StaTube: Facilitating State Management in Instant Messaging Systems

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ABSTRACT
Instant messaging systems, such as Skype, offer text, audio and video channels for one-on-one and group conversations, both for personal and professional communication. They are commonly used at a distance, i.e., across countries and continents. To avoid disrupting other tasks, they display personal states to signal others when to contact someone and when not. This mechanism, however, heavily relies on users setting their own state correctly. In an online survey with 46 participants we found that neglecting state updates leads to unwanted messages, either because the state is incorrect or others disrespect it because they assume it to be wrong anyway. We address this situation with the *StaTube*, a tangible object offering (1) peripheral interaction for setting one's own state and (2) peripheral awareness of selected others' state. In an in-situ evaluation we found first indicators that (1) peripheral interaction fosters more frequent state updates and more accurate state information, and (2) that our participants felt more aware of their contacts' states due to the physical ambient representation.

Author Keywords
Peripheral Interaction, Ambient Information, Instant Messaging, Tangible

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces: Input Devices and Strategies, Interaction Styles; H5.3 [Information interfaces and presentation]: Group and Organization Interfaces: Synchronous Interaction

General Terms
Design, Experimentation, Human Factors, Verification

INTRODUCTION
Digital communication has become an important factor in both personal and professional settings, as friends or collaborators are often spread in different physical locations [2]. In addition to phone calls or meetings in-person, companies and individuals have started to rely on instant messaging (IM, e.g., Skype or MSN). It provides an easy and fast way to send chat messages or make video calls, allowing for responses in real time. Overall, these systems provide two benefits: (1) Quick but important questions can be answered instantly without making a potentially disruptive phone call. (2) IM facilitates a more lightweight communication in physically distributed workgroups. However, IM may also be disturbing: Many people neglect changing their state to match their current work situation, mostly because this involves switching windows and thus the current focus of attention. As an alternative, IM systems provide mechanisms to set the state automatically. For example, if there is no keyboard or mouse activity for a certain period of time the state is changed to *away*. Nevertheless, the fact that states are often incorrect makes others simply ignore them.

Figure 1. *StaTube* is a tangible presence indicator located on the user's desk: Each ring represents a Skype contact with the top-most ring as one's own state (a). Rotating allows for changing one's own state (b). Pressing the tube sets a timer for when a user will return to the desk (c).

To get a deeper understanding of the current issues with IM systems, we conducted an online survey. Based on the results, we built a tangible object – the *StaTube* (see Figure 1) – that lets users both change their own state (by rotating the top-most ring) and observe the states of their favorite contacts (with each ring glowing in a color encoding the state) in a peripheral and ambient fashion. In this way, users become aware of the states of others over time (and get a feeling of state reliability) *before* accidently interrupting them. At the same time, the tube *reminds* and *assists* users of setting their own state accordingly. We conducted an in-situ evaluation and found that peripheral interaction makes adjusting the state easier and therefore leads to more accurate presence information. Additionally the direct visual overview of contact's availability creates better awareness.

RELATED WORK
Due to collaborators in today's office scenarios often being spread over different rooms, cities, or countries, companies

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have introduced IM systems. For our work, we looked at the usage of IM (particularly during work), at how presence information is displayed, and at interaction in the periphery.

Instant Messaging in the Workplace

The general usage of IM has been explored in both personal [8] and office contexts [2][11]. Nardi et al. described four core functions of IM systems for office and personal use: "short questions and clarifications, coordination and scheduling, arranging impromptu social meetings, and keeping in touch with friends and family" [16]. Further work points out that there are two distinct user groups: The first uses IM mainly for short interactions and scheduling, while the second uses it for longer and more complex conversations [13]. Most studies, however, were designed to investigate the use of IM in general, such as the quantity and frequency of messages, without focusing on side effects, such as state information or interruptions [7][15]. Nevertheless, research has shown that, interruption is a crucial factor of IM in the workplace [9]. For example, Czerwinski et al. presented different interruption severity levels that depended on the current task and reported notifications to be most disruptive during execution and evaluation phase, especially when typing or interacting with toolbars [3]. Additionally, Garrett et al. point out that IM can also help manage interruptions in general [6] because of the state indicator and the social acceptability of postponing answering an instant message. Herbsleb et al.'s work further shows that the option to display presence information is often the reason to start using IM [11]. This led us to investigate state information in more detail and to use this insight to make such spontaneous chats more likely and convenient.

