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Interruption management and office norms: Technology adoption lessons from a product commercialization study

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ABSTRACT

This paper explores factors that influence technology adoption in an office environment, with an emphasis on technology aimed at managing focused and collaborative work by reducing unwelcome interruptions for its users. Based on surveys, focus groups, and usability studies, our findings suggest that workplace social norms play a pivotal role in the adoption and use of interruption management technologies. Our findings display a marked lag of social norms behind the importance placed on uninterrupted time by individuals; even when individuals see the efficacy of the technology, they often misjudge their peers' attitudes, underestimating their colleagues' similar needs. In spite of high levels of perceived usefulness reported by our participants, need and ease of use alone were insufficient to predict uptake; when technology has implications for the office behavioral environment, it must be supported by social norms encouraging adoption. Our results further suggest that feedback, which actively engages a product's user, could be crucial to encouraging prolonged use and enhancing the user experience. Although the findings are drawn from a pre-commercialization study of an interruption management technology, they are broadly relevant to technology adoption cases, with special salience for those within the office context.

1. Introduction

Interruptions are becoming a pervasive element within the contemporary workplace context. Haynes (2007b, 2008a) identifies the office behavioral environment as the most important factor in enhancing/hindering office productivity[1] and demonstrates that the dynamic elements of the office environment (i.e., interaction and distraction) have the largest positive and negative influences on office productivity. In office settings, studies show that employees can be interrupted frequently and for relatively long durations (O'Connell, 2008). O'Conaill and Frohlich (1995) report an average of four (4) interruptions per hour, with approximately 10 min an hour spent engaged in an interruption. In an 8-h work day, Sykes (2011) observed an average of 121 interruptions experienced by technical leaders, which took up 5.7 h of their working time. Sykes (2011) observed other staff to get interrupted less frequently but still at a significant rate: on the average, 24 interruptions and 73 min total interruption time in an 8-h work day. Further, Czerwinski, Horvitz, and Wilhite (2004) report that office workers experience multiple interruptions while they perform a single task.

Interruptions have become a larger concern in the recent years with increased reliance on a variety of electronic communication tools that result in heightened availability and an expectation of rapid response time. These technology mediated interpersonal interruptions appear to have increased at a rapid rate in the recent years and although they constitute new realities of the contemporary workspace, these disruptions are becoming so frequent as to decrease, rather than increase, workplace productivity (Karr-Wisniewski & Lu, 2010). Face-to-face interruptions are also still of concern given the rise in popularity of open concept office design, which aims to encourage collaboration.

It should be noted that collaboration is important for businesses to remain successful (Innes & Booher, 1999) and is a crucial aspect of modern workplaces (Sykes, 2011). One of the most difficult challenges faced in managing interruptions is navigating the balance between collaboration and interruption (Haynes, 2008a, 2008b). For example, Perlow (1999) observed that her subjects, namely software engineers, considered 96% of their interactive activities

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[1] By enhancement of office productivity we mean enhancing the long-term quality of a firm's products and services as perceived by its clients and the amount of economic activity performed during specified and comparable periods of time, e.g., quarters (Haynes, 2008b).

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to be helpful. However, her subjects also considered only 10% of these activities to be urgent, suggesting that the majority could be scheduled for a later time without negative repercussions for anyone involved. Despite this possibility, 95% of the interactive activities in this study occurred spontaneously, fragmenting the engineers' day and giving them no control over their schedules. Interruptions can carry important content, which can benefit the recipient (O'Conaill & Frohlich, 1995), and are in fact often welcomed depending on the nature of work (e.g., interdependencies of activities, pressure to respond to crisis) and the work culture (e.g., reward system based on individual heroics) (Hudson, Christensen, Kellogg, & Erickson, 2002; Perlow, 1999). However, if interruptions take over control of their schedule away from the workers, they may disrupt focused work and deteriorate productivity. Further, if they happen at inopportune times, they can also be quite detrimental to performance.

The negative effects of interruptions on task performance are well documented in the literature. Interruptions can cause errors and reduce people's efficiency. For a comprehensive review, see Trafton and Monk (2007). Interruptions also reduce the quality of work (Foroughi, Werner, Nelson, & Boehm-Davis, in press). One mechanism that contributes to the role of interruptions in performance degradation is their interference with prospective memory (Brandimonte, Einstein, & McDaniel, 1996). Diary and observational studies suggest that 41% of tasks are not resumed immediately after an interruption (O'Conaill & Frohlich, 1995) and 23% are not resumed at all within that day (Mark, Gonzalez, & Harris, 2005). Even if the resumption occurs, individuals may experience source confusion and neglect to complete certain components of a task, thinking that they were completed before the interruption took place (Trafton & Monk, 2007). Unpredictable and uncontrollable interruptions can also induce personal stress, which can in turn negatively impact performance (Cohen, 1980), and ultimately an individual's well-being. There is increasing recognition that lack of personal control on workplace demands can lead to increased ill health and in particular chronic conditions (Ganster, Fox, & Dwyer, 2001).

Emerging amidst the shifting workplace landscape, Covey (1989) developed a matrix that identifies typical tasks as urgent or non-urgent, and important or non-important. The popularity of email-enabled mobile devices, push notifications, and instant messaging has allowed the urgent items within this matrix to become increasingly visible, detracting attention away from important but non-urgent tasks. In this scenario, important tasks, such as strategic planning, product design, and detailed analysis, can be set aside to address interrupting instant messages. In fact, Czerwinski et al. (2004) found that information workers were interrupted the most while performing high-priority and complex tasks involving information management. Further, they found that it was difficult to return to these complex tasks and that interruptions had the worst effect on these types of tasks. The dominance of urgent over important has further implications given the nature of the mindset required to complete these complex tasks, which often require high concentration (Perlow, 1999). The cost of interruption can be very high for such high cognitive load tasks (Iqbal & Horvitz, 2007).

