Empatheticons: Designing Emotion Awareness Tools for Group Recommenders

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ABSTRACT

Group recommender systems help users to find items of interest collaboratively. Support for such collaboration has been mainly provided by tools that visualize membership awareness, preference awareness and decision awareness. However, these mechanisms do not address group dynamic issues: how member may affect each other. In this paper, we investigate the roles of emotion awareness tools and how they may enable positive group dynamics. We first describe the design process behind a set of dynamic emoticons, which we call **empatheticons**. We then show that they allow users to represent, annotate, and visualize group members' emotions in GroupFun, a group music recommender. An in-depth user study (N = 18) with GroupFun demonstrates that users' emotion annotation for recommended songs can be influenced by other group members. Most importantly, empatheticons enhance users' perceptions of the **connectedness** (immediacy) and **familiarity** (intimacy) with each other and the positive group dynamics.

Categories and Subject Descriptors

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

General Terms

Interface design

Keywords

Emotion awareness; group recommender systems, group dynamics

1. INTRODUCTION

Group recommender systems aim to produce a set of items that satisfy the interest and preferences of their members. Examples include recommending music playlists for a party, tourist sites for a family, and movies to a group of friends. Earlier research has considered group recommenders as typical groupware that helps users to find optimal items collaboratively. Most methods to support collaboration have been translated into interfaces that visualize several crucial awareness factors [11] including membership, preference, and decision awareness. Besides supporting collaboration, members' social relationship and

interaction dynamics [8] were also identified as an important dimension for designing awareness tools [25]. For example, recent study results show that the more a user is familiar with other group members and the more s/he trusts them, the more s/he will like the items they proposed [20]. Other group members' judgments and emotions can also influence an individual's satisfaction in a group recommender [15] and thus presenting other members' emotional states towards recommended items would make it easier for users to accept items they do not like. However, researchers have not paid attention to the active design of affective interfaces that may influence group dynamics and improve group satisfaction.

In this paper, we describe the design process behind a set of dynamic emoticons. We are interested in understanding how they affect group dynamics and group satisfaction. The following is a motivational example:

Alicia, Victoria and several of their friends are using GroupFun, a music group recommender, to organize a party tonight. They will rate the songs that the group members have contributed. GroupFun will determine the final playlist. The more actively a member rates the songs, the more her preferences will be taken into account in the final playlist. In the traditional version, members can rate songs using a scale from 1-5 (least to most preferred). In the new version, they can not only provide their ratings but also describe how the music makes them feel using an emotion annotation tool. When Alicia is rating and annotating a song, she can "see" how Victoria and others feel as well as read their ratings.

In the above scenario, we refer to the functionality (which allows group members to annotate and visualize emotions) as **emotion awareness**. We designed and implemented a set of nine empatheticons (for empathy) for GroupFun based on the kinetic behaviors. **Empatheticons** represent emotions visually by applying a set of motion schemes to each individual user's profile picture. When multiple participants have annotated the songs with their emotions, GroupFun shows these dynamic emoticons in a continuous and animated way while the music is playing.

Results from two rounds of studies show that users can distinguish and recognize accurately the emotions presented by our empatheticons. In an in-depth laboratory study, participants indicated that empatheticons can enhance user-perceived togetherness and familiarity with other members' preferences, thus increasing their satisfaction with GroupFun. Additionally, users' emotional responses are not only influenced by the other group members, but also serve as a predictor of users' satisfaction for a group recommender. Our work extends the state of the art by designing an emotion awareness tool and investigating its impact on group dynamics and group satisfaction.

2. RELATED WORK

2.1 User Issues in Group Recommender Systems

Jameson [11] studied some of the key user issues for group recommender systems and investigated several measures for promoting collaboration and coordination by designing user interfaces to enhance mutual awareness. In group recommender systems, mutual awareness is translated into a number of interface and interaction features to visualize member's presence, and to highlight other members' preferences and the decisions of the group as a whole [17]. We refer to these features as membership awareness, preference awareness, and decision awareness.

Membership awareness allows users to check which users are in the group, helps users to decide how to behave, and thus enhances trust within a group recommender. Membership awareness can be implemented in an online group by allowing the display of all members in a list [19, 28] or by notifying users when a new member joins [16]. Other group recommenders require users to cooperate in a face-to-face manner [17].

