

Comparing User QoE via Physiological and Interaction Measurements of Immersive AR and VR Speech and Language Therapy Applications

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Introduction

- Speech & language therapy (SLT) is the practice of assisting people speech, language, communication, and swallowing difficulties.
- 12% of people internationally experience a speech and language difficulty.
- Speech language difficulties can occur early or later in life as a result of traumatic brain injury or stroke.
- Traditionally, paper based assessments such as The Comprehensive Aphasia test are used in a clinical setting to evaluate speech and language difficulties.
- Interactive and immersive multimedia technologies have the potential to enhance paper based assessments.
- Augmented Reality and Virtual Reality technologies provide unique multimedia experiences.
- Quality of Experience (QoE) evaluations are key to the success of any application or service.
- System, Human/User, and Content factors impact user perception of QoE.
- Traditionally QoE is measured through subjective methods such as post-test questionnaire.
- Objective metrics in the form of physiological measures provide unbiased insight into user perception of a multimedia experiences.
- Digitally enhanced assessments allow the capturing of more precise measures of interaction for this type of test.

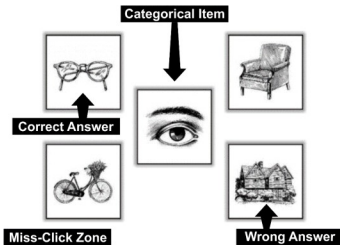


Fig. 1: Semantic Memory Assessment

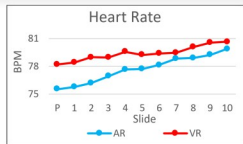


Fig. 2: Average Heart Rate captured during stimulus interaction

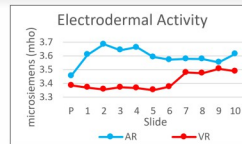


Fig. 3: Average Electrodermal Activity captured during stimulus interaction

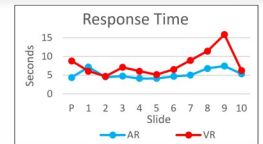


Fig. 4: Average Response Time captured during stimulus interaction

Methodology

- Information & Screening Phase** - Participants were provided information on the test and screened for visual defects.
- Resting Phase** - Baseline physiological metrics were captured for over 5 minutes using aPIP Biosensor and FitBit Charge.
- Training Phase** - The training phase consisted of a series of training videos. Participants were asked to complete a training exercise using the HMD.
- Testing Phase** - Participants completed the virtual SLT assessment which was followed by a subjective questionnaire.

Impacting Factors:

- System
- Human/User
- Content

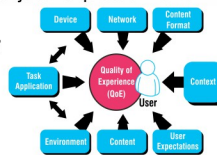


Fig. 5: Factors Impacting Quality of Experience

Results

- Performance of both groups fall within one standard deviation of the normative data for the paper based assessment.
- Both AR and VR groups experience a similar reaction in terms of HR elevation.
- EDA for the AR group indicates that they become accustomed to the virtual environment over time.
- The VR group experience a rise in EDA which coincides with increased cognitive load as reflected through increased response time.
- Higher rates of error are experienced in the VR group.
- User response times are favorable towards the AR group.

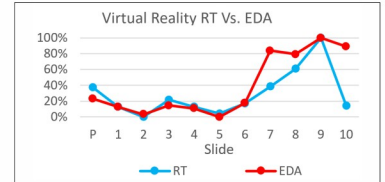


Fig. 6: Correlation between Response Time and EDA for Virtual Reality group

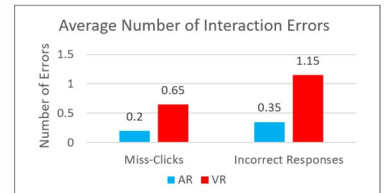


Fig. 7: Average number of Interaction Errors experienced by the AR and VR Groups.

Conclusion

- Test performance indicates that both technologies are applicable for semantic memory analysis as part of a speech and language assessment.
- Physiological (EDA) and interaction measures (Response time, Miss-Clicks, and Incorrect answers) are favourable towards the AR group.
- Future work will involve further analysis of the physiological measures, specifically with respect to the SD of HR and EDA.
- This work will also be extended to the development and evaluation of SLT diagnostics and interventions based on AR technologies.

Acknowledgements

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