Designing calmworklight: Signaling Focus with a Desk Light

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Abstract

While working, we are not always in line with our ability to focus, which sometimes tends to change on a minutely basis. Being more mindful of own cognitive abilities may contribute to a more pleasant work experience.

This paper presents calmworklight, an initial design proposal for dealing with this issue. calmworklight is a desktop lamp that responds to changes in peoples' focus strength, using the commercially available NeuroSky MindWave. The lamp's expression depends solely on the user's level of focus. If it is strong, the lamp returns a steady, calming warm light. If not, the light emission follows a breathing pattern, aiming to encourage the user to be more mindful of their breath. We conducted 4 user studies to get a better understanding of calmworklight's usage and benefits.

The most striking outcome of the study is the office worker's need for a regulating system that helps them plan when to socialize and when to focus, which should be considered for future office designs.

Author Keywords

Attentive user interfaces; office environment; brain-computer interfaces.

Figure 1: Participants at the Ideation Workshop.

CCS Concepts

•**Human-centered computing** → *Participatory design;* Usability testing; Empirical studies in HCI;

Introduction

Light designs are in use in many settings, some -that include traffic lights- regulate communication [7] and some guide meditation sequences [6]. Light's non-intrusive nature is a good companion for designing calm technology [4, 5]. Light design is critical for office environments, wherein a large part of the population spends the majority of their daytime [3].

In our explorative research, we strived to investigate how office environments could turn into places better-suited for focusing on the task at hand, while also providing time for socialization, collaboration and inspiration. Through an online survey, we investigated how frequent office workers experience changes in their capability to focus. We found out that a majority experiences daily changes. Later in an Ideation Workshop, participants designed, discussed and voted for concept designs that set out to help office workers focus. While we decided not to pursue with designing the emerging 17 designs, we extracted 3 design objectives out of them to inform calmworklight's design.

Our research contributes to HCI community in exploring office environments to design more useful office objects to allow for better focus and socialization periods.

Preliminary Work

Participants and Procedure

We conducted an online survey with 36 knowledge workers in Turkey regarding some selected aspects on their everyday work experience. The age of the participants ranged from 21 to 55 (M=27.6, SD=7.0). All of the participants spend the majority of their work time at typical office environments.

Analysis

We found that 81% of the participants experienced changes in their capability to focus at longest on a daily basis. Among them, 21% stated experiencing hourly and a further 21% minutely changes. 33 participants (92%) expressed that the "ability to focus on relevant matters" contributes to how good they feel. 61% of participants experienced changes in their stress level at shortest on a daily basis. As these suggest, knowledge workers who spend the majority of their work time at typical office environments experience minutely to daily changes in their capability to focus, which affects how good they feel. Thus, we can infer that there may be a positive correlation between the incapability to focus and office workers' not "feeling good".

Ideation Workshop

We decided to organize an Ideation Workshop with designers and office workers to obtain insights about office workers' capability to focus, its' effect on how good they feel as well as to ideate on and discuss concept designs emerging from these insights.

Participants

We conducted the workshop with 11 participants; 4 designers (2 interaction, 2 industrial), 4 office workers, 2 psychologists and 1 architect. The participants' age ranged from 21 to 43 (M=27,8, SD=5,7).

Procedure

We conducted the workshop at an open-plan university located within the university campus. We asked participants to (1) discuss the positive / negative sides of office environments in groups, (2) ideate on concepts to enhance their capability to focus individually by using the provided Con-

Figure 2: When a user has a weak focus, calmworklight is pulsing from low (1) to a higher (2, 3) light emission.

Figure 3: Preliminary user test.

cept Design Template, (3) present their own concept and (4) vote for the 3 concepts they favor the most. The workshop, comprising of above 4 tasks with discussions in between, lasted a total of 3 hours.

Outcomes and Analysis
Discussing the positive sides of office environments, one group stated that being in the proximity of focused people helped them motivate themselves to try to focus. Another group expressed that the high possibility to interact with and be inspired from neighboring workers was a positive side. Discussing the negative sides, one group put forth the visual and auditory crowdedness in office environments. Further, another group claimed that they found it hard to sustain attention at office environments.

