

Blink rate vs Inner self perceived cognitive state while using virtual reality applications with haptic devices.

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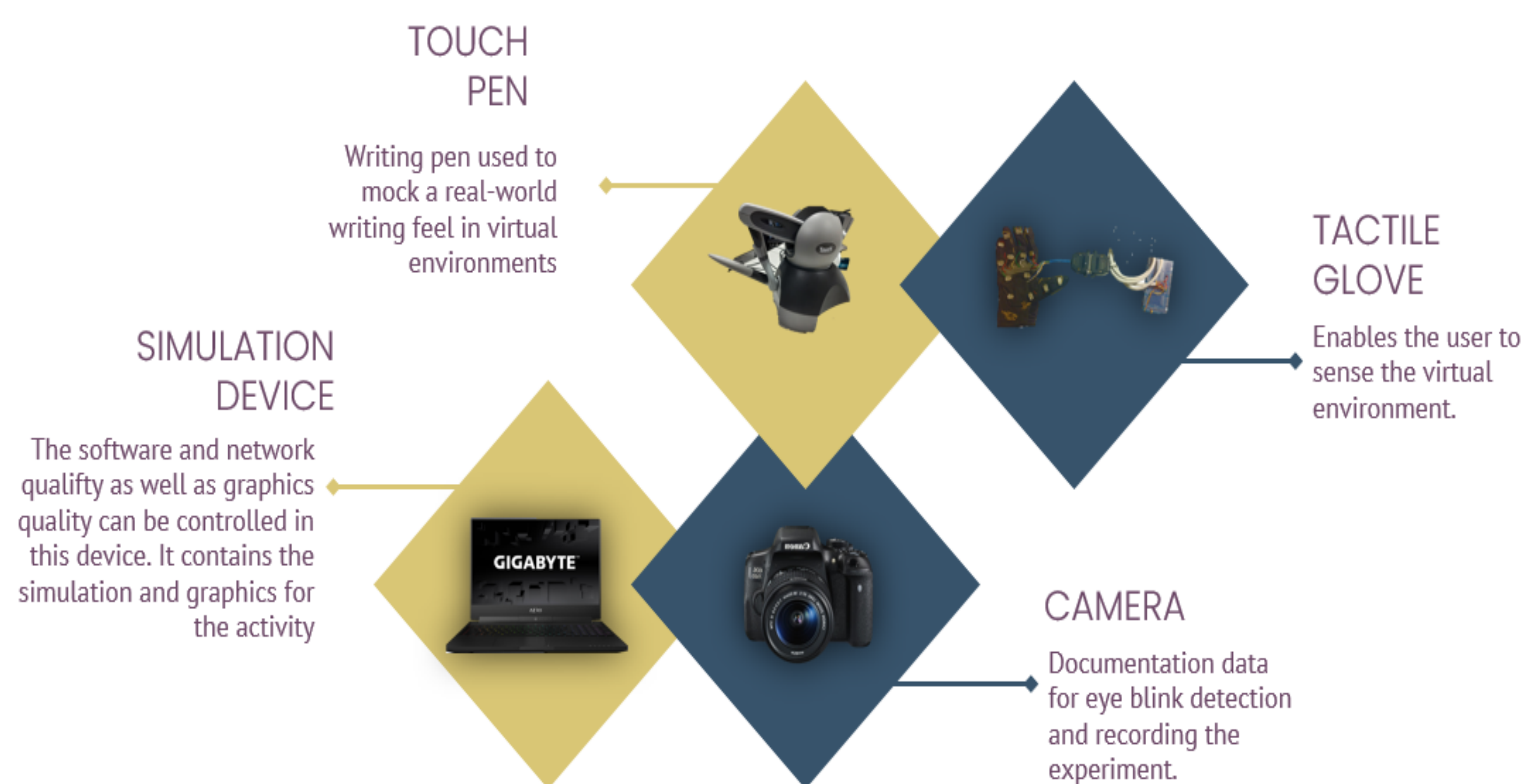
Introduction

The new era of education and online experience bequeaths mixed reality applications. The effectiveness of these tools need to be measured and understood through cognitive behaviors. Quantifying physical and emotional states using eye blink rate is one such approach [1,2]. This is an evaluation of the experience based on eyeblink rate while using haptic devices. We identify the correlation between blink rate and users own perception of inner cognitive state while using haptic devices in different scenarios. Statistical analysis is performed based on the following:

- Blink rate vs three scenarios- (1) Free writing control on a virtual simulation, (2) writing with a haptic glove(i.e., tactile) and (3) a game-based scenario.
- Blink rate vs focus, stress, boredom, experience as seen below.

