Conveying mood and emotion in instant messaging by using a two-dimensional model for affective states

J. Alfredo Sánchez, Norma P. Hernández, Julio C. Penagos, Yulia Ostróvskaya
Universidad de las Américas, Puebla
Santa Catarina Mártir
Cholula, Puebla, 72820 México
+52-222-229-2666
{j.alfredo.sanchez, frizbiss}gmail.com, penagoscorzo@mac.com, yuliaa.ostrovskaya@udlap.mx

ABSTRACT
We discuss the development and initial experiences with an instant messaging (IM) system that has been enhanced with functionality that facilitates the expression of affective states. This functionality is based on: (1) the use of a graphical, two-dimensional base model developed by psychology researchers; (2) refinements of the base model to allow for increased precision in the expression of affective states while exchanging messages; and (3) the definition of meaningful icons associated with the aforementioned model. Experiments have been conducted which show that users are able to take advantage of the proposed IM enhancements when trying to convey affect.

Categories and Subject Descriptors
H.5.2 [**User interfaces**]: *Prototyping, screen design;* H.5.3 [**Group and Organization Interfaces**] *Synchronous interaction.*

General Terms
Design, Experimentation, Human Factors

Keywords
Affective computing, instant messaging, emotion models, chat, emoticons.

1. INTRODUCTION
In spite of their widespread use in very diverse settings, instant messaging (IM) systems often lead to communication problems due to their limitations for conveying affect. Users typically experience problems in accurately expressing their emotions during IM conversations, as text-based illocutions fail to carry sufficient information about the participants' predominant state of mind. Thus, for example, statements intended to be ironic may be taken seriously, or humorous remarks may not be interpreted exactly as intended. Affective variations, both positive and negative (*e.g.* happiness, joy, enthusiasm, sadness, sleepiness or depression), may be even more difficult to convey or to detect in IM conversations. Users have resorted to mechanisms referred to as "smileys" and "emoticons", which are provided by popular IM programs, seeking to overcome the IM systems' lack of expressiveness, but problems still persist.

In [11], an IM system was introduced which incorporated a graphical interface for expressing affective states in a persistent manner. The interface they prototyped was based on a two-dimensional model proposed by Lang [5], which was mapped to an "affective panel" in the user interface, from which a prevalent mood can be selected. Although preliminary tests showed that users were able to set and maintain a preferred mood using this interface during IM conversations, the prototyped model-to-interface mapping explored only a few affective states and its layout did not follow an experimentally-based approach. Moreover, although the representation of affective states needed to be discrete for practical reasons, comments from users indicated that a finer granularity was necessary in order for the affective panel to provide sufficient expressivity.

In this paper, we describe a new IM prototype that also incorporates a two-dimensional representation of affective states, but goes further in three aspects: (1) the base model is one that suggests more precisely the placement of affective states on a plane, based on experimental research; (2) the base model has been refined to allow for increased precision in the expression of affective states; and (3) icons associated with affective states have been redesigned also based on experimental work.

For the sake of consistency, we use the terminology for affect discussed by Brave and Nass [1]: *Emotions* are reactions to events, typically short-lived, and directed to objects. *Moods* last longer and act as filters through which events are appraised. Finally, *sentiments* are persistent, almost permanent attitudes of individuals towards classes of objects. Thus, for example, if a person becomes angry at something, or excited about an event, we are talking about an emotion. A general depression without reference to an event or object would refer to a mood. Finally, when someone develops a stereotype and, say, generally likes or dislikes certain kinds of movies, we are describing a sentiment.

As in previous work, we contend that existing mechanisms for representing affect in IM environments, such as smileys and

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emoticons, help in representing a feeling at one given instant during a discussion, or a reaction to a given issue that occurred during a conversation, but are insufficient to convey moods or sentiments. As a conversation progresses, the emotional state of IM participants may change or remain the same but, unless emoticons are continuously added to each line, there is not an explicit indication of such states. Emoticons enhance or underline the meaning of certain text elements, but as text scrolls upwards and disappears from view, they are rendered insufficient to represent longer-lasting affective states. The work presented in this paper focuses on IM enhancements aimed at dealing with the need for improving the expression of emotions and moods.