Following the tasks 2 and 3, out of the emerging 17 concept designs, one concept titled the "Orange Elephant" summoned the largest number of votes and was appraised the most. We extracted the following design objectives to inform the upcoming system design:

1. *Signaling availability for conversation by using shared meanings* was a prominent objective in 2 concept designs. One design featured color coding (yellow for "I'm open for chit-chats", green for "I'm open for work-related discussions" and red for "Do not disturb / need to focus on my own"). The other concept design included a palm-sized object (in its designer's words: "for example a small statue of an orange elephant"), available at every desk drawer. Users take the orange elephant out of their drawer and put it on a visible area of their desk to signal their need for peace and quiet in the office.
2. *Identifying co-workers that need to take a break and encouraging them to together take a break without causing distraction by actually initiating a conversation* is a common objective (as elaborated in the Concept Design Template) of 3 concept designs.
3. *Priming the worker to focus* is the objective of 1 concept design. 2 participants described how they change the light setting to do so, another one explained how they start chewing a gum to make clear to themselves that they needs to focus.

Designing calmworklight

We chose the third objective for our first design iteration, due to it being effective on the individual office worker level, whereas the other two objectives touch upon social communication within co-workers.

We set out to define a simple physical and temporal form for calmworklight [2], that sought to explore whether office workers can be supported in focusing. The minimalist shape of a cube was deliberate choice to prevent the design from causing unwanted distraction. Further, light is a useful medium in "calm technology" research [5, 4]. Thus, our initial hypothesis follow the logic that a slow pulsating light might function to promote relaxation and guided attention [6] and support the user into concentrating more, while the steady-state encourages sustaining the concentration.

Previous studies further demonstrate light objects' non-intrusive and communication abilities [5, 4]. Following this reasoning, we chose to build a desk light-based solution aiming to prime the worker to focus.

Prototype development
The NeuroSky Mindwave [1], functioned as the technical focal point while designing calmworklight. Processing was used to create the communication between the EEG output

(brainwave activity for delta, theta, alpha, and beta waves) from the Neurosky Mindwave headpiece and the computer.

We used the technical setup to listen specifically to the EEG-output 'Attentionlevel', which is an inherent NeuroSky algorithm, ranging from 0 ('strongly lowered') - 100 ('elevated' level of concentration), which monitors the user's focus and concentration [1]. For the sake of the experiment, we created a threshold-value (50) and a basic function, that parcels a value to the Arduino.IDE program. Further, a simple algorithm with a count limit of the accumulation (50 instances) was created in order to avoid frequent state-switches to prevent the lamp from provokeing unwanted distractions. Value 'x' (under the threshold) initiates a slow light pulsation of the lamp, whereas value 'y' (over the threshold) initiates a steady light-function.

User study

We conducted three user studies to evaluate calmworklight's current features.

Participants & Procedure

Before each user test, we explained the participants that we study the self-awareness own focus capability with calmworklight. A total of 3 participants (nicknamed N, H and A) took part in the user tests. Following the user study (35-60 minutes), each participant was interviewed (20-35 minutes).

Results

All 3 participants didn't realize that the lamp had different emission states. This suggests that the lamp isn't communicating its intention clearly. Some participants thought that the lamp was trying to distract, or even entertain them. Further, 2 out 3 participants showed dissatisfaction with the lamp's monitoring abilities. One participant noted, "I don't like to be encouraged to be self-aware of my own focus ability". All participants described how the lamp was useful in the beginning, however, distracting in the end.

Further, all 3 expressed their wish to be reminded when to take breaks. 2 out of 3 of the participants (A, N) argued that studying made them unnecessarily exhausted, since the did not know when to take breaks. As (N) explains it, "I think I would be more productive when I get back to work (after a timely break)."

These results are in line with the current design iteration's objective of priming the user to focus (keeping in mind that priming is only effective for the beginning of the work session and not throughout accompanying).

Conclusion & Future Work

The findings from our preliminary work indicated that there are changes in a majority of office workers' ability to focus, which may have effects on how good they feel. In an ideation workshop, we discovered potential ways to eliminate the office environment's negative impact on office workers' ability to focus. From these potential ways, i.e. concept designs, we extracted design objectives to inform the design that we want to bring into life. We tested one of the design objectives, "priming the worker to focus" as part of the first design and test iteration of calmworklight.

Our most interesting finding is the need for a communication regulation system to regulate focus and socialization times based on shared meanings, as highlighted in the three design objectives extracted from the workshop outputs. We plan to conduct further user studies to understand users' feedback and work on further developing the prototype. Once we design and implement features taking the other two design objectives into account, we can suggest improved design recommendations on office environment technology specifically for supporting the focus abilities of office workers.

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