This study was developed in response to these personal, professional, and health considerations relating to interruption management. The research team embarked on a program to test and evaluate a product in its pre-commercialization phase, designed to publicly distinguish between time dedicated to collaboration or to individual concentration requiring focused periods with no interruptions. The product was designed to mitigate face-to-face as well as technology mediated interpersonal interruptions, in both traditional and open concept office layouts. Through a series of research components that tested the product's software and hardware, we examined the prevalence of different workplace interruptions, perceived need for focused work, as well as the relationship among usability features, social norms, and predicted adoption uptake. We also explored the importance of social norms in an office environment as drivers in the adoption of this new technology and identified further product development suggestions. As will be discussed in later sections, the successful uptake of this product can be defined not only by the individuals' use but also by their colleagues adjusting their behavior based on the status of an individual communicated to them through the product. Thus, the results of this research bear on technology adoption in general, especially in office environments, and point to new research directions exploring the interaction between individual and group attitudes toward productivity enhancement in the office context.

2. Theory

2.1. Technology adoption and diffusion

The theory, the process, and the necessary preconditions for the adoption of new technology formed the underlying basis of this study. The literature on technology diffusion has traditionally focused on two crucial elements that have been assumed to be essential drivers: apparent need, and the ease of use of a new technology (Davis, 1989; Rogers, 1995). Davis (1989) proposed the Technology Acceptance Model primarily based on these two determinants. The first of these describes the requirement for a new product to address a specific need that has been identified within the target population. Often, new product design occurs as a direct result of this explicit demand or need. The second factor is heavily dictated by product design, and suggests that if a new technology is easy to use, it can reduce the barriers that an individual faces before adopting it. Intuitive product design is one strategy to ensure ease of use. This approach often relies on the creation of a new product that has an analogous design to pre-existing products with which the target audience has prior experience (Blackler, Popovic, & Mahar, 2006; O'Brien, Rogers, & Fisk, 2008). While both an identified need and easily understood products are necessary factors, nuanced views of the process indicate that these elements may not be sufficient to predict the uptake of new technology.

2.2. Social norms and behavior change

Analyzing several theories related to social norms and behavior change, Straub (2009) suggests that social influence is a further crucial factor in technology adoption by individuals. The lens of social psychology can be applied to deepen our understanding of the interaction between social norms and adoption behaviors and to understand the complexities of individual behavior change in the broader context of social norms. To accomplish this, the Theory of Planned Behavior offers insights into the antecedent causes of behavioral change. Within this typology, attitudes, perceived control, and social norms are all precursors to the intention that leads to behavioral change (Ajzen, 1991). This sentiment is emphasized in the Theory of Reasoned Action, which suggests a positive correlation between the strength of a social norm and the intention to act (Ajzen & Fishbein, 1980). These theories have received support from subsequent technology adoption studies that have found that social context and norms provide support for the adoption of new communication technologies (Green, 1998; Schmitz & Fulk, 1991).

A factor that appears to interact with social norms is the voluntariness of technology adoption. Venkatesh and Davis (2000) extended the original Technology Acceptance Model proposed by Davis (1989) to suggest that social norms will play a role in intention to use if the product use is organizationally mandated. However, they also suggested that regardless of voluntariness,

favorable social norms will have positive direct and indirect effects on perceived usefulness thus impacting traditionally defined drivers of technological adoption. The indirect effects are attributed to 'image' as an intermediary factor; image is defined as the degree to which the use of an innovation enhances perceived social status (Moore & Benbasat, 1991). In a study of wireless Internet adoption, Lu, Yao, and Yu (2005) found that favorable social norms positively impacted the perceived usefulness of new technologies. Given this relationship, social norms may create positive feedback cycles supporting adoption, which consequently reinforce the normative strength supporting its further proliferation.

Perceived social norms may have even a larger role for products, which may not fully realize their ultimate utility if others do not comply with them. Interruption management inherently depends on the various parties to change behavior. For example, Perlow (1999) tested the idea of having scheduled, quiet time periods in an engineering office and found that her subjects self-reported to have productivity increases and to become more cognizant of others' needs for focused time. However, the practice was not adopted in the long term as the engineers indicated that quiet time alone did not work, that they had no incentive to abide by quiet time, and that no one did.

To our knowledge, previous technology acceptance models do not capture group dynamics from the perspective of technology and information management efficacy being dependent on group use. Our paper presents a case study exploring the role of social norms in the predicted uptake of such a technological product.

3. Product description and interruption management technologies

Our focus was on a hardware and software product in its pre-commercialization phase (Fig. 1) that, for selected periods of time, aims to minimize workplace interruptions that reduce employee concentration on creative and analytical tasks. The product was designed to mitigate face-to-face as well as technology mediated interpersonal interruptions, in both traditional and open concept office layouts. Recognizing the importance of collaboration within the office context (Haynes, 2008b), the product makes explicit the need for interactive time between individuals by allowing them to designate and share specific time periods for interaction and collaborative work.

The product software blocks different incoming forms of electronic interruptions, like email, chats, and Skype (Fig. 2), as configured by the user, and at times determined by the user, while the hardware (a button that can illuminate as red or green, powered by a USB cable, to be placed at the entrance to the office or by a work station) serves as a communication device to convey the need for focused time in the office to others via the visual cue of a red light. The software also communicates red and green (collaborative) states to the other users of the product.

