



Citation for published version:

Kelly, R 2011, 'Subliminal computing: The support you don't see' *XRDS: Crossroads, The ACM Magazine for Students*, vol. 18, no. 1, pp. 25-28. <https://doi.org/10.1145/2000775.2000786>

DOI:

[10.1145/2000775.2000786](https://doi.org/10.1145/2000775.2000786)

Publication date:

2011

Document Version

Peer reviewed version

[Link to publication](#)

Publisher Rights

CC BY-NC

University of Bath

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Subliminal Computing: The Support You Don't See

By Ryan Kelly, University of Bath

Article Overview

Can information presented below the threshold of consciousness be used to provide support to the users of interactive computer systems?

Introduction

Many attempts at providing help and support to users of computer systems are badly designed. Some are rather intrusive too. Consider interactive agents, designed to 'converse' with their users during times of need. One particular example comes to mind: several years ago, if I were to type the words 'Dear Sir/Madam' while using a certain word processing package, a small character would materialize offering help with the task of writing a letter. Though the agent's intervention was both timely and well intended, it was also disruptive and unsolicited. To this day, I still don't know of anyone who found this particular kind of support helpful.

Sometimes applications refer their users to the 'Help' menu. Now, if there ever was a cop-out in interaction design, then it's a reference to the help menu. I'm not really sure which is the more difficult experience: searching a help menu for an answer to a simple question, or creating an accurate three-dimensional model of the entire Universe. OK, perhaps I'm being a little facetious here - after all, user support has come a long way since the days of command line interfaces (anyone need /help with those?). But imagine an interface that could provide support without drawing attention away from your day-to-day activities. Now wouldn't that be a *real* help?

Overt User Support

Most user support in software applications is administered in what I call an 'overt' manner. That is, the support is readily perceptible, and requires a user to think about the information via conscious processing. Such information has to be perceived, cognized and acted upon in order to be useful. In other words, overt user support is designed around the conscious mind. This is rightly so in many cases, because it is the conscious mind that allows us to reason about and understand the structure and day-to-day happenings of the world that we live in. Unfortunately though, overt help systems also cause task disruption. In many cases, users are required to stop what they are doing in order to think about the steps required to solve a given problem. This leaves me curious. Might we be able to provide new kinds of user support that don't cause task disruption?

The Unconscious Mind

Interestingly, the conscious mind is not the only gateway to human cognition. We also have an additional processing system that we often take for granted - the unconscious mind. This area of the human mind is surprisingly powerful. Not only is the unconscious responsible for regulating many bodily processes, it also holds sway over a number of higher mental functions too (Bargh & Morsella, 2008). Moreover, psychologists have been able to demonstrate that it is possible to utilize unconscious processing by presenting visual information for a very brief duration. The upper limit on this duration lies somewhere around 30ms, and is known as the threshold of conscious perception. Any information presented for less than this duration cannot be consciously perceived but is still processed by the mind. That is, people are able to 'see' the information without actually realizing it. Such stimuli are termed *subliminal* - by contrast, stimuli that undergo conscious processing are deemed *supraliminal*.

The effects of exposure to subliminal stimuli have been demonstrated in numerous ways. Consider, for example, the literature on priming, an experimental technique where the activation of mental representations in one context can affect subsequent behavior in another, altogether different setting. In a typical priming

experiment, participants are asked to fixate on a point at the centre of a computer screen. Images or words are then presented in the outer regions of the screen for extremely brief periods. The unconscious processing of stimuli presented in this manner has been shown to affect behavior in a variety of ways. Consider a study by Bargh & Pietromonaco (1982), where participants were subliminally primed with words related to hostility (e.g. “punch”, “hate”, “stab”). Later, in an ostensibly unrelated task, participants were asked to read a description of a person and then rate that person on a variety of trait scales. The researchers observed that the more hostile words participants were exposed to, the more negative their impression of the stimulus person, in turn showing that the unconscious processing of stimuli altered their judgments to match the content of the primes. Studies such as this demonstrate that subliminal information does undergo at least some level of cognitive processing, and though the effects of the stimuli are sometimes rather weak, the important point is that they are capable of guiding behavior for a short period of time.

