MOBILE EMOTION SHARING AND IMPLICATIONS FOR SOCIAL SUPPORT AND HEALTH

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ABSTRACT

Numerous studies have expounded on the benefits of social support for health, yet not all of us have access to extensive social support networks or supportive group therapy. Even fewer of us have constant access to such support. Mobile technology can help to bridge this gap by connecting individuals with one another regardless of time or place, but mobile phones are an imperfect medium for engaging in socially supportive activities, partly because of form factor issues (small screen, no keyboard) and partly because of the inability of computers to understand human emotion. Design and evaluation considerations for mobile emotion sharing systems are presented and the building and evaluation of such a system, Aurora, is described. Aurora and the study presented here represent first steps toward that end, examining (1) how well users are able to share emotions using abstract representations of emotion such as colors and photos, (2) whether users prefer sharing emotions using colors or photos, and (3) whether such a system is viable and enjoyable in mobile contexts. Aurora users were able to share emotions using either colors or photos—particularly when supplementing them with textual notes, they preferred photos to colors, and they enjoyed sharing emotions on their mobile phones, even with strangers. These findings have implications for how one thinks about designing emotion-sharing technologies in the future and for uses of such technologies in the context of social support and health.

BIOGRAPHICAL SKETCH

John (JP) Pollak, was born in Woodland, California, and moved to Ithaca, New York shortly thereafter, where he grew up and eventually graduated from Ithaca High School as part of the class of 1995. Following high school, JP spent two years at the University of Pennsylvania studying molecular biology and computer science, a year in England playing soccer, and finally two years at Cornell University studying genetics and Human-Computer Interaction.

In the years following graduation, JP worked as a software consultant in the life sciences, during which time he developed the software used by nearly every zoo in the world to manage genetic and demographic data, the gold standard software for population viability assessment in conservation, and countless other applications used around the world. This work culminated in a hiring as the Vice President of Product Development at Advanced Warning Systems, Inc., in Carlsbad, California, where JP was responsible for defining and managing the development of the company's entire health care software product line. JP returned to Ithaca and Cornell in 2007 to complete graduate work in Communication and Information Science.

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I am also in debt to members of the faculty who have served as mentors, teachers, sounding boards, and reality checks on numerous occasions. In particular, I would like to thank Jeff Hancock, Toni Oltenacu, and Dan Cosley. I would also like to thank Dr.'s Andy Dannenberg and John Leonard at Weill Cornell Medical School for recognizing the importance of research in communication and the social sciences in the design of novel interventions for patient care.

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LITERATURE REVIEW

Social Support And Technology

Numerous studies have expounded on the benefits of social support for health. In particular, individuals facing difficult life challenges associated with disease, disability, emotional distress, psychological distress, dependency, obesity, etc., generally exhibit a greater need for social support, as demonstrated by numerous studies spanning a variety of areas of study. Perhaps most notable of these studies is the finding that supportive group therapy has been shown to increase longevity (Spiegel, Bloom, Kraemer, & Gottheil, 1989), reduce pain, and dramatically improve the quality of life in terminal or potentially terminal patients (Goodwin, Lescz, Ennis, & Koopman, 2001; Spiegel, Butler, Giese-Davis, Koopman, Miller, Dimiceli, Classen, Fobair, Carlson, & Kraemer, 2007). Additionally, social support has also been linked to higher rates of tobacco cessation and abstinence (Murray, Johnston, Dolce, Lee, & O'Hara, 1995) and adherence to diets and weight loss (Wing & Jeffery, 1999). Further, social connectedness has been shown to be an important contributor to health (Sapp, Trentham-Dietz, Newcomb, Hampton, Moinpour, & Remington, 2003) while conversely, isolation has been shown to be extremely deleterious (Cacioppo, Hawkley, Bernston, Ernst, Gibbs, Stickgold, & Hobson, 2002; Cacioppo & Hawkley, 2003).

Evidence for the health benefits of social support is found not only in academic research, but also in the great many groups and organizations that exist solely for this purpose. Organizations such as

Weight Watchers and Alcoholics Anonymous have had successful followings for years, and there are support groups for nearly every affliction that one could imagine. Unfortunately, supportive group therapy or joining groups such as Weight Watchers can be expensive, and not all individuals have extensive networks of family and friends from which they can draw social support in times of need. Further, in times of need, even the most well connected individuals might not have access to their social support network due to factors like time of day, geographic location, or a lack of access to communication devices.

Computer-based social support, particularly over the Internet, poses an interesting alternative or supplement to more traditional forms of social support. Preece (1999a) has extensively explored social interactions in online communities and has in fact found that social support, much of in the form of empathy among members, is present in most communities. In work more specifically targeted toward social support, Preece (1999b) finds that individuals congregate in medically focused online communities to seek out both facts and empathy from individuals facing similar circumstances. While this work found that fact-finding was sub-optimal in most cases, empathy and social support were readily available to members and were in many cases the driving force in social interactions.

Further, online discussion forums have been shown to benefit cancer patients while offering broader accessibility and a higher degree of privacy (Fernsler & Manchester, 1997). Unlike scheduled weekly meetings or even friends who may not be available to take a call or meet up, these forums are ever-present, and because of time

differences and the infinite geography of the World Wide Web, are active at nearly any time of day (Wallace, 1999). Wallace (1999) and McKenna (McKenna, Postmes, & Reips, 2007) have shown that relationship and group formation is often significantly improved via Computer-Mediated Communication such as message boards as described above, and Joinson (2001) has shown that self-disclosure is easier and occurs more frequently than in face to face encounters. As such, not only will the patients have greater access to their peer support group, but in theory, they should be able to form strong bonds with one another and feel comfortable sharing a good deal of personal information and thought.

Unfortunately, even accessibility of computer-based social support is limited in its use—obviously one must be at a computer to access support in this way. Of course, in many of the instances in which people might need social support the most, such as in the waiting room at a doctor's office or lying awake in bed late at night, access to a computer isn't readily available. Considering this and the fact that one cannot always anticipate when and where they might be in need of social support, thinking of ways to use mobile devices that facilitate socially supportive activities and connection is an interesting design opportunity for improving people's lives.

Mobile phone-based social support has clear advantages over computer-based systems in that it would provide anytime, anywhere accessibility. Also, mobile phones are becoming increasingly ubiquitous; a Pew Research study found that in 2007, 73% of Americans use a mobile phone, and 62% of Americans use a mobile

phone for activities other than voice calls, such as text messaging, emailing, and using the Web (Pew, 2007). Further research has shown that for many, mobile phones are viewed as trusted companions; Fogg has even gone so far as to use the term "marriage" when describing an individual's relationship with their mobile phone (Fogg & Eckles, 2007).

Unfortunately, mobile phones suffer from obvious form factor limitations (small screen, inefficient keyboard, etc.) that reduce their utility in many of the social support activities in which one would participate online. For example, extensive use of online discussion forums is quite difficult on existing mobile phones, as the size of the screen makes it difficult to read and scan through the large volumes of text, and the limited keyboard is prohibitive in typing responses or asking questions.