Preference awareness enables users to be aware of the preferences of other members. An important technique is collaborative preference specification (CPS), as presented in [11, 16, 17]. CPS has three functions [11]: 1) it enable users to persuade other members to specify similar preferences by giving them information that they previously lacked; 2) it supports explanations and justifications of a member's preference; and 3) it encourages assimilation to facilitate conflict minimization.

Decision awareness is a status in which users are aware of other members' decision-making processes. Decision awareness can be achieved through face-to-face discussions [17] or mediated agents [11, 13]..Travel Decision Forum aimed to bring the merits of face-to-face interaction to asynchronous communication by introducing animated characters, which visually represent group member's attitudes through gestures and facial expressions. However, these animated characters mainly aim at verbal arguments and negotiation between group members. Even though Masthoff and Gatt [15] addressed the theory behind the importance of social influence and emotional contagion in decision-making in group recommender systems, they did not provide a practical solution to emotion awareness features.

2.2 Emotion Awareness Tools in Computer Mediated Communication

Emotion awareness is not a new concept in groupware systems. A typical application area is computer mediated communication (CMC). Emoticons are an important kind of language of emotions utilized in CMC. They are approximate facial expressions simulated by a combination of certain keystrokes, and they are widely used in online communications, e.g. instant messaging and emails [26]. Studies [22] show that users who used emoticons in online communication were more satisfied than those who had no access to emoticons. Concretely, emoticons help users to perceive the correct emotion, attitude and attention intents of received messages [14].

There has been some work on animation to visualize emotions. Wang et al. [27] prototyped a chatting system that animated text associated with emotional information to show users' affective states. Their study results show that emotional sharing improves the accuracy of the perception of each other's meanings and enhances the user's chatting experience. Another dimension for communicating emotion is haptic feedback. A typical example is

Category	Explanations
Wonder	Happy, amazed, dazzled, allured, moved
Transcendence	Inspired, feeling of spirituality
Tenderness	In love, affectionate, sensual, tender
Nostalgia	Sentimental, dreamy, melancholic
Peacefulness	Calm, relaxed, serene, soothed, meditative
Energy	Energetic, triumphant, fiery, strong, heroic
Joyful activation	Stimulated, joyful, animated, dancing
Tension	Agitated, nervous, tense, impatient
Sadness	Sad, sorrowful

Table 1. Emotion Categories in Geneva Emotion Music Scale.

iFeel_IM! [18], which interprets user emotions through chatting messages and transmits them through an online avatar coupled to a haptic simulation apparatus. Cui et al. [2] used video recordings to deliver emotional responses and found emotional responses can enhance social interaction in close-knit groups.

However, in a group music recommender system, users listen to music continuously over 3--4 minutes, while in CMC users exchange information in a much shorter time frame. The different requirements for users' attention and experience flow drive us to explore other possibilities for communicating emotions in group music recommenders.

2.3 Emotion Categories

There have been various ways to represent emotions. The best-known model is Ekman's [5], represented by 6 basic human emotions (anger, disgust, fear, happiness, sadness, and surprise) and their relations to facial expressions. The Geneva Emotion Wheel [23] evaluates emotional responses related to objects, events and situations; it is a more refined model of emotion, incorporating 20 emotion categories. Besides these two general models, researchers have provided domain-specific emotion models, such as emotions related to products [4], visual interfaces [9], music [29], films [6] and pictures [1]. The above research shows that domain specific emotions can provide more accurate descriptions of users' emotions in the corresponding contexts. Most of these emotion categories are visually represented by facial expressions and body language [3, 9] using anonymous and non-personalized figures.

In this paper, we focus on emotions related to music. We selected the nine emotion categories from the Geneva Emotional Music Scale (GEMS-9) [29], which is considered as the first tool devised to measure music-evoked emotions. Table 1 explains these nine categories.

2.4 Kineticons

We were motivated to use the concept of kineticon [7] -- an iconographic motion technique -- for visual representation for two reasons. First, research has shown that motion is one of the most prominent types of affective response to music [10], as opposed to text or colors. Second, watching a user (i.e., his profile picture) dance or move brings more intimacy than a neutral avatar. See Section 3 for the design rationale.

