CHAPTER 23

Reducing Interruptions at Work with FlowLight

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The Cost of Interruptions at Work

In today's collaborative workplaces, communication is a major activity and is important to achieve a company's goals. Especially given the sociotechnical nature of software development, communication between stakeholders is important to successfully complete projects. Communication thereby takes many forms, such as e-mail and instant messaging, phone calls, or talking to colleagues in person. Despite the overall importance of communication, it can also impede productivity of knowledge workers (see Chapter 7 for a definition of knowledge work). In fact, around 13 times a day, a knowledge worker gets interrupted and suspends his or her current activity to respond to a co-worker asking a question, to read an e-mail, or to pick up a call. Each of these interruptions takes an average of 15 to 20 minutes and leads to an increased work fragmentation. Not surprisingly, interruptions are considered one of the biggest impediments to productivity, costing substantial time and money ($588 billion per year in the United States) [1]. Additionally, interruptions have been shown to cause stress and frustration for the interrupted person and lead to an increase in the errors created after resuming the interrupted task [2, 3]. These negative effects and costs of

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interruptions are particularly high when the interruptions happen at inopportune moments and cannot be postponed. This is why in-person interruptions are one of the most disruptive types of interruptions. Compared to other types of interruptions such as an e-mail notification or an instant message, it is difficult to ignore a person waiting next to the desk and first finish the current task at hand. Yet, the interruption cost can be reduced significantly by mediating interruptions to more opportune moments, e.g., moments when the mental load is lower, when the worker might have taken a short break anyways, after just finishing a task or during work on less demanding tasks. Refer to Chapter 9 for more details on interruptions.

FlowLight: A Light to Indicate When to Interrupt

The FlowLight is an approach we developed to optimize the timing of interruptions and reduce the cost of external interruptions. The FlowLight is a physical desk "traffic light" and an application that computes and indicates the current availability to co-workers (see Figure 23-1) [4]. Similar to the colors of a traffic light and the status colors of instant messaging services, the FlowLight has four states: away (yellow), available (green), busy (red), and do not disturb (red pulsating). The physical LED lamp is usually mounted on a person's desk, cubicle separator, or office entrance to be easily visible by co-workers. Depending on personal preference, the light can be places so that it is visible for the workers themselves, for use as a personal flow monitor, or on a less visible place, to prevent distraction. After installing the FlowLight application on a user's computer, it calculates the users' "flow status"—the availability for interruptions—based on the user's current and historical computer interaction data. A change in flow status results in an update of FlowLight's LED color, as well as an update to the user's Skype status, resulting in muted notifications at times of low availability for interruptions.