Additionally, there is an issue of privacy introduced with the mobile phone that does not exist to the same extent with a desktop computer or even a laptop. When on a mobile phone, a user may move repeatedly in and out of public and private spaces. The way a user negotiates these boundaries and modifies (or fails to modify) their behavior in these different contexts would certainly have an impact on use.

A means of capitalizing on what is positive about mobile devices while circumventing some of the issues raised would be to focus on one element of social support and build a system around that. While this approach cannot deliver a complete technology-based social support system (if such a thing exists), it is more technologically

realistic in the context of mobile phones and evidence will be presented supporting the notion that such a system would still provide many of the benefits of social support. Social support can be broken roughly into the categories of seeking and providing various kinds of assistance, including emotional, informational, network, esteem, emotional, and tangible. At least in the context of online discussions, emotional support is seen most frequently of these, with informational support following closely (Braithwaite, Waldron, & Finn, 1999). Informational support could certainly be provided over a mobile phone, but the depth of information and ease of finding key information might prove inadequate when delivered on a mobile platform. Emotional support is a complex issue in and of itself, but it may be one that is more easily tackled in the mobile context.

Emotion Sharing

Donald Norman (2004) describes emotion as a key component of how people interact with one another and the world around them. While the role played by sharing emotion in our day-to-day existence is important, it becomes doubly so when we experience duress and are in need of social support. In particular, the sharing of emotion is particularly important in dealing with stress and anxiety (Panagopoulou, Maes, Rimé, & Montgomery, 2006; Pennbaker, Zech, & Rimé, 2001; Gump & Kulik, 1997)—afflictions that are all too common.

Designing technology to support rich emotional interaction is filled with challenges. The difficulty stems from the fact that in order to share emotions through technology, at some point the computer must attempt to convey complex emotions in some way ranging from finite and descriptive text to highly ambiguous abstract representations. Given that computers themselves are not inherently social or emotional entities, deciphering or representing complex human emotions is an impossibly difficult task for any computer. In fact, when computers actually try to do so, it can make for a less meaningful and "disenchanting" experience (Sengers, Boehner, Mateas, & Gay, 2008).

A means to circumvent this problem and potentially create a more meaningful experience for the user is to design a system in such a way that the computer plays a minimal role in interpreting and representing emotion (Sengers, et al, 2008). Such a system would provide a framework in which users are empowered to come up with their own representations of emotion, preferably in ways that provide a good deal of interpretive flexibility (Mateas, 2001). In addition, a system such as this might be better suited to allow for users to share and construct meaning for emotion representation. Constructing meaning is a process that occurs over time as part of an ongoing social interaction, not an instantaneous occurrence resulting from single isolated data points (Boehner, DePaula, Dourish, & Sengers, 2005).

Designing for Social Sharing of Emotion

Human-computer interaction and related research in the social sharing of emotion has an interest in designing systems that facilitate the process of emotion sharing. A segment of this work, much of it inspired by Rosalind Picard's groundbreaking *Affective Computing* (Picard, 1997), focuses on the role of the computer in deducing a user's affective state and recreating it in some electronic form that can then be decoded by other users. Work along these lines typically relies on the assumption that the current emotional state of a user is something that can be inferred from behavior or physiology, and that emotion can be recreated electronically in such a way that users can assess the information presented to them and accurately infer affect.

The assumption that emotion can be inferred from behavior is understandable. However, when dealing with computer-mediated communication involving two or more parties, it is easy to see the potential problems that can arise as the computer essentially becomes a sort of emotional translator between two parties, but neither party understands the language the computer is speaking. A recent notion in HCI research is to examine emotion as an ongoing social interaction rather than as a discrete state of an individual that can be somehow decoded and transmitted by a computer to others. The traditional, discrete transmission model approach such as that assumed by Picard (1997) fails to allow for the fact that an individual might only be able to properly formulate their emotions through interaction with another, and as such, only over time through ongoing interaction with others

can shared meaning for various representations of emotion be constructed (Boehner, et al, 2005).

To that end, Sengers argues for the design of systems that allow users to create their own representations of emotion and meaning without computer intervention. A means of doing so is introducing ambiguity into a system's representation of emotion. Giving the user more control of representation and interpretation in the hands of the user can pave the way for more meaningful interactions, as users are apt to interact with one another to construct meaning where there might otherwise have been none. (Sengers, et al, 2008; Leahu, Schwenk, & Sengers, 2008).

Gaver, Beaver, and Benford (2006) unpack the nature of ambiguity and its potential for generating new experiences or reflections. In examples provided from computational systems and famous works of art, ambiguity is defined as the interpretive relationship between the user and the artifact or system. Ambiguity signals and invites open interpretation, creating a system that is readily appropriable and encourages new reflection and new experiences (Sengers, Kaye, Boehner, Fairbank, Gay, Medynskiy, & Wyche, 2004). Mateas (2001) uses the term *interpretive flexibility* for systems open to interpretation or appropriation. In interpretively flexible systems, meaning is negotiated between the user, designer, and the computational intelligence of the system itself (Boehner, et al, 2005).

Finally, research in user experience and experiential design that suggests that we need to design with the expectation that we cannot

understand the full complexity of human life and experience (Wright & McCarthy, 2003). This work begs the question of what roles do users, designers, and systems play in creating the meaning and experience of a system? Further, how can a system be designed to allow for this range of experience, and possibly subtly co-shape it? To begin to unravel these broad research questions and find direction for design, existing systems and the interplay between interpretive flexibility and different practical methods for representing emotion were explored.

Prior Work: Emotion Sharing Technologies

Current research on emotion sharing fits broadly into two categories: technologies designed for other or more general purposes that users have adapted to share emotion and those that have been specifically designed for emotion sharing or interpretation. In the first category, technologies whose primary function is not emotion sharing, there are services such as blogs, discussion forums, social networking sites such as Facebook, so-called micro-blogging services such as Twitter, and even text messaging on mobile phones. While the technologies in this category are not central to the focus of this study, they remain of interest due in part to the fact that a great deal of social sharing of emotion does go on in these services.

Finding emotion in a variety of digital services is an area of interest for a number of researchers. For example, mining of blog entries on the service livejournal.com for the time period surrounding the catastrophe on September 11, 2001, revealed a significant increase

in negative emotions present in the writings of over one thousand bloggers (Cohn, Mehl, & Pennebaker, 2004). We Feel Fine searches new blog posts from a number of services for the phrases that begin with "I feel" and "I am feeling" to take the pulse of the mood of the bloggers of the world (Harris & Kamvar, 2008). In the mobile space, researchers found that Connecto, a mobile location-sharing application, was actually being used more as a storytelling and emotion sharing system than for the intended use (Barkhuus, Brown, Bell, Sherwood, Hall, & Chalmers, 2008).

