Exploring user attitudes toward affect recognition in web-capable applications

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ABSTRACT
In this paper we present the results from a qualitative study exploring people's opinions and reactions to the possibility of emotion-aware adaptive web user interfaces, those which will have the capability to read users' emotions and adapt accordingly. The purpose of this work is to improve understanding of how people envision such emotion-aware interfaces may be a part of their computing experience, and to explore any concerns that people have relating to this technology. We expect that such information will be helpful for directing the development of new emotion-aware adaptive web interfaces.

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Adaptive websites; Affective computing; Qualitative evaluation

ACM Classification Keywords
H.5.2 User Interfaces—User-centered design

INTRODUCTION

Adaptive websites typically rely on user models constructed from interaction data (e.g., keystrokes and mouse movements or navigation history) or user-supplied questionnaire data to adapt their appearance or content according user interests, preferences or knowledge (e.g. [8,18]). While powerful, this type of interaction data ignores the importance of the user's affect or emotional state. People interacting with other people constantly adapt interaction strategies based on their interpretation of others' affective states, and thus in order to be truly intelligent, some have argued that computers should likewise adapt their interaction to this information channel [14].

Developing websites which adapt to affect involves many non-trivial challenges, including how to assess user emotions from biometric signals (e.g., [5]), facial expressions (e.g., [2]) and/or body gestures (e.g., [7]) and how to design lightweight biometric devices which can be practically used (e.g., [17]). In addition to these technical challenges, effective interface design will require answering questions of how affect can or should be used by adaptive web applications, and what sorts of applications will make sense to end users.

There are proposals for emotionally intelligent websites, for example, an e-commerce interface which evaluates and adapts to user affect [16], and also suggestions for using affective computing in collaborative networks [10]. However, we are not aware of any work which provides end-user generated data and opinions on emotionally intelligent websites. As with any interaction design problem, having only a limited understanding of target tasks, end users, and their preferences greatly increases the risk of application failure [15]. This is particularly risky for emotionally-aware applications given the difficulty and time commitments required of constructing them. Thus, we argue for the importance of having a solid user-opinion and expectation grounding for affect-aware web systems, for successful and efficient application development. In this paper we present an initial-step qualitative study on end-user opinions and preferences regarding emotionally adaptive websites.

We take a user-centered design approach for our first step towards exploring the potential design space of affect-adaptive websites. We conducted a set of semi-structured exploratory interviews with 19 potential end users to elicit possible applications and concerns regarding how websites could adapt to affect, and through this brainstorming exercise we identified a number of promising directions and potential web-specific pitfalls for this type of technology. By describing users' attitudes toward emotion-aware possibilities our results help to inform the development of future applications.

EXPLORATORY STUDY OF USER OPINIONS ON EMOTION-AWARE ADAPTIVE WEB INTERFACES

We recruited 19 participants from the general university population, aged from 18 to 57 (M=31.42, SD=7.67), 12 male / 7 female. Most (17/19) use the internet several times a day while the others (2/19) use the internet every day or two. Participants said their internet and web skills are fair (3 ppl.), good (6), or very good (10).

We conducted semi-structured interviews (15-20 minutes in duration) to elicit people's opinions toward affect-aware websites and ideas for applications. Each interview started by asking participants' opinions on emotion-aware systems. Then, we focused on their opinions of how emotion-aware adaptive web interfaces can be useful, where the interfaces can be applied, and what benefits people could expect to get. Participants were paid a $10 honorarium.

Study Context – Validating an Affective System

The semi-structured interviews were conducted as part of a larger one-hour study; we briefly present the details here to provide context. The one-hour study had three components: a) we conducted a psychological study to validate an off-the-shelf EEG system (the Emotiv EPOC Neuroheadset[1]), b) we tested an original affective-adaptive website prototype (developed in-house), and c) we finished study sessions with semi-structured interviews (described above).

For part a) we applied the International Affective Picture System [9] to elicit affective states and used the Emotiv Affectiv Suite™ (a black-box mapping from raw EEG to affective states) to rate affective response. Unfortunately, we did not find a significant effect of stimulus on EEG rating. Potential problems might be lack of device sensitivity or our study environment itself might have been too noisy (a small room with other graduate students working quietly behind the participant).