Presence Information

Numerous displays (e.g., [16]) and objects (e.g., [18]) have been built to convey presence information with varying information capacities. Earlier work primarily focused on purely displaying presence information. Holleis et al. use a tangible object with an embedded display [12]. Placing the object in different ways changes the user's state, which is then displayed at the same time. To display states of other users in a meaningful manner, Tyman et al. investigated the use of different mappings, such as distance or rotational speed of contacts [22]. Although this system relies on semi-public displays that (potentially) require an attention shift, it also demonstrates how ambient displays can be used in the context of IM in workplaces. Some systems encode additional information, e.g., which activities are carried out, which location the user is in, or who is talking to whom. *Online Enlightenment* uses the office's physical structure to display whether a person is at his or her desk or not [21]. This birds-eye representation makes it unnecessary to search for a particular person in lists. Dourish et al.'s *Portholes* uses live video data to indicate a particular contact's presence at his or her desk [4]. These systems convey presence information, and share a common goal with our work: improving awareness – especially in the office context. Most of these systems provide *ambient information*: information residing in the periphery of the user's attention that may be brought to the focus in case of changes or interest [19]. This appears to be a promising approach if a system should not distract users from their main task.

Peripheral Interaction

With the exception of Holleis et al. [12], Kuzuoka et al. [14] and Peek at al. [18], the aforementioned systems just display the state, but do not offer any way to enter state information. Most importantly, most of them require that users maintain their state through the IM client's GUI. In terms of interaction, one possible logical counterpart to an ambient information display is peripheral tangible interaction. Edge defined such interactions as "episodic engagement with tangibles, in which users perform fast, frequent interactions with physical objects on the periphery of their workspace, to create, inspect and update digital information which otherwise resides on the periphery of their attention" [5]. Combining this style of interaction with ambient presence indication is the basis of our work.

SURVEY: CURRENT USAGE OF INSTANT MESSAGING

To understand the benefits and drawbacks of current IM tools (and their usage in everyday work practice in particular), we conducted an online survey. The survey consisted of 36 questions addressing: (1) general IM use, (2) IM use at work, and (3) thoughts as well as ideas for a potential physical object in the periphery to extend an IM client. We used free-text answers and 5-point Likert scales when applicable (*never* (1), *sometimes* (2), *regularly* (3), *often* (4), *always* (5)). We spread the survey via email and social networks, gathering a total of 46 responses (25 female) ranging in age from 21 to 55 (average age was 29). 44 work full or half time and 43 use a computer with Internet access at work, with the majority working in the IT sector. In the following, we present the results of our survey.

General Usage

Participants rated their frequency of using IM with a median of 4. Also, 39% use IM at work. Those who use it at work use it very frequently (median = 5). Regarding different clients, 61% use Skype followed by Facebook chat (41%) and ICQ (37%). One-to-one text chat is used most commonly (61%), followed by textual group chats (39%), and audio/video chat (10%).

States

All IM tools allow participants to set their current state. The most used state is *available/online* (63% of all participants use it), followed by *away* (48%) and *invisible* (41%). Most interestingly, only 22% use the state *do not disturb*. We asked about the reasons for state changes in more detail: Participants named absence from their desk (often set automatically) or that they do not want to be disturbed (i.e., using *away*, *invisible*, or *do not disturb*). Participants use the additional text field (*mood messages* in Skype) only rarely (median = 2). We also found that 25% of the participants never change their state. In contrast, participants check the state of their colleagues quite regularly (medi-

an = 3). When asking for the detailed reasons for doing so, we found that 56% of them check the state before contacting the person. In addition, 12% only check the state when their chat partner is not replying to their messages immediately.

Disturbances

We asked our participants whether instant messengers add a level of disturbance while they are at work. 21% stated that they are disturbed by chat messages; half of them claim to be disturbed often. The most named reasons are messages unrelated to the current work task (43%), chatty messages which assume an always availability (21%) and in general the blinking in the taskbar (14%).

Participants also dislike audio notifications that inform them about new messages or contacts coming online/going offline. Some participants also said they were annoyed by the diversity of clients, spam messages and advertisement, which is beyond the scope of this paper.

Additional States and Envisioned Object

We asked our participants whether they wanted additional information besides existing states built into current IM clients. They stated that they would like to add additional information about their absence (e.g., in a meeting, or on holiday), or their general location (e.g., at desk). One participant requested states based on the project he is currently working on (e.g., analyzing requirements, testing).