Additional setting options not presented in Figs. 1 and 2 include the ability to display groups, show offline members, minimize to tray when closed, keep always on top, remember previous timer setting, start the product when the computer starts up, choose different formats of displaying user names (e.g., first, last) and how these names are sorted (e.g., status, then name), and transparency settings.

Several approaches to interruption management have been developed for interpersonal communication technologies (Grandhi & Jones, 2010). These approaches include (1) prevention by blocking (e.g., closing an application), (2) dissuasion (e.g., "Do Not Disturb" on Skype), (3) notification modification (e.g., setting the phone to vibrate rather than ring), and (4) preview (e.g., call screening). There have also been studies trying to automate technology to select one of these four options by determining the interruptibility of individuals based on cognitive load and social context (e.g., Fogarty et al., 2005). Grandhi and Jones (2010), however, showed that there are further factors (e.g., historic interrupter–interruptee interaction), which they group under relational context, that guide how individuals manage interruptions.

The product that we studied utilizes the prevention and the dissuasion approaches and is manually controlled by the users, except for the automatic switch between modes, which can be setup using a timer. Therefore, the management decisions are left to the individuals. Although we have not tested the effectiveness of the product on task performance, previous research does not fully support the use of notification modification and preview as effective strategies for maintaining task performance given that a notification can still disrupt performance even when a message is ignored (Cutrell, Czerwinski, & Horvitz, 2001). Of course, task type also matters, and further research is needed to test the effectiveness of these different interruption management strategies. Research by Wiberg and Whittaker (2005) also lends support to the idea of notification modification and preview not being effective alternatives. The authors tested a 'negotiator' interface to help individuals schedule incoming call requests, and found that participants preferred to schedule calls as soon as possible rather than deferring them until a time that they were free. This finding is in line with other research, which suggests that people prefer to take interruptions as soon as possible in most contexts (Hudson et al., 2002). The potential reasons cited for this behavior are feelings of social obligation and avoiding the overhead of having to remember future commitments (Wiberg & Whittaker, 2005).

Wiberg and Whittaker (2005) also studied face-to-face interruptions in an office context. They identified four critical properties of availability management: negotiation (i.e., deciding if and when to talk), awareness of other participants' current activities, brevity of negotiations, and attentional disengagement and cognitive load due to context switching. The product that we are reporting on aims to support awareness of other participants' current activities by enabling each user to specify their focus. It also aims to support negotiation to some extent through the timer function.

4. Methods

Several complementary methods were utilized to examine the product in its pre-commercialization phase with the intention of moving it closer to marketability. The product testing that took place was for the physical hardware and the software dashboard, both of which continue to be developed. The key methodologies consist of a usability study, a survey of existing users, interviews, and focus groups with intended users. Table 1 provides a summary of the sample size and characteristics used for each of these methods. The research was approved by the University of Toronto Research Ethics Board.

4.1. Usability study

The usability study was conducted in a controlled laboratory environment in one-on-one sessions with a study administrator. The participant was seated at a desk in a cubicle. The product hardware and software were run on a desktop PC, and the software interface of the product was demonstrated on a 20-inch monitor. Participants were compensated for their participation in the study, which took approximately 45 min to complete.

Sixteen participants completed the study. They were representative of two groups: eight (8) were 'human factors experts' (employed in academia or industry), while the other eight (8) were 'non-experts' with the occupations mirroring those of the