The second category, services specifically designed for emotion sharing, represents a smaller sample. Examples in this space are: MoodJam, a widget that allows users to share emotion on the Web with multicolor representations (www.moodjam.org), LinkMood, a social networking site in which users share their current mood with an emoticon and choice of emotion word (www.linkmood.com), and Affector, an experimental webcam and wall-mounted digital display system that streams video with arbitrary and abstract distortion of some kind, leaving the affective interpretation entirely to the user (Sengers, et al, 2008). In the mobile space, there are fewer examples yet, but of particular interest are eMoto, an individual to individual text messaging system in which users shake and squeeze a stylus to generate colors and shapes that make up the background image for the messages they send (Sundström, Ståhl, & Höök, 2007), and PosiPost, a simple messaging system in which users complete the open-ended phrase "Today, I like" with any sentiment they like (Kanis & Brinkman, 2007).

These examples illustrate different means for users to represent emotion and varying levels of associated interpretive flexibility. At one end of the spectrum is LinkMood, in which the emphasis is placed on the social aspects of the site. In this system, users simply choose from a list of emotion words, and that word along with a corresponding emoticon is posted for their friends to see. The level of effort required by the user is minimal both in representing and interpreting emotion, and there is limited room for interpretive flexibility. At the other end of the spectrum is Affector, a system that gives users no ability to choose a representation for their emotions and provides no framework for disambiguating the representations that are created. While no effort is required on the part of the user to represent emotion, the extremely high level of interpretive flexibility in the representation results in much ambiguity.

METHODS

This study examines Aurora, a mobile phone-based emotion-sharing system designed to support interaction between people in groups, such as friends, families, support groups, and project teams. The overarching goal of this work is to explore issues surrounding the design of a mobile system that allows users to have a rich experience sharing emotions with their peers. The role Aurora plays in working toward that goal lies at the intersection of the practical and the theoretical: can a system be designed that provides users with enough interpretive flexibility to effectively share emotion but is still quick and easy enough to be enjoyable to use day-to-day on a mobile phone?

As a first step toward answering this question, this study specifically aims to examine (1) how well users are able to share emotions with one another using abstract representations of emotion such as colors and photos, (2) whether users have a preference for representing emotions as either colors or photos, and (3) whether a system such as this is viable and enjoyable in a mobile context. These events will be evaluated through an examination of a group of individuals using Aurora for one week. Two constructs for mood sharing were tested: representing moods with colors and representing moods with photos.

Design of The Aurora System

Two elements seem to be missing from the research space examining technology-based emotion sharing, particularly in the

mobile context. First, no systems providing a simple but abstract means for users to share their current mood with other members of a group and easily view the moods of the others were found. Second, there is no well-defined methodology for evaluating the usefulness of these systems. This gap has provided us with an opportunity to build a system that will enable us to explore the research questions described earlier.

A key consideration, consistent with the discussion above, was that the system must allow users to construct their own representations of emotion and decide how they should be shared, in no way dictating to the user to what to share and how to share it. In an ideal system, the user would have ability to select a representation for their mood without too much effort that would have enough ambiguity to allow for creative representations and interpretations, but not so much that the user would feel that what they're sharing has no meaning to others. It was also decided that the social aspects of the system would aim to imitate some of the elements that make service such as Facebook and Twitter popular, namely regularly updating status snippets and an always-current "news feed" listing updates.

The first crucial decision was what artifact to use for the representation of emotion. The research direction limited the possibilities somewhat; emoticons with obvious meanings or the emotion words themselves would be too concrete, not leaving enough room for interpretive flexibility. Yet, it would be difficult to venture too far into the realm of the abstract or ambiguous such that there would be limited to no research linking emotion to the representation of

choice. Mayer, DiPaolo, and Salovoy (1990) successfully demonstrated that individuals are generally quite good at perceiving the consensually agreed upon emotional meaning of various abstract visual stimuli. In an experiment, adults were shown color swatches, faces, and various designs and asked to describe the emotional content. The results found that individuals reached consensus for the general or simple emotional meaning (happy, sad, angry, etc.) of a number of the abstract representations. Interestingly, the strongest associations were found in relation to empathy, an important finding as this work relates to work with cancer patients as described here. Examples of an appropriate level of abstraction turned out to be colors, photographs, sounds, abstract designs and shapes, and textures.

The next limitation was that the system had to work in the mobile context; simplicity would be of the utmost importance. To this end, color was initially selected color as the representation for emotion. A vast body of research links colors with emotion, although the findings vary somewhat from study to study. D'Andrade and Egan (1974) as well as Naz and Helen (2004) have shown that colors have generally agreed upon emotional associations across individuals. They found it most likely that individuals will consent on the meaning of certain colors, such as the primary colors and intermediate hues. Naz and Helen in particular demonstrated that much of the emotional association has to do with underlying associations made with a color, such as red and blood or danger and blue and the ocean or sky, so the emotional associations are strongest when there are strong symbolic associations for a particular color. However, these works are careful to

point out issues surrounding culture, context, and personal history as determinants of how a user might interpret a given color (D'Andrade & Egan, 1974).

This notion that emotional associations with colors are imperfect and dependent on a great many factors makes color a good fit as a medium for emotion sharing, at least within the goals set forth for Aurora. The idea that certain colors will have different meanings for different people or groups could contribute to adding a desirable measure of interpretive flexibility to the system. For the colors, 10 were chosen with even spacing from around a standard color wheel, but during prototyping this number changed to 15 to provide more flexibility to the users.

After a number of users of the first prototype system requested a richer representation of emotion during prototyping, a parallel version of the system was built that would use photos instead of color. One possible source of photos was Lang's (1995) International Affective Picture System (IAPS), an archive of photos that represent a validated instrument for eliciting a variety of emotional response across a range of cultures. Lang has assembled collection of images is comprised of highly suggestive imagery that includes a range of subject matter from extreme violence to vicious animals to sleeping babies. In various experiments, subjects were exposed to the imagery and physiological measures that are often mapped to emotional response, such as Galvanic Skin Response and EKG response, were collected. The final collection of images that comprises the IAPS were those that elicited a consistent response across the study population.

The findings of Lang's work are relevant in two important ways. First, it is important to note that photographs can have a shared emotional meaning across large groups of individuals. Second, it is important that these photographs actually elicit a predictable emotional response from those viewing them. Unfortunately for the purposes of this design, in order for these photos to consistently elicit such responses, the subject matter they depict typically falls at extreme ends of the spectrum. As such, pilot testers indicated that most would not be photos they would choose for themselves.

Table 1. Emotion words from Russell (1980) and Lazarus (1994) coded by valence and arousal.

