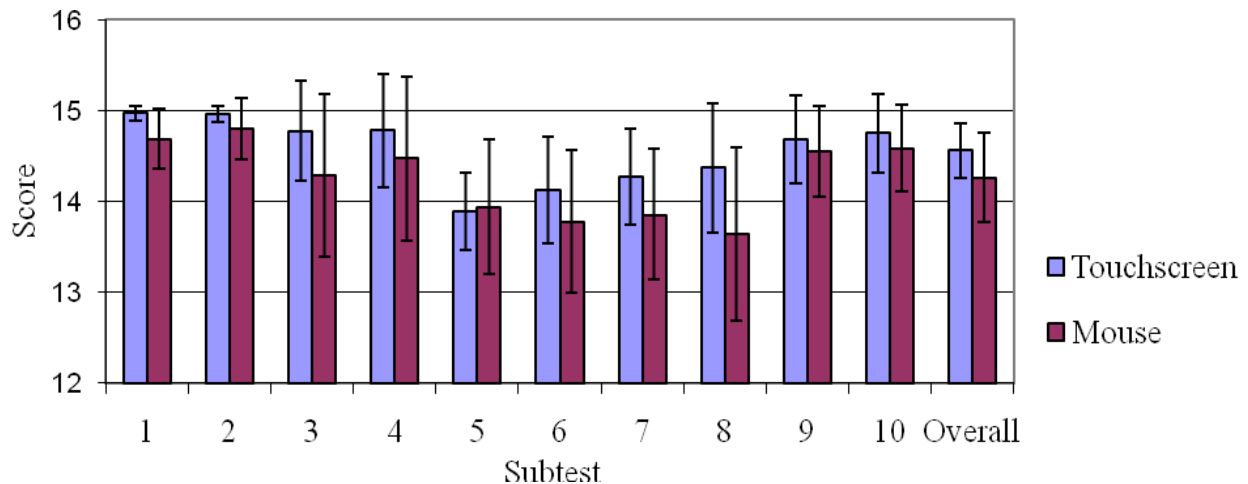


Figure 1. Mean subtest and overall scores for Touchscreen and Mouse access modes. Error bars indicate +/- 1 standard deviation.

A dependent t -test was used to address the overall score difference in answer to the first research question. The results indicate that the touchscreen access version overall mean score ($M=14.56$, $SD=.30$) was significantly ($t(39)=5.28$, $p < .01$) higher than the overall mean score from the mouse access version ($M=14.26$, $S=.49$). There was a moderately high correlation coefficient between the overall scores from the touch access version and mouse access versions ($r=.68$, $p < .01$). It was also found that when the mouse was used, participants received an immediacy score 14 % of the time compared to 5% of the time when the touchscreen was used.

A two-way analysis of variance was also used to answer the first research question. A significant main effect for subtest ($\Lambda=.13$, $F(9,31)=24.13$, $p<.01$) was found. There also was a significant main effect for access mode ($\Lambda=.58$, $F(1,39)=27.86$, $p<.01$), with higher scores obtained with the touchscreen than with the mouse. The interaction between subtests and mode of access was significant $\Lambda=.39$, $F(9,31)=5.4$, $p<.01$.

Pairwise t -test comparisons were computed to locate the source of the significant interaction between access mode and subtests. This analysis revealed significantly higher scores on subtests one ($t(39)=5.15$, $p < .005$), three ($t(39)=4.29$, $p < .005$), four ($t(39)=3.41$, $p < .005$),

seven ($t(39)=3.72, p < .005$), eight ($t(39)=6.27, p < .005$), and ten ($t(39)=3.09, p < .005$) when the touchscreen was used.

A chi-square test was used to answer the second research question. The results indicate a significant preference for touchscreen ($\chi^2(2, N=40) = 31.40, p < .001$).

Means and standard deviations of touchscreen and mouse test and retest administrations are presented in Figures 2 and 3.

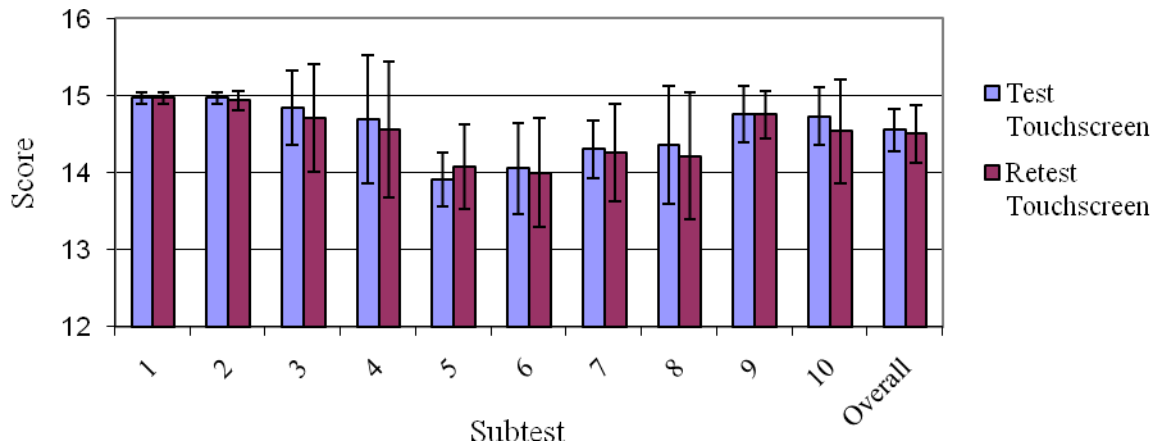


Figure 2. Mean test and retest, subtest and overall scores for the touchscreen access method. Error bars indicate +/- 1 standard deviation.

