Evaluation of a fixation-based tuning mechanism for large aperture tunable lenses in a presbyopia correction prototype

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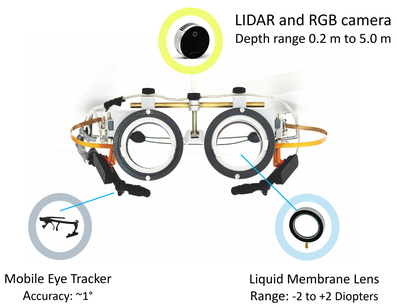
Purpose

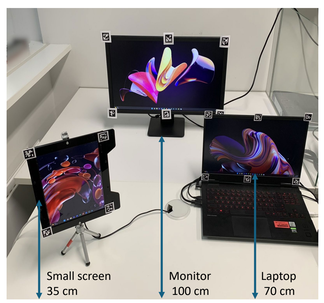
Presbyopia is an inevitable refractive error that affects people starting in their late 40s. Over the recent years, various mechanisms have been developed to tune power of optical lenses with dynamic focus ability for presbyopia correction.[1,2]

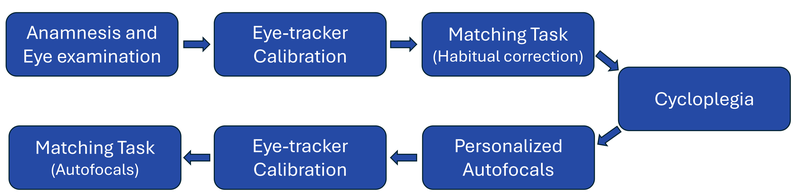
We developed and tested an algorithm to utilize fixations from an eye tracker and depth data from LIDAR camera to tune the focus of the wearer's prototype to the fixation distance.

Methods

This study consisted of seven healthy participants with a mean age of 26 ± 3.1 years old and a mean spherical equivalent of - 1.03 ± 1.34 D.







Matching Task

Landolt C rings

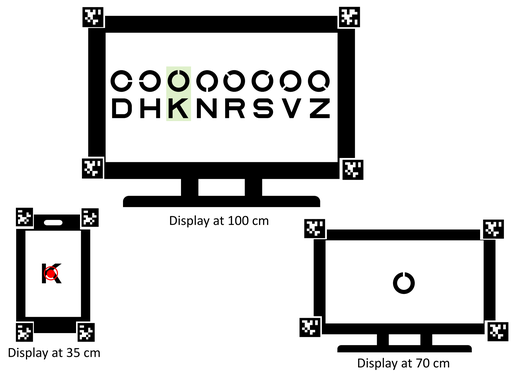
Sloan Optotypes

D H K N R S V Z

Matching optotypes?
Match: True/False

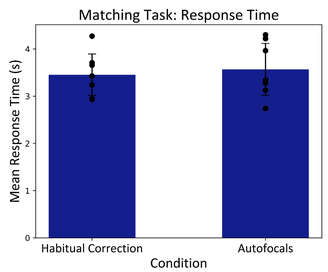
Subject responses:
Match : True/False
Response Time

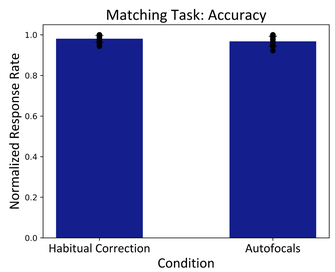
3 repetitions
30 trials for each repetition



Results

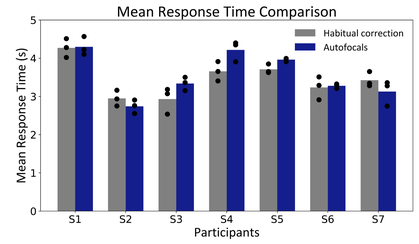
The response time was higher and accuracy marginally lower for the autofocal condition as compared to the habitual correction, however, no statistical difference was observed between the two conditions for the matching task.

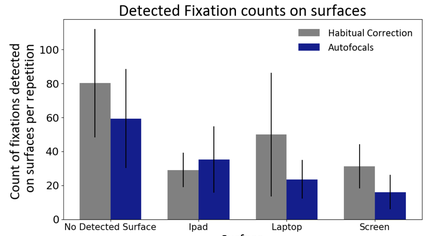




- *The performance of the participants was similar between habitual correction and autofocal condition.*

- *Response time changes over repetitions did not depict any kind of learning effect.*
- *The participants employed different strategies for performing the matching task.*





- *Fixations were detected in real-time using dispersion-based method from Pupil Labs.*
- *Inter-participant differences were observed in fixation counts over surfaces.*

Conclusion

The results of this study demonstrates that the participants performed the task with multiple focus distances, similarly with their habitual correction and the developed autofocals.

Thus, it can be concluded that our fixation-based feedback system is feasible for presbyopia correction with focus tunable lenses.

References

1. Nitish Padmanaban, Robert Konrad, and Gordon Wetzstein. 2019. Autofocals: Evaluating gaze-contingent eyeglasses for presbyopes. Science advances 5, 6 (2019).
2. Juan Mompeán, Juan L Aragón, and Pablo Artal. 2020. Portable device for presbyopia correction with optoelectronic lenses driven by pupil response. Scientific Reports 10, 1 (2020), 1–9.

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Disclosure: Rajat Agarwala, Björn Severitt, Benedikt Hosp: None; Siegfried Wahl: Carl Zeiss Vision International GmbH (E)