		Valence	
		Positive	Negative
Arousal	High	aroused astonished delighted excited happy hopeful love proud	afraid alarmed angry annoyed distressed frustrated jealous tense
	Low	at ease calm content glad pleased relaxed relieved satisfied serene sleepy	ashamed bored depressed droopy envious gloomy guilty miserable sad tired

A more appropriate source of photos is the online photo-sharing service Flickr, primarily because the community of Flickr users has tagged many of the photos on the site, often with words of affect. Russell's Circumplex Model of Affect (Russell, 1980; See Figure 1), provides a list of emotion words and a framework for the classification of emotions in two dimensions: valence (positivity or negativity of the emotion) and arousal (level of energy associated with the emotion). Russell's list of 28 emotion words was augmented with eight more vague emotion words (such as *relief*, *guilt*, and *love*) from Lazarus and Lazarus (1994) in the hopes of gathering images allowing for even greater interpretive flexibility. The final list of words, coded for valence and arousal, are depicted in Table 1. For each of the 36 emotion tags, as many as 1,000 images were downloaded from Flickr, resulting in approximately 28,000 photos for use in the system.

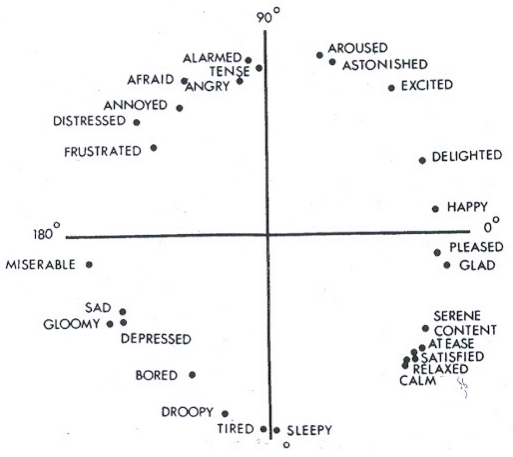
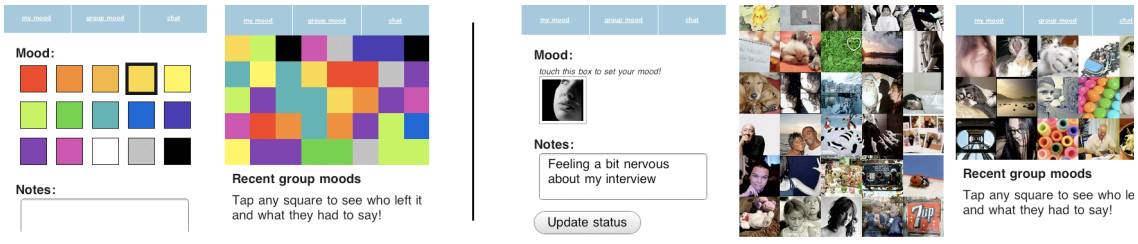


Figure 1. Russell's (1980) Circumplex Model of Affect, where the y-axis represents arousal level of the emotion (high arousal at the top, low arousal at the bottom) and the x-axis represents valence (negative valence to the left, positive to the right).

The Aurora System

The basic premise of Aurora is that of a system in which users log in and are greeted with a screen asking them to choose from either a palate of colors or a selection of photos that represent their current emotional state (Figures 2a,c,d). A text box allows users to enter a brief note about their selection if they choose. After making their selection, users are presented with a screen displaying the most recently posted emotions of other group members (Figure 2b,e). There is also a chat room allowing users to communicate asynchronously with others in the group directly from the application.

Following prototyping of these initial concepts, Aurora was iteratively refined over several development cycles and continually tested in groups of 3-5 users for 3-7 day periods. Each of four rounds of testing was driven by the following evaluation parameters: the ease of selecting an emotional representation for the user, the 'right' amount of interpretive flexibility, and ultimately, whether people would enjoy using it. Aurora is a web-based system that, for the time being, has been optimized for use on the Apple iPhone. In fact, Aurora is *two separate systems* used independently of one another, one using colors (Figure 2a, 2b) and one using photos (Figure 2c-e). Each consists of three screens: a screen for posting a mood update (Figure 2a, 2c), a screen for viewing the moods of the group (Figure 2b, 2e), and a chat room.



a b c d e

Figure 2. Aurora user interface. Color mode: (a) Mood update screen (b) Group mood screen; Photo mode: (c) Mood update screen (d) Photo selection screen (e) Group mood screen

Based on the goal of simplicity for mobile users, the update screen (Figure 2a, 2c) was refined to the point where users' login credentials are optionally stored on the phone, the update screen consists only of a palette of 15 colors or an empty picture frame, a text area for an optional note, and a submit button. To select a color the user simply taps it; to select a photo, the user taps the empty frame to reveal 72 photos, two randomly selected to represent each of the 36 emotion words (Figure 2d). The reason for using such a large number of photos compared to colors stems from richness and specificity of some of the photos and the ambiguity of color; while a given color may represent many moods, this would likely be less true for photos. Further, certain photos might not resonate with some users.

The group mood view (Figure 2b, 2e) lays out the most recently posted moods as either color swatches or photos, depending on which version of the system is being used. To increase user incentive to post, functionality was added to allow users to tap on a mood swatch left by others and see which user had left the swatch and when they had left it along with the text note they entered. In case the incentive of

viewing the moods of others wasn't enough, users are required to post an update before visiting the group screen. In addition, during testing, the participants frequently reported wanting to know more about other users' posts. To address this need, a chat room was added to allow users to communicate with other users about their posts.

Study Methods

In evaluating Aurora, the goal was to determine (1) how well users are able to share emotions with one another using abstract representations of emotion such as colors and photos, (2) whether users have a preference for representing emotions as either colors or photos, and (3) whether a system such as this is viable and enjoyable in a mobile context. To that end, moods left by a group of individuals were tracked over the course of an eight-day study, questionnaire data from each was gathered upon completion, follow up questions were posed to some users.

The study included 9 iPhone and 1 iPod Touch user(s) (5 female, 5 male; aged 18-35) using convenience sampling. The users were anonymous and mostly strangers. The users were provided with a private link to access the web-based Aurora application, and only brief instruction on how to use the system. Each was asked to try and use the system a minimum of two times each day for eight days spanning two weekends and a full week of work or school. For the first four days of the study, the participants used the color-sharing version of the application, and for the second four days the photo-sharing

version was used. This design introduces issues of order and was not ideal but was unavoidable due to sample size. While it would have been beneficial to counterbalance regardless, it seemed more valuable to have all subjects using the same system (colors or photos) simultaneously to ensure that there were enough posts made to the system on a daily basis to maintain interest among the subjects.

During the study, the application server logged the colors, photos, and accompanying notes left by each user, as well the time at which each was left.

RESULTS

Users' Experiences With Aurora

Over the course of 8 days, users left 108 notes—62 during the color-sharing portion of the study and 46 during photo sharing, for an average of 1.35 posts per user per day. There were only 3 messages posted in the group chat, all "hello world" in nature. Following the study, participants were asked to complete a questionnaire evaluating their experience with the system and their preference for sharing mood with color or photos (9 completed the survey).

Emotion Sharing

Success in emotion sharing is operationalized in these findings with two components: whether the group demonstrated some level of agreement of meaning for a given representation and how comfortable the users described feeling about the sharing process. Each post

made during the study was analyzed, comparing each color or photo with its corresponding note.

