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TelMeA—Expressive avatars in asynchronous communications

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Abstract

TelMeA is an asynchronous online community system that uses avatars to enact the messages of the users. We present an overview of the system, including the results of a usability study and its effect on the redesign of the system. Furthermore we present an empirical evaluation of the avatar's animations. The animations offer a wide repertoire of expressions along the valence dimension, but additional animations with low arousal should be added. Next we performed a case study of TelMeA in Japan. The members of the community more often used the high arousal and extreme valence animations, but the more subtle animations were still used in 30% of all cases. The less frequent use of subtle expressions could be explained by the fact they are not necessary in an asynchronous communication to negotiate turn taking.

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1. Introduction

In face-to-face conversations, people use all of their natural channels, such as speech, body language (gesture, pose, etc.) and facial expressions (gaze, emotion, nodding, etc.) to communicate with each other. Gaze, for example, is an important channel to negotiate the turn taking (ES et al., 2002). These conversations take place in shared contexts, such as a café, and may include the presence of other people and objects. Together they present a rich source of information that helps people to conduct a pleasant conversation and to develop a community.

When the participants are in different locations they can use various internet based technologies to communicate, such as videoconference, email, chat and forums. One can distinguish two types of online communications: asynchronous and synchronous. In the latter, the participants are present throughout the communication and react in real time to messages. Videoconference systems and chat are good examples of synchronous communication. In asynchronous communication, the participants are not present during the communication and several days may pass before a reaction to a message is posted. Newsgroups and internet forums are instances of asynchronous communication.

Particularly internet forums and their resulting online communities are currently becoming increasingly important (Rheingold, 2002; OSDN, 2004) and help people to share problems and to organize activities. At the same time the communication in today's forums is restricted to text messages, which offers only a fraction of the information available in face-to-face conversation. This results in frequent misinterpretations especially if the messages involve irony. The widespread usage of emotions demonstrates that pure textual information lacks natural communication channels.

To overcome these restrictions virtual representations of the participants, so called avatars, are being developed (Damer, 1997). The embodiment of the participants through avatars enables the participants to use body language and facial expressions in their messages. Avatars have already been successfully introduced into web pages (Bickmore et al., 1998) and internet chat (Kurlander et al., 1996).

The Media Equation (Nass and Reeves, 1996) suggests that in certain ways users will treat such avatars as social actors and hence communicate with them as they would with other humans (Takeuchi and Katagiri, 1999; Takahashi et al., 2000). The anthropomorphic appearance of the avatar also helps the users to identify other participants and hence makes it easier to follow a discussion. Furthermore, the avatars can help the users to understand the context of the conversation, including the involved personalities and their social relationships toward each other (Takahashi and Takeda, 2001). Placing avatars in virtual environments can also provide shared context information.

TelMeA is such an enriched internet forum that enables participants to use their avatars to communicate rich emotional messages. It also provides a method to refer to shared context in form of web pages. A detailed description of TelMeA's functionality is available in the next chapter.

The key advantage of TelMeA is its avatars' animations. They should include a full emotional repertoire, ranging from low valence and arousal expressions to very high valence and arousal expressions. Even though the two dimensional valence and arousal model might not be the optimal model for an emotional space (Schiano et al., 2000) it appears best suited for TelMeA because its generality can also be applied to communicative acts, such as waving hands and nodding. These communicative acts are an essential part of TelMeA and would not fit into a categorical approach to emotions.

The first research question is if TelMeA's animations offer this full repertoire of valence and arousal. The second research question is based on the necessity to have multiple avatars to resemble the different participants in a conversation. Does the shape of the avatars influence how it is perceived in terms of valence and arousal? The expressions of an avatar usually appear in conjunction with an utterance. A certain animation might be perceived differently in conjunction with different utterances. Given these avatars and their animations the question arise how people use them in their messages. Since intense expressions are rare in face-to-face communication, are subtle expressions preferred in TelMeA? We would like summarize our research questions:

1. Does TelMeA's avatars offer a full repertoire of expressive animations?
2. Does the form of avatars influence how people perceive an animation?
3. Do people prefer to use subtle expressions in their messages?

This paper first describes the design process and its difficulties, before we report on two empirical studies in the second part of this paper that answer the research questions.

2. TelMeA design

The basic functionality of TelMeA is similar to internet forums. Users can post their messages to the server of TelMeA and then the messages automatically become available to all other users. The main advantage of TelMeA is its avatars that present the messages of the users. TelMeA was developed as a research vehicle to investigate the effect that expressive avatars have on the user's conversational behaviors. By analysing logs of long-term online community activities, we hope to be able to find rules of social conversation. Such rules would be helpful for autonomous avatars to act naturally and hence better fulfilling their purpose, such as stimulating discussion between unacquainted users (Isbister et al., 2000).

2.1. TelMeA prototype

Based on some design challenges (see below) we implemented a first TelMeA prototype as a web application system. The server uses Java Server Pages (JSP) and the avatars on the client's side employ Microsoft Agent software. The

communication between the clients and the server is based on a proprietary XML-based script format (Takahashi and Takeda, 2002). These scripts also control the Microsoft Agents. Users of TelMeA access TelMeA communities with their web browser and using the standard http protocol. Fig. 1 shows the conversation process in TelMeA.