Apple Inc. was one of the earliest companies that integrate motion icons. A typical example is an application icon in the dock of the Mac OS. When a user clicks on an icon to launch an application, the icon jumps in the dock to indicate that the application is preparing to launch. Harrison et al. [7] also established a set of 39 kinetic behaviors, such as spin, bounce, running, etc. These kineticons are designed based on the following sources: 1) biological motion, i.e., animal and human body motions; 2) gestures, e.g., head nod, shoulder shrug, thumbs up; 3) organic motion, e.g., blossoming of a flower, beating of a heart; 4) mechanical motion, e.g., toggles, knobs, buttons and sliders; 5) physical and natural effects, e.g., how a leaf falls from a tree or paper folds; and 6) cartoon conventions, which are exaggerated translations of animation to 2D graphical interfaces. These inspirations provided us with guidelines for designing our empatheticons.

Up till now, kineticons were designed to convey the status of a system in a graphical interface. Our work is novel, as it exploits kineticons as a means to visualize emotions.

3. EMPATHETICONS: EMOTION CUES IN GROUP RECOMMENDER SYSTEMS

3.1 What is an empatheticon?

An **empatheticon** is a set of pre-defined motion frames (or deformations) to visualize an emotion, which could be adapted to any given pictures. Given that every member has a profile picture in GroupFun, we design empatheticons to present each group member's emotions by applying motion features to the profile pictures. Currently, empatheticons present the nine music-evoked emotions in GEMS-9. The empatheticons are implemented as a library on Android system, with a specified emotion and a picture as input and a kinetic animation as output.

By applying the empatheticons, GroupFun allows a user to specify

his/her emotions when listening to a group song. We herein refer to the process as **emotion annotation**. The emotions will display as an animated profile picture of the user who annotates. These annotations are temporal and can last as long as the song itself. The user can change his/her emotions and thus a song can have different labels at different time. Group members can see the user's emotions and vice versa. Empatheticons are so far best suited for the following two criteria [3].

- **Intimacy**: an animated profile picture can convey intimacy better than an anonymous and non-personalized emoticon;
- **Immediacy**: 1) they are more vivid because of their animation nature; 2) an animated profile picture can last as long as the song itself; 3) the emotions they express change during the song so they give more emotional nuances.

3.2 Design Procedure

We first selected one song for each emotion category as a starting point to design the empatheticons. The music was selected by referring to Zentner's criteria [29] and covered four genres: classical, jazz, pop/rock, and techno.

3.2.1 Choice of Emotion Presentations

We first identified the mental model of emotion presentation related to music. Besides Harrison's inspiration sources for kineticons, we also referred to the emotion metaphors summarized by Kovecses [12]. The reported emotions include anger, fear, happiness, sadness, love, lust, pride, shame and surprise. We were inspired by the metaphors of anger (for tension), happiness, sadness, love (for tenderness), surprise (for wonder) and pride (for transcendence). For example, we designed *joyful activation* (abbreviated as *joyful*) using the metaphor 'leaving the ground and up in the air' and *sadness* using the metaphor 'lowering down'. For *nostalgia* and *peacefulness*, which were not covered by Kovecses, we took videos of people's body expressions in daily

Emotions	Inspirations	Descriptions	Animation timeline
Wonder	**Biological**	A person swaying his body from left to right, trying to discover what happened.	
Transcendence	**Biological**	A light object ascending and descending quietly and slowly.	
Tenderness	**Biological**	A person rocking the cradle from left to right slowly.	
Nostalgia	**Biological**	A person breathing deeply.	
Peacefulness	**Physical**	Water surface changing flexibly and adaptively.	
Energy	**Biological**	A rugby player performing 'The Haka' dance.	
Joyful	**Biological**	A person jumping up and down with expectation.	
Tension	**Mechanical**	An object expanding and shrinking intensely.	
Sadness	**Gesture**	A person lowering her head slowly.	

Table 2: The design inspirations of empatheticons and their animation sprites.

life, concerts and parties when they were listening to music. The videos also worked as a source to refine empatheticons that were already designed. Other information sources include online videos, television, etc. Table 2 lists the outcome of empatheticon design, inspirations, descriptions and visual illustrations.

3.2.2 Creation of Empatheticons

We started creating empatheticons by the low-fidelity prototype, i.e., sketches based on deformation to a square. This is followed by high-fidelity (Hi-Fi) prototypes using Adobe Flash. Hi-Fi prototypes also helped us to get feedback from users before implementation. We then implemented the empatheticons by texture mapping in OpenGL ES 10. We chose OpenGL to overcome limitations of Android Animation API, which only supports affine transformation, such as rotation and scaling. Each picture was divided into a 2x2 grid, which yielded 9 control points. These points served as the boundary of an image and defined the animation of a picture. OpenGL then created a new image by deforming the original one and interpolating colors. The resulting animation is composed of a series of images displaying at 30 frames per second.