There are, however, many unanswered questions about the unconscious mind. We might wonder, for example: how much information is the unconscious capable of holding at any one time? Such questions are difficult to answer because, somewhat ironically, we cannot consciously access the problem space, and it thus becomes very difficult to quantify and measure. In many ways, the unconscious mind is like the Loch Ness monster - lots of people talk about it, some claim to have seen it, and yet somehow it remains a mythical beast just beyond our grasp. Conversely, the properties of conscious perception are fairly well understood. For example, it has been recognized that directed attention works like a beam as it moves around our visual field; that working memory is capable of holding 7 (plus or minus 2) pieces of information at any one time; and that techniques such as ‘chunking’ bits of information together can assist in overcoming limitations associated with processing large amounts of information. Such considerations have often been leveraged to inform the design of interactive software applications. For example, eye-tracking systems can monitor visual attention in order to provide recommendations about where to locate important information on a user’s screen.

Furthermore, a staple lesson in interaction design is that computer systems should be designed such that they do not overburden the cognitive load of their users.

A Checkered History

Though psychologists often refer to subliminal stimuli in their work, the popular understanding of what is meant by ‘subliminal communication’ is rather different. Part of this misunderstanding stems from the equation of ‘unconscious processing’ with popular views related to ‘subliminal persuasion’ (Bargh & Morsella, 2008), a term often greeted with a sense of suspicion and related feelings of discomfort.

Much of this ill feeling stems from the work of one James Vicary. In 1957, Vicary posited that if images of popcorn and other refreshments were quickly flashed during movie screenings, moviegoers would instantly jump from their seats and indulge in an otherwise unplanned soiree towards the nearest concessions stand. Vicary claimed to have employed this technique successfully, increasing sales of popcorn and soft drinks in one theatre by almost 60% and 20% respectively. Vicary’s results were later sensationalized in Vance Packard’s *The Hidden Persuaders* (Packard, 1957), which revealed (and I use that word loosely) how advertisers were using ‘psychological methods to tap into our unconscious desires’. Advertisers were portrayed as society’s puppet masters, capable of hypnotically controlling consumers via the power of subliminal messaging.

It was only later in 1962, when, under pressure from peers who had not been able to replicate his results, Vicary confessed to having falsified his study. Unfortunately, Vicary’s confession came too late and did little to quell the growing ill feeling towards subliminal stimulation. The success of *The Hidden Persuaders* had already led to a public outcry and to conspiracy theories of governments and cults using the technique to their advantage. Fuelled by a healthy dose of Cold War-era suspicion, laws were passed in several countries banning the use of subliminal advertising during public broadcasts. A study conducted by the United Nations

further concluded that subliminal indoctrination was a major threat to human rights throughout the world.

A decade after Vicary's confession, a volume by the researcher Wilson Bryan Key, entitled *Subliminal Seduction* (Key, 1973), was pitched as an exposé of how consumer behavior can be influenced by sexually charged material embedded in printed advertising. Key accused those pesky admen of all kinds of subliminal mischief; an embedded 'sex' here, a phallic symbol there - you name it, they'd hide it in the corner of an otherwise innocuous whiskey ad before shipping it out with the next edition of *Razzle*.

Jokes aside, the conjecture that arose from the work of Packard, Key, and their contemporaries led to a general mood of discomfort towards the concept of subliminal stimulation. To me, it is interesting that the dominant perspective on this issue was always a negative one. I suppose this is understandable - people don't like to think of themselves as susceptible to covert manipulation by sinister advertising campaigns. But I am still curious as to why many writers were so paranoid about the topic. Nobody ever suggested that subliminal presentations could be used in a positive fashion. What if exposure to subliminal stimuli could have positive, useful and uplifting effects on human behavior?

Enter The Computer

Computers are ideal for the presentation of subliminal stimuli. As we have seen, subliminal cues need to be presented both briefly and quickly, and computers are great at this kind of behavior - it is hardly surprising that psychologists have been using computers to this end for decades. Moreover, subliminal stimuli need to be presented whilst their intended recipient is staring at a screen. Now, isn't this something that millions of people spend their entire working lives doing? I'd wager that a large number of these people have struggled with a difficult task at some point, and I'm also willing to bet that they would love to see computers capable of giving them more effective support during such times of need. This leads me to my

next question - could we not utilize the power of subliminal stimuli and the unconscious mind to provide task support, thereby enhancing the user experience in the process? Considering some past studies that have explored the use of subliminal cues during human-computer interaction (HCI) may help to explore this question.

