Probing calmness in applications using a calm display prototype

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Abstract
In this paper, we challenge the current approach to calm technology as described by Weiser and its goals, highlighting individual user different expectations, suggesting that user needs to be in the center of defining what does calm mean for them. We discuss how applications could support the notion of calmness, and describe a prototype "calm display" which we deployed in an initial n=1 study to help understand this space further.

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calm technology; calm displays; attention; workplace.

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H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces; H.5.3. Group and Organization Interfaces.

Introduction
The concept of calm technology was introduced by Mark Weiser and John Seely Brown in their 1995 article "Designing Calm Technology" [1]. This states three signs of calm technology:

- easily moves from center to periphery and back;
- enhances peripheral reach
  (brings more details into the periphery);

- locatedness (tunes us into what is happening, has just happened and will happen).

However, Weiser and Seely Brown did not provide any arguments why these signs are desirable or any suggestions on how to make technology calm, or how to evaluate calmness.

The HCI research community has almost exclusively focused on the first sign of calm technology: moving between foreground and background, making technology invisible and not distracting. Few measures of calmness have been proposed ([2, 3, 4]), and all of them take into account the first sign only.

What does calm mean?

How useful is Weiser's definition of calmness in practical terms? Are the three signs necessary and/or sufficient, and does technology need to have all of them to be calm?

Amber Case argues that calm technology shouldn't make any decisions on behalf of humans: "You as a human decide. Every time you make a computer make a decision on behalf of a human, you end up making a human into a machine." [5] On the other hand, Bashir et al. for example argue that calm computing should remove user from the system and that system should work proactive rather than reactive to the user [6].

This is an example of two directly opposing ideas of what calm technology should mean and neither of them is wrong or right. What is experienced to be calm by one user, may be experienced to be distracting by another use in another user usage situation [2].

Therefore, it might be inevitable to allow users to be in control of what calm technology does for them.

Calmness in applications

We would like to take this distinction further, and explore how individual applications can become calm and support users in focusing on their work while still making them aware of what happens in the periphery of not only their current task, but also around them. Interruptions from some applications might be critical for the user's current activity while others can be unwelcome. For example, prompts by collaboration software could be important for an ongoing meeting, but notifications from social media distracting (or vice versa).

Some of the behaviors that we envision the applications could provide in help of keeping the user focused on what they need could be following:

- Animations could be removed or reduced, as well as sudden changes of content. A different, less distracting color scheme could be used.
- When a window asks for user attention, the operating could just visually mark it rather than resorting to e.g. flashing, jumping, etc.
- Notifications could be muted or filtered.
- Audio volume could be lowered.
- Updating of all statuses might be on explicit user request only, or when the user is away.

The idea of calmness in applications does not necessarily have to be an on-off setting, it could be multi-level or even continuous. Examples of

Figure 1: "Calm display" mode used in this probe, under different lighting conditions. In each photo, calm display at top left, printed paper at bottom left and normal display at top right. [8]

application-specific behaviors leveraging various levels of calmness could be:

- Notifications with different severity levels.
- User-defined triggers, e.g. notify when user's name is mentioned, or when enough users vote for a message [7].
- Message rates can be decreased.

However, to be able to build similar calming features into applications, we need to understand in which applications and at what occasions they are desirable.

Calm display probe

In previous work, we had prototyped a "calm display" mode for devices [8], in which the display automatically reacts to ambient light so that it mimics the appearance of a piece of paper with the same content. In normal indoor lighting conditions, this means that the calm display is darker than a normal display (see Figure 1).

We adapted the calm algorithm to run on desktop monitors and tried to use it as the first probe into calm applications as follows: We set up a desktop computer workstation with two monitors, where one monitor was used as a normal working monitor, and the second monitor was used as a calm display. Application windows on the calm display were regarded as in calm mode, but no other special behaviors were implemented at this stage.

For this preliminary and exploratory study, a single user (the first author) used the 2nd calm screen as a part of his normal day-to-day computer use. The initial pilot testing has proven very informative, and we will now discuss the findings from this pilot study.

Monitor placement

The placement of the monitor had significant effect on how the monitor was used. When the monitor was placed separately, it ended up being more like an ambient display and it was very easy to put it into the periphery, not caring about its content and brightness very much. Nevertheless, the fact that it still was technically a second computer monitor made it very easy to manage its content without the need to operate yet another device. Perhaps if the ambient displays around us would all be natural display extensions of existing devices such as computers, it could increase their usually limited utility.