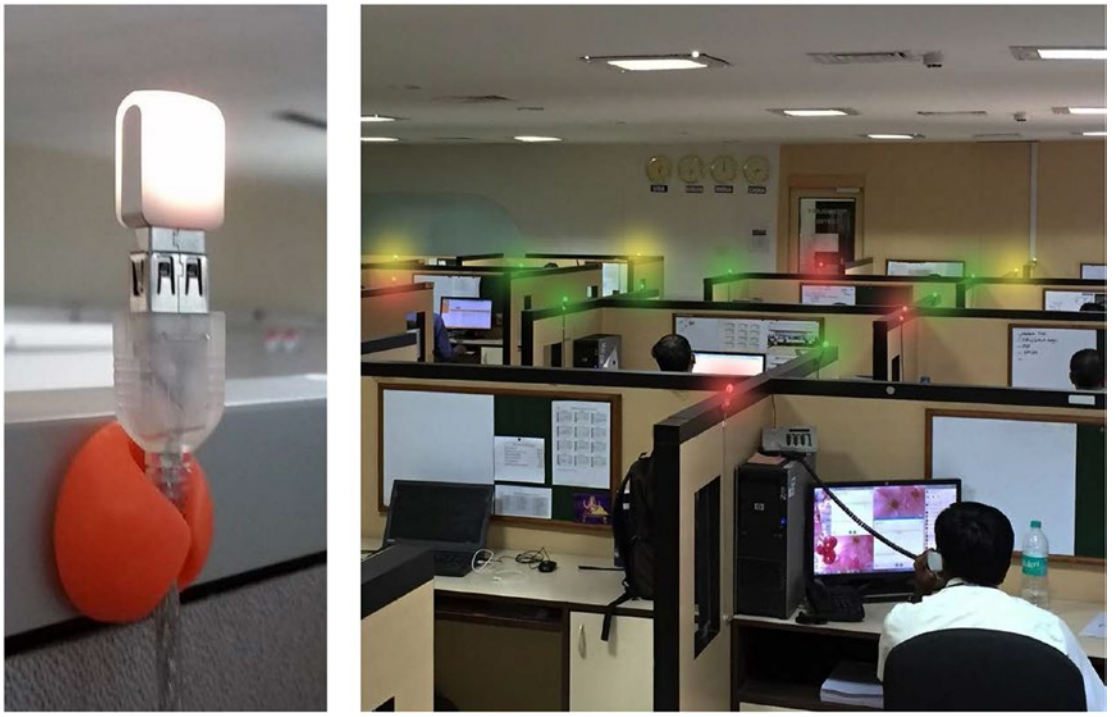

Figure 23-1. *FlowLight in use at the office*

Evaluation and Benefits of FlowLight

We evaluated the effects of FlowLight in a large-scale field study with 449 participants from 12 countries and 15 sites of a multinational corporation. The participants worked in various areas such as software development, other engineering, or project management and evaluated FlowLight while working normally for several weeks. Our goal was to investigate how knowledge workers were using it and how interactions and perceptions of productivity changed after introducing the FlowLights. Overall, the FlowLight reduced the amount of interruptions significantly, by 46 percent, without eliminating important interruptions, and participants continued using the FlowLight even long after the study period ended. Participants also stated that the FlowLight increased awareness of the potential harm of interruptions, that they generally paid attention to their colleagues' FlowLight, were more respectful of each other's work and focus, and either waited for a more convenient time or switched to a different media to communicate with their colleague when the interruption was not urgent.

"The pilot increased the sensitivity to interruption[s]. Team members think more about whether an interrupt is necessary and try to find a suitable time."

"People ask each other if they are available, even when the light is green, even to people with no light. When I see the colleague I want to ask a question (…) has a red light, then I wait a while, or write an e-mail."

These positive effects also led to an increased feeling of productivity, on the one hand because of the increased amount of undisrupted time to work on one's own tasks, and on the other hand because some participants actually liked to observe their status and felt motivated when they realized that the algorithm detected that they were "in flow."

"I definitely think it resulted in less interruptions both in person and via Skype. This resulted in more focus and ability to finish work."

"When I notice that my light is turning yellow, and I'll feel like, 'Oh yeah, I've been idle' and then I do something…I think the other way, yeah, there's some effect there too. Like, if I see that it's red, or even flashing red, then I'm like, 'Yeah, I've been very active, or productive, I should keep that going.' At the same time, I think it's also a little bit distracting too. Sometimes just because the light is there, I turn around to check it."

Finally, most participants stated that their FlowLight's automatic state changes were accurate. Nonetheless, there is potential for improvement. For instance, in situations when a knowledge worker experiences a high cognitive load but is not interacting with the mouse or keyboard intensely (e.g., when reading complicated text or code), the FlowLight will signal the user to be available for interruptions. One way to improve the algorithm is to integrate more fine-grained data, such as application usage or biometric data. Application usage data could, for instance, allow the algorithm to tailor to specific development activities, such as indicating no availability during debugging or availability after code commits. Data from biometric sensors, such as heart rate variability, could be used to more directly measure cognitive load or stress, which in turn influences a person's availability for interruptions.

Key Success Factors of FlowLight

The iterative process of developing and evaluating FlowLight revealed many insights on the factors that contributed to the FlowLight's success.

Pay Attention to Users

For the development of the FlowLight, we followed an iterative, user-driven design process. In particular, we made sure to roll out early versions of the FlowLight to receive user feedback and to improve the approach iteratively. This iterative design helps

to identify issues that might be small with respect to the underlying concept of the approach but might have a big impact on user acceptance. For instance, in the beginning we set the FlowLight to busy (red) and do not disturb (red pulsating) for approximately 19 percent of the day based on previous research. However, early users perceived the FlowLight to be red too often and noted that the state switched too frequently so that it was almost annoying. Therefore, we decreased the percentage and introduced and refined a smoothing function.

Furthermore, the early pilot studies revealed that the FlowLight needs to account for specific job roles, such as managers. While software developers value time spent on coding tasks without any interruptions and Skype messages muted (the "do not disturb" mode) and sometimes wanted to increase this undisrupted time, managers want to be available at all times. Therefore, we added a feature to manually set the do not disturb mode for longer periods as well as a feature to completely disable the do not disturb mode for managers.

Finally, the user feedback also illustrated how the company culture and office layout can impact the value of the approach. While the FlowLight was valuable to almost all teams, there were two smaller teams of people sitting very close together in the same office who were generally interested in reducing interruptions but did not want to spend the extra effort of looking up and checking for the FlowLight status before asking a question to a colleague. In these two teams, the FlowLight did not have any value despite the teams' wish to reduce interruptions, so we uninstalled it shortly after.

