Virtual reality and visual impairment: A comparative analysis of performance in a head-contingent task between patients with visual impairment and control subjects

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Résumé

Virtual reality (VR) offers innovative perspectives in the field of visual impairment. The general and exploratory goal of this study is twofold. First, we investigate how well patients can perform a pointing task in a VR environment compared to normally sighted controls. Second, we assess whether the individual characteristics of patients' scotoma correlated with their pointing task performance. Normally sighted and visually impaired subjects performed a head-contingent task developed with PTVR (https://ptvr.inria.fr/). Subjects had to move their head to point with a gaze-contingent reticle at a static target in the virtual environment. Pointing had to be maintained for 2 sec to be validated. A timeout occurred after 30 sec without valid pointing. Reticle position in the headset's viewport was either in the center (centered condition) or 10◦ away from the center, at one of 8 possible half-meridians (eccentric condition). An additional perimetric exam was conducted for patients using a microperimeter (MP-3 Nidek Inc.), thus providing information about the scotoma's position, size, and shape. We measured the time needed to achieve valid pointing. We also estimated the percentage of correct trials during the experiment. Linear mixed-effects models were used to analyze the effect of the different conditions on reaction time. Our preliminary data (N=8) show that visually impaired subjects are able to perform our head-contingent task. However, reaction times were longer in the patient's group (mean, 9.2 sec) than in the control group (mean, 2.2 sec). The mean reaction time was homogeneous for control subjects whatever the position of the reticle. Patients had a lower percentage of correct trials (89.8%) than normally sighted subjects (99.7%). Patients' results indicate an anisotropy of pointing performance across the reticle's positions. Further investigation of microperimetry data will help us understand how this idiosyncratic anisotropy may be related to the characteristics of each patient's scotoma. These data will lay the ground for new rehabilitation tools based on pointing tasks.

Mots-Clés: Pointing, Virtual reality, Head, contingent task, Central vision loss, Scotoma, Microperimetry

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