Each note was coded as either positively or negatively valenced and high or low arousal by mapping it to one of the emotion words described in Russell's work (Russell, 1980). In cases where the note explicitly contained one of these emotion words, notes were coded with the valence and arousal assigned to the word by Russell. For example, the note, "tired" directly matches Russell's emotion words, and as such was coded with a negative valence and low arousal. If the note did not contain any of Russell's emotion words, but was easily mapped to one based on culturally agreed upon meanings, it was. For example, the note "Chillin'" (An American colloquialism generally taken to mean that one is relaxing) was mapped to the Russell word *relaxed*, and as such coded positive valenced and low arousal. Any note that did not fall into either of these two categories or used two Russell words was excluded from the study. Notes from 85 of the 108 posts were used.

Overall Trends

Of the 85 coded notes, 54% were positive. Looking at arousal, 74% were low arousal comments. While leaving a note with a selection of a color or photo was not required, 91 of the 108 posts included a note. Of these 91 notes, 85 contained a singular reference to emotion. Of those that didn't contain a specific reference to emotion, some appeared to be affective, but could not be coded ("watching DNC speeches," or "level 87 chip's challenge"). Users clearly found value in leaving the textual messages to supplement their color or photo choice.

One user noted that they "really needed to have text to get the message fully across to the group.

Color Sharing

Color data was analyzed by looking for patterns in the coded notes for each color. Colors with a majority of users posting similar notes or notes coded with the same valence and arousal would be identified as colors in which the users seemed to attach some shared emotional meaning. Colors with a greater variety of notes associated with them would be deemed to have a weaker shared emotional meaning, and as such were probably more difficult to use as a representation.

A distinct pattern emerged for 4 of the 15 colors, more specifically two shades of purple and two shades of green. The darker shade of purple used in the system had 5 annotated posts. Of the remaining notes, 4 contained the word *tired* and one contained the word *sleepy*. *Tired* is a negatively valenced emotion, according to Russell, and *sleepy* is positively valenced, and both connote low levels of arousal. The lighter shade of purple had 7 annotated posts. Of these 7 posts, 6 were coded with a negative valence: 4 referenced some distress that was most likely work or school-related (e.g. "8 am meeting tomorrow :(", "tense and anticipative maybe." Taken together, the two shades of purple included 11 of 12 posts coded with a negative valence and 10 of 12 coded with a low arousal.

Of the two shades of green represented in the system the darker shade had only 3 posts, one of which was discarded (empty note) while

the lighter shade had 7 posts. These two colors were grouped together for analysis as they are fairly similar to one another and because the coded notes were quite consistent. Of the 9 grouped posts for the green shades, all were positively-valenced, and all but one were low arousal. The notes did not, however, show the consistency of topic to the extent seen with purples; two notes referenced the weather, two mentioned being rested, and two mentioned exercise.

Figure 3. Bands of color for notes coded with negative (above) and positive (below) valence.

For the remaining colors, the notes showed virtually no consistency within color or the color had too few posts to be considered. However, looking at the colors sorted by valence (Figure 2) does reveal a pattern to the naked eye. Of the remaining colors, two shades of orange were evenly divided between positively and negatively coded notes, with a range of comments such as "tired hungry sweaty" and "in a good mood – sunny weather and clear blue skies." A turquoise color was also prominent with 7 posts, but exhibited a similar range of notes, including comments such as "running around (virtually) playing whack-a-mole with email" and "tired, watching baseball." Gray had only 3 coded posts, but all were negative valence and low arousal ("I'm bored sitting at home", "meh", "tired").

When the users were asked if they felt they were able to share their emotions adequately with color, 4 responded positively and 5 negatively. Three of the participants commented that they felt leaving a note was useful in helping to convey their mood. Three of the participants noted that it was very difficult to represent more complex moods such as disinterest or confusion and wanted to be able to choose multiple colors at once, similar to MoodJam.

Photo Sharing

The analysis presented in this section is somewhat different from that above. With thousands of photos to choose from, the group establishing norms for a given photo or even certain subject matter is unlikely. So instead, given that these photos have already been tagged by other individual emotion words, how well users' intended sentiment (inferred from their coded note, as above) matched with the photos' tags was used as a measure of success. Rather than try to determine if users selected an image whose tag precisely matched their current mood—the user would have to use the specific emotion word in their note, the focus was on whether or not the user chose photos that matched their note in valence and arousal. While this is far from perfect, in most cases the words of same valence and arousal are similar, such as *depressed*, *droopy*, *gloomy*, and *miserable*. This could be viewed as similar to Lang's (1995) work on the IAPS described earlier, but it should be noted that there is a difference between the reactive, physiological responses analyzed by Lang and the conscious selection of a photo to represent a current emotion used in Aurora.

First, each photo and its corresponding note were examined, comparing the valence and arousal of the coded note with the valence and arousal of the photos tag. Of the 46 posts, 34 were coded. Table 2 shows the proportion of posts where the codes for photo tag and note matched for valence, arousal, and both. Note that users selected a photo that matched the arousal level of their note approximately 74% of the time, and 41% of the time (significant, chance is 25%) they selected a photo that matched both the valence and arousal level of their note. These results represent data from a limited sample but they certainly imply that users were selecting images that match the interpretation others had applied to them as well.

Table 2. Comparison of valence and arousal for each photo's tag and corresponding note. * denotes results of a Chi-square test <= 0.05. Users performed better than chance in all but matching valence.

Test	Frequency	Chi-Square
Valence Match	55.9%	0.493
Arousal Match	73.5%	0.006*
Both Match	41.2%	0.029*
One or Both Match	88.2%	0.075

The proportion of photos that fall into each quadrant was also compared to the same proportions for notes (See Table 3). The proportions of both valence and arousal for the coded photos mirror the valence and arousal for the coded notes nearly perfectly. The sample is too small to demonstrate that the variance in the two systems is the same, but the finding suggests that on average the

mood of the photos reflected the mood of the group.

Table 3. Mean valence and arousal for photo tags and coded notes.

		Photos	Notes
Valence	Positive	58.7%	58.8%
	Negative	41.3%	41.2%
Arousal	High	39.1%	38.2%
	Low	60.9%	61.8%

When asked if they thought they were able to represent their mood with the photos, 6 of the 9 responses were positive. 4 users mentioned the emotional specificity of some of the photos, 3 of which said they were frequently able to find a photo that precisely matched their mood. One participant commented that the narrowness of the moods in some photos made it difficult to choose one at times. Possibly related is the fact that a large portion of the photos in the sample contained images of people. Two of the participants commented that they frequently selected photos of people as they often had a facial expression that matched their current mood. Conversely, one participant responded that they rarely if ever selected a photo of a person and preferred the ambiguity of photos with other types of subject matter.

