Are Touch Screen Devices Appropriate for Neurocognitive Testing?

Jim X. Wei1, Dexter Morgan2, Alan F. Boyd2

1University of North Carolina Eshelman School of Pharmacy, 2CNS Vital Signs, LLC

ABSTRACT

OBJECTIVE: The primary study objective is to evaluate in computerized neurocognitive testing the accuracy and sensitivity of touch screen devices on response capture and timing compared to keyboard devices.

METHOD: Healthy volunteers were selected to take the CNS Vital Signs (CNSVS) neurocognitive test battery either on the iPad 2 (Apple, Inc) using web browser interface and compared to the matched subject data take from the CNSVS normative database.

RESULTS: The touch screen tablet interface resulted in significant difference in timing as compared to keyboard interface. Response accuracy was impacted as well.

CONCLUSIONS: There are significant differences in device reaction time when comparing touch screen to keyboard. Tablets and other touch screen devices should be used with caution in computer based neurocognitive tests. Researchers and clinicians should understand that they do not provide reliable reaction time when compared to devices with native keyboard.

INTRODUCTION AND BACKGROUND

INTRODUCTION: CNSVS is a computerized neurocognitive test battery that was developed as a routine instrument1. Several tests record reaction time with millisecond precision. CNSVS is originally designed for subjects using conventional computer keyboard. With popularity of tablets and other touch screen devices, question arises whether the touch screen interfaces affect test result compared to keyboard interface. Valid neurocognitive tests of reaction time require millisecond precision.

BACKGROUND: Currently the iPad is the most popular touch screen tablet on the market. Clinicians and researchers are using iPads to access clinical and other information. It is well known that different touch screen devices suffer from inconsistent input lag2. A review of the technical literature has revealed that the iPad 2 has an input lag of approximately 235 milliseconds, which is an improvement from iPad 1’s input lag of approximately 290 milliseconds3. It is also known that input lag does not always improve in newer generations of touch screen devices4. Furthermore the performance of these flash memory based touch screen devices tends to erode over time which can potentially affect input lag and recorded reaction time5.

METHODS and STUDY DESIGN

Using the CNS VS web battery, we tested the iPad 2 against a traditional keyboard laptop to determine if iPad’s touch screen input affect test result. Three tests from the CNS VS test battery were used for this study:

1. Verbal Memory Test (VBM): Fifteen words are presented, one by one, on the screen every two seconds. For immediate recognition, the participant has to identify those words nested among fifteen new words. There is a delayed recognition trial as well.
2. Visual Memory Test (VIM): Fifteen geometric figures are presented, one by one, on the screen. For immediate recognition, the participant has to identify those figures nested among fifteen new figures. There is a delayed recognition challenge as well.
3. Continuous Performance Test (CPT): Participant is asked to respond to the target stimulus “B” but not to any other letter. CPT has a ceiling effect. Normal subjects are expected to have near perfect scores. The 200 stimuli are presented at random for 5 minutes.

DESIGN: Group A subjects took the tests on the iPad. The tests will be administered with a proctor in the room where the participants will remain seated during the time of test administration without interruptions.

PARTICIPANTS: 15 participants were selected for Group A, 15 control subjects for Group B were selected from normative database age matched to Group A.

DEMOGRAPHICS: Group A age range from 29 to 54 with mean of 42.5 years old. Group B age range from 29 and 59 with mean of 42.6 years old.

EXCLUSION CRITERIA: current or past psychological disorders, currently treated for psychological disorders, inability to use laptop or tablet, inability to complete the test.

NORMAL SUBJECTS: age 12-60, English speaking male and females, with “everyday” familiarity and ability to use tablets and computers.

RESULTS

REACTION TIME COMPARISON: Reaction time between tablet and laptop revealed significant differences in the VBM’s initial reaction time, VIM’s initial reaction time, and CPT’s correct hits reaction time with p < 0.0003 for all three reaction times. Although VBM’s and VIM’s delayed reaction time did not reach significant difference, they were all trending toward significant differences with tablet’s mean reaction time greater than laptop’s mean reaction time.

REFERENCES


CONTACT INFORMATION

Jim Wei, Pharm D Candidate
University of North Carolina School of Pharmacy
J WeiP@gmail.unc.com

Dexter Morgan, VP Clinical Operations
CNS Vital Signs
DMorgan@cnsvs.com

Disclosure: Mr. Alan Boyd is the CEO of CNS Vital Signs and a developer of the CNS VS test battery.