We can conclude that the factors stress, and their initial mental state have significant correlation to blink rate.

Apparatus used



Experiments Conducted



Figure 1: Blink rate detection using Ear aspect ratio.

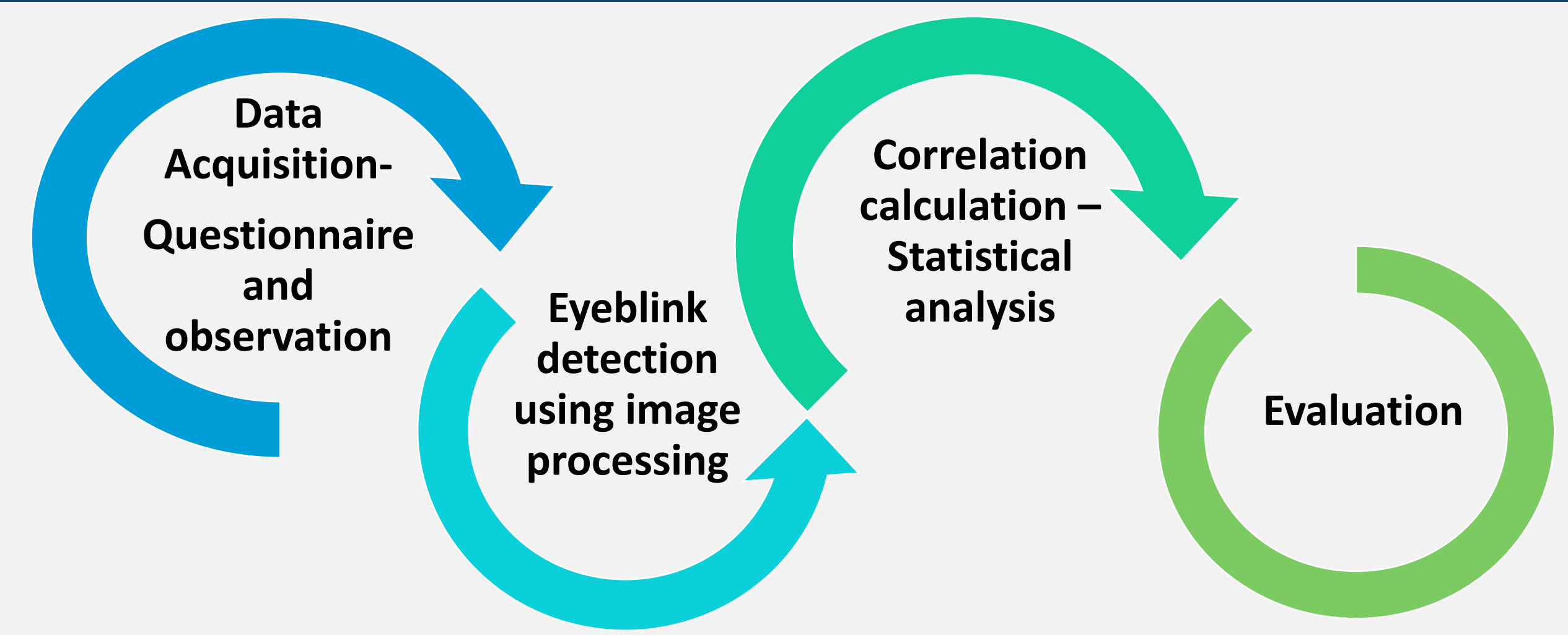
Table 1: Spearman's correlational values for self perceived mental state.

Self perceived mental state	P-value
Physical Fatigue	0.246
Stress	0.922
Comfortability	0.152
Interaction	0.615
Focus	0.035
Overall experience	0.795
Boredom	0.872

Conclusion

The eye blink rate is an important factor in the reflecting the intrinsic response of an individual. The eye blink rate is quantified in this experiment. Based on the subject's interpretation of his/her own feelings correlated. The conclusion is that stress and boredom induced high blink rate and have a strong correlation indicated by their p-value. This can be used as an additional tool in measuring the interactive-ness enjoyability of a given virtual reality task with and without haptic devices.