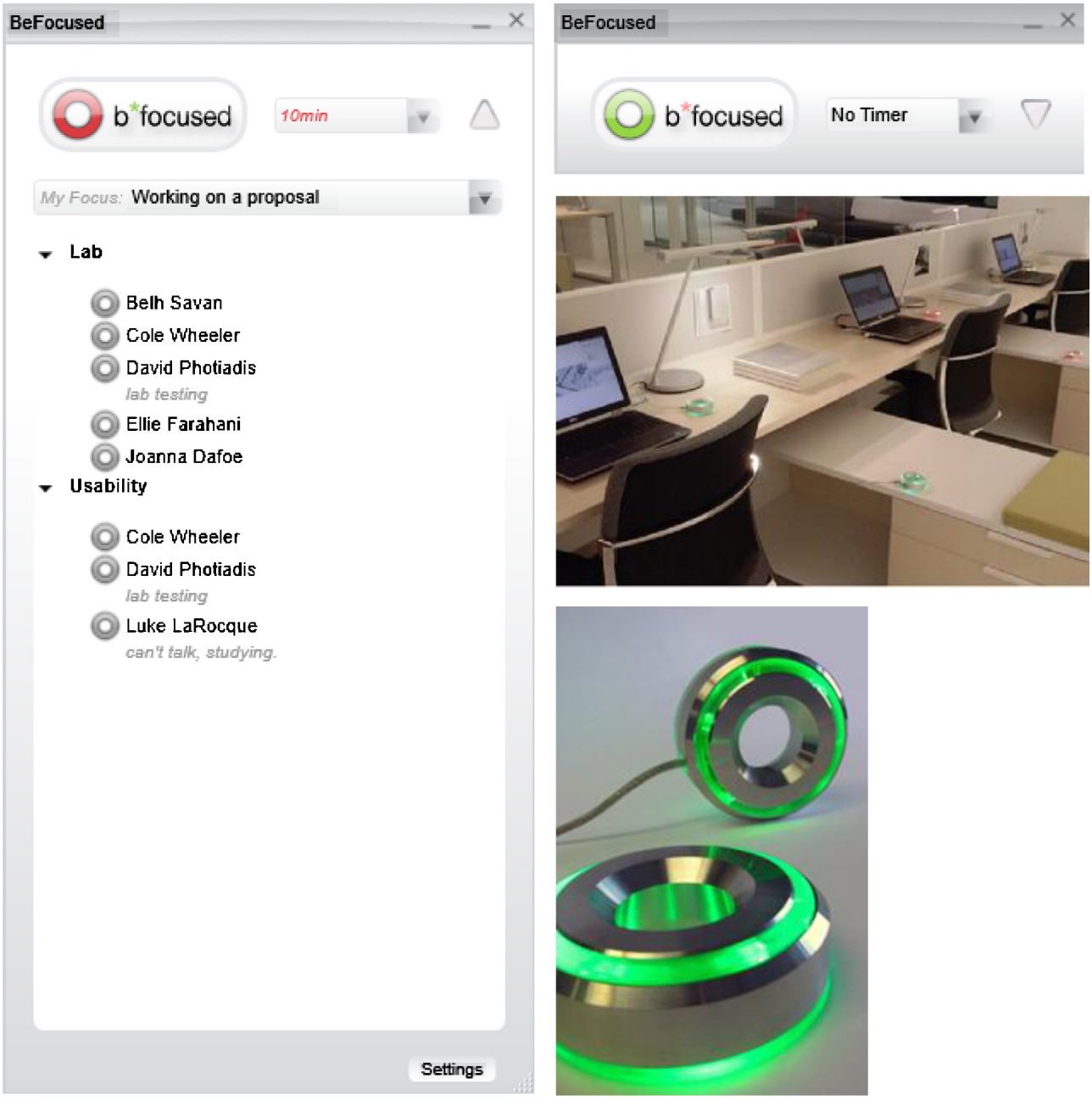

Fig. 1. Product interface. Left: the user is set to be in focused mode working on a proposal for the next 10 min as indicated by the timer which will countdown in minutes, other users are offline as indicated by gray rings in front of their names which turn green when they are in collaborative mode and red when they are in focused mode, the user set two specific groups of interest – lab and usability; top right: the user is in collaborative mode as indicated by the green ring, interface is minimized; bottom middle: hardware buttons in an open office environment lit in green (collaborative) and red (focused); bottom right: close up picture of the hardware in collaborative mode. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

product's target demographic – people working predominantly on computers, with a need to complete tasks requiring focused time (e.g., marketing, web development, IT, security engineering, technical editing, business development). This distinction was chosen in order to test whether feedback on the system differed between the two groups, as well as to provide insight from both a critical perspective, along with end-user feedback. The majority of the participants (73.3%) stated that they worked in an office environment with a combination of individual offices and open concept and shared spaces.

After signing an informed consent document, participants completed a confidential, web-based survey on workplace interruptions. The survey was organized around three themes that impact workplace productivity: (1) the perceived importance and social norm of focused time at work; (2) the frequency of different types of workplace interruptions; and (3) the severity of different types of workplace interruptions.

After completing the survey, participants were provided with a written description of the product along with its intended purpose. The participants were also explained both in written and oral form, that the purpose of the usability portion of the study was to gather feedback on their experiences interacting with the product and that the study sought their opinion on functionality and design aspects of the product including the intuitiveness of the interface and navigation features, aesthetic design, ease of use, etc., and also their overall impressions. Each participant was