The following section provides further background on the development of models for representing affective states and how a specific model was selected and adapted so it could be used in the context of an IM system. Then, Section 3 offers details of the process we followed for designing the interaction in a specific IM system that would benefit from using a model for affect. Section 4 presents the initial results observed from experiments using our enhanced IM prototype. Finally, Section 5 discusses ongoing and future work as well as our conclusions.

2. SELECTING A MODEL FOR AFFECTIVE STATES

A number of models have been proposed by researchers in psychology to provide means to describe and study affective states and processes. As stated earlier, our goal was to explore how a scientifically validated model for affect could be used as the basis to assist users in expressing emotions and moods in ways that are more effective than conventional smileys and emoticons. We thus reviewed various alternatives for models that could be suitable to be mapped onto a user interface.

Research in affective computing has studied models for affect with different purposes, from inferring emotions expressed in texts to producing programs that synthesize and convey affect at different levels. Thus, for example, the well-known OCC model is based on the theory developed by Ortony, Clore and Collins that considers emotions as valenced reactions to consequences of events, actions of agents or aspects of objects [6]. The model proposes a rich taxonomy of emotions that can be used for creating systems that are capable of reasoning about emotions.

Most psychologists have found evidence that has led them to describe affect as a set of dimensions, such as pleasure, distress, depression or excitement. Roseman, for instance, used empirical analysis to suggest five cognitive dimensions in order to determine whether an emotion will arise and to predict which emotion that might be. Up to 48 combinations of such dimensions may be formed, which in turn correspond to 13 emotions. This model underwent a number of modifications but, overall, was confirmed in several respects by empirical research and used with relative success for emotion inference [2].
The model proposed by Fridja and colleagues suggests ten aspects or action tendencies (*e.g.* being with, dominating, submitting) that determine the same number of emotions (*e.g.* enjoyment, arrogance, resignation). This model has been used as the basis for a system intended to "feel" and convey emotion [4].

Other models intended for inference or emulation of affect are discussed in [8]. Our goal, however, has been to assist users in conveying the affective states they, and not the computers, are experiencing. Thus, for the purpose of explicitly allowing users to express their emotions in a graphical interface, we considered the models just described would introduce a level of complexity that would not encourage users to dynamically map a given emotion or mood onto a model representation.

A series of models that called our attention for their simplicity and graphical expressiveness are based on the use of two main dimensions to characterize affect. Research by Lang [5], using a large library of so-called standard emotional pictures with more than 100 subjects, showed that affective states are consistently mapped to quadrants defined by the judged valence (appetitive/pleasant or aversive/unpleasant) and arousal triggered by picture impressions. Figure 1 illustrates how emotions are mapped to the space defined by the *pleasure* and *arousal* dimensions.

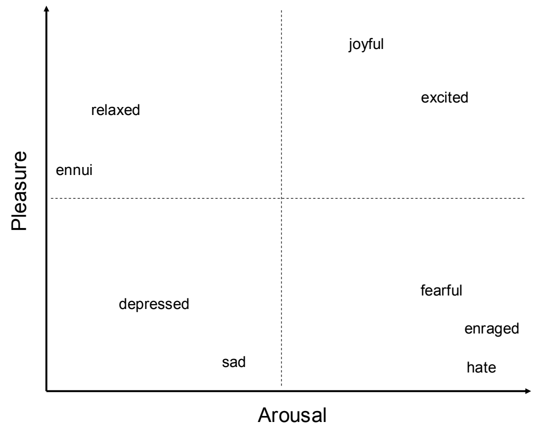

Figure 1. Some emotions mapped to the pleasure-arousal model (adapted from [5]).

This model was the basis for the Affective IM discussed in [11]. As noted earlier, the use of Lang's model was exploratory in nature and only included a small number of affective states. In order to advance in this exploration, we decided to consider the suitability of the model proposed and studied by Russell, which is briefly described next.

Russell's "circumplex model of affect" [9] also considers two main dimensions for characterizing emotions: valence and arousal. An important distinction of this model, though, is its finer-grained and more precise placement of emotions, which is based on empirical evidence from a series of experiments. The evidence suggested that these interrelationships can be represented by a spatial model in which affective concepts fall onto a circle in the following order: pleasure (0º), excitement (45º), arousal (90º), distress (135º), displeasure (180º), depression (225º), sleepiness (270º), and relaxation (315º). Further experimentation allowed Russell and colleagues to demonstrate that the structure of their model, rather than being dependent on the English-speaking student population in which it was originally obtained, occurs in different languages and cultures [10]. The use of 28 words that are typically associated to emotions (such as "angry," "tense," "relaxed," or "miserable") allowed researchers to find there was a consistent placement of those words in precise locations in each of the four quadrants. In particular, experiments showed that the model's structure can be generalized for Spanish-speaking subjects [12].