Method



Data Acquisition method



Blink rate vs scenario

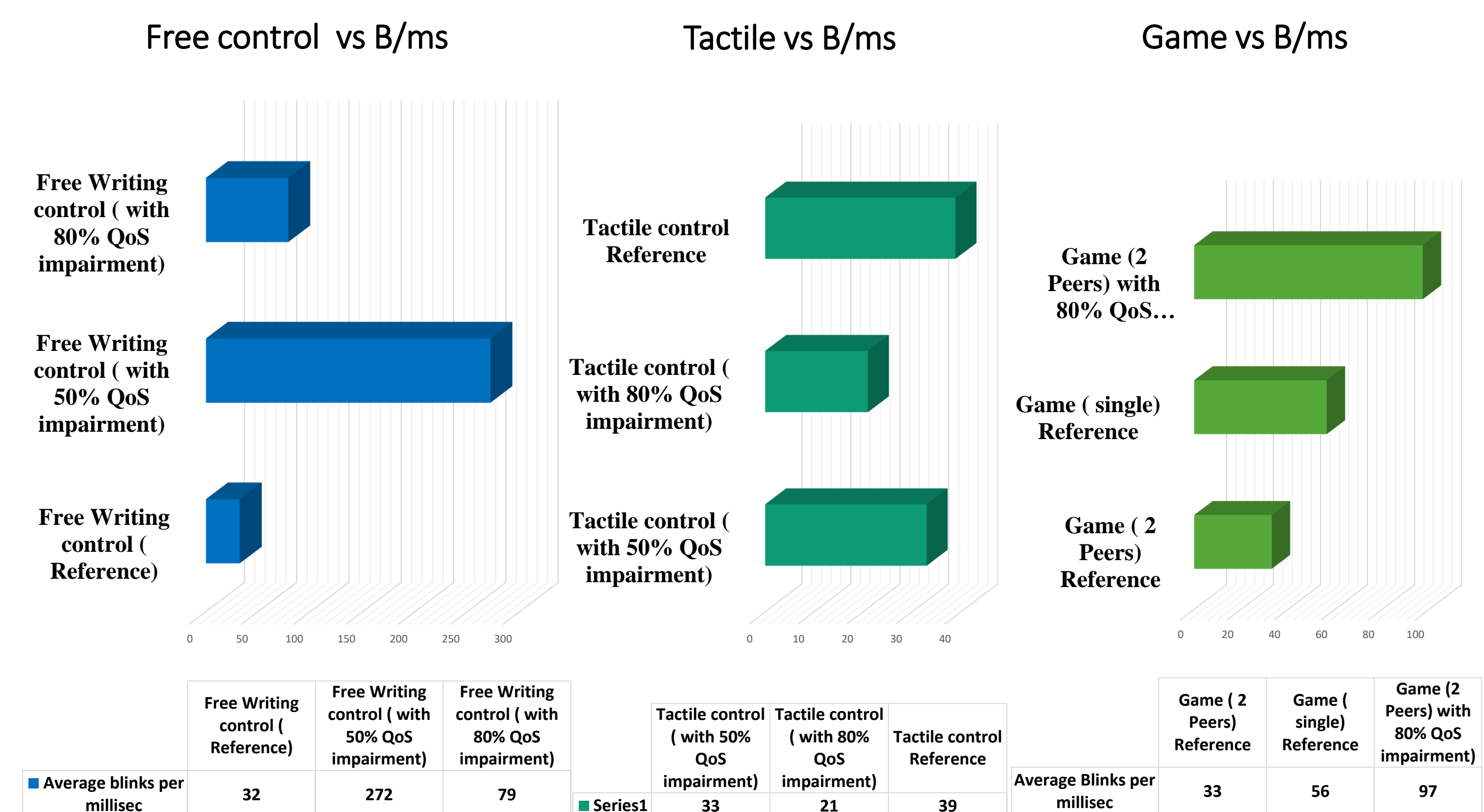


Figure 2: Blink rate vs three scenarios, Free control writing, tactile and game based

Results and Discussion

Figure 1, is the eye blink detection capture technique used after the experimentation. Figure 2, depicts the results of blink rate on three scenarios. Table 1, is the correlation analysis of the blink rate vs the self perceived inner cognitive state.

The experiment was set on three scenarios with varying network quality and hardware quality. Free writing control, tactile control and game-based scenarios showed that eyeblink rate was significantly high in hardware and network quality impaired scenarios. Additionally, spearman correlation value showed that subject perception of current state of mind vs the blink rate which is an intrinsic impulse vary. Stress, boredom and interaction were clearly linked to high blink rate. However, focus, the comfortability of the experiment and physical fatigue produced a null hypothesis.

References

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- [2] Hömke, P.; Holler, J.; Levinson, S.C. Eye blinks are perceived as communicative signals in human face-to-face interaction. *PLoS ONE* 2018, 13, e0208030.
- [3] A. Z. Attiah and E. F. Khairullah, "Eye-Blink Detection System for Virtual Keyboard," 2021 National Computing Colleges Conference (NCCC), 2021, pp. 1-6, doi: 10.1109/NCCC49330.2021.9428797