User's Preference for Color or Photo Sharing

The questionnaire results show that the participants in this study had a clear preference for the photo-sharing version of the

system. In fact, 7 of the 9 respondents preferred *sharing* their mood with photos, and 7 of 9 stated a preferred *viewing* the moods left by others as photos. While the order issues with the study described earlier may have influenced these results, the comments made by subjects in the questionnaire do provide further insight. One user stated that they felt "the photos were a lot more expressive than the colors," and another found that,

> "each time I was able to find a photo that had a human or animal with a facial expression that seemed to me to convey the same emotion I was experiencing." – Male, 18-25

Worth noting, however, is that 2 of the respondents and nearly all of the early usability testers noted that it was significantly easier to get a quick impression of the group's mood when using the color version. While not an explicit focus of this study, this discrepancy has implications for future decisions about how to represent emotion. This will be explored later in discussing implications for other applications.

User's Overall Enjoyment and Experience

Overall, the participants enjoyed using Aurora—8 of the 9 respondents said that they enjoyed using the system, and 4 of the users expressed interest in using the system again. Some users reported finding a great deal of enjoyment in viewing the other users' posts and would log in with interest in what others had posted. 3 users stated that they most enjoyed viewing the responses of others. In addition 3 users stated they would enjoy using the system more if

they could use it within their existing social network. According to one user,

> "It was fun to view the moods of other members of the group. I think it would be even better if the group was not anonymous." – Female, 26-35

Users also found value in the reflective value of the system:

> "I enjoyed using it because it asked me to create soundbites for how I was feeling at the time." – Male, 18-25

> "I enjoyed the challenge of having to take a step back and figure out what my current mood was and then having to break it down even further into just a color or a photo. It was a fun exercise." – Female, 18-25

DISCUSSION

The results show that the Aurora system has taken important first steps toward reaching its goals. Users were able to share emotions using abstract representations of colors and photos, and some degree of consensus on interpretation of both colors and photos was evident. While there is clearly merit for both modes, the users in the study clearly favored using photos to represent emotion over colors, at least in the context of this system. Finally, it seems clear that most participants very much enjoyed using the Aurora system and many said they would use it again in its current form.

Users Were Able to Share Emotions

For the purpose of this study, success has been defined as a combination of whether or not some level of consensus within the group was reached on the emotional meaning of various color or photo representations and how users felt about the sharing mechanism. In both regards, the findings were positive.

During the color-sharing portion of the study, group consensus emerged for four of the colors—two shades of purple and two of green. Two possible explanations exist. First, the colors purple and green could have an inherent emotional meaning for a number of the participants in the study. This is certainly plausible, and these findings would be expected based on previous work in color-emotion relationships. Much of this work shows green to be the most positive

color space and typically reflective of relaxation and lower arousal emotions, while purple is typically less positive and lower arousal (Naz & Helen, 2004; D'Andrade & Egan, 1974).

A second possible explanation could be that given the small size of the group participating in the study, each of these colors developed a socially accepted meaning in the group regardless of any standard interpretations that may exist. The reality is likely some combination of these two possibilities. For the purpose of this research, any of these causes for the consensus of meaning for these colors is a strong indicator that users were successful in sharing emotions, at least by the standards set forth.

The fact that users didn't appear to form consistent meanings for more colors could be a factor of the sample size and duration of the study, or it could be a result of the fact that the emotions people would choose to represent with these colors are more diverse. A follow up study will be conducted with more users over longer periods of time to examine what patterns emerge.

For the photo-sharing portion of the analysis, consensus is defined as when the notes the users post loosely agree with the emotion with which the corresponding photo is tagged. Again, the results indicate that more often than not, the users were selecting images that corresponded with the tone of the note they were posting. It's interesting to note the difference in dealing with consensus and the social construction of emotional meaning for photos when compared to the discussion about color. In this case, the users in the study are not necessarily constructing meaning for a given photo within their group,

although it could be argued that the community of Flickr users tagging the photos already has. Of course, over time certain norms could form regarding the emotional representation of photos.

When asked, users were divided as to whether they felt they were able to adequately represent their emotions during the study when using color, but most said they were able to represent their emotions with photos. However, in both modes, participants noted that the addition of a textual note improved their ability to share emotion, which raises an interesting point. As mentioned earlier, while leaving a note with a color or photo was optional, posting without a comment was a rarity during the study. One possible explanation for this is that the users of the study (all Facebook users, when asked) were so used to leaving status messages that it was second nature to do so. Another possibility is that early on in the study the majority of posts had an accompanying note, and the leaving of notes developed into the norm for the group. A slightly more interesting possibility is that the users felt that they had to leave a note to disambiguate the emotion they were attempting to represent with their color of photo choice.

Users Preferred Sharing Emotion With Photos

All users of Aurora but one favored sharing their emotions with photos rather than with colors. Based on comments in the questionnaires, it appears that this is in part because users felt they were better able to select a photo that represented their mood, due to

the richness and diversity of content present in the photos. Certainly when compared to a simple color swatch, most photographs are vastly richer in terms of content and meaning, as well as the possibility of invoking emotion of their own, as per the discussion of the IAPS. In addition to this, or maybe in part because of it, the photo sharing system simply had an additional fun factor that the color sharing did not. Besides simply viewing photos left by the group, some users even reported repeatedly refreshing the photo selection screen when updating their mood just to see what batch of photos would be loaded next.

Another possible explanation for this finding is simply that the system design favored the use of photos in some way. Perhaps if users were more color choices or the option of displaying more colors at once, the color-based system would have been better received? Still, the "fun factor" and richness of the photo sharing might still win out. One user commented,

> "I really enjoyed it–particularly when we got to the photos part. I think it has a lot to do with my being really interested in photography and it allowed me to see photos I haven't yet come across on Flickr."– Female, 18-25

One aspect of color sharing that users did prefer was viewing the group's moods. While it is very easy to look at the color-sharing version and quickly determine things like the most dominant colors and variability of colors, and hence the general mood of the group, interpreting photos is a more complex process and therefore requires more time. This is an important consideration—particularly for mobile,

when taking into account research into cognitive load demonstrating that a user's cognitive resources are limited (Wickens, 1991). Matthews draws on this and proposes a design framework for creating *glanceable* displays that are better suited for the amount of cognitive resources a user might be able to allocate at a given moment (Matthews, Rattenbury, & Carter, 2007). In Aurora, the group view comprised of color swatches almost certainly requires fewer cognitive resources to interpret than does the view with photos, and as such is likely more appropriate for certain mobile applications, as will be discussed shortly.

Users Generally Enjoyed Aurora

Users enjoyed using Aurora, in both color and picture format. Most said that they liked it as is, and nearly all of them at least enjoyed certain aspects of it. The most frequently cited source of enjoyment was visiting the aggregate page and going through each of the posts to see who left what and what they had to say about it. This should come as no surprise as this behaviors models well to the common practice of checking friends' Facebook status, reading messages on Twitter, or from the past, reading AIM away messages. One user who enjoyed using Aurora commented that, "it was fun to view the moods of other members of the group, even though they were anonymous."

Along the lines of that sentiment, a number of users expressed an interest in using Aurora within their existing social network. The

fact that users were so compelled to return to Aurora to view the moods of complete strangers is a testament to either the voyeuristic nature of humanity or, maybe more likely, the stickiness of the social aspects of the application. If this is the case, it would follow that using such a system within an existing social network would lead to an even better experience.

