Assessment of Inhibition Deficits with the Virtual Classroom in Children with Traumatic Brain Injury: A Pilot-Study

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Abstract. This study compared the performance of 8 children who have sustained a traumatic brain injury on the traditional VIGIL Continuous Performance Test and the Continuous Performance Test included in the Virtual Classroom. Results supported the hypothesis, showing that the Continuous Performance Test from the Virtual Classroom showed more sensitivity concerning inhibition deficits. More precisely, children showed more commission errors and longer reaction time. These results can be explained by the ecological character of the Virtual Classroom, meaning that this instrument is close to real-life experiences and requires more attention and inhibition resources.

Keywords. Virtual Reality, Virtual Classroom, Children, Traumatic Brain Injury, Inhibition Deficit

Introduction

Traumatic brain injury (TBI) represents the most reported neurological injury in children. It generally involves attention, inhibition, working memory, and processing speed deficits [1]. It is expected that attention deficits are closely related to learning and school performances. Furthermore, attention assessments must be sensible, complex and cognitively demanding, so subtle deficits can be identified with neuropsychological evaluations.

Traditional neuropsychological assessment makes it possible to represent cognitive impairment, but many doubts remain concerning the representativeness of the actual functioning in everyday life. Virtual Reality (VR) brings a plus to current neuropsychological instruments and answers criticisms raised, mainly because it invites the user to interact in real-time three-dimensional environment equivalent to normal daily situations, with no risk of harm, all simulated by a computer. The participant therefore goes in immersion with the help of a visor on which the virtual environment is projected. This technique has many advantages of which the most outstanding are the improvement of the sensibility and ecological validity of the instrument. This particular
context of evaluation makes it possible to seize the child’s real potential and functioning since he is left by himself to behave naturally.

In 2000, Rizzo et al. [2] developed the Virtual Classroom to evaluate attention in ADHD children. This particular virtual environment includes a Continuous Performance Test into a Virtual Classroom. The child must carry out the task, presented on the chalkboard of the classroom, while resisting distractions similar to a real classroom. The environment has been completely redesigned by Digital Mediaworks [3]. Although initially developed for children with ADHD, the Virtual Classroom is an interesting instrument for the assessment of attention with children who have undergone a traumatic brain injury. Objective: the objective of this study was to compare the performance given by children with a Traumatic brain injury (TBI), which generally involves attention deficits, on the traditional VIGIL Continuous Performance Test to the Continuous Performance Test included in the Virtual Classroom. Hypothesis: it is expected that the Virtual Classroom will show more sensitivity concerning attention and inhibition deficits than the traditional VIGIL Continuous Performance Test because of its ecological nature.

1. Method

1.1 Subjects

The sample is composed of 8 children from 8 to 12 years with a TBI.

1.2 Tests

- The Virtual Classroom [2] [3];
- VIGIL Continuous Performance Test [4].

Variables drawn from these tests: total of omissions, total of commissions, and reaction time.

2. Results

Mean comparison tests with repeated measures were used to compare the output of children with a TBI concerning the number of omissions, the number of commissions and the reaction time, on the traditional VIGIL Continuous Performance Test and the one from the Virtual Classroom (VIGIL CPT vs. CPT from the Virtual Classroom). Table 1 shows the children’s mean for each of the variables: total of omissions, total of commissions, and reaction time.

There was no difference between the two kinds of CPT on the total of omissions. However, paired t-tests showed that children made significantly more errors of commission and that their reaction times were significantly longer in the CPT of the virtual classroom compared to the traditional CPT.
Table 1. Means and standard deviations for the group on the standard VIGIL CPT and the CPT from the Virtual Classroom and results for the paired t-tests (N=8)

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIGIL CPT Mean</th>
<th>VIGIL CPT SD</th>
<th>Virtual Classroom CPT Mean</th>
<th>Virtual Classroom CPT SD</th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission (total)</td>
<td>6.8</td>
<td>5.1</td>
<td>6.6</td>
<td>3.0</td>
<td>0.06</td>
</tr>
<tr>
<td>Commission (total)</td>
<td>3.6</td>
<td>3.7</td>
<td>10.5</td>
<td>6.8</td>
<td>-3.56**</td>
</tr>
<tr>
<td>Reaction Time (msec, mean)</td>
<td>319.1</td>
<td>38.9</td>
<td>449.4</td>
<td>72.7</td>
<td>7.67***</td>
</tr>
</tbody>
</table>

** p < .01, *** p < .001

3. Discussion

Using a virtual environment as an assessment tool represents a revolutionary practice and little is explored in this field in neuropsychology, especially in children with TBI. Results from this study support the hypothesis, showing that inhibition problems in children with a TBI are more important in the Virtual Classroom CPT than the VIGIL CPT. Thus, the evaluation approach based on Virtual Reality is more sensible to the repercussions of a TBI than the VIGIL CPT. These conclusions can be explained by the ecological character of the Virtual Classroom, meaning that this instrument is close to real-life experiences and requires more attention and inhibition resources.

Errors of commission are associated with a deficit of inhibition. It is particularly interesting to demonstrate this kind of deficit in children who have sustained a traumatic brain injury as the impact of frontal areas are associated with such deficits. However, it is important to be careful in the interpretation of these results because of the few TBI participants and the absence of a control group. Others aspects than the ecological characteristics of the Virtual Classroom could explain these results. It seems important to pursue this type of work.

Acknowledgment

The authors would like to thank Mr Roman Mitura from Digital Mediaworks (Canada), and Dr. Rizzo from University of Southern California (USA), for their authorization to use the Virtual Classroom.

References