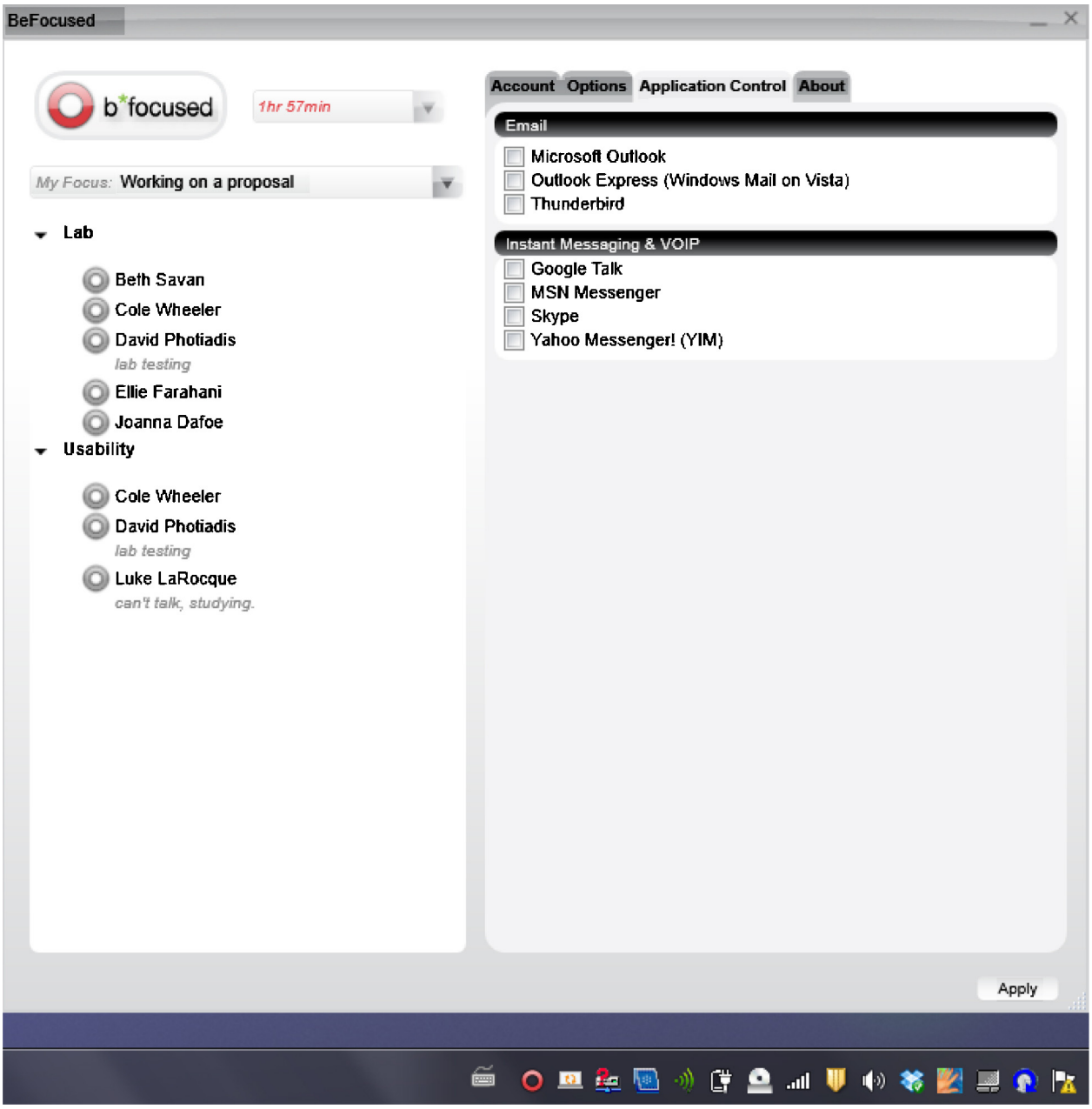

Fig. 2. Product software interface with settings options expanded (this version of the product did not have the capability to block cell phones and land lines but the developers intended to include this functionality in later versions). The system tray icon is also visible in the figure: red ring at the bottom. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

encouraged to comment on the various components of both the hardware and software portions of the product.

Following the instructions, participants were first asked to explore the product on their own, by imagining that they were at work and that they have just downloaded the software for the first time. They were told to take as much time as they felt necessary. After this initial exploration phase, participants were guided by the administrator through a series of tasks (e.g., set yourself to red mode using the software, set the timer to a time of your choosing). The administrator asked for participants to provide feedback after each task and occasionally asked the participant to return to the written instruction document where the requested actions were written for reference. The administrator then asked follow-up questions to receive further feedback from the participant (e.g., "Can you describe any difficulty you had finding any of the features that can be manipulated?", "Were you frustrated during this test? If yes, why?", "Can you identify any improvements that would enhance the features within the interface?"). A video screen capture recorded the movements of the computer mouse during the usability portion of the study. Throughout the experiment, the administrator took notes and participants' verbal responses were audio recorded.

At the end of the study, participants were asked to complete a second survey component that sought overall feedback on the product, including design commentary as well as expected effectiveness and rate of use in each participant's office context. These questions were presented in two formats: some as a five-point Likert scale (e.g., "How easy to use is the tool?", "How intuitive is the navigation of features in the user interface of the tool?", "How likely would you be to use the tool, if given the opportunity?", "Based on your experiences in this study, how effective do you think the tool would be at improving your workplace

Table 1
Sample sizes and characteristics used in the research.

Method	Sample size (n)	Sample characteristics
Usability study	16	8 'human factors experts' (employed in academia or industry) and 8 'non-experts' with the occupations mirroring those of product's target demographic, i.e., people working predominantly on computers, with a need to complete tasks requiring focused time
Existing user survey *Circulated to 37 users*	10	People who have been using the hardware and software for over three months
Intended user focus groups *Conducted in two different sites*	5 + 6 = 11	Site 1: A more traditional office context and layout, with individual, separated workspaces Site 2: A highly collaborative open plan office space environment
Senior staff interviews *Conducted in two different sites*	1 + 1 = 2	The sites were the same as the ones used in the focus groups.

productivity?"), while others were open-ended questions that allowed participants to write more detailed responses and provide qualitative feedback (e.g., "Based on your experiences in this study, can you please describe your overall impressions of the tool?", "Can you describe any reasons why someone may not use this tool?").

4.2. Existing user survey

Another survey was circulated to 37 people who have been using the hardware and software for over three months, and the research team received responses from 10 individuals, one of whom did not complete the entire survey. The purpose of the existing user survey was to examine the impact that the technology has had on those who have been using it for longer periods of time, and to gain insight from their experiences. The questions asked had some overlapping focus with the surveys administered in the usability study (e.g., workplace interruptions, type of work, product design commentary). Further, the respondents were asked to report their patterns of use and provide open-ended comments related to uptake.

4.3. Intended user focus groups

This part of the study was designed to provide information to the research team from potential users of the product. Two sites were chosen, one in a more traditional office context and layout, with individual, separated workspaces, and one in a highly collaborative open plan office space environment. Focus groups were designed in accordance with the literature, with the exception that the widely accepted guideline of using six to twelve participants (Onwuegbuzie, Dickinson, Leech, & Zoran, 2009) could only be realized at the lower limit. Each focus group consisted of 5–6 individuals, who were asked about their work habits, interruption trends in their workplace, and views on productivity. The participants were then shown the product and asked for their opinions on design, functionality, and the projected usefulness of the product in their workplace.

4.4. Senior staff interviews

The research team also conducted two semi-structured interviews with senior staff at the organizations that hosted the focus groups. The purpose of these interviews was to explore each workplace's unique office culture and the productivity metrics they use as well as to better understand the constraints office spaces face in balancing collaboration with focused work.