An early study of subliminal cueing in HCI was conducted by Wallace, Flanery, & Knezek (1991). In their study, subliminal cues were used to implement task-oriented support within a text editor. They found that participants asked for help on a less frequent basis when task-relevant information was presented in a subliminal manner. This early study suggests that the presentation of information below the threshold of conscious perception could have a positive impact during tasks that are demanding, confusing or difficult to complete.

In a slightly different context, researchers at MIT used wearable glasses to project information subliminally for what they described as 'just-in-time' memory support (DeVaul, Pentland, & Corey, 2003). Their study involved a face recognition exercise, where participants were first tasked with memorizing a set of name-face pairs. Subjects were then asked to don the rather fashionable glasses and were tested on their ability to correctly match names to the faces appearing on a screen in front of them. It was found that when a target's name was presented subliminally in the glasses, each participant's ability to recall the correct name was increased by a factor of 1.5, as compared to those who did not receive the subliminal cues. From this study, it seems that subliminal cues could be a useful alternative to overt cuing for memory support.

Finally, a study by Chalfoun & Frasson (2008) explored the benefits of incorporating subliminal cues into a computerized number puzzle. In their experiments, Chalfoun & Frasson taught participants solution strategies by providing subliminal cues during the learning process. It was found that those who received the subliminal stimuli made 44% fewer mistakes and significantly less backtracking moves than those in a control condition. Again, this study demonstrates a potentially useful effect of information that is presented below the threshold of conscious awareness.

I believe there are some running themes that bring these studies together quite nicely. First, all of the studies I have described used subliminal cueing to provide help and support to a user. Thus, unlike the popularized image of subliminal communication, these studies have been able to find a practical application for the phenomenon that is overwhelmingly *positive*. Second, these studies delivered subliminal information at a time when the user had reached a tricky stage of their work. It would appear, then, that subliminal information is most effective when it is *timely*. Third, participants in the studies were actively engaged in a cognitively demanding task at the point of information delivery. This in turn suggests that subliminal cues could be useful in *alleviating the burden associated with high cognitive load*. Finally, recent studies of subliminal cueing have shown that such cues are most influential when the user has a related goal active (e.g. Karremans et al., 2006). In all of the studies I have described, users had an activated goal at the time when information was delivered. In DeVaul & Pentland's study, for example, users had the goal of pairing a name with a face, and subliminal presentation of the name increased performance. In the study from Wallace, Lanery & Flazek, users had the goal of finding task-oriented support, and subliminal presentation of relevant information increased performance. Thus, *goal-relatedness* is key - subliminal cues are likely to be most effective when the content of the cue is directly relevant to the goal of the user's current task.

Concerns

There are likely to be a number of concerns regarding the use of subliminal stimuli in computer applications. The first, and perhaps important, is related to ethics; for example, is it ethically sound to influence behavior without a user's conscious knowledge of the influence? I believe this is a fair question, but it is for the reader to decide what the answer should be. In my opinion, use of unconscious processing is not entirely different to influencing users through persuasive technology, and it is ultimately a moral issue that needs to be dealt with on a case-by-case basis. It will be

up to designers to make users aware of what their interfaces do, and to decide what is morally right or wrong when it comes to guiding human behavior. There is certainly room for a sneaky attempt at subverting user behavior, but as I have tried to emphasize in the latter half of this article, it is more appropriate to influence behavior in a positive and ethically sound manner. Problems may arise, however, when the distinction between right and wrong is not clear-cut. Consider a shopping website successfully increasing their online sales through the use of subliminal stimuli. From the perspective of the online store, this is resoundingly positive, yet I can't help but wonder if users would view the situation in quite the same way.

A second concern relates to how and when subliminal stimuli can be most successfully incorporated into the design of computer systems. The studies I have reviewed in this article provide a good starting point: as timely, unobtrusive interventions when users are engaged in cognitively demanding tasks. An alternative use might be to employ subliminal stimuli in order to enhance feelings of emotion when interacting with digital media - I make this suggestion tentatively, however, as I foresee an entire can of ethical worms exploding in my face if I make any more claims of this nature.

