Continuous, objective assessment of viewing behavior for printed and electronic tasks

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Purpose: Evidence regarding the influence of near work on myopia is conflicting, likely due to the subjective nature in which near work is traditionally quantified. Recently, the Clouclip, a light weight wearable sensor, was developed for objective measures of light exposure and viewing distance. The purpose of this study was to test the capability of the Clouclip device, and to use the device to determine viewing behaviors for various near viewing tasks.

Methods: For the first experiment, five Clouclip devices were measured against known distances from 5 to 200 cm in 5 cm intervals, and for different indoor and outdoor illumination. Clouclip-measured light levels were compared against a lux meter. For the second experiment, 41 healthy subjects (21 non-myopic and 20 myopic) with ages 18-39 years participated in four different near tasks, including 1) passive reading of printed material, 2) active writing on printed material, 3) passive viewing on an electronic device, and 4) active engagement on an electronic device. Clouclip devices were mounted on the right temple of subject’s habitual spectacle frames or the provided frame with plano lenses. Viewing behaviors were compared between different tasks and between myopic and non-myopic subjects using ANOVA and t-tests and post-hoc tests for pairwise comparisons.

Results: For the first experiment, Clouclip-measured and actual distances were highly correlated between 5 and 120 cm, with a mean difference of 0.53 ± 0.73 cm (r= 0.9998, p <0.0001). Light intensities using the lux meter and Clouclip were also highly correlated for wide range of intensities (r= 0.96, p <0.001), but with greater variability for outdoor light levels. For the second experiment, mean viewing distance for passive printed tasks was 33.22 ± 8.78 cm, for active printed tasks was 29.46 ± 6.68 cm, for passive electronic tasks was 40.79 ± 10.39 cm, and for active electronic tasks was 35.36 ± 7.97 cm. The type of refractive error (i.e. non-myopia or myopia) did not have a significant effect on the viewing distances subjects adopted while performing different near tasks [Two-way ANOVA, F (1,156) =0.7129, p=0.661]. A closer viewing distance was seen for active tasks compared to passive tasks. The number of viewing breaks differed between the tasks, with lowest number of breaks taken for active printed task for both myopes and non-myopes. Multiple pairwise comparison showed a significant difference only between active printed and passive electronic tasks (p<0.05).

Conclusions: The Clouclip performed well with respect to measuring near and intermediate distances and illumination, and the Clouclip could accurately distinguish between indoor (<1000 lux) and outdoor (>1000 lux) illumination. A closer working distances was seen for active tasks, and fewer breaks were taken while using electronic devices. The Clouclip will be useful for studying near work and temporal properties of viewing behaviors in relation to myopia.