Focus on Simplicity

A lot of time and effort during the development of the FlowLight went into creating an easy and simple setup and installation process. For instance, the application can be installed by running an installer in the course of a few seconds. To set up the FlowLights in an office, we further had a member of the research-team visit the team, introduce the functionality to the whole office site, and assist users in placing the lamps in highly visible spots for the co-workers.

We further focused on creating an application that is intuitive and runs smoothly without user interaction. Knowledge workers have used manual strategies for indicating availability before, e.g., using manual busy lights or headphones, but often abandoned them because of the additional effort. The automatic nature of the FlowLight for changing the availability status appealed to the participants and led to the continued usage of the light long after the end of the study. Furthermore, the intuitive design of

the FlowLight that combined the idea of a traffic light with availability states common in instant messaging applications made it easy for users and co-workers to pick up the meaning and reason of the FlowLight and contributed to its success.

Pay Attention to Privacy Concerns

Productivity is a sensitive topic in the work environment and monitoring sensitive work-related data for productivity reasons can quickly result in privacy concerns. Since FlowLight harnesses sensitive and work-related data to calculate a person's availability state, we provide transparency of the data tracking and store the collected data only locally on the users' computers. We asked users to share their data with us only at the end of the study and at the same time gave them the opportunity to delete or obfuscate any data they did not want to share.

We further focused on tracking as little data as possible. While we considered leveraging application usage data from the beginning, we ended up only tracking mouse and keyboard interaction to reduce invasiveness and privacy concerns that users raised in the beginning. Once users appreciated the FlowLight and its value, they themselves asked for refining the algorithm by taking into account further data using additional tracking methods. For instance, users asked us to integrate application usage data to avoid getting into the do not disturb or busy state when reading social media during lunchtime or to make sure they are in busy when they focus on debugging in the IDE. By letting users drive the data collection, users see a clear value from using a rich data set and privacy concerns can be reduced. With productivity in the workplace, peer pressure and competition among team members is another concern. Participants were concerned about being the one who is never "busy" and therefore considered as not very focused by their peers. We designed the FlowLight in a way that reduces the possibility for competition or peer pressure. In particular, we set the FlowLight to be approximately the same amount of time in the busy and do not disturb states for each participant and day by setting the thresholds for changing the states based on historical data of each individual. We further allowed users to change their light manually and broadly communicated that the available state is not representative of "not working" but that it only indicates the availability for interruptions.

Focus on Value First, Not on Accuracy

While each study participant mentioned ways in which the FlowLight's accuracy could be improved, the accuracy of our approach was good enough to lead to a large and quick

adoption. We found that as long as the FlowLight provided some value to its users, was easy to understand by everyone, and did not require much effort, the accuracy was only a secondary concern. Therefore, our focus on simplicity and value first paid off, and now that we have a large user base and can test different options, we have time to improve the accuracy of the flow algorithm.

Let Users Surprise You

The main intention of the FlowLight was to foster awareness of a person's availability for interruptions to co-workers. However, many users found their own way of using it. For instance, they used it as a personal monitor to reflect on their own productivity or also to check whether someone is in the office before going over to a colleague's desk either via checking the light bulb from a distance or looking up the person's Skype status. Getting feedback from users early on allowed us to identify and potentially extend such new use cases that were not anticipated by the creators.

Summary

FlowLight is a traffic-light-like LED that indicates when knowledge workers are available for a chat or to answer a question. A study with 449 participants has shown that the FlowLight decreases interruptions, improves productivity, and promotes awareness on the topic of interruptions. Overall, the FlowLight project was very successful, picked up by various media (http://sealuzh.github.io/FlowTracker/), and study participants continue to use it. We believe that the key factors for successful adoption are to ensure that the approach addresses a problem of its users in a way that is easy to install and operate, respects privacy concerns, and is adapted to the users' needs and use cases.

Get Your Own FlowLight

Do you want to get your own FlowLight? We are happy to collaborate with Embrava (https://embrava.com/flow) to bring FlowLight to a wider audience. The office productivity company licensed the FlowLight software and plans to offer a subscription for an integration of the automatic algorithm into their own products, such as the BlyncLight status light or the Lumena headset with status light.

Key Ideas

The following are the key ideas from the chapter:

- Interruptions, and especially in-person interruptions, are one of the biggest impediments to productivity.
- FlowLight indicates the availability for interruptions to co-workers in the office with a traffic light like LED.
- FlowLight reduced interruptions by 46 percent and increased the awareness on interruptions, and users felt more productive.
- Success factors of FlowLight are its simplicity and continued development using a user-driven design process.

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