Regarding the tangible, participants had several ideas. They considered an object showing colleagues' states when they urgently need to contact a person either through IM, directly via phone or by going to their office. When asked about the number of displayed contacts on the object, they answered between 1 and 100 (median = 5; mean = 10). We also asked about their preference regarding the input modality (i.e., how to set their own state) and got varying answers: (1) buttons on the object, (2) touchscreens, (3) sliders and, most prominently, (4) turning the object. Regarding the object's shape, the answers ranged from cubes to small displays with some extravagant ideas, such as flowers with leaves for every contact or a traffic light for each contact.

DESIGNING THE OBJECT

Based on the survey results, we set out to design an object that meets these desires. In this section, we first describe the design decisions we derived from the survey, how they can be met, followed by details of our implementation.

Design Requirements and Decisions

Our survey revealed that the object has to serve a variety of purposes, such as displaying contacts' state information, changing one's own state, and extending the IM features.

Displaying State Information

We want to decrease disturbances and need to explicitly check the contact list. Therefore, we decided to use ambient information located in the periphery to ultimately convey information in a non-distracting manner through subtle changes of light. We used color to code different states similar to state-of-the-art IM clients (e.g., yellow for *away* or red for *do not disturb*).

Changing State Information

As seen in our survey, having accurate state information is important (e.g., checking a contact's state before sending messages). However, changing one's own state unfortunately occurs infrequently, possibly because it requires an entire focus switch of the user. Users should be able to perform state changes in the periphery to avoid such context or focus switches, ultimately hopefully leading to more frequent and thus more accurate state changes.

Extending Instant Messaging

Our participants wanted more information in their absence state (e.g., being in a meeting). Since we had decided to use colors to encode one's state, we incorporated this by adding more colors for states, which are normally represented as mood messages in IM clients. Green (*online*), yellow (*away*) and red (*do not disturb*) are already used for predefined states. Additionally we added a timer to offer information about the expected time span the user remains in a certain state (also shown in the mood message). While the timer proceeds, the corresponding light dims.

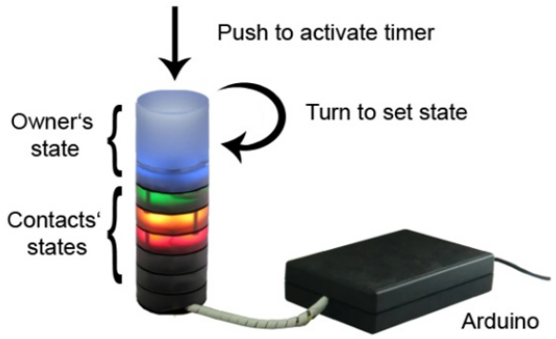

Figure 2. The prototype: the illuminated tube and Arduino.

The Final Design

With this in mind we considered the proposed shapes, but finally decided on a tube as shown in Figure 2 for several reasons: (1) it allows turning the upmost layer to change the state from any direction and thus in a peripheral fashion. (2) The tube shape offers an arbitrary number of different state displays as opposed to the six sides of a cube. (3) A tube can be extended with round plates to increase the number of shown contact states. (4) A tube-shaped object can be viewed equally well from any direction and does not require a specific orientation. To decide on the best fitting diameter, we created four paper prototypes with different diameters: 8 cm, 6.5 cm, 5 cm, and 4 cm. We asked five potential users to select the tube that can be rotated most easily with one hand. Three people chose the 5 cm tube and two selected the 6.5 cm one. The test further revealed that smaller tubes topple over more easily. To counteract this, we chose a diameter of 6 cm.

Our design decision is further supported by findings from Alavi et al.'s *Lantern* [1], a similar looking object designed for class orchestration. Although the use case is different they also show that the design is successful in increasing awareness and thereby productivity.

Implementation

Our prototypical system consists of the object's hardware including an Arduino[1] controller, and a software client.

Hardware

We built the prototype from frosted acrylic glass, hiding electronics inside but letting light shine through. Each layer hosts two RGB LEDs (Multicomp SMD OVS-5309). Layers are separated by black plates; the top-most, larger layer represents a user's own state. It contains a rotary encoder (Panasonic EVE-QDBRL416B) and can be turned to set one's state and pushed to set a timer. Due to technical limitations building the prototype, it offers only four active layers (the bottom holds the wiring and cannot be lit). However, adding more LED drivers allows extending the tube to allow for more contacts. An Arduino Duemilanove receives input and controls the LED driver (TLC5940) which powers the RGB LEDs. The object is connected to the computer via USB, which also serves as power supply.