As can be seen, Russell's model offers a number of features that can be mapped directly to a graphical user interface intended for users to specify their current emotion or mood. We describe the design of the IM environment that incorporates Russell's model next.

3. DESIGNING THE INTERACTION FOR CONVEYING AFFECT

We decided to directly use the experience reported by Russell with 28 "affective words" in order to present them to IM users so they could select the one that best fit a current affective state. We reasoned that if people consistently placed affect-related terms on a plane, spotting one of these words when in the corresponding affective state should occur naturally.

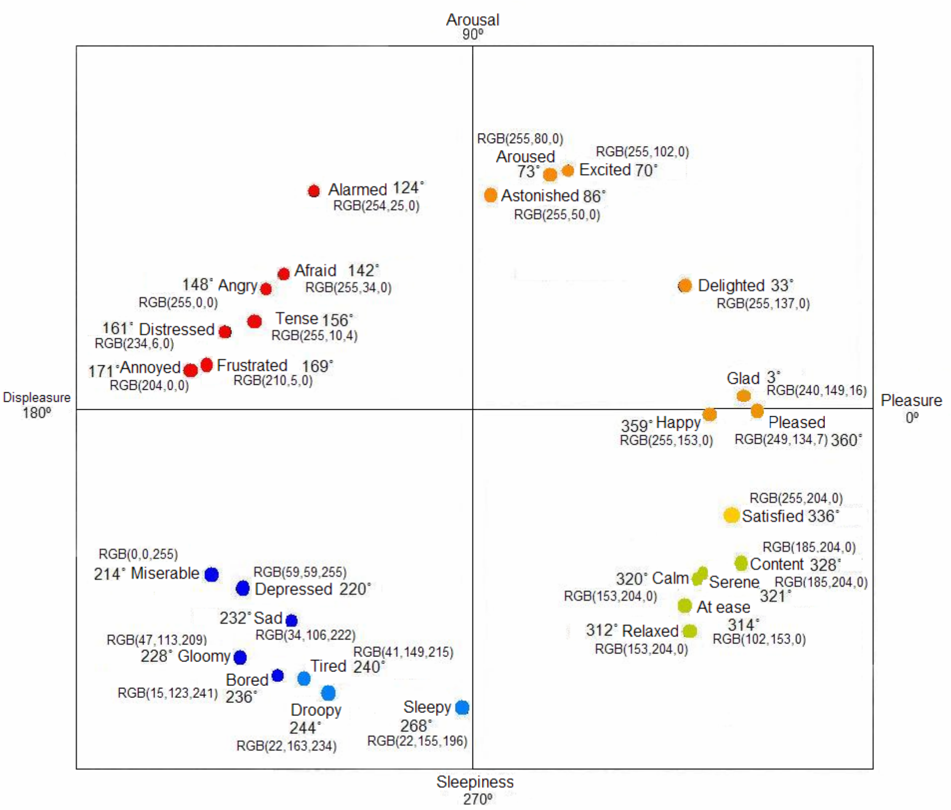

Figure 2. A model mapping for a paper prototype.

3.1 Mapping the model directly

The IM prototype reported in [11] rendered the representation of its underlying affect model as a panel that accompanied the regular text conversation. We developed a rapid, paper prototype for a panel that would represent Russell's model in a similar manner. Figure 2 illustrates our initial take on mapping Russell's model to a user interface, showing each of the 28 affect-related terms next to a small colored circle denoting its exact location in a quadrant plus a number that denotes the angle at which the term is located (the number is included for reference and was not actually shown to users). At this point we had this prototype tested by a group of students taking a course in color theory. They explored the use of colors associated to each affective term, suggesting the use of shades of orange for the positive valence-high arousal quadrant, shades of red for negative valence-high arousal, shades of blue for negative valence - low arousal, and shades of green for positive valence-low arousal. This aspect of the representation, however, was not explored in more detail (except for text color), as other means for facilitating access and selection were devised, as explained next.

