EyeWise: A Nudge Theory-Based Approach to Enhancing Blink Behavior in Computer Users

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Abstract: In the digital age, prolonged computer use often leads to digital eye strain, negatively impacting productivity and Quality of Life (QoL). This paper introduces EyeWise, a system that leverages nudge theory to encourage regular blinking. Unlike previous solutions, EyeWise provides customizable reminder intervals and employs subtle prompts to guide user behavior. Preliminary testing demonstrated high usability (SUS score: 78.86) and positive user engagement. However, no statistically significant difference in blink rates was found compared to the baseline system without nudges ($p > 0.05$). While EyeWise may influence blinking patterns in some users, it did not consistently improve blink rates for all participants.

1. Introduction

Prolonged computer use often leads to digital eye strain and various eye health issues, adversely affecting both productivity and Quality of Life (QoL). Given that over 80% of information is processed visually [1], and with the World Health Organization (WHO) estimating that 2.2 billion people experience visual impairment [2], addressing eye health is crucial. Previous research underscores the importance of regular blinking in maintaining eye moisture and reducing strain, particularly during extended computer use when blink frequency typically decreases.

Given the importance of regular blinking in maintaining eye health, this study introduces EyeWise, a novel system designed to encourage habitual eye blinking among computer users by leveraging nudge theory. Unlike previous systems [6], EyeWise incorporates "decoys," a concept from behavioral economics where an inferior alternative is presented to make other options more appealing. By guiding users toward more frequent blinking reminders, EyeWise aims to reduce eye strain and improve overall eye health.

This paper outlines the development and evaluation of the EyeWise system. The main objective is to measure its effectiveness compared to a baseline system in increasing user blinking rates.

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2. Literature Review

Reduced blinking during prolonged computer use is a significant health concern as it impacts ocular surface health and clear vision by spreading the tear film across the eye. Lack of blinking can lead to dry eyes, irritation, and other issues [3].

Nudge theory, originating from behavioral economics, influences behavior without restricting choice and has been successfully applied in various health contexts. For instance, Nakamura et al. promoted healthy eating [4], Stirapongsasuti et al. increased hand hygiene awareness [5], and Romadoro encouraged computer users to take breaks [7]. These applications highlight the versatility of nudge theory in influencing user behavior.

In the context of eye health, several studies have developed blink recommendation systems for computer users. For example, Jurczy et al. [6] created a system that provides periodic reminders to blink. However, these existing systems do not fully leverage advanced behavioral change strategies to enhance user engagement.

3. System Overview

3.1 Nudge Theory Implementation

We implemented several types of nudges based on the work of Caraban et al. [8] to enhance user engagement with blink reminders. Nudges are subtle design elements that influence behavior while allowing freedom of choice. In this context, a "decoy" is an inferior option introduced alongside other choices to make the primary options appear more favorable. This approach guides users toward selecting more frequent blink reminders without explicitly restricting their options.

The EyeWise system presents users with three options for blink reminder intervals in the settings menu, as shown in Figure 1.

Among these, a less desirable alternative (the decoy) is included to encourage the selection of more frequent reminders. The system's user-friendly interface allows users to easily navigate through the options and make informed decisions.

The system interface also includes visual feedback mechanisms designed to reinforce desired behavior. Two color bars are displayed in the corner of the monitor: a green bar that increases with good blinking behavior and a red bar that increases when more frequent blinking is needed. These color changes are based on real-time data tracking the user's blink patterns and are designed to subtly encourage more regular blinking without disrupting the user's workflow.

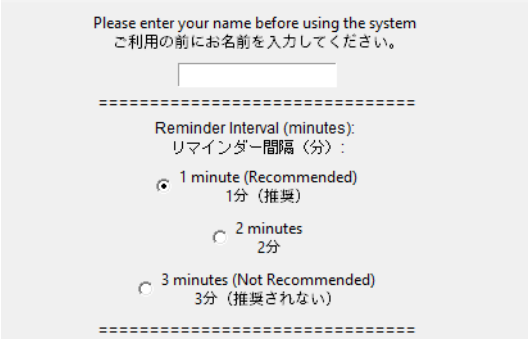

Fig. 1 Options window for selecting blink reminder intervals. Users can choose between three interval options, with the decoy option serving to make the other choices more appealing.

This feedback is designed to be minimally intrusive while effectively promoting habitual blinking, contributing to overall eye health during prolonged computer use.

3.2 Preliminary Evaluation

To evaluate the effectiveness of the EyeWise system, we conducted a preliminary assessment with 11 laboratory participants (average age: 25.7 years). Each participant used both the baseline system, which only detects user blinks without any additional nudges, and the EyeWise system, which introduces reminder intervals based on nudge theory. The baseline system simply monitored blink frequency without providing prompts, while EyeWise aimed to subtly guide users toward more frequent blinking through its design. Each system was used during a 3-minute session of predetermined computer tasks, with the order of systems counterbalanced to prevent bias.

To assess the usability of EyeWise, the System Usability Scale (SUS) was employed. The SUS is a tool for measuring usability, with a mean benchmark score of 68 (SD 12.5) [9]. It provides a score ranging from 0 to 100, and EyeWise achieved an average SUS score of 78.86, indicating that it was well-received and considered usable by participants.

Figure 2 compares the average blink counts of participants over a 3-minute period between the Baseline System (System A) and the EyeWise System (System B). The blue circles represent the blink counts for System A, while the orange x-markers indicate those for System B. Each point on the graph corresponds to an individual participant's average blink count. The red dashed line, set at 15 blinks per minute, represents the standard blink rate. While System A generally shows higher blink counts than System B, both systems exhibit considerable variability among participants. A Wilcoxon Signed-Rank Test revealed no statistically significant difference between the two systems ($p > 0.05$). This suggests that although the EyeWise System may influence blinking patterns for some users, it does not consistently bring blink counts closer to the standard across all participants.

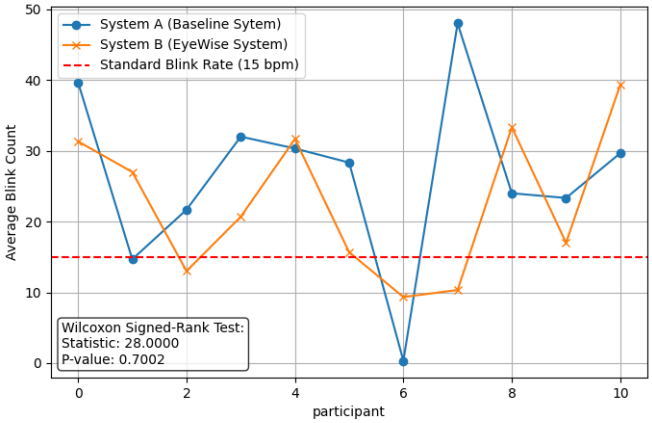

Fig. 2 Comparison of Baseline System and EyeWise System Blink Rates

4. Conclusion

This study introduced EyeWise, a system designed to promote regular blinking through the application of nudge theory. The preliminary evaluation revealed no significant difference in blink counts between EyeWise and the baseline system, suggesting that the current implementation may not yet be sufficient to achieve the desired results. While EyeWise achieved good SUS scores, indicating it was well-received and considered usable, it did not consistently improve blink rates for all participants.

To enhance the EyeWise system, future work will focus on refining it based on user feedback. This will involve exploring adjustments to reminder timing, visibility, and feedback mechanisms to improve its impact. Additionally, comparative studies will be conducted to identify specific areas for improvement and optimize the system's effectiveness in promoting regular blinking.

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