Software

The client software, implemented in Java, controls the communication between the object and an IM client. The prototype is connected to Skype (the most used IM client in our survey) with the help of Skype4Java[2]. In a one-time setup, users have to select the serial port, which the object is connected to, and allow the application to access their Skype client. A GUI lets users initially link each layer to a contact to be displayed and set the preferred timer interval.

IN-SITU DEPLOYMENT

Our system is intended to support communication and lessen disruptions in a working environment. Based on this use case as well as literature [10][23] we considered an in-situ evaluation the best fit. Additionally, we apply methods from MILCs [20], i.e., repeatedly interviewing participants, and automatically logging user activities (here: in Skype).

Apparatus

The object we deployed to our study participants displayed one's own state and up to four states of selected contacts. Users can turn the upmost layer to set their own state. Besides the existing states *online* (green), *away* (yellow), *do not disturb* (red), and *invisible* (white), we added *on the phone* (blue), *cannot answer* (turquoise), *eating* (pink), and *in a meeting* (violet). No light is shown for an *offline* contact. We based our mapping on colors mixed with red for longer absence (i.e., *pink = eating* and *violet = in a meeting*), and colors related to blue for shorter absences (i.e., *blue = on the phone*, and *turquoise = cannot answer*).

To allow the integration with contacts of participants not using our object (and thus not having extended states), additional states are shown as *away* in Skype with the additional information given in the mood message. Vice versa, these mood messages are parsed, and displayed in the appropriate color on the *StaTube*. Thus, a user without the tube can control the tube of his contacts by writing an appropriate *mood message*. To activate the timer, the user pushes down and releases the upmost layer. Each push of the upmost layer adds a predefined time length to the current time.

Participants

We built two identical objects to evaluate two users at a time. We always chose a pair of office workers that collaborate but do not sit in immediate vicinity. Each of them already used Skype in daily office routine. Overall we recruited six participants (three pairs, one male and female each) ranging in age from 26 to 30 (average age was 28). Two pairs worked in the same building but on different floors. One pair worked in separated buildings (one in the office, the other one from home). None of the participants took part in the previous survey. Furthermore nobody reported color blindness, so we could use our color-coding.

13 contacts (6 female) of our participants answered the questionnaire after the three weeks. They ranged in age from 23 to 39 (average age of 30). 92% use Skype also at work and 85% daily. They stated to be in frequent contact with their corresponding participant (median = 4 on a 5-point Likert scale). We collected at least one answer for each of our six participants.

Procedure

Our initial evaluation took three weeks per participant and consisted of three semi-structured interviews and logging.

Baseline: One Week without the Object

The evaluation started with a first interview to determine the participants' Skype behavior. Subsequently, we installed a logging tool on the participants' computers to log the following interaction: (1) *if* and *when* a message (i.e., chat or call) was *exchanged*, *who initiated* the conversation and *who took part* in the conversation (in case of group chats/calls) and (2) *states*, *state changes* and *mood messages* of the participants and all their contacts. For privacy reasons all contacts were encrypted as MD5 hashes, which allowed identifying each contact throughout the evaluation, without knowing the actual identity. An icon in the system tray indicated that the logging software was running.

Week 1 – With the Object

After gathering information about their general Skype usage, we installed the *StaTube* and gave a short introduction on the system and its functionality. Participants were allowed to place the object at their preferred location on their desk (see Figure 3). After the participants were familiar with the object, we gave them a link to a web form containing a blank text field and told them to use it whenever they experienced something interesting, ran into problems, or

[1] http:// www.arduino.cc
[2] http://blogs.skype.com/developer/2006/10/skype4java_a_developers_collab.html

wanted to contact us. To gain a deeper understanding of the *StaTube's* usage, we additionally logged: (1) *which contacts* are *assigned* to the object, (2) all *timer usages*, and (3) if the *state* was *changed through Skype or the object*.