After few days without much use, the calm display was put side by side next to the normal monitor, like a standard second monitor would be. That made it much more available for everyday applications, but it also required some cognitive effort not to end up using it as a common extension of the working desktop.

Light adaptation

Since the calm desktop monitor was using a color sensor to adapt to the lighting conditions, it not only became naturally darker than the main monitor, but it also become brighter when direct sun was shining into the office (see Figure 2). It still felt as a natural part of the current environment, the way it should be, so it was kept used for its calm mode purpose rather than for hosting the main work activity. It would also mean that as the sun goes away, the work would have to be switched back. It made it clear, however, that the normal monitor could do much better. It was easier to

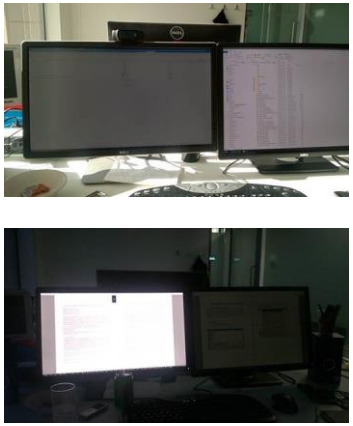

Figure 2: Normal display (left) and display in background mode (right) blending into the environment. Left displays are the same brightness in both photos. Top: direct sunlight, bottom: working at night.

tolerate decreased legibility of the main monitor rather than being bothered changing its settings. There is no reason why adaptive brightness should be limited to mobile phones.

One aim of the background mode developed in previous work [8] was to make it an active display like a piece of paper. However, applications often use various color schemes, including white text on black background, which is not a common practice on paper media, and even though the monitor might have matched it visually, the readability of those user interface was much worse, especially as it got darker. Calm applications should take into account the environment conditions and how the underlying system is responding them – even though a dark theme was used in the main monitor, it might have worked better if applications switched to a light theme when used on calm display.

Notable use cases

A nice example of use case for calm mode turned out to be long-running code compilation, during which text is continuously output into a console window for tens of minutes. You want to see warnings and errors as soon as possible, but you don't want to be focusing on all the produced text unless necessary. The background mode effectively moves the output activity to the periphery; unfortunately, it does so equally well with the important output. This is an example of an application already producing information of varying importance, and one that might use some triggers to draw users' attention.

Another use case was putting day-long live video streams from a conference on the calm desktop. When the monitor is placed separately, the audio should reflect its position, as it is rather distracting having audio coming from a different location – the main work area – than the video, and interfering with notifications on the normal desktop. When something interesting was going on, I simply moved it to the main monitor and attended to it.

On more ambient side of the spectrum, I put a global weather and wind visualization webpage (windy.com) on the calm desktop, which shows a constant animation using moving particles. This application has direct signs of Weiser's locatedness, informing about what is happening and what is about to happen, yet the animation itself is critical carrier of the information. The default settings result in isolated and prominent particles that are indeed source of distraction even on calm display. However, the website can be set up so that the particles have long traces and blend into each other, which still communicates the data when user focuses on it, but ceases to be grabbing unwanted attention – something that website could do on its own once it detects it should be in calm mode.

Moving between normal and calm desktop

The experience of moving windows between normal and calm monitors – either by mouse, touch or keyboard shortcuts – is very natural and demands no additional cognitive load, as users are moving windows around all the time. That becomes especially apparent when you realize you can express the change in your attention needs *while* watching the video. The use of a dedicated space where applications should be calm gives users the feeling that they are directly in the charge of moving applications between center of their attention and periphery.

For multi-level or continuous notion of calmness, the desired calmness level might be determined by the distance of the application window from user's current center of attention. While defining a static working space for calm applications is one option, it could also be determined and changed dynamically based on user's activity, gaze etc.

A noteworthy situation arises in the window switching scenarios when the operating system or another application shows the windows of other applications together at one place (e.g. Alt-Tab experience in Windows). Since the background display mode is implemented on hardware level, windows from both normal and calm desktops were intermixed without any visible difference, which caused confusion and introduced context interruption not previously associated with the task of switching windows. Marginalizing or grouping the windows with various calmness in these user interfaces seems to be a reasonable recommendation.

Conclusion

With this paper we explore the idea of calmness in individual applications that users might use during work, to keep their attention better focused on the applications they care about at any given time.

We used a background "calm display" mode on a desktop computer monitor to explore some of the experiences of giving users a dedicated part of workspace intended for applications that should stay in the background, and presented observations from a two-week exploratory probe study.

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