# Reliability of Bell's Test Conducted with Virtual Reality

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## ABSTRACT

Cancellation tasks are commonly used assessment tools to detect unilateral neglect. Bell's Test, one of the most commonly administered cancellation tasks, requires individuals to quickly and accurately identify "bells" randomly placed in an array of symbols. The reliability of Bells Test conducted with a paper and pencil is well established. A newly developed, commercial software application, allows Bell's Test to be administered in fully immersive virtual reality environment. **PURPOSE**: The purpose of this study was to measure the reliability of the Bell's Test using a virtual reality (VR) system and to establish the level of agreement between the pen-paper and VR administration. **METHODS**: Fourteen apparently healthy individuals between the age of 24 – 73y volunteered (47.9±20.7y; 166.0±5.2cm; 77.5±16.3kg). Subjects were excluded if they had a history of concussion or had perceptional or visual deficits. Participants completed Bell's Test a total of four times. The first time, it was completed with a pen-paper (PP). Then, participants completed an initial assessment in VR (VR$_{base}$); the same test was administered again in VR one-hour (PostVR$_{1hr}$) and one-week (PostVR$_{1wk}$) post baseline. Realization time, total time, and the number of errors committed in the right and left field of view were recorded. Cronbach's alpha was computed on realization and total time in all VR conditions. Additionally, an ANOVA with repeated measures was used to determine differences in PP, VR$_{base}$, PostVR$_{1HR}$, and PostVR$_{1wk}$. The Holms-Sidak method was used to determine pairwise differences. Alpha was set at $p<0.05$, *a priori*. **RESULTS**: Reliability for realization time for the Bell's test conducted in VR was acceptable ($\alpha=0.79$). There was, however, a significant difference between trials (F=6.65; p=0.013). VR$_{base}$ (29.25±8.11s) was significantly different than PostVR$_{1HR}$ (15.52±4.30; p=0.006). and VRpost1wk (21.24±5.89s; p=0.01). Additionally, PP realization time (15.31±4.25s) was significantly different than PostVR$_{1HR}$ (p=0.02) and PostVR$_{1WK}$ (p=0.03). Reliability for total time for the Bell's test conducted in VR was good. ($\alpha=0.82$). There was not a significant difference between the trials (F=4.34; p=0.06) for VR$_{base}$(24.1±6.7s), PostVR$_{1HR}$ (45.44±12.6) or VR$_{post1wk}$(p=0.06). However, there was a significant difference found in PP$_{total}$ time taken and VR$_{1wk}$ with the (p=0.03). The average number of left side omitted bells was 0.50±0.65; 0.07±0.26; 0.07±0.26; 0.14±0.36 for PP, VR$_{base}$, Post VR$_{1HR}$, and PostVR$_{1WK}$; respectively. The number of bells omitted on the right side was 0.50±0.85, 0.21±0.57, 0.14±0.36, for 0.14±0.36 for PP, VR$_{base}$, PostVR$_{1HR}$, and PostVR$_{1WK}$; respectively. **CONCLUSION**: These data indicate that the reliability of the Bell's Test for the realization time is acceptable and the total time reliability was good in the virtual reality system. Healthy individuals performing the Bell's Test in VR show slight improvements one hour after baseline, but there was no difference after one week. More data are needed within different age groups to determine reliability in young and older individuals. Additionally, future studies are required to determine the reliability of Bell's Test in VR for individuals suffering from neurological injuries or diseases.