Convergent validity of virtual reality neurocognitive assessment: a meta-analytic approach

ALEXANDRA NEGUT 1
SILVIU-ANDREI MATU 2
FLORIN ALIN SAVA 3
DANIEL DAVID 4

Abstract
A new paradigm for neuropsychological assessment is virtual reality-based assessment which is considered to be an alternative for classical neuropsychological assessment. Fourteen studies met our inclusion criteria: included correlational analysis between classical or computerized measurement instruments and virtual reality assessment tools of the same cognitive process. We computed mean effect sizes from fourteen studies (N= 553) using correlation coefficient r. Based on a random effects model, results point out a positive significant medium correlation between virtual reality measures and classical or computerized measures (r = .51). For executive functions, memory and other neurocognitive measures subgroup analysis revealed medium effect sizes for the association between classical or computerized measures and virtual-reality-based measures. Moderation analysis was performed and revealed that participant’s mean age and gender, as well as type of control measurement instrument are significant moderators. The current meta-analysis brings evidence in favor of the convergent validity of virtual reality-based measures.

1. Evidence-based Assessment and Psychological Interventions Doctoral School; The International Institute for the Advanced Studies of Psychotherapy and Applied Mental Health, Babeș-Bolyai University, No. 37, Republicii Street 400015, Cluj-Napoca, Cluj, Romania. Telephone number: 0264434141, e-mail address: alexandra_negut@yahoo.com
2. Department of Clinical Psychology and Psychotherapy, Babeș-Bolyai University, No. 37 Republicii Street 400015, Cluj-Napoca, Cluj, Romania. Telephone number: 0264434141, e-mail address: silviu.matu@ubbcluj.ro
3. Department of Psychology, West University of Timișoara, No. 4, Vasile Pârvan Bulevard 300223, Timișoara, Timiș, Romania. Telephone number: 0256592252, e-mail address: afsava@gmail.com
4. Department of Clinical Psychology and Psychotherapy, Babeș-Bolyai University, No. 37 Republicii Street 400015, Cluj-Napoca, Cluj, Romania; Icahn School of Medicine at Mount Sinai, New York. Telephone number: 0264434141, e-mail address: danieldavid@psychology.ro
Virtual reality consists of an advanced interactive human computer technology that generates a 3D environment. Virtual reality technology uses different technological tools which recreate a realistic virtual environment. The most used virtual reality platforms are based on a head mounted displays (HMDs) which provide a full 360° view of the environment or consist of gesture-based video-capture systems that use video camera that captures and converts the participant’s movements in a 2D world on a large monitor (Rand et al., 2005). Some of the virtual worlds are presented by complex systems, such as cave automatic virtual environments (CAVE). The resulted virtual environments are a computerized representation of a real environment in which the participant is immersed (Elkind, Rubin, Rosenthal, Skoff, & Prather, 2001; Ku et al., 2003; Lalonde, Henry, Drouin-Germain, Nolin, & Beauchamp, 2013; Rheingold, 1991).

Virtual reality environments are expanding into the clinical psychology field and are being used for neuropsychological assessment (Henry, Joyal, & Nolin, 2012; Parsons, Courtney, & Dawson, 2013; Rizzo et al., 1999), rehabilitation of cognitive processes (Chan, Ngai, Leung, & Wong, 2010; Foreman & Stirk, 2005; Rose, Brooks, & Rizzo, 2005), as well as for the treatment of anxiety disorders (Opriş et al., 2012; Parsons & Rizzo, 2008; Powers & Emmelkamp, 2008).

**Current approaches in neuropsychological assessment**

Currently, there are two main directions in neuropsychological assessment: classical paper-and-pencil tests and computerized tests which are standardized and have good psychometric properties, such as reliability and validity (Morganti, 2004; Schultheis, Himelstein, & Rizzo, 2002). They are administered in a controlled environment and are scored by a trained practitioner or automatically by the computer (Bauer et al., 2012; Butcher, 2003).

In line with technology advances a new paradigm for neuropsychological assessment is represented by virtual reality-based measures. Researches have used virtual reality-based assessment tools for the cognitive assessment of memory and learning (Gamberini, 2000; Matheis et al., 2007; Pugnetti et al.,...