Week 2 – With the Object

At the beginning of the last week, we conducted another interview to find out about their experiences with the object so far. We also wanted to know how they perceived its effect on their Skype usage. After this interview we left the participants for another week with the object. At the end of the week we conducted a final interview to figure out whether their experience had changed. After they completed the interview, we uninstalled the object's software and provided them with a link to a questionnaire. We asked them to hand it to their Skype contacts to find out whether they experienced any difference in the behavior or states of their contact (i.e., our participant).

Figure 3. *StaTube* placed at one of our participant's desk.

RESULTS OF THE IN-SITU DEPLOYMENT

In the following we present results from our in-situ deployment. We illustrate the findings from Skype usage without and with the object.

Skype Usage without the Object

We analyzed our participants' Skype usage without any additional system for two reasons: (1) as a baseline for later comparison with their behavior using the object, and (2) to verify our online survey results described earlier.

General Skype Usage

All participants use Skype daily while at work (only one person closes it very rarely when being focused). Five participants also use it in their personal time when their computer is running. All participants are primarily chatting, and one never uses audio/video chat. Equally to our survey results, they rate their Skype usage with a median of 4 on a 5-point Likert scale. Logs reveal that, on average, every 10.2 minutes (median = every 8.2 minutes) a chat message was sent or received. During the day most chats are short enquiries, but may turn into longer conversations. All participants also were active in group chats (26% of all messages). Most chats are closely related to work, but private messages occur every now and then. One participant is chatting more privately than work related, as she was working from home without well-defined working hours.

Own State

Frequencies of state changes were mixed among our participants. While two participants consider their state to be fairly accurate (using all available Skype states), the majority of them rate the accuracy of their own Skype state rather low (median = 1.5, cf. previous survey: median = 2). They consider state changes as additional task that is often forgotten. Half of the participants never changed their state during the week (cf. survey: 25%). The logs further revealed a difference in state changes between accurate and inaccurate participants: 87 minutes between state changes compared to 940 minutes. These changes include Skype's automatic *away* after a predefined idle time.

Participants feel that their contacts do not respect their states and are sending messages anyway, which was considered annoying. However, our participants also send messages even if their contacts are unavailable, assuming that they can answer when they are back and have time. The interview answers further suggest that each user interprets a state differently (e.g., *away* may indicate that a user has left the desk or that they do not want to chat). Preferences differ when using *do not disturb* or *invisible* to minimize disruption. One participant used *do not disturb* when leaving the desk to signal that it is impossible to reach her.

State changes are carried out via the Skype window as well as the system tray icon. Mood messages are used rarely (median = 1.5; cf. survey: 2). When used, they contained the current location or random personal messages, but usually did not give information about the current activity.

Contacts' States

To observe the contacts' states, the user has to bring Skype to the foreground. Half of our participants explicitly consider this too cumbersome. Five participants usually keep Skype minimized in the taskbar or system tray. One always keeps it open on the secondary monitor to be informed about his contacts. Five participants activated popup messages about their contacts' *online* and *offline* changes, but opinions largely differ: two are annoyed and disrupted; two hardly noticed them (median = 3). In general, a popup only appears briefly, increasing the chance of missing it. Audio is used at home but not in the office as it may disturb coworkers (median = 5). Thus, having a permanent, physical representation in the user's periphery may be beneficial.

Additionally, five participants are interested in the states of their contacts, but are annoyed by incorrect states (e.g., an *online* contact does not answer). They neither feel *well informed* about the states of their contacts nor *trust* them (both median = 2). This confirms the survey results making our participants an appropriate sample for the study.

Skype Usage with the Object

After one week of logging we installed the object for two weeks at our participants' workplace. The findings were contrasted against the usage without the object.

General Usage

Each participant had the object connected for 74 hours on average, thus 92.5% of the average 80 hours of work time in this period. During the second week, three participants forgot to start the object immediately. The decrease in usage can further be explained due to less Skype usage: three participants had a stressful week and hence partly abandoned Skype. We also found that the novelty effect faded away: two participants stated that their "play instinct" decreased over time. One participant stated after the second week *"the system wasn't that present anymore (…), it was better integrated in my daily workflow"*.

Own State

Compared to state changes without the object (avg: every 655 minutes), we found a difference in state changes during the first week with the object (avg: 90 minutes). During the second week, however, the frequency of state changes decreased again to an average of 368 minutes but is still not back at the baseline level. We attribute this to both the dying novelty effect and to the three participants being busy. 93% of all state changes were carried out using the object, suggesting that it caused the difference in state changes.