5. Results and discussion

5.1. Workplace interruptions

The majority of participants in the usability study (81%) considered workplace interruptions to be detrimental to their productivity at work and almost all (87.5%) stated that it was important for them to have focused time in the work week. Despite the stated importance of focused time, only half of the participants indicated that they were able to take measures at work to reduce interruptions, underlining the need for supporting interruption management in office settings.

These participants were also asked to indicate how much time they spent responding to different interruptions throughout the course of a work week. The type of interruptions they were asked represented common interruption sources and ones that are targeted by the product that was evaluated. Table 2 presents participant responses collected on a 5-point Likert scale ranging from 'very little time spent: 1' to 'most time spent: 5'. Among all interruptions asked, responding to emails (work and non-work related) and work-related face-to-face questions from colleagues (urgent and non-urgent) appeared to take up most of the working time. Phone-calls and non-work-related interactions with colleagues were considered to take up much less time. Responses were divided into two groups (i.e., 1–3, and 4–5), and chi-square tests were conducted comparing the former four groups combined (email and work-related questions from colleagues, i.e., rows 3–6 in Table 2) to the rest combined (phone calls and non-work-related interactions with colleagues, i.e., rows 1, 2, and 7 in Table 2). The grouping was performed to meet the minimum cell count requirement of a chi-square test. Overall, the difference was significant ($\chi^2(1) = 17.36$, $p < 0.0001$). Further, there were no differences between email (work-related and non-work-related) and work-related questions from colleagues (urgent and non-urgent) ($p > 0.05$). These findings suggest that despite the rise of technology-mediated interruptions in the recent years, face-to-face interruptions are still of concern. Sykes (2011) found that interruptions from email and colleagues were of similar frequencies. Our results combined with the results of Sykes (2011) give support to the usefulness of the hardware component of the product, where the illuminated button displays the availability of the user for collaboration or interruption, based on whether it is red or green.

5.2. Product usability

During the usability study, participants overwhelmingly indicated that the product is both easy to use and that its navigational features are intuitive. After the participants had been exposed to the product, they were asked to indicate how intuitive the navigation features of the product were on a five-point Likert scale. The question received positive responses, emphasizing the product's intuitive and simple design (Fig. 3). The usability was further tested through the responses to the question "How easy to use is the tool?". In response to this question, all participants except

Table 2
Time spent on responding to interruptions ($n = 16$: row total; data from the usability study).

Interruption by	Very little time spent; 1	2	3	4	Most time spent; 5
Work related phone call	6	2	5	2	1
Non-work related phone call (e.g., personal cell phone)	7	5	3	1	0
Work related e-mail	0	1	3	8	4
Non-work related e-mail	4	3	2	4	3
Colleague with a non-urgent work question	2	2	4	7	1
Colleague with an urgent work question	1	4	2	7	1
Colleague with a social, non-work, matter	1	3	8	3	1

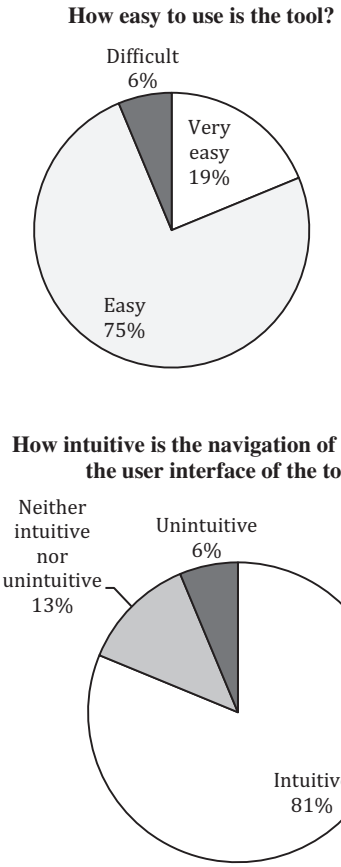

Fig. 3. Product intuitiveness and ease of use ($n = 16$; data from the usability study).

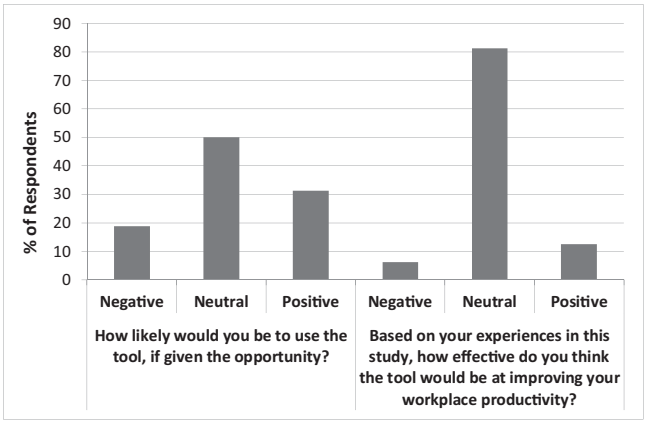

Fig. 4. Likelihood of future use and perceived effectiveness ($n = 16$; data from the usability study).

one felt that it was either easy or very easy to use (Fig. 3). Overall, experts appeared to be more critical, to respond in more detail, and to provide more suggestions for enhancing usability compared to non-experts. However, the differences between the two groups' usability ratings were minimal. Similar responses were obtained from the existing users of the product. All existing users indicated that the product was intuitive and easy to use ($n = 9$).