3.2.3 Verification of Emotion-Animation Mapping

Before integrating empatheticons into a group recommendation system, we investigated whether people could correctly identify the empatheticons as the emotional states that they intended to represent. We recruited 15 students and researchers, 11 males and 4 females aged between 22 and 33 (M = 26.8, SD = 1.9). Participants went over the nine empatheticons one by one, and chose the emotion that they perceived from a given set of options. Results showed that six out of the nine empatheticons were correctly guessed, meaning that the proportion of the option that is supposed to be chosen outweighed the proportion of other options (Table 3). Note that Table 3 only lists the two most frequently chosen emotions. More specifically, few people mistook *tension* and *sadness*. *Energy* (guessed as *wonder*), *peaceful* (guessed as *nostalgia*), and *tenderness* (guessed as *peaceful*) appeared to be ambiguous. The rest of the empatheticons were correctly recognized only by a small margin.

We revised empatheticon design based on feedback collected from participants. We made the *energy* empatheticon more vivid by increasing the intensity of rock gesture and adding short pauses when 'the foot stepped on the ground'. While participants agreed that *peaceful*, *tenderness* and *nostalgia* were difficult to separate and sometimes co-existed, they suggested us to pay more attention to details when illustrating sublime emotions. We thus changed the metaphor of *peaceful* from tranquil water surface to gentle ripples. We also improved *tenderness* by adding feet movement

Categories	M	SD
Wonder	3.51	1.21
Transcendence	3.32	1.23
Tenderness	3.88	1.04
Nostalgia	3.83	1.10
Peacefulness	4.20	0.95
Energy	4.27	0.87
Joyful	4.43	0.77
Tension	3.98	1.01
Sadness	4.20	0.90
Overall	4.20	0.65

Table 4: Average ratings for empatheticons in representing emotions in music context.

when a person was waving a cradle.

Since we aimed to employ empatheticons in the context of listening to music, we conducted a second round of verification to see to what extent the animations could adequately express the emotions evoked by music, with a group of 42 students (27 males and 15 females) pursuing different levels of educational degrees (bachelor, master or Ph.D.). Five participants were Asian, and the rest were European. None of them have participated in the previous round of verification. This time, a piece of background music accompanied each of the empatheticons. We asked participants to rate, on a scale of 1 to 5, how well the given empatheticon represented the emotion perceived in the corresponding music. We also encouraged participants to provide comments on the design.

Table 4 shows the average acceptance and standard deviations of the empatheticons in representing music-evoked emotions. Most ratings of the empatheticons are above 3.5, indicating that users accepted the empatheticons and believed that they are recognizable. Particularly, *joyful* is considered the most representative (M = 4.43, SD = .77). This is mainly due to the vividness of 'jumping' metaphor, as reported by participants. Only the average rating of *transcendence* is below 3.5, with highest standard deviation compared to other empatheticons. A major reason of the lower average rating is reported as users' understanding of the emotion of transcendence per se. As users pointed out in the comments: "*It's difficult to rate this one because I am not very familiar with this word, but I do think the animation matches the feeling expressed in the song very well.*" Since many comments expressed that the empatheticon *transcendence* can well present the feelings embed in the song (N = 22), we decided to accept the current version of *transcendence*.

In summary, participants can well recognize the emotions represented by the empatheticons, especially in the context of music listening. Furthermore, to well present an emotion with an empatheticon, it is essential to choose a representative metaphor and delineating the details of the animation.

3.3 Integration of Empatheticons in GroupFun

After verification, we integrated empatheticons in GroupFun. Users can log in to GroupFun with Facebook accounts, create and join a group, invite members, upload music, and listen to a common playlist. They can specify music preference by rating the songs provided by GroupFun. GroupFun will generate music playlists by aggregating group members' ratings. We do not

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Wonder: wonder = 53.3%; nostalgia = 40%

Transcendence: transcendence = 53.3%; peaceful = 46.7%

Tenderness: peaceful = 46.7%; tenderness = 40%

Nostalgia: nostalgia = 40%; wonder = 33.3%

Peaceful: nostalgia = 60%; tenderness = 26.7%

Energy: wonder = 46.7%; energy = 40%

Tension: tension = 80%; energy = 13.3%

Joyful: joyful = 53.3%; energy = 47.7%

Sadness: sadness = 73.3%; tenderness = 20%;