Along these lines, the virtual anonymity of the group likely explains the lack of use of the chat feature of Aurora. During initial user testing, there were actually more comments left in the chat room then there were mood postings. This is likely explained by the fact that in each case, the user testing groups were either already friends or coworkers. The chat feature was used largely to ask others about posts they had made, usually in an effort to disambiguate a color, photo, or note, but on occasion to ask about an experience referenced in a note.

Finding the "Right" Level of Interpretive Flexibility

A higher-level goal of this research, as described earlier, is to explore the balance between keeping the system quick and easy to use in the mobile context and providing the user with enough interpretive flexibility and room for ambiguity to allow for the richest possible experience.

The color-sharing platform offered a higher level of ambiguity and interpretive flexibility that required very little effort on the part of the user. As it turns out, many users indicated difficulty in selecting a

color that adequately matched their mood meaning it required more effort than was anticipated. Also, on the part of those trying to interpret others' emotions, the system was slightly too ambiguous. The addition of the textual note, however, offered further context and seems to have made the experience whole for many users.

The photos, on the other hand, provide an interesting dynamic in terms of interpretive flexibility; many of the photos are either somewhat abstract or at least not clear in their representation of an emotion, while others have very specific subject matter that leaves little room for interpretation. This fact alone could be responsible for the finding that most users found it easy to represent their emotions with the photos. There are undoubtedly differences among individuals with regards to preference for abstraction and tolerance for ambiguity (in fact the findings support this), and the spectrum of ambiguity to clarity represented in these photos likely provided an adequate choice for users at different ends of this spectrum.

With both colors and photos, context, culture, and personal history are clearly important influences on what representations and meanings are formed at both an individual and social level. For example, not only does the color red have different meanings across cultures, it can take on a variety of different meanings for a given individual based on a host of contextual cues. As this study found, a color could even be used to represent something seemingly mundane like the color of a political party. Photos can be equally context-dependent; a photo of an elderly woman could mean many different things to many people, or even to the same person in different states of

mind. The Aurora system clearly allowed for these contextual differences in the posting of photos and colors. Further, as described above, the additional channel of text on one hand reduces some of this context-based ambiguity, but on the other embraces it, allowing users to make more abstract representations with the knowledge that they can provide textual context for those who might want it.

Roles of the User, the Designer, and the System

In accordance with the discussion of work by Gaver (2003), Mateas (2001), and Boehner (2005), as well as the questions raised in response to Wright and McCarthy (2003), what has been learned about the roles of the user, the designer, and the system in negotiating meaning and sharing emotion in a mobile context? The role that the users played in shaping the system has largely been established in this study. The users shared emotion in terms of abstract representations such as colors and photographs, and a pattern of usage involving leaving and reading of textual comments with those representations emerged as a norm. The colors and photographs that users chose to represent certain emotions, how they chose to supplement them with text, and how they chose to negotiate their experience viewing others' posts are what truly defined the system as described here.

It would, however, be naive to posit that the decisions made by designers, played no role in the development of the experience of the users. Obviously, the design decision to use colors and photos as the

representation of emotion and the decision to provide an additional textual channel fundamentally impacted the experience that the users ultimately created for themselves. Had a different representation, such as sound been used, or had the text channel not be implemented, the norm for interaction in the system would certainly have been different. From this and experiences in early user testing, it can be inferred that in at least in the mobile context, presenting the user with a variety of easy to use channels, rather than a single channel, makes for a more open-ended experience that the users can shape into their own.

Finally, the system itself played a role in determining how users interacted with the representations of shared emotions. First, the fact that the system was deployed on mobile devices impacted how the users physically interacted with these representations. Small screens influence the display of representations, limiting the size of each representation and the number of posts that can be displayed on the screen at a given time. Small or nonexistent keyboards influence what text users left and expected to see left by others. In spite of this, users' experiences with the system largely centered around viewing these representations and the text that accompanied them—clearly if you design a system with functionality users want, however limited, they will incorporate it as an important part of their experience.

Further Implications and Future Work

The work and findings presented here provide an interesting starting point for research in other areas as well as a platform for further development of the Aurora system concept. Certain aspects of the system as well as aspects of its use should be re-examined in future work. For instance, it would be prudent to experiment with other representations for emotions that might work within the mobile context. Abstract shapes and designs, as suggested by eMoto could be a reasonable next step and would work well with the design constraints of the mobile device design platform. Sound, on the other hand, would be more difficult to implement, particularly on a mobile device, but could provide unusual or insightful results as demonstrated by ArtLinks (Cosley, Lewenstein, Herman, Holloway, Baxter, Nomura, Boehner, & Gay, 2008) in a museum setting.

One point missing from the discussion of Aurora to this point is an examination of users' interaction with one another beyond just emotion sharing, from a broader Computer-Mediated Communication (CMC) perspective. There were almost certainly behaviors taking place during the study that could have been better explained by or may have had implications for impression formation, impression management, and community and relationship formation. This perspective has been ignored thus far, but it is likely that these behaviors, perhaps impression management most of all, are shaping the way in which users are interacting with the system and one another and needs to be examined.

The first important consideration of impression management is the concept of selective self-presentation. Goffman (1959) proposed that each of us assesses situations and environments that we are placed in and selects accordingly a pattern of behavior, demeanor, and expression based on how we want to be seen by others in the situation. Wallace (1999) evaluates this behavior in online spaces, and relevant to Aurora, describes ways in which users alter their self-descriptions, attitude expressions, and non-verbal behaviors to manage their self-presentation. Given the low cost of altering these aspects of ones' self in CMC, as well as the privacy afforded by CMC, selective self-presentation is deemed to be easier and more frequent online then in other contexts. For Aurora, this implies that users will not necessarily post photos, colors, and leaving notes that represent their true emotions, but rather they may be posting what they feel is most appropriate given the situation or what casts them in the most desirable light.

Also of interest related to impression management is the way in which individuals choose the medium through which to communicate with others. Certainly Media Richness Theory (Daft & Lengel, 1984) presents a framework with which to think about this. Media Richness Theory is of minimal assistance in this case, however, as it would mostly suggest that individuals would choose not to share emotions in a lean medium such as that created by Aurora, yet the findings in this study suggest otherwise. O'Sullivan (2000), however, presents the finding that the valence of what is being shared as well as the locus (whether the item to be shared has to do with the self or another) has

as much to do with the selection of a channel as anything else. These findings show that individuals are more likely to share negatively valenced sentiments, particularly when they pertain to the self, through leaner media. This has obvious implications for Aurora users, especially ones who communicate with other members of their group through other channels. O'Sullivan might suggest that users would primarily share negative emotions through Aurora, and share more positive sentiments with one another over the phone or face to face.