For part b) we designed a web system which adapts to a user's level of *arousal* by changing the color scheme: more vivid colors could match high arousal, for example, to match the user's mood, with subdued colors for low arousal. Given the potential lack of reliability of our instrument as found in part a), this data was discarded.

We note that the first two study parts biased our semi-structured interview results, for example, by showing people what an EEG may feel like (this one was quite uncomfortable) and by providing an example affective-adaptive application. We do not believe that this hinders our study, however, as our results highlight that participants were not limited in their feedback based on this initial priming. On the contrary, we believe that the example work may have helped people brainstorm and understand the somewhat-ephemeral idea.

Qualitative Analysis and Findings

We performed an exploratory qualitative analysis on the collected interview data, taking an affinity diagram [4] approach to uncovering emergent themes, presented below. While we asked participants to comment on web-specific uses of the emotion sensing, we note that our participants' ideas often extended beyond website tailoring. As an overview, we found that participants were interested in having computers monitor their emotional state and try to change (improve) it, *reflect* it back to them to improve self-awareness, or modify an interface to adapt to one's mood. Participants were also interested in having the computer report emotional states between people for therapy or social awareness and sharing. While participants were generally enthusiastic about the possibilities for emotion-aware technology, they did express special concern for privacy.

[1] http://emotiv.com/

Modify Users' Emotional States

Most participants (14/19) explicitly stated that they want emotion-aware intelligent systems to try and modify their emotional state, for example, to sense when they are unhappy or overwhelmed and perform actions to help mitigate their current emotional state:

> "Just came from University, so [I'm] very much *(sic.)* tired. Computer knows that we are very much tired. [Then] it will do something to cheer me up and make me relax … [because] if you are happier, it will get you more works [done]." [p12]

> "If computer knows my mood, computer should do something to adjust [my] mood. If you feel something really bad, at that time, you should not work, or [you will] make some mistake." [p15]

Above, P15 and P12 suggested that the computer should do something in response to their affective state to increase their productivity or to protect them for making errors. P19 suggested that under these circumstances the computer should simply prompt the person to take a break:

> "Maybe [the computer] prompts user [to] take a break." [p19]

Many participants (8/19) also expressed interest in having the computer take corrective actions to help alter their affective state, such as automatically playing or suggesting music to help them relax:

> "Computer may play some soft music to help you release…" [p14]

> "If you feel sad, computer suggests there is a great music that can help you lift your mood." [p19]

> "[Mood] can be really affected by music. … Speaking from experience, I play different kinds of music; it tells me how I am feeling." [p16]

In addition to using music as a means of altering affect, participants suggested adjusting screen brightness or switching user-interface themes, for example, modifying visual contrast of text, changing fonts, etc.

Tailor the Quantity of Information Delivered

Other participants (4/19) also wanted the computer to react based on their mood, but to do so by tailoring the quantity of information delivered. For example, P18 discussed limiting notifications when the person should not be disturbed, while P19 suggested simplifying the contents of a webpage:

> "Maybe someone calls me, *(sic.)* and if I am really, if [the interfaces] know I don't want to be disturbed; [the phone call popups] won't show up, something like that." [p18]

> "If someone feels confused, he comes to website and can't navigate, right? If the browser can sense it, 'oh

this person is confused, maybe, this page is little bit complicated.' Then, the web browser can suggest, for example, 'would you like me to simplify this page for you?'" [p19]

When tailoring on behalf of users, however, P19 indicated that it should be done seamlessly, as too much prompting and verification could defeat the purpose:

> "Too many questions … being helpful is good. But, if you go over the top with it, then that's pretty much the problem. But I am sure there would be ways to solve [this problem]… I mean it is adaptive, if the system already knows what the user likes..." [p19]

Feedback on One's Own Emotional State

Apart from proactive emotion-tailored support, some participants (3/19) expressed a desire for an emotion-aware system to simply provide them with feedback on their changing emotional state:

> "You are going to be done your day; you suddenly realize, 'oh, this [emotion] reading means I am sad.' It makes you explore what's making you sad and how you can deal with that." [p16]

While P16 quote above indicates a desire to learn about one's emotions through self-reflection, one participant was hopeful that the computer could also explain the causes:

> "Maybe, computer can try to explain why this emotion was caused … When I am looking at the interface, tell me why I am sad." [p4]