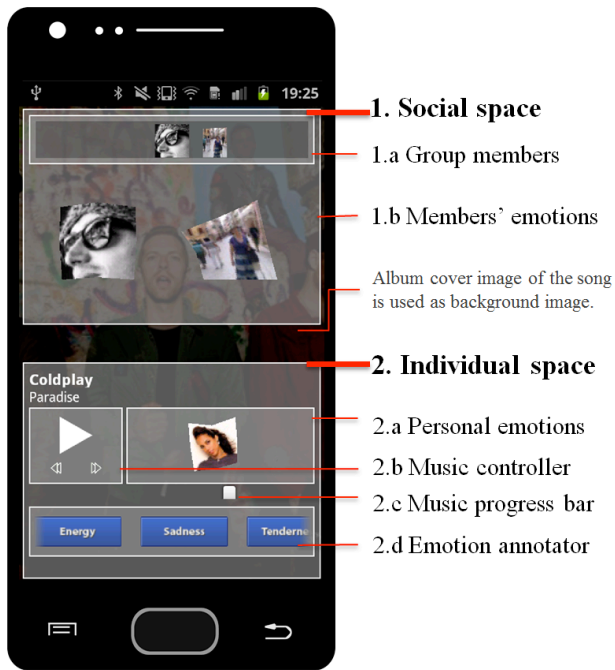**Table 3: Percentages of selected labels for empatheticons.**

Figure 1. Integrating empatheticons to GroupFun.

discuss the preference aggregation method since it is out of scope of this paper.

Group music interface contains two sections (see Figure 1). Section 1 is a social space, which consists of Facebook profile pictures of all group members (1.a) and emotional states of members that a user chooses to see (1.b). If a member in Area 1.b changed emotion at the timeline of the song, his/her empatheticon updates accordingly. Section 2 is an individual space, including the name and artist of the music, music controller (2.b), current emotion of the user (2.a), music-player progress bar (2.c) and emotion selection area (2.d). Users can slide from left to right in Area 2.d to browse all nine emotions. For example, Alicia is listening to the song 'Paradise' by *Coldplay*. She feels energetic at the beginning, and thus selects *energy* from Area 2.d. She then drags the profile pictures of her friends Lucas and Victoria from Area 1.a to 1.b, from where she noticed that Lucas was feeling *nostalgia* and Victoria was feeling *wonder*. When the song approaches the climax, Alicia feels differently and changes his emotion to *joyful*.

4. EVALUATION OF THE USE OF EMPATHETICONS IN GROUPFUN

To assess the impact of empatheticons in GroupFun, we studied how users may use, perceive, and react to empatheticons when using this group music recommender system. In particular, we investigated *whether* and *how* the group members' emotion could influence a user's behavior.

We decided to conduct a study in our laboratory to make an in-depth observation of the participants and collect their comments when they were using the system. Each participant was invited to the laboratory individually to mimic a non-collocated and asynchronous music-listening scenario. To understand whether and how a user may be influenced by his/her group members' annotations, we preset group members' annotations, which we call **manipulation**. The total number of group members' annotations is set as a controlled variable. The manipulation was not revealed

to participants until after the study was completed. This is another reason why we decided to conduct an in-lab study. Both quantitative and qualitative methods were used to analyze the results.

Emotion annotations were logged to analyze the correlation between a user's emotion annotations and his/her group members'. A post-study questionnaire (see appendix) was used to assess user experience such as user-perceived intimacy, immediacy and their satisfaction with the system. The questionnaire was designed based on ResQue model [21], which assesses quality of user experience of a recommender system, and Tu et al.'s measurement of social presence in online learning environment [24]. Each question was responded on a 5-point Likert scale. Pearson correlation analysis was used to investigate the relationship between the survey items and annotations.

Participant observation method was used to gain an in-depth understanding of how users used empatheticons and their impacts on GroupFun. Participants were encouraged to think aloud during the study. The process during which users interacted with GroupFun was audio-recorded for further analysis. Additionally, each question in the post-study survey was followed by a text area so that the participants could provide comments.