3.2 Extending Russell's model to improve accuracy

During the initial prototype testing we sensed users often needed to somehow qualify the affective state they selected. Essentially, we detected it would be useful to be able to indicate a level of intensity for each of the affective words on display. We used this feedback to suggest that the base model could be extended to allow for this functionality in the user interface. We thus considered that the terms on the original circle could be used as a reference to define additional inner and outer circles with the affective words located at exactly the same angles but indicating lower and higher intensity levels, respectively. In essence, the distance of a word from a neutral center would be directly related to affect intensity. A modified version of the model considering only two additional circles (for low and high intensity) is illustrated in Figure 3.

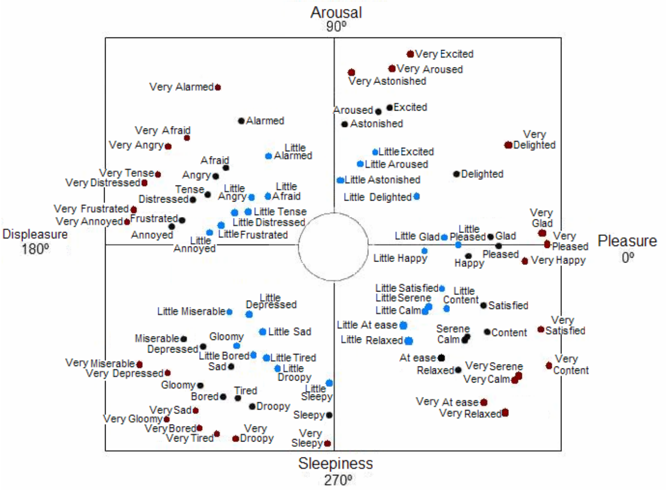

Figure 3. An adaptation of Russell's model.

3.3 Partitioning the affective space

It soon became clear that presenting all the model information in one screen overburdened users and that selecting an appropriate term for their affective states required time and effort they could not be asked to invest during an IM session. We thus decided to experiment with two strategies aimed at improving the proposed interaction style: partitioning the model representation into manageable chunks, and designing meaningful icons for each of the affective states to be presented.

In order to find a way to reduce the amount of information simultaneously presented to the user, we provided a group of students with a model representation similar to that in Figure 2. We explained what the model was about and asked them to select a single word they considered was the most representative for each of the four quadrants. The results we obtained led us to propose the simplified model shown in Figure 4, in which only one term is displayed per quadrant: "delighted", "angry", "sad", and "happy" for quadrants I through IV, respectively. We thus decided that in order to set a specific affective state, the user could start by selecting one of the four representative terms and use it as a handle to get to view the other affective words in the corresponding quadrant. This interaction is illustrated in Figure 5, where the user has selected "delighted" in the first quadrant before setting its mood more specifically to "excited."

We still needed the design to reflect our modified model to suggest an additional level of granularity, so users could indicate a low, normal or high intensity level for any emotion or mood. We decided not to display explicitly the inner and outer circles, since that would clutter the screen. Instead, we maintained only the original circle to facilitate term selection, but allowed for an easy qualification mechanism, as illustrated in Figure 6. After a few trials with users, we settled for this general interaction design, though more graphical depictions of affective states were still needed.

Figure 4. Simplified model using one representative term per quadrant.

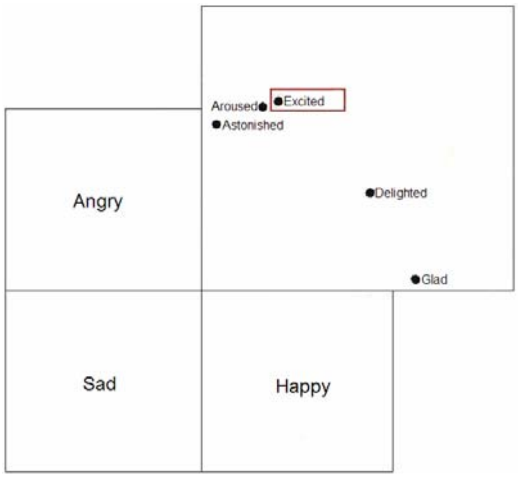

Figure 5. Using a simplified model for selecting an affective state.

