A Measure of Calm

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Abstract
We propose the prototype of a quantitative metric for evaluating whether or not a piece of technology is "Calm". Our approach is based on Weiser's vision of Calm Technology (CT) and on the principles of Anthropology-Based Computing (ABC) and Peripheral Interaction (PI). Our hope is to derive feedback from this workshop that will allow us to further develop our metric as a tool for use in the fields of HCI, Design, and Human Factors.

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Metrics, Calm Technology, Peripheral Interaction, Anthropology-Based Computing

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H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
Calm Technology (CT) describes any tool that can be used with uninterrupted focus on a central task while new outside information is perceived and processed peripherally. This dynamic allows the user to decide whether to divert their attention and change their focus at any time, providing a cycle of perceptual feedback and response similar to the cortical discharge cycle by which all animals interact with their environment [4].These iterative

cycles of perception, evaluation, and reaction have shaped our evolution and continue to shape our understanding of, and interaction with, the world around us.

Even though the idea of "Calm" was introduced into HCI nearly twenty years ago [7], it is still not quantified. To help realize the promise of "Calm", we propose the development of a simple quantitative metric based on an understanding of how humans perceive, process, and respond to environmental stiumulii.

Anthropology-Based Computing (ABC)

ABC is based in part on the fact that the human animal perceives and processes data in certain specific ways [3]. Our model generalizes them into three progressive categories, each named for a part of the brain.

1) The medulla oblongata represents *reflexive* responses to sub-cerebral stimuli, like pulling your hand away from a flame or squinting when a continued noise is too loud. This part of the brain is where we knit and walk and chew. One HCI example is a cursor forcefield providing subtle haptic feedback [1]. If the interaction is inconsistent or surprising then it will trigger a higher level of attention.

2) The amygdala represents *pre-attentive* responses to familiar patterns of sight or sound or motion. This is where we perform familiar tasks like typing a pre-written phrase, tying our shoe-laces, and turning off the lights as we leave a room. A HCI example is clicking recognised software pop-ups to close them without reading them carefully. If a pop-up is inconsistent or surprising, the pattern change will trigger a higher level of interaction.

3) The prefrontal cortex represents *attentive* thought. A pattern that cannot be easily recognised pre-attentively is referred to the prefrontal cortex for deeper analysis. For example, this is where I am writing this paper, and it is where you are reading it. There is no higher level of attention to go to if another task arises to make additional demands on your *attentive* system. This means that your attention will now have to be divided.

Peripheral Interaction (PI)

PI usually describes the perception, processing and reactions that take place on the edge of our attention [2]. Our understanding of PI is based on the fact that while we are attending to a task in any one of the three attentional categories given above, we can still perceive, process, and act on information in either of the other two. A caveat is that tool use or task performance, singly or in combination, is only "Calm" if the user can, at any time, receive, process, and react to peripheral information.This is an important distinction. A prolonged *attentive* task may lead one into "flow" [5] where performance is improved but peripheral perception becomes narrowed or even disappears. When that happens, our *pre-attentive* processors create false patterns to fill in the blanks. You may feel calm when you are working deeply at a task, lost in the flow of coding or painting or some equally-immersive task, but that does not mean the task is "Calm". In fact, getting so lost in a task that you cannot perform any PI can be very dangerous.

Some thoughts on context, task switching and multitasking
A wall clock is a perfectly "Calm" technology. To begin with, the technology is transparent. You are looking at the clock but you are seeing the time. The clock does not demand any attention at all when it is not being used. When it is used, a glance should be enough to recognise one of the limited instances of a known pattern that could reflect the current time. This recognition will happen pre-attentively and will not interfere at all with any

attentive process happening elsewhere in the brain, or with any purely *reflexive* processes, either. Of course, this is only true if you know how to read a clock. We can conclude from this that knowledge can have an effect on "Calm". We can infer more mitigating factors.

A siren will not affect you as strongly if you hear it pass by in the distance as it will if it is right behind you: location affects "Calm".

If you are involved in a very focussed, all-consuming task like, say, giving birth, you may not even notice the siren at all: priority affects "Calm".

Continuosly patting yourself on the head with a gentle up and down motion of one hand is not, for most of us, a challenging task... for the first few minutes: fatigue and/or boredom affect "Calm".

The continuous patting becomes more difficult with the addition of an unrelated task for the other hand: multitasking affects "Calm".

This is even true of multitasking across modalities. Singing is more difficult while patting your head, unless you match the rhythm of the one to the other.

The Metric

As a first usable step towards a quantitative measure of "Calm", we propose matrices which identify the *reflexive*, *pre-attentive*, and *attentive* demands of a task or tool. As shown in Figure 1, one plots the type of attentional demand required during each element of performance. We suggest that starting a task may be attentionally different that performing it in "flow". We also suggest that there may be attentional differences in pausing, resuming and stopping a task. Finally, we insist that any tool or task requires attention in a "worst case" scenario. The matrix for interuptive signals or alarms is shown in Figure 2.

Classification of Attenional demands in a Layered Matrix			
ELEMENTS	**DEMANDS**		
	REFLEXIVE	PRE-ATTENTIVE	ATTENTIVE
START			
FLOW			
PAUSE			
RESUME			
STOP			
WORST CASE			

Figure 1: CALMatrix for evaluating tools and tasks

We offer the example of "driving", which involves continuous processing that is both *reflexive* (haptic and optic) and *pre-attentive* (recognising signs and markers, distances, movement patterns). Furthermore, because driving has potentially catastrophic consequences, the driver must always be ready to respond immediately with full attention, in a "worst case" scenario.

CALMatrix for Signals and Alarms			
RESPONSES	**DEMANDS**		
	REFLEXIVE	PRE-ATTENTIVE	ATTENTIVE
PERCEIVE			
PROCESS			
DELAY (snooze)			
DENY			
ACCEPT			
IGNORE			

Figure 2: CALMatrix for evaluating signals and alarms

Once matrices have been filled in, different tasks can then be compared to see if it is safe to perform them at the same time. In this way we can see that it is not safe to combine driving and texting. Both demand *attentive* processing at all times and both are susceptible to the

unwitting loss of peripheral perception. "Multitasking" might feel safe, but that is due to diminished attention to the periphery, not to diminished risk.

A final caveat: learning requires *attentive* processing, even when the task will eventually be performed *reflexively*, like walking or *pre-attentively*, like speed chess.

The Act of Proposing Such Measures...

It may not be possible to achieve a universally-accepted measure of Weiser's "Calm", but we hope there is some value in the attempt. Fenton and Pfleeger [6] wrote: "Even when it is not clear how we might measure an attribute, the act of proposing such measures will open a debate that leads to greater understanding."

Today, we would like to open the debate on whether or not it is possible to quantitatively measure "Calm".

Simple Hazard Identification through the Evaluation of Layered Displays		
INTERRUPTIVE EVENT	Possible? Y/N	REMEDIAL ACTIONS (PRE- & POST-)
MINOR DISTRACTION		
MAJOR DISTRACTION		
PHYSICAL BREAK		
MENTAL BREAK		
TOOL FAILURE		

Figure 3: Prototypical "S.H.I.E.L.D." risk evaluation matrix

Keep Calm and Carry On

We are currently testing "Calm" ringtones and a "Calm" replacement for pop-up messages and trying to further develop our "Measure of Calm". It is our hope that an accepted quantitative metric and the related improved understanding of peripheral interaction will not only improve the day-to-day experience of ubiquitous computing, but will lead to the acceptance of a metric like the one shown in Figure 3 to help Ergonomists and Human Factors Specialists mitigate the dangers in high-risk fields.

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