We further found a trend that participants changing their state more often also consider it to be more accurate in week 1 (median = 4.5) and week 2 (median = 3.5) compared to the baseline (median = 1.5). When asked why they changed their state more often, half of the participants felt that it is easier and faster using the object than the existing GUI. More importantly, five stated that the object reminded them to change their state, which eventually decreased during the second week when they became used to the device. One participant reasoned: *"…because it is physical, it is better integrated in the 'leaving-the-desk-flow', when I leave I also lock the door, which is also physical"*. However, even with the object, participants did not change their state for a short absence.

30% of our participants' contacts recognized more frequent state changes, with 75% of them perceiving the state as more reliable. Our participants could not remember disturbances when being in the state *do not disturb*.

Contacts' States

Four participants consider it beneficial to see the state of their most important contacts at a glance. The other two never use the Skype window to check for a contact's state. This suggests that the permanently visible object adds value to users caring about their contacts' states. Five participants stated that they are more aware of their contacts' states. They state that they especially like the easy distinction between being connected to Skype or not (i.e., light is showing or not), which constituted 77% of all switches displayed on the tube (i.e., it is important to know whether a contact is *available*, but not whether s/he *can answer* immediately). The remaining participant felt more aware of his own state, which in turn helped maintaining it.

The log data revealed that participants, on average contacted five different contacts per week, while three of them were displayed on the tube and two were not. All in all, 62% of all contacts our participants interacted with were assigned to the object. Being asked, they generally were happy with the overall number of four contacts shown on the tube. We further found a change in behavior when a contact's state was switched: two participants explicitly remembered feeling encouraged to start a conversation when a state changed to green (*online*). Logs revealed that nine contacts were contacted in the first two minutes after coming online, only one contacted of these nine was not displayed on the tube.

Disturbances

We analyzed the number of *initial* chat messages (i.e. the chat window popped-up and was not open before) to a participant whose state is currently set to *do not disturb*. We found that this only occurred twice during the study (once without and once with *StaTube*). One reason might be the infrequent initial messages: while on average participants wrote chat messages every 10 minutes, they only initiated a new chat every 7.7 hours. Also, only 3.1% of all state changes were changes to *do not disturb* further decreasing the occurrence of such interruptions.

Additional States

Approximately every fourth state change (24%) was set to one of the additional states (38% *eating*, 29% *in a meeting*, 25% *on the phone*, and 8% *cannot answer*). Contacts of our participants, noticing this state information, liked the hinting at the duration of absence, even without timer usage (with the exception of *cannot respond*). Similar to overall state changes, changes to additional states also decreased in the second week from every 523 minutes to every 925 minutes on average. Participants stated that they had problems remembering the new colors in the beginning. After two weeks, however, participants remembered the additional states they considered useful (two to three).

Timer

The timer was used rarely: only nine timer activations were logged. Selected values ranged from 10 to 90 minutes (average 30 minutes). Reasons for little usage differed among participants: (1) they forgot about the function, (2) worked from home, being at their desk not having meetings, (3) considered setting the timer too cumbersome, and (4) could not precisely estimate the length of absence. The last statement is also supported by our data: the difference between the actual (we counted the next state change as return) and the estimated return was more than 25%. Three of our participants' contacts recognized timer activations; two of them appreciated this additional information. Participants did not recognize the change of brightness on the object related to a contact's timer. However, they may have been away from their desk during these rare timer activations.

Ambience

When fully focused, only one participant recognized contacts' state changes in her visual periphery. Interestingly, this was the only participant with only one display connected to her computer. She also was the only participant who worked late (e.g., she used the object in dark environments, making it easier to perceive). Three participants reported that they noticed state changes when not being fully concentrated. As participants could place the object on their desk wherever preferred, distances from the main monitor to the object widely differed (10 to 50 cm), but we did not find any correlation between distance and notifications.

Object Appearance

Half of our participants had problems distinguishing between layers, suggesting that the separating plates were not noticeable with glowing layers. To remember contacts, one participant attached sticky notes with the first letter of each contact's name on the layers. Two participants also found it hard to remember the mapping of contacts and layers when changing the displayed contacts. Nevertheless, participants rated the object's appearance as rather appealing (median = 4). As a reason for not rating 5 they named problems based on the prototype stage (e.g., the large black box carrying the Arduino) but did not criticize the concept itself.