Feedback on Others' Emotional States

Discussions on adapting to one's emotions also sometimes included a desire to have feedback of others' emotional states (2/19). There was a focus on children who could benefit, such as autistic children who have difficulty expressing emotions or socially isolated children, a theme already in the field [11]:

> "They [autistic children] are not being able to express themselves. Having that [displaying children's emotion] might help you as a caregiver or as a parent." [p16]

> "Good for the kids … [who] are not able to group for the studies … Some of them don't play, some of them want to sit alone *(sic.)* isolated … For them this study [exploring emotion-aware interfaces] can be used. And what's more, this study can be used for those who are abused." [p6]

Expressing One's Emotions to Others Online

In addition to applications which may work well for off-line general computer use, a few participants (2/19) wanted an emotion-aware computer to serve online social purposes by sharing their emotional states to family and friends:

> "I am going to share why I am happy and what I am feeling." [p4]

For others, any emotion sharing was viewed as a potential downside. For example, some (4/19) expressed hesitance as they felt computer-generated emotion representation was no substitute for direct interaction with people:

> "Relationship is based on communication. But, if I didn't talk to my friend; I just saw their emotion on computer, then that is not good. Because I just know they are angry or happy, but I don't know why." [p18]

> "I am super happy, so … all I am going to do is sitting on my chair and seeing 'I am happy,' then computer senses it and share to my friends. I don't feel too involved; it's taking out the level of social interaction." [p19]

Privacy Concerns

In addition to worry over negative impact on social interactions, many participants (9/19) expressed a range of privacy concerns inherent to this type of technology:

> "No! I don't want, I don't want computer to read my emotion to adjust interfaces. I like my privacy." [p1]

Others did not mind their emotions being read and used for user-specific tailoring, but expressed worry about the technology exposing or sharing their emotions:

> "Emotion has to be within you. This must be private. One will never prefer sharing their emotion." [p6]

> "If computer reads someone else's emotion, changes whatever [interfaces], and exposes the information automatically, it might be really dangerous to others. But if it is just between the monitor, like the computer, and me, it wouldn't be that bad." [p10]

The following quote illustrates that these concerns are particularly important with web interfaces, where data is often stored in an easily accessible location:

> "Like what Google does by storing cookies … it [emotion] will be stored somewhere … somebody comes into and opens the application, [and knows] he [the owner of emotions] is most of time angry." [p8]

DISCUSSION

Our interview results and summarized end-user opinions unveil several potential application domains for affective-aware web systems, and highlight key areas of concern.

Many participants focused on the idea that an affect-aware interface can be an emotion reflector, displaying one's own or others' emotions. This approach is already commonly used in many scenarios, for example, for biofeedback therapy, where a machine informs a person of their state to help them correct a behavior [3]. A benefit of integrating this approach into daily computing would be that it could improve accessibility to this therapy technique, and more

people could gain from the positive advantages. One integral challenge with this approach is the question of how to communicate, or perhaps visualize, users' affective states, for example, as interruptive notifications [13], through ambient displays [1], or as dedicated applications [6].

On a similar note, many people were interested in having computers that could leverage knowledge of their affective state to improve their interaction experience, e.g., by trying to improve their mood (such as through playing music) or by improving productivity by recognizing when they are confused or do not want to be disturbed; these fall along the lines of arguments for how positive affect in computing can improve experience and productivity [12,14]. While all of these applications themselves will require careful technical and interaction design consideration, our results show that, at the very least, some people are open to the idea of productivity tools that leverage their emotional state.

Participants voiced strong concern over the privacy of their emotions, and as such, interfaces will have to directly consider this problem. This is not a binary issue, however: some did not want their emotions read, others were okay with a computer using the information but did not want to share with others, and some were concerned about how this may limit or change existing social interactions. Thus, providing a level of granularity of control based upon level of sharing might help mitigate these concerns.

SUMMARY AND FUTURE WORK

In this paper we presented results from a set of semi-structured interviews that elicited end user opinions and preferences regarding emotion-aware interfaces. Our results indicate that people are interested in a diverse range of applications of emotion-aware technology including mood improving recommendations, tailoring information content and interruption frequency based on cognitive load and allowing people to reflect on and share their emotional states.

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