Although the usability study provided detailed feedback indicating that the product is intuitive in its design, other factors appeared to influence product uptake. Despite an overall positive response to the usability of the product, respondents in the usability survey were uncertain about their likelihood of use of the product and its efficacy (Fig. 4), indicating that other factors would influence adoption. These results are given context by qualitative responses to open questions, which suggested that social factors within the office would also play a role in product adoption. One respondent wrote that the "usefulness of this tool is strongly dependent on the organizational culture where it is implemented", a sentiment that was mirrored in other responses.

These survey responses were given additional context through focus groups, in which limitations of the product became apparent. During one focus group, an installation of the software on user computers led to concerns about the customizability of the product, a concern that affected people's desire to use it. The ability to tailor the product to specific needs was seen as a requirement of use in both focus groups, with individuals suggesting that making the product fit each unique office context including its layout and design, field of work, and culture was crucial to its functionality. Specifically, ensuring seamless interaction with the multitude of office software and hardware was seen as critical to the product's success, a factor that would be aided by customizability. Furthermore, technical difficulties that arose from this session led participants to immediately abandon use of the product, suggesting that there is a low threshold for technology malfunction.

5.3. Social norms

A second consideration that became apparent when studying this product was the interaction between social norms and projected adoption, with research suggesting that establishing normative support for adoption would be a crucial part of the product's uptake and success. In usability study survey responses, it became apparent that there is a discrepancy between what behaviors people desire surrounding interruptions versus what they perceive their co-workers desire with regard to interruptions (Fig. 5). The survey found a 25% disparity between participants' stated importance for focused time at work and the perceived importance of focused time for their colleagues. Thus, either our participants did not feel that their colleagues are respectful of their needs or that our participants tended to be aware and more cognizant of their own focused time needs than that of their colleagues. Anecdotal evidence from Perlow (1999) also suggested that her participants, namely engineers in one workplace, were more aware of their need for quiet time than they were aware of their colleagues' needs. The gap between stated attitudes and perceived social norms discovered in our study along with the results of Perlow (1999) suggest that an under-stated social norm devalues the importance of focused time at work.

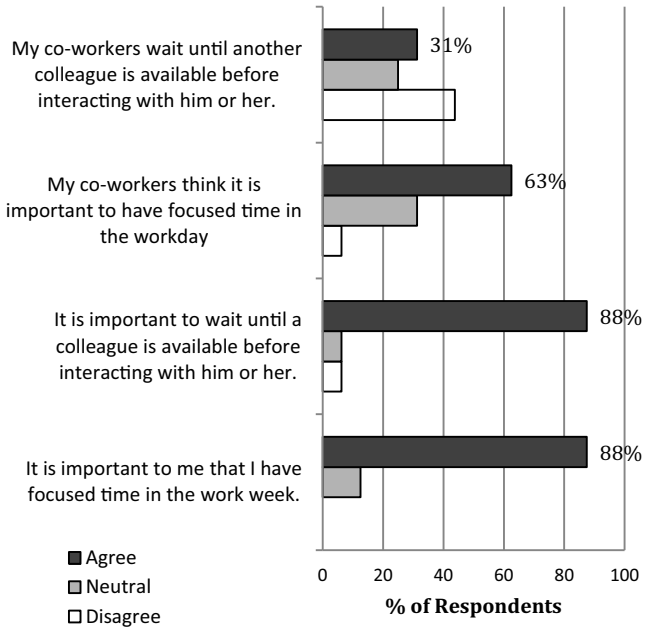

Fig. 5. Attitudes and social norms of focused time ($n = 16$; data from the usability study).

Although 88% of respondents to this survey agreed that it was important for them to wait until a co-worker was free before interrupting him or her, only 31% of the same group of respondents felt that their co-workers thought it was important to wait until others were available before interrupting them. This discrepancy strongly indicates the lack of strong social norms surrounding non-interruption within the workplace that could lead to the perception that the product would be ineffective in the office.

The same questions were asked to the focus group participants and similar trends were observed in their data. Combining the responses from the focus group and the usability study participants enabled us to conduct inferential statistics on these data. Overall, 13 out of 27 total respondents felt that their co-workers thought it was important to wait until others were available before interrupting them, whereas 22 out of 27 total agreed that it was important for them to wait until co-workers were free before interrupting them. The difference in responses for these two questions was significantly different ($\chi^2(1) = 6.58$, $p = 0.02$).

To further support this finding, almost half of the respondents (5 out of 9) from the existing user group suggested that office training regarding implementation of a new technology would have helped in the implementation of the product in their workplace. Of respondents supportive of this training, four specified that a collective agreement on the use of the product would be helpful. Participants in one of the focus groups agreed with this sentiment, suggesting that training is an important part of setting the norms around use of the new technology so that individuals feel entitled to focused time as well as collaborative time during their workday, as both contribute to work productivity.

5.4. Feedback information displays

A third emergent theme that became apparent throughout the study of this product was the potential for it to provide self-assessment of productivity, a helpful vehicle for individual feedback. In interviews with managers, it was indicated that organizations have difficulty measuring productivity effectively, although some function on the assumption that individuals are expected to complete their work on deadline, and that is the only real way in which employees should be or can be evaluated. This measure of task completion does not fully encompass how effectively an organization functions; however, it is a challenge to develop metrics that can fully capture the myriad factors that influence employee outputs. In fact, through a review of the literature, Haynes (2007a) identified that there are no universally accepted means of measuring office productivity but that researchers tend to adopt a self-assessment approach.

