Using immersive VR to explore individual differences in visual processing styles

Sarune Savickaite
School of Psychology
University of Glasgow
Scotland, UK

sarune.savickaite@glasgow.ac.uk

Elisa Gaillard
School of Psychology
University of Glasgow
Scotland, UK

elisagaillard8@gmail.com

Neil McDonnell
School of Humanities
University of Glasgow
Scotland, UK

neil.mcdonnell@glasgow.ac.uk

David Simmons
School of Psychology
University of Glasgow
Scotland, UK

david.simmons@glasgow.ac.uk

ABSTRACT

The aim of this study was to analyze drawing performance in a Virtual Reality (VR) environment using a combination of personality questionnaires and screen captures of participants' viewpoints.

Introduction

Autism Spectrum Disorder (ASD) and Attention-Deficit Hyperactivity Disorder (ADHD) are neurodevelopmental conditions often characterized by a local bias in visual processing and difficulties with executive functions, such as planning and working memory. These difficulties have previously been experimentally assessed using the Rey-Osterrieth Complex Figure (ROCF) task, an extensively used neuropsychological tool in which drawings of a complex figure (first copied and then re-drawn from memory) are analyzed. Building on our previous work,[4] we investigated visual processing and executive function patterns in a novel Virtual Reality (VR) version of the ROCF task

Methods

92 (39 male, 53 female) neurotypical participants (average age 22.5) filled in AQ[1], ASRS[3] and SQ[2] questionnaires and then a standard ROCF task (i.e. Copy, Immediate Recall and Delayed Recall) was completed in VR. Standardised scoring systems were used to quantify emerging visual processing and executive function patterns. The order in which elements of the ROCF were completed was visualized and compared to ideal sequences (Figure 1).
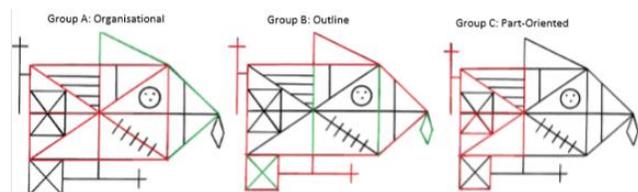

Figure 1. Three patterns were observed in videos and used in further analysis: A. organisational, B. outline, C. part oriented. Red lines indicate elements drawn first and green shows elements, which were occasionally drawn before the red elements.

Results

Although significant differences were not found in the drawing tendencies of participants with differing levels of autistic and ADHD traits, drawings scoring higher on the standardized scales were systematically linked with higher performance rates. Higher ROCF organization predicted better performance for both recall conditions.

Discussion

Our study offered several innovative ways of visualizing and evaluating VR data. This new approach supported other empirical findings that organization is a predictor of performance in the ROCF task. The organizational level is thought to correlate with executive function abilities, but, surprisingly, we did not identify significant performance differences in neurotypical participants with differing levels of autistic, ADHD and Systemizing traits. Consequently, we have no evidence to confirm that visual processing and executive functioning biases vary with these personality trait levels. However, modification of the task to suit VR better, and recruitment of diagnosed autistic participants are the next steps in identifying what the visual processing and executive function patterns we have identified really mean.

KEYWORDS

Virtual Reality, Visual Processing, Autism, ADHD, Executive Function

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