Finally, we know that subliminal stimulation works in the laboratory. The problem is that laboratory conditions are strictly controlled, and such conditions, together with the stimuli themselves, are not naturally occurring. If it turns out that unconscious stimuli are only effective in such artificial circumstances, it is difficult to see how effective they might be in a busy office environment, where task switching and other factors are likely to disrupt the effectiveness of subliminal cues.

One upside of these concerns is that they present a wide variety of future research opportunities. More work is required on user reactions to subliminal cues, in addition to the development and ratification of legislation governing their use in computer applications. Further, we need to assess the real-world applicability of subliminal cues in order to better understand how they can be utilized within computer systems. Opportunities also exist to determine the most useful points of intervention for these cues, as well as an exploration of how divided attention disrupts the impact of subliminal cueing. Future studies might also explore the

impact of subliminal cues in more representative tasks, in the use of mobile devices, or in gaming applications.

The Future for Subliminal Communication

In this article I have suggested that subliminal stimuli could be incorporated into the design of computer systems, specifically to enhance user support in new and beneficial ways. Whilst my proposals may be outlandish to some, they are based on empirical evidence and I do not consider them too far-fetched or impossible to obtain. It is merely my view that when it comes to providing user support, designers, programmers, and other computing professionals have not yet fully harnessed the power of unconscious processing. In time, we may be able to support users through this mystical and often poorly understood communication channel. I will happily be the first to admit that there is a long way to go, and there are myriad opportunities for further work in this area - we need to better our understanding of unconscious processes, as well as considering the kinds of signals we can send to users without breaching the ethical guidelines of our discipline.

All said and done, I am excited about the potential for augmenting user support via subliminal cues. I am also pleasantly surprised by the fact that I am not the first to consider the potential benefits of unconscious communication - I recently encountered a call for papers from a scholarly journal for a special issue on subliminal communication in HCI. Example topics included characterizing subliminally delivered information, analysis of subliminal processes, and, crucially, studying the impact of subliminal information on alleviating the cognitive load. With academic interest on the rise, the field of subliminal communication research is sure to see a growth in published articles in the near future. In the meantime, I hope this article has made you think carefully about the untapped power of subliminal stimuli. I am confident that it did, even if you weren't consciously aware of it.

References

Bargh, J.A., & Pietromonaco, P. (1982). Automatic Information Processing and Social Perception: The Influence of Trait Information Presented Outside Conscious Awareness on Impression Formation. *Journal of Personality and Social Psychology*, 43(3), 437–449.

Bargh, J. A., & Morsella, E. (2008). The Unconscious Mind. *Perspectives on Psychological Science*, 3(1), 73–79.

Chalfoun, P., & Frasson, C. (2008). Subliminal priming enhances learning in a distant virtual 3D Intelligent Tutoring System. *IEEE Multidisciplinary Engineering Education Magazine*, 4(4), 1–1.

DeVaul, R. W., Pentland, A., & Corey, V. R. (2003). The memory glasses: Subliminal vs. overt memory support with imperfect information. In Proceedings of the Seventh IEEE International Symposium on Wearable Computers, (pp. 141–142). IEEE Computer Society.

Karremans, J. C., Stroebe, W., & Claus, J. (2006). Beyond Vicary's fantasies: The impact of subliminal priming and brand choice. *Journal of Experimental Social Psychology*, 42, 792–798.

Key, W. B. (1973). *Subliminal Seduction: Ad Media's Manipulation of a Not So Innocent America*. New York, NY: Signet, New American Library Inc.

Packard, V. (1957). *The Hidden Persuaders*. New York, NY: ig Publishing, 2007 reissue edition.

Wallace, F. L., Flanery, J. M., & Knezek, G. A. (1991). The effect of subliminal help presentations on learning a text editor. *Information Processing and Management*, 27(2– 3), 211–218.

This is the author's accepted version. Cite as:

Ryan Kelly. 2011. Subliminal computing: the support you don't see. *XRDS* 18, 1 (September 2011), 25-28. DOI=<http://dx.doi.org/10.1145/2000775.2000786>