In further interviews and focus groups, it was suggested that the data collected through the product about when the product is in each setting could become useful for individuals to manage their time as well as for managers to see if any employees are being inundated with interruptions to the point that they cannot setup focused time periods. In the context of an organization's staff, certain people are hired mainly for 'reactive' positions (such as customer service) while others should be mainly in 'proactive' roles (such as creative developers). Ensuring focused time for the latter type of workers is especially important, as it is harder to resume complex tasks that require high levels of cognitive demand (Czerwinski et al., 2004; Iqbal & Horvitz, 2007).

Although the team was sceptical about giving this personal information to managers or employers, feeling that employees would be less likely to use the product to its full potential if they were being monitored, the idea of feeding back information as anonymous statistics to users was one that gained traction over the course of this study. Focus group participants were the most vocal about this feedback idea, suggesting that the software component could become a type of game, where things on a task list are completed, and dashboard information on the number of interruptions blocked in each red time is displayed. This two-way flow of information would help people to be conscious of their use of time and would serve to make social norms and even relatively inconspicuous interruptions visible within the office context.

6. Conclusions, limitations, and future work

The findings of this study support the importance of balancing work time devoted to collaboration and focus, and the general interest in creating space to concentrate on important yet non-urgent tasks. Both face-to-face and technology mediated interpersonal interruptions are considered to be an important impediment to productivity and concentration, a finding similar to Sykes (2011), as well as a consideration in information management. When asked about different interruptions, our participants indicated that responding to emails and work-related questions from colleagues took up more of their working time.

The product we tested showed promise to address many of these concerns effectively, with a good general design and a legible and easily used interface. The positive findings of our usability study were also strengthened by the literature supporting many of the design decisions utilized in the product. As discussed in Section 3, previous interruption management studies appear to favor prevention and dissuasion over notification modification and preview; the latter two strategies can still create a disruption in work, leading to task performance declines (Cutrell et al., 2001). Further, receiving even a simple notification may tempt users to engage in the interruption. In most contexts, people prefer to take interruptions as soon as possible (Hudson et al., 2002; Wiberg & Whittaker, 2005). However, blocking of incoming technology-mediated interruptions, as designed in this product, may also lead to a delay in receiving important information. Redesigning the product to give the user more custom control over the blocking functionality is a potential solution to this issue.

The product enables users to set their availability status with an indication of their focus along with a timer. This design choice is in

line with how people manage availability in face-to-face interactions: by deciding when to talk to someone and by assessing other participants' current activities (Wiberg & Whittaker, 2005). One potential problem with the design approach taken to have users manually set their availability is that, as suggested by previous research, people may forget to set or reset their profiles to represent their current state or the overhead of doing so may result in the underutilization of the product (Milewski & Smith, 2000; Wiberg & Whittaker, 2005). Further testing is required to evaluate these design choices in a field study.

Our findings indicate that, in spite of the strong user reviews, use could be limited by organizational culture and peer behavior, as well as the flexibility of the product to fit in with individual and local needs. Our results strongly suggest that for a technology like this product to be successfully adopted, need and ease of use alone are often insufficient. When the technology has implications for the office behavioral environment, it must be supported by social norms encouraging such adoption. For example, one possible explanation for the unsuccessful long-term adoption of the office quiet time proposed by Perlow (1999) might be the managers of the study site not being aware of the productivity implications attached to their employees being considerate of other people's work time.

Our findings also display a statistically significant marked lag of social norms behind the importance placed on uninterrupted time by individuals, a conclusion similar to the anecdotal evidence provided by Perlow (1999). Further, even when individuals see the efficacy of the technology, they often misjudge their peers' attitudes, underestimating their colleagues' similar needs and hence potentially their eagerness to adopt. These are novel findings, which can inform interruption management research within the office settings as well as other domains, such as healthcare where unnecessary interruptions are recognized as a major problem (Sasangohar, Donmez, Easty, Storey, & Trbovich, in press).

From these findings, it follows that when social norms are not explicit, even if positive attitudes toward technology adoption are widespread, resistance can result. In this case, group training as well as discussion of adoption protocols and their possible effects on the office environment are critical to successful adoption and use. As for other ways of supporting behavioral change, hands on testing of the product along with collective development of protocols for its use would likely advance adoption and broaden use of the new technology. Ongoing discussions of this type would encourage dissemination by social diffusion (Bass, 1969) in which lead users incorporate the technology into their workplaces in such a way that new social norms are developed.

The interest of our study participants in carving out focused time was nearly universal, and, while the tested technology was promising, feedback enhancements were recommended in order to provide more control and understanding of task completion by both staff and managers. In this way, ongoing assessment of the balance of effort on various kinds of work, and the impact of interruptions, focused work time, and collaborative activities could be more effectively assessed and adjusted. The improved control over the balance of focused, collaborative, and personal time can then provide users with more manageable work–life balance and quality of working life.

A limitation of the current study was the relatively limited sample size for our user surveys. We set out to provide complementary evidence using various techniques, yet, we were limited by the fact that the product has not been released to the market. We were able to complement existing user surveys with a usability study, thus increasing statistical power for some of our comparisons. A follow-up study with a larger sample size is needed assessing perceived social norms surrounding office interruptions. Another point of further research is the long-term use patterns of this product. Venkatesh and Davis (2000) suggest that the effect of social norms on intention to use diminishes over time. However, their model does not capture the role of social norms in the use of products for which utility level depends on group use. Future research should explore long-term use under such group dynamics. The product was designed to support both open and traditional office layouts. Although we recruited participants from both types of offices, given our small sample size, we were not able to separately analyze their data. Thus, a final point of future research is to study the effectiveness of this product for different office contexts.

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