4.1 Participants

We recruited 18 participants in 6 groups, each group consisting of 3 members. They were recruited on campus via word-of-mouth. The 6 groups were made of friends, classmates or colleagues. All the participants had Facebook accounts. The participants included 8 females and 10 males from 9 different countries in Europe and Asia (Switzerland, Spain, Korea, China, etc.). Their ages ranged from 18 to 28 (M = 24.9, SD = 2.3). All of them were currently using smartphones and were familiar with listening to music on smartphones. At the end of the study, all participants were rewarded with a specially designed music-theme USB stick.

4.2 Material

We installed GroupFun on Samsung Galaxy SII 9100 with Android OS 2.3.2. A desktop computer with a 22-inch wide-screen display was used for participants to fill in the post-study questionnaire. We provided them with a list of 9 emotions and explanations on an A4 paper. We also observed user behavior and logged down on paper.

To prepare for the manipulation, we first selected 20 songs from top tracks in Last.fm to cover various genres. The length of the songs ranged from 2.9 to 4.8 minutes (M = 3.56). We then preset the emotions for all participants. The preset emotions were collected by inviting two students from the university music association to annotate the songs. We also controlled the number of each song's annotations so that the annotation count of the 20 songs is evenly distributed, i.e., from 5 to 22. We randomly assigned the number of preset annotations of each song by lottery. We then randomly filtered the annotations to meet the controlled number. The categories of preset annotations (n = 247) for the 20 songs were distributed as follows: *energy* 11%, *joyful* 18%, *nostalgia* 6%, *peacefulness* 12%, *sadness* 7%, *tenderness* 9%, *tension* 10%, *transcendence* 18% and *wonder* 8%. Finally, we employed another two students to double-check the preset annotations to avoid obvious inappropriate emotions of the songs.

4.3 Procedure

Each participant scheduled one hour with us and provided their Facebook homepage via email. We obtained their Facebook ID from Facebook Graph API and created a group for the participant

and his/her two group members in GroupFun. Upon arriving in the laboratory, participants were informed that their group members had participated in the study prior to them, regardless of the actual participation time. For participants who had already known their group members' experiment time, we told them that their friend(s) have rescheduled the time.

Participants were first debriefed about the scenario (same as in Introduction) and procedure of the experiment. They then logged in to GroupFun with their Facebook accounts, entered their group and familiarized themselves with the interface (see Figure 1) using a warm-up song. They practiced to annotate songs with empatheticons and watched their group members' emotions, which were also manipulated. The warming-up session lasted for an average of 2.4 minutes (Max = 3.2, Min = 1.2).

Afterwards, they started to listen to 10 songs randomly shuffled from the 20 songs that we had chosen. They could annotate emotions during the timeline using empatheticons. This procedure took up to 40 minutes. Finally, they filled in the post-study questionnaire.

At the end of experiment, we informed the participants of the manipulation in the study, including the fact of presetting emotion annotations and their group members' actual participation time.

4.4 Results
Overall, users found empatheticons easy to use (M = 4.65, SD = .61), easy to learn (M = 4.59, SD = .94) and entertaining to use (M = 4.24, SD = .66). Users also considered empatheticons as a useful tool in GroupFun (M = 4.18, SD = .72). This subsection reports user evaluation of empatheticon interface and how empatheticons affected user-perceived immediacy, intimacy, group dynamics in GroupFun.

4.4.1 Immediacy
We first assessed the immediacy of empatheticons. By immediacy, we refer to the system's ability to allow users to instantly feel each other's emotions and presence. According to [30], an individual's sense of being with others and immediacy of social interaction are psychological phenomena. User report is conventionally used as a subjective measurement.

User-perceived immediacy is evaluated by Q7 "I immediately felt my friends' emotions." (M = 4.18, SD = .53). User perceived social presence is assessed by Q8: "I felt I was listening to music with my friends" (M = 4.24, SD = 1.03). The results indicate that users could immediately feel group members' emotions and effectively perceive members' social presence, which we refer to as perceived togetherness. Furthermore, eight users have elaborated on perceived togetherness in their comments. For example, User 7 remarked, "*I really like to see what my friends' feeling at the moment I was listening, made me feel like we were listening to music together, have more fun.*" These comments further provide evidence that empatheticons could enhance user-perceived togetherness.