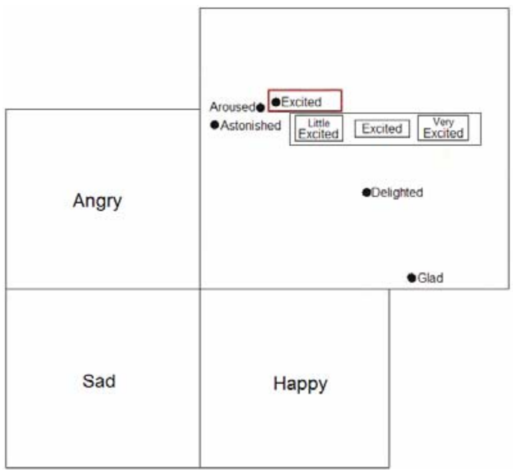

Figure 6. Specifying an intensity level for *excitement*.

Figure 7. Design of emoticons.

3.4 Designing meaningful icons

Thus far, only text had been used for representing the affect-related terms suggested by Russell's model. In order to make interaction more natural, we decided to investigate the design of appropriate icons that could be used to represent each of the affective terms used in our selected model. We thus considered the well-known work by Ekman on a Facial Action Coding System (FACS) [3], which identifies a very specific set of facial cues associated with a wide range of emotions. In FACS, for example, raised eyebrows with horizontal wrinkles across someone's forehead and more of the white of the eye visible are clear indication of surprise, whereas lowered eyebrows with vertical lines in between and lips pressed together are associated to anger.

FACS has been used with significant success in facial recognition systems, achieving accuracy as high as 90-98% on limited sets of emotions and explicitly produced expressions. We provided the list of facial cues to a graphic designer and asked her to use it as the basis for producing meaningful emoticons for each of the affective words in our base model. After a few runs and considering user feedback, we settled for the icons displayed in Figure 7. Admittedly, even though FACS was used as a general design framework, some stylistic traits have been added to some emoticons for emphasis or to denote differing intensity levels. Note that for each of the 28 affective words there are three icon variations that correspond to each of the intensity levels discussed earlier. Figure 8 shows how the emoticons for the four representative affective terms of Figure 4 would be arranged.

Using these elements, we were ready to prototype an IM system that incorporated Russell's model and mapped its affective words to the emoticons that considered Ekman's FACS system as a guiding pattern. We refer to this prototype as the Russkman IM (after **Russ**ell and E**kman**).

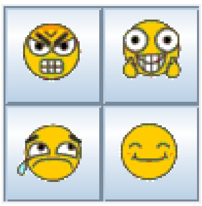

Figure 8. Emoticons for representative affective terms.

Figure 9 shows the various components of the main interface of our enhanced IM environment. The typical text conversation panels are displayed on the left hand area. On the right hand side, a list of active users is presented, including their names and current affective state represented in each case by one of the 28 available emoticons. The bottom section of the right hand panel presents the simplified version of Russell's model for affect. By sliding the cursor on top of any of the four representative emoticons, the corresponding quadrant and its emoticons are expanded and made available for selection. This interaction and the selection of an intensity level for a given affective state are illustrated by Figure 10.

Figure 9. Russkman's main interface.

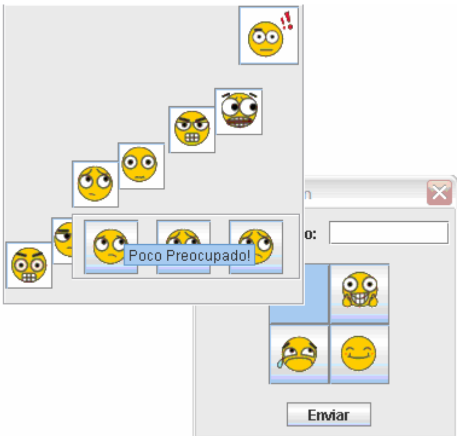

Figure 10. Selecting an affective state ("a little worried").

3.5 Typography and color

The use of specific font types, sizes and colors associated with affective states are aspects that were considered but not evaluated with sufficient depth in the work presented in [11]. During our design phase we ran a number of tests with a group of students of a course on Typography. Although we were seeking for associations between font types or sizes and affective states, our results did not converge to any useful extent. We thus decided not to include font types as part of our current design. As for font sizes, we opted for using only three general sizes (small, medium, large) to indicate (low, normal, high) affect intensity. Finally, with respect to color, we did follow the recommendations from the color theory group mentioned earlier and decided to apply them to text entered by users.

