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Normative Data for a Next Generation Virtual Classroom for Attention Assessment in Children with ADHD and Beyond!

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ABSTRACT

Numerous researchers and clinicians have recognized the unique match between Virtual Reality (VR) technology assets and the requirements of various clinical assessment and treatment approaches and an encouraging body of research has emerged. In the area of cognitive assessment related to central nervous system dysfunction, traditional approaches often rely on paper and pencil psychometric tests, qualitative ratings of behavior, and flat screen computer tests to inform diagnosis and to track changes in clinical status. VR offers options for enhancing the assessment process beyond these methods with the creation of standardized immersive simulations within which user performance can be consistently measured under conditions that may be more relevant to the challenges present in the real world, to better inform diagnostic and treatment decisions. Similar to traditional methods, normative data from typical children can be accumulated from VR simulations that provide performance standards for comparison with that of atypical children. This presentation will initially discuss the history of the USC Virtual Classroom (VC) (since 1998) for testing attention processes in children with ADHD and other neurological conditions. This will be followed by the presentation of a new version of the VC and the results from a neurotypical standardization sample of 695 children (age 6-13) tested in the VC. Ongoing data collection from children with attention impairments will be discussed in the context of the development of this research program.

1. INTRODUCTION

The USC VC project commenced in 1998 with the initial aim to explore the feasibility and usefulness of VR as a tool to assess children with ADHD within ecologically relevant and systematically controllable stimulus conditions. The rationale for this effort was also bolstered by the idea that movement data could be easily collected leveraging the on-board head and body tracking technology that was naturally part of the implementation of VR. Movement was thought to be an area of assessment often neglected in standard psychometric tests, but vitally relevant to making an informed assessment of the hyperactivity component of ADHD. In 2003, after cognitive and movement data from an initial clinical trial documented the value of this approach for differentiating children with ADHD from neurotypicals, a commercial test publisher supported efforts to productize the application. However, primarily due to the cost of VR equipment at the time and the general unfamiliarity with the technology by practicing clinicians, the product development effort was discontinued and the resulting VC reverted to becoming a tool for cognitive/clinical research by academics. In 2018, as low cost and high fidelity VR technology became more readily available and with the accumulation of positive findings over more than 20 studies Parson &

Rizzo, 2019), it was decided that the VC would undergo an update with the aim of promoting its wider distribution as a commercial product. In partnership with a commercial entity, Cognitive Leap, a new VC was created, informed from knowledge gained from previous research with the various USC versions. Similar to traditional testing approaches, data collected across different neurotypical age groups was needed to establish a normative database. This was essential for creating the standards by which the performance of children suspected of having ADHD could be compared. The results of that effort are detailed next.

Images 1-2. *Virtual Classroom (L) and Users interacting with the system (R).*

2. METHOD

Six hundred and ninety-five, non-diagnosed, typical children (female n=321) across the ages of 6-13 were tested on a 13-minute VC test to establish normative data for each age group. Children were evaluated on an A-K continuous performance task delivered on a white board within the VC, while common distractions (typical of a regular classroom) were also presented. Key performance variables that were measured included Omission Errors (O), Commission Errors (C), Reaction Time (RT) and Reaction Time Variability (RTV). Head Movement variables were also recorded from the VIVE HMD tracking system during the test sessions to document behavior related to hyperactivity and distraction.

3. RESULTS

Results from this normative sample showed clear linear performance improvements on all variables across the ages of 6-13, as was predicted across this developmental period. For example, when grouped by 2-year intervals, male participants showed a reduction of both omission (O) and commission (C) errors across the age groupings (for ages, 6-7, 8-9, 10-11, and 12-13, mean O's = 13.6, 6.6, 4.2, and 2.1, and mean C's = 22.5, 12.1, 5.4, and 2.9, respectively). Moreover, reaction time and reaction time variability produced similar reductions (mean RT's (in msecs.) = 523, 450, 407, and 402, and mean RTV's = 197, 149, 124, 110, respectively). Results for female participants followed the same linear pattern.

4. CONCLUSIONS

These findings provide support for the VC's capability to capture performance change over this span of early childhood development. More data from this normative dataset and its importance for making comparisons with children with ADHD will be presented at the conference. At the current time, the VC is in use at three clinical sites to collect performance data on children diagnosed with ADHD, off of their medications during the testing to allow for performance comparisons with the normative sample. At the same time, variations on the VC classroom are being explored to address other cognitive processes and clinical populations. Auditory attention tasks and an adult version of the VC will be used to expand the range of use for this application concept.

5. REFERENCES

Parsons, TD and Rizzo, A. (2019) A Review of Virtual Classroom Environments for Neuropsychological Assessment. In: *Virtual Reality for Psychological and Neurocognitive Interventions*. (A Rizzo & S Bouchard, Eds), Springer, New York, NY. pp 247-265.