Peripheral Interaction

Four participants reported that they had to focus on the object when rotating the upper layer to change the state during the first week. Two of them, however, considered it much easier in the second week with the object. We are not surprised that a learning period is necessary for this kind of interaction (i.e., without directly focusing on the object).

Social Aspects

Besides the direct consequences on IM habits, one participant stated that he felt closer to colleagues that were displayed on the object. Another one liked that he was able to see *"the office coming alive"*. One participant reported that there were situations in which he wanted to call somebody with the normal phone, but did not try to contact him or her as the contact was not online. Thus, a better awareness of states may reduce unsuccessful contact attempts.

The object also caused interest among colleagues in the office as well as over Skype. One contact even started imitating the system and entered corresponding mood messages to cause the object to shine in the colors of special states. Although the tube was easily visible when walking into the office, a glowing red for *do not disturb* did not stop colleagues from interrupting our participants in person. Similar to one of our participant's observations, we speculate that this is due to the little familiarity with the system. The participant assumed that, once all colleagues are equipped with our object, it might also affect real life conversation.

DISCUSSION & LIMITATIONS

Our initial exploration of *StaTube* in the context of instant messaging already showed that ambient information could increase the overall awareness of one's contacts' states (especially for *online* vs. *offline* states) without actively monitoring the contact list on-screen. Additionally, peripheral interaction simplified state maintenance and led to more state changes as participants could perform them without particularly focusing on the object. Participants considered their status more accurate and overall liked the appearance of *StaTube*. Features enhancing IM were partially adopted: (1) additional states were used, but (2) the timer was mostly abandoned for several reasons.

Nevertheless, this initial study with a small set of participants and limited time only offers a first approximation of the usefulness of such a device. We were already able to witness a decrease of the novelty effect but cannot rule it out completely yet. As well, when evaluating in the wild, we cannot control the context of use. That is, events triggering interesting findings (e.g., in our case, *away* and *do not disturb* have only been used rarely by our participants), simply did not occur [10].

It is further noteworthy that some applications including IM demand *collective adoption* to be beneficial for users [11], and thus requiring a *critical mass* of users. In our first in-situ exploration with a handful of such objects, we naturally did not reach this critical mass. However, our initial exploration reveals that the physical nature of our object may lead to a change in both online and offline communication (assuming states are reliable): one participant did not call a colleague because *StaTube* showed him as not being available. People walking by randomly may adopt this behavior as well and decide not to interrupt a colleague when the tube glows *red*.

CONCLUSION & FUTURE WORK

We presented findings from current IM usage in general and while at work in particular. The survey revealed that users are interested in the states of their contacts, even though they are aware of their incorrectness, but also do not keep their own state up to date. We addressed these shortcomings (i.e., maintaining one's state and observing the ones of contacts) using a tangible object called *StaTube*. It offers peripheral interaction for setting one's state and an overview of selected contacts in an ambient fashion.

In our in-situ evaluation, which has not been executed for many ambient information systems before, we found that our participants felt more aware of their contacts' states. They also considered their own state more accurate due to easier maintenance and remembrance through the object itself. Overall, these first insights suggest that *StaTube* overcomes the aforementioned limitations while not adding a burden due to its ambient nature. To manifest the findings of this study, we plan to conduct a longer evaluation with a larger number of participants, taking into account the findings of this study (e.g., neglected timer) and requests by our participants (e.g., starting a chat with a selected contact by manipulating the object). We believe that we can confirm our insights and gain more regarding *StaTube's* influence to direct communication in the office apart from IM.

Due to the physical shape of our prototype, we envision other application areas as well. For example, we can use the levels as progress bar, manipulable through the turning and pressing the upmost level. We can further indicate the upcoming appointments by having each layer presenting a predefined time frame showing different appointments and free time in different colors. Through pressing down the topmost layer, users can access more information about the next upcoming appointment without switching windows to the calendar application.

Although this work particularly focuses on IM, we anticipate that our results regarding peripheral interaction can be applied to other fields. Our exploration indicates that interaction in the periphery represents a shortcut to functions that users would otherwise neglect. In the given scenario of Skype, users wanted to be better informed about their contacts and their accurate state. At the same time, however, they did not keep their own state up to date because of the attention current user interfaces require – even for such a simple task. We envision that the peripheral nature can facilitate many other secondary tasks (e.g. retrieving calendar information or controlling an audio player). We plan to investigate this interaction style in more depth with several different prototypes (not exclusively focusing on tangibles) in the future.

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