By observing users, we also found cues of user enjoyment brought by perceived immediacy and togetherness. All users laughed when they saw their friends' profile pictures jumping and dancing. Some users (User 2 and 18) even stood up and danced together with the empatheticons. The excitement was more obvious when the participant changed the emotion *concurrently* with her friends. User 16 laughed loudly and showed a surprising face when she changed to *joyful* simultaneously with her friend. As she said: "*It's impressive that we start to change all at once when the song reaches climax.*" The excitement also came when all members in

a group were exhibiting the same emotion and movement. As User 12 remarked, "*It is exciting to see all of us jumping together. It looks like a group-dance*" The above observation further explains the statistical correlation between user-perceived togetherness and entertaining of use.

4.4.2 Intimacy
We also evaluated whether empatheticons could improve intimacy. By intimacy, we refer to the system's ability to bring familiarity and friendship to its members. Similar to immediacy, intimacy is also a subjective metric [30] and we evaluated it through self-report.

Users were asked to rate to what extent they paid close attention to their friends' emotional responses (Q9). Results (M = 4.53, SD = .62) indicated participants had attentively watched their group members' feelings during the music timeline. We also discovered some patterns of how users paid attention to group members' emotions. First, users showed interests in comparing their emotions with their friends'. As User 10 commented, "*Every time he changed, I started to think why he changed, am I feeling the same, and should I change*?" At a point when both friends changed to the same emotion, User 8 naturally asked whether he should also change accordingly. Users also expressed doubt when what they felt was obviously different from other members' emotions. As User 2 remarked, "*I really want to ask him how he can stay calm in such a joyful song!*" Additionally, users also showed excitement and pride when they selected an emotion which was immediately followed by other group members (User 18). Furthermore, users showed high enthusiasm in understanding group members' music tastes. For example, User 14 reported proudly, "*I think I have found their pattern: less active at the beginning and gradually becoming active. From the frequency of emotion changes, I can guess how much they like the song.*"
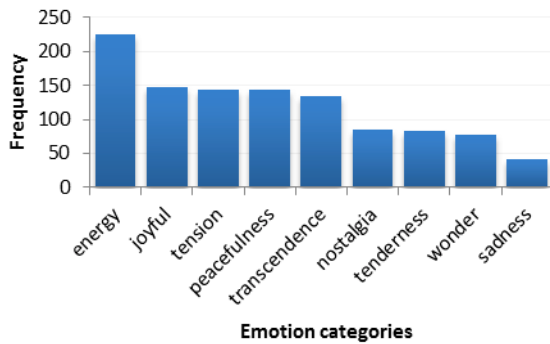
Users also pointed out empatheticons' potential in enhancing friendship. This mainly refers to the tendency to share emotions and interact more with group members. "*I'm more motivated to interact with them. No need to input any text (yeah!!), but using a very cute way to dance together with them. I really feel we were spending time together,*" commented by User 3. His group mate, User 2, also commented, "*Looking at my boyfriend's profile picture soon brings me to think I'm spending time with him. Maybe he is trying to pass on messages in the music.*"

4.4.3 Group Dynamics
Furthermore, we studied group dynamics by examining whether group influence exists when using empatheticons in GroupFun. By group influence, we refer to members' impact on each other. We investigated group influence by both subjective metric and annotation logs.

Perceived group influence was subjectively measured by Q10 of post-study questionnaire, which asked users to rate to what extent their friends' emotions had influenced theirs. Participants' answers have a high deviation (M = 3.53, SD = 1.07). The distribution of the rating is also scattered, with p(2) = 17%, p(3) = 35%, p(4) = 24%, p(5) = 24%, which shows diverse levels of perceived group influence. Users' different attitudes were also reflected in their comments. For example, User 2 showed her willingness to be consistent with other members in her comments, "*It's more interesting to see everyone in the group moving and dancing together in the same style. That makes the experience more harmonious and brings more fun!*" Some participants felt satisfied when their feelings gradually became closer to their friends'. As User 13 commented while listening to music, "*I don't*

Figure 2: Distribution of annotations by emotions.