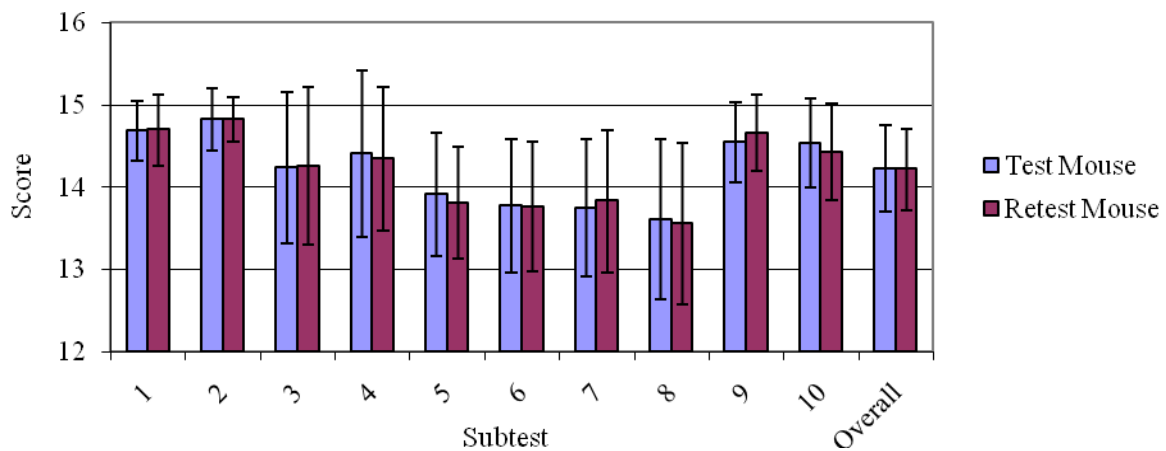


Figure 3. Mean test and retest, subtest and overall scores for the mouse access method. Error bars indicate +/- 1 standard deviation.

A three-way analysis of variance was used to answer the third research question. The results indicated a significant main effect of access mode, $F(1,19)=23.03, p < .01$. Scores obtained in the touchscreen condition were significantly higher than scores obtained in the

mouse condition. When the mouse was used in the retest condition participants obtained a score of twelve (immediacy) 19% of the time, compared to only 9% of the time when the touchscreen was used. A significant main effect for subtest ($F(9,11)=10.75, p<.01$) was found. There was no main effect for test-retest ($F(1,19)=.36, p=.56$). The results also indicated that there were no significant interactions between test-retest and access mode ($F(1,19)=.35, p=.56$) or between test-retest and subtest ($F(9,11)=1.32, p=.33$). A significant interaction between access mode and subtest ($F(9,11)=4.59, p<.05$) was present. There was no significant three-way interaction between test-retest, access mode, and subtest, $F(9,11)=.51, p = .84$.

Results from a Paired Sample *t*-test revealed significant differences between subtests one ($t(19)=3.78, p<.005$), three ($t(19)=4.57, p<.005$), seven ($t(19)=3.31, p<.005$), and eight ($t(19)=5.25, p<.005$).

The correlation coefficients indicate a moderate relationship between test and retest, regardless of the mode of access (see Table 1). No significant difference between the test and retest correlation coefficients ($z=.04, p=.968$) was found. Correlation coefficients were within the same range between access modes as within access modes and between tests as between retests.

Table 1. Correlation of Test-Retest Overall Scores on the CRTT for both Access Conditions

Variable	Test Touch	Retest Touch	Test Mouse	Retest Mouse
Test Touch	-	.736**	.730**	.581**
Retest Touch		-	.715**	.800**
Test Mouse			-	.742**
Retest Mouse				-

Note. * significant $p<.05$ level, ** significant $p<.01$ level.

Discussion

The touchscreen access method produced significantly higher subtest and overall CRTT scores than the mouse access method, along with equivalent reliability performance in this young normal participant population. The difference between the mouse access mode and the touchscreen access mode was likely due to the higher number of immediacy scores received when the mouse was used. Immediacy receives a numerical score of 12 in the 15 point multidimensional scoring system and means that the participant initiated their response before the verbal command was finished being delivered. The participants likely received this lower score because they wanted to finish the task as quickly as possible or they wanted to demonstrate that the task was not particularly challenging. Additionally, the differential use of immediacy in the mouse condition may have been due to the ease with which it could be executed as the participants kept their hand on the mouse during the test; whereas they had to move their limb from the bottom of the screen to the object on the screen for the touchscreen response.

Unlike previous studies, the participants preferred to use a mouse. The participants in this study completed the CRTT with their non-dominant hand, which likely contributed to the poorer performance with the mouse which requires greater fine motor skills than the touchscreen. Alternatively, the participants may have been less comfortable using the mouse with their non-dominant hand.

This study also examined the test-retest reliability of the CRTT and found that both versions were equally reliable. While both access versions of the CRTT demonstrated only

moderately-high reliability correlation coefficients, these normal participants performed within a very narrow range of scores; a finding consistent with previous reliability for normal participants on the CRTT (McNeil, et al., 2008ab).

Although the touchscreen access method produced significantly higher scores than the mouse, it is not clear that the touchscreen should be used as the preferred access method. Algorithms might be generated for equating the previously established psychometric data and normative sample derived from the touchscreen access method to that of mouse. If this were possible, then there would be no need to re-standardize the test. If such an algorithm cannot be successfully generated, it may be worth the expense to develop new validity, reliability and normative data for a mouse version since a mouse accessible CRTT would be less expensive and more applicable to a variety of settings.

References

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