4. RESULTS

A functional prototype for the Russkman IM has been implemented as a Java JFrame under a client-server architecture, allowing for multiple users to exchange text messages. Text hints or "tooltips" are used to supplement information provided by emoticons, as illustrated in Figure 10.

We have conducted various experiments involving a limited number of users, all of them college students from different majors. We devised scenarios that would move users to be in specific moods (e.g. an upcoming exam, an unfair grade, a recent party, and son on). Users were observed during IM sessions, which were recorded using screen capture software, and then given questionnaires to obtain explicit feedback.

Our initial experiments involving seven users generally supported our premises regarding the usefulness and potential of Russkman to convey affect during IM conversations. We report here preliminary, mostly qualitative results, as a formal, statistical analysis is still pending. Among several interesting results, the following are worth mentioning:

- Emoticons in Russkman are easy to identify. Though initially some users tended to confirm the meaning of some of the icons via the "tooltip" option, the time required to find an emoticon for a desired emotion or mood remained under manageable limits. When explicitly asked about this issue, none of the users mentioned having problems to determine the meaning of the available emoticons, whereas five of them (71%) mentioned the precise icon they needed was fairly easy to spot in the interface.
- The proposed emoticons conveyed appropriately the intended affective state. While thinking aloud, users indicated what affective state they wanted to convey and their counterparts would express which emotion or mood they were sensing. In all cases, the intended affective state was appropriately detected. This also coincided with the answers from users to the corresponding item in the questionnaire. Statistical results show positive correlations between participants' self-evaluations and evaluations of their responses taken from computer screen recordings. Correlations ranged from .80 to .96 with $p < .001$.
- Persistent emoticons in Russkman associated with IM participants made it easier to convey and detect affect. By keeping an emoticon visible next to each of the names for active participants, moods and emotions are handled by the user and general awareness increases on prevalent affective states. In all cases, users were able to tell exactly how other participants were feeling about what was being discussed.
- Partitioning the "affective space" determined by Russell's model did not make it harder for users to find an appropriate term for denoting a mood or emotion. This was a major concern about our interface design, as three steps are needed to reach a desired affective state in exchange for not having to deal with a very large model representation. We did observe users needed a short period to learn the mechanics of the interface, but in general, interaction proceeded smoothly. When expressly asked about this issue, only one user mentioned having problems with the interface for selecting emoticons, whereas four users (57%) indicated the interface allowed them to set a mood or emotion very easily.

- The organization and layout of emoticons in Russkman can be considered an improvement with regard to other well-known schemes. When asked to compare our approach to other IM systems, four users (57%) considered Russkman to be an improvement over IM systems they had previously used. None of the participant users compared Russkman unfavorably with regard to other IM systems.

5. CONCLUSIONS

We have designed and implemented Russkman, an Instant Messaging system that has been enhanced with functionality that allows users to convey moods and emotions while interacting with other users. We consider the main contribution of this work to be the adaptation and use of the circumplex model developed by Russell for studying affect, in which affective terms are placed on a circle at specific angles. The main change introduced to the model is a dimension representing affect intensity, which graphically can be mapped to the distance from a given affective term to a neutral center. Another contribution of the work is the use of Ekman's FACS system as the basis for the design of emoticons. Both of these aspects of the work are incorporated into the design of the Russkman IM system. Our initial experiences with a prototypical implementation of Russkman indicate that the proposed design improves existing functionality to convey affect in synchronous text communication.

Our approach has focused particularly to providing users with means to convey their mood and perceive their counterparts' moods during conversation. Although the set of emoticons we have designed can be used also to convey instantaneous affective states (emotions), the potentially greater cognitive effort required to select an affective state from the proposed bi-dimensional representation is more appropriate for the less frequent mood changes.

A number of issues remain open. We plan to study more formally the use and potential of our IM system. In particular, we would like to deploy Russkman in our lab and actual settings and observe users for extended periods of time. We also would like to investigate the impact of using color in text messages on the effectiveness of conveying affect and on determining a general mood for sessions. In this sense, our conjecture is that newcomers would be able to sense the prevailing atmosphere just by visually inspecting the color of the text that has been entered, which could be logged by the system. Finally, we are considering alternative interaction designs that would allow users to personalize the simplified model, in such a way that representative affective states for each quadrant could be defined according to individual preferences.

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