Figure 3: Annotation count: preset vs. user generated (mean). User-generated annotations come from two users.

want to behave too differently from other members. It might be embarrassing." Some participants were unconsciously influenced by members. For example, User 6 reported, *"When I saw my friends changing emotions, I naturally wanted to change mine."* By contrast, some participants were less willing to be influenced by others. User 4 is a typical user who wanted to be unique in a group, *"I don't want to appear the same as them. Imagine you were in a party. How boring it would be if everyone is the same!"* User 16 also mentioned that he was hardly influenced by others, *"For me, listening to music is a conversion with myself. I would rather listen to my heart how I felt about the music."* Therefore, while empatheticons help us to discover group influence in GroupFun, whether users are actually influenced by group members' emotions may differ from individual to individual.
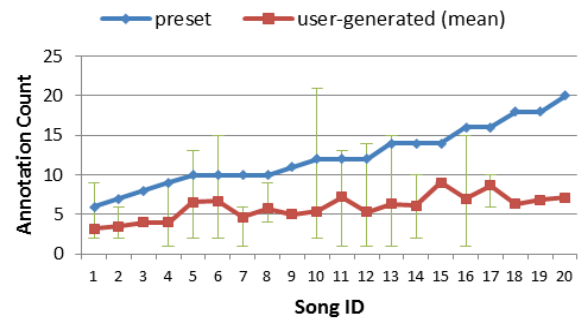
We also found cues of group influence by analyzing annotation logs. We first present a descriptive statistical analysis of annotations. We have collected a total of 1081 annotations from the 18 users. Users have provided an average of 60.1 annotations using empatheticons (Max = 112, Min = 38, SD = 5.04). The distribution of annotations by emotion is shown in Figure 2. The most frequent emotions are *energy* (n = 225, p = 21%) and the least frequent one is *sadness* (n = 43, p = 4%).

We then calculated each user's emotion agreement, defined as the case when the selected emotion is the same with at least one group member at the time of annotating. Dividing by the user's total annotation count, we calculated the **agreement rate**, with the highest at 50.0% and lowest at 8.3%. Admittedly, the agreement could also result from emotions evoked by music per se.

We further examined the impact of group members' activeness in annotation. We measured *activeness* using the number of annotations. Since group members' annotations were actually manipulated, we evaluated the relationship between the number of user annotations and preset annotations. Figure 3 shows the distribution of preset annotation count and the average annotation count (with minimum and maximum) for each song. By preset annotation count, we mean the sum of two group members' annotations. A two-tailed Pearson correlation test showed an approximately significant correlation ($r = .425$, $p = .079$) between the preset annotation count and users' average annotation count of each song. It indicates that the more active the group members are, the more annotations a user is likely to provide.

5. CONCLUSIONS

In a group recommender system, mutual awareness is crucial for users to gain a better understanding of each other's preferences. It is also an essential element in maximizing group satisfaction. To achieve mutual awareness, prior studies have presented solutions in membership awareness, preference awareness and decision awareness. In this work, we investigated emotion awareness and its impact in promoting group satisfaction. We first designed a set of interface elements called empatheticons. These empatheticons were verified and improved during two initial verification studies, showing that users could easily map the empatheticons to their respective emotions *in a musical context*. The empatheticons were then integrated in an empirical environment -- GroupFun -- to validate our hypotheses. In an in-depth user study, we showed that empatheticons could effectively enhance users' perceptions of togetherness, i.e., the feeling of listening to music together with friends. Additionally, empatheticons also served as a useful tool with which users can provide emotional annotations and familiarize themselves with group members' preferences. Furthermore, the number of a user's annotations was found to be influenced by other members' and enable positive group dynamics.

A few limitations are worth mentioning. Firstly, our study was conducted in the laboratory with manipulation. An in-situ study can bring us with further insights into the use of empatheticons. Additionally, we investigated GroupFun *with* empatheticons to obtain an in-depth understanding of users' attitudes and behavior patterns. In the future, we will compare our findings to GroupFun *without* empatheticons.

6. ACKNOWLEDGEMENTS

7. REFERENCES

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Appendix: Survey questions in User Study

Q1: Overall, the emotion interface has successfully visualized the emotions in a musical context.

Q2: The emotion interface is useful in GroupFun.

Q3: The emotion interface is easy to use.

Q4: The emotion interface is easy to learn.

Q5: The emotion interface is novel.

Q6: The emotion interface is entertaining to use.

Q7: I immediately felt my friends' emotions.

Q8: I felt I was listening to music with my friends.

Q9: I paid close attention to my friends' emotions while listening to music.

Q10: My emotion annotations were influenced by those of my friends.

Q11: The songs recommended by GroupFun fit my tastes.

Q12: The songs recommended by GroupFun fit my friends' tastes.

Q13: I am satisfied with group experience with GroupFun.

Q14: I would like to use GroupFun again in the future given the opportunity.