Related to impression management is how users will form impressions about others in their groups based on their interaction with Aurora. Walther (1996) describes a hyperpersonal model of online impression formation, which stems from the fact the selective self-presentation described above is likely the sole source of information available about another individual. Under the hyperpersonal model, form impressions based on this limited set of cues, and in turn reinforce the self presentation that the other individual has put forth, resulting in an intensification loop that results in strong feelings and opinions about an individual relating only to those characteristics that are known.

These hyperpersonal impressions might then combine with the phenomenon of fundamental attribution error (Ross, Greene, & House, 1977), in which individuals incorrectly determine that fleeting actions or characteristics of another individual are representative of that individual on the whole. For example, if a user of Aurora posts a couple of sad messages, rather than determining that the individual is simply sad at that moment, others might deem them a depressing and

sad person. This has obvious implications for future user groups as individuals where users might not already know one another particularly well, as these intense and potentially inaccurate impressions of other group members will be likely to form.

In addition to re-examining these aspects of Aurora, an important future consideration is the implications of this work in other contexts. In addition to social support and health, an area that could benefit from the findings of this work is that of team and project coordination. A common need of both team members and managers is a clear picture of the current status of each of the individuals on the team. Typical project management software allows users to update their project status, but typically conveys little information about the person's emotional status, which in reality could have as many performance and job completion implications as the actual status of the project. A system such as Aurora that encourages team members to keep their statuses up to date and regularly check in on one another has the potential to improve group cohesion and aggregate performance. In fact, during the early user testing of Aurora, one of the test cohorts was a team of students and the faculty member overseeing them. At one point, the students' project had run into a stumbling block, and noticing a slew of black and red color swatches appearing in the group view, the faculty member quickly set up a group meeting to assess the problem.

Aurora, Social Support, and Health

This work has shown that a system such as Aurora can be an enjoyable and useful venue for sharing emotions, even among total strangers with no stresses beyond those found in typical, day-to-day life. Now, the question is asked of how would such a system fit in the context of social support in cases where the group of users is under greater strain? Further, what benefit would exist, if any, to the users of the system? These questions are central to future explorations of applications of this line of research. For now, however, the existing social support literature will be used to begin to formulate possible answers to these questions.

Evidence that individuals facing difficult situations are more likely share emotions suggests that distressed users of Aurora would be inclined to share emotions more frequently than was seen in the study described above. Luminet, Bouts, Delie, Manstead, and Rimé (2000) report evidence that individuals who experience strong, negatively valenced emotions are more likely to share their emotions with others. Furthermore, Herbette and Rimé (2004) provide evidence that individuals suffering from chronic pain or illness are more likely to share and discuss their emotions with one another.

In this study, there was a slight counter example to this; one participant in noted that her cat passed away during the photo-sharing portion of the study. After posting a few sad photos, she quit

using the system to avoid "depressing everyone else in the group," although she commented that had she been in a group of friends, or had someone reached out to her, she would have been happy to share the experience. However, in examining the user's response, it is reasonable to posit that if she had known other users in the group had experienced a similar situation, she might have behaved differently. Indeed, there is evidence to support this notion in previous work.

Gump and Kulik (1997) found that individuals facing stressful situations are more likely to affiliate with one another. In particular, their findings demonstrated that individuals that believed they were facing a similar stressful situation (i.e. the same source of stress) were more likely to affiliate with one another than those facing different sources of stress. Given that is that users of Aurora for socially supportive purposes will probably be doing so as part of a support group, in peer groups during disease treatment, or in other similar situations, it is likely that Gump and Kulik's findings will be quite relevant. As such, even groups of users who start out as relative strangers may soon begin to form closer relationships.

While it seems likely that people using Aurora for social support in distressing situations would be likely to share emotions frequently and affiliate with the other users in their group, the question remains as to whether they actually derive benefit from doing so. A wealth of literature exists supporting the premise that the sharing of emotion has predictable benefits for psychological and physiological health. Panagopoulou and colleagues (2006) found that individuals who actively shared their emotions with others prior to cardiac surgery

experienced reduced levels of preoperative stress. Of interest in these findings was the discovery that the perceived quality of the sharing seemingly had more of an effect on the outcome than did the quantity of the sharing—an important note for design consideration to be sure.

In a summary of various studies into emotion sharing, Smyth (1998) found that individuals expressing emotion through writing experienced benefits in the areas of physical health, psychological well being, physiological functioning, and general functioning. Pennebaker in particular has extensively researched the link between expressively writing about one's emotions and improvements in both mental and physical health. In various studies, Pennebaker has shown that the process of writing about the emotions one is experiencing actually makes for a reduction in the amount of negative emotions an individual feels they are experiencing, and more broadly has positive outcomes for physical and psychological well being (Pennebaker, 1997; Pennebaker, Zech, & Rimé, 2001).

Support for the potential benefits of Aurora in the context of social support and health can be found in the above-mentioned work of Gump and Kulik (1997), who found that groups of individuals suffering from similar stresses engaged in behavioral mimicry and showed signs emotional contagion. Of particular interest, is that the authors examined mimicry and contagion in terms of anxiety level, and in the experiments, subjects paired with less anxious confederates experienced lower overall levels of anxiety. It would be interesting to examine whether similar results could be reproduced through the use of an emotion sharing system such as Aurora.

While the emotion sharing that Aurora encourages may not be as rich or meaningful as the expressive writing that Pennebaker (1997) has examined or participation in a social support group, this work does represent a lower effort, more pervasive alternative. Further, Aurora is not proposed as a replacement but rather as a supplement that could be integrated with these existing activities. As a supplement to these activities, Aurora offers a few added benefits, such as those described above relating to mobile technologies, the ability to view the emotions shared by peers, and that it might encourage individuals to share who might not have done so otherwise.

CONCLUSION

This study has presented Aurora, a platform that enables users to share emotions with one another via mobile computing devices. Aurora has been presented not merely as a new technology, but as a vehicle for attempting to make inroads into answering difficult questions regarding using computers as a medium for sharing complex emotion. How must a system be designed to allow for the rich sharing of complex emotion? How does one design a system to allow for the users to dictate the experience rather than vice versa? Finally, what roles do users, designers, and systems play in shaping this experience?

The question has been asked of whether a system can be designed that provides users with enough interpretive flexibility to effectively share emotion but is quick and easy enough to use that it is enjoyable for day-to-day use on a mobile phone. In answer to that question, three pieces of evidence indicate that this line of work is on the right track. First, users of Aurora were able to share complex emotions with one another using their mobile phones. Second, the choice of how emotion is represented matters—in the study users preferred photos to colors. Finally, a mobile system for sharing emotions can in fact be quite enjoyable, even among total strangers.

In the future the goal is to draw nearer to answers to these broader research questions and while examining them further in other contexts. Of particular interest are contexts in which health and other tangible benefits might result from the sharing of emotion, such as

social support. Previous work linking social support and health provides a picture of how emotion-sharing technologies such as Aurora might be employed as a means of encouraging and supporting healthy social behavior. Whether or these benefits can in fact be derived through the use of Aurora or a similar system remains to be seen, but the path toward that understanding is now clear.

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