When users want to make new messages in TelMeA, they can choose between either replying to an existing message or starting a new topic. In both cases the message editor window opens and enables the user to create the message (see Fig. 2).

A message is composed of any number and order of five different components: speech, animation, distance, reference and pointing. By clicking buttons on the top of this editor window, users can add any number of associated components in the middle part of the window. The avatar of a user will play the components in the order in which they were composed in the editor window.

Each speech component consists of a text box and a menu that lists performative verbs. Sentences in the text box will be played using a synthesized voice. Performative verbs in the list are associated with adequate animation of the avatar. For example, if the user inputs a text "Hello." in the text box and select a verb "greets," then the user's avatar will wave its arms and smile and speak "Hello".

Each animation component consists of only a menu list. It lists numbers of emotional expressions and interpersonal attitudes, which are associated adequate animations of the avatar as well. Each distance component has one text box and one menu list, but the functions are different from speech component. The menu list shows distances from another avatar indicated in the form of the user's e-mail address in the text box. Users can select an interpersonal (inter-avatar) distance from four levels: from a close distance to a far distance. Each reference component and pointing component has one text box that indicates URI of web content or local file

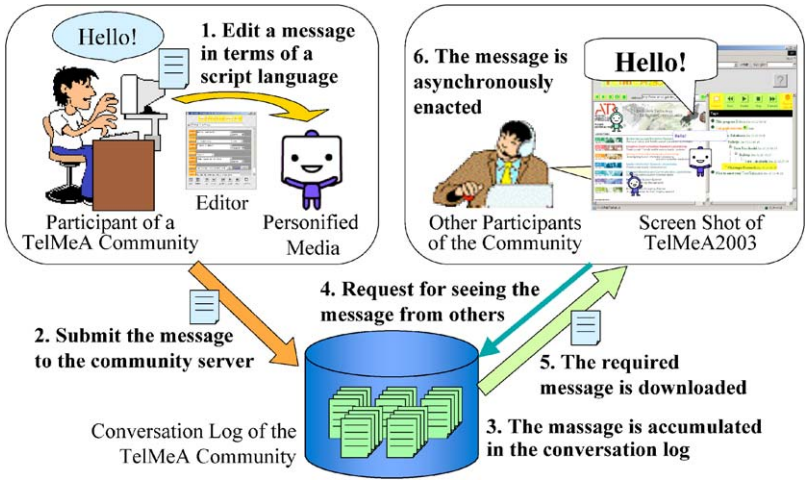

Fig. 1. The conversation process of TelMeA.

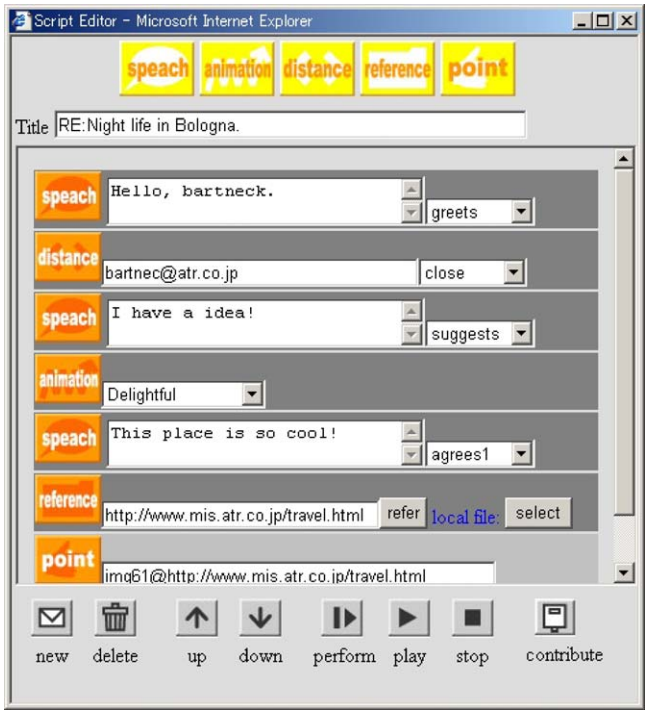

Fig. 2. TelMeA editor window.

that referred in the message and pointed by the avatar. Users make messages in combination of these components.

All of TelMeA's terms, such as the performative verbs, emotional expressions and interpersonal attitudes are associated with animations. If a user selects a term from a menu while he/she edit a message, an associated animation is automatically played. In a menu, some terms of expression are listed not only once but multiple for some of them like "happy1", "happy2" and "happy3." Each of them is mapped with a different kind of animation, which enables the users to select an adequate animations each term. This results in a multiple to multiple relationships. Each term can be associated to multiple animations and each animation can be associated with multiple terms. The complete message is coded into the proprietary XML-based script format before it is submitted to the server where they are stored in a log file.

2.2. Design challenges

The design of the first TelMeA prototype was challenged by several problems that could compromise the expressiveness and believability of the online community and its avatars.

2.2.1. Personalization

Each participant in the TelMeA community is represented by a character, i.e. his/her avatar. To quickly identify the various participants in a conversation, a unique embodiment for each avatar is necessary. In the TelMeA prototype eight avatars of different shape and color are available. We would like to expand this set to allow further personalization, but the high number of expressions required by each avatar puts a heavy load on the development resources. Consequently, we first focus on an analysis of the usage of the various avatars before extending the grade of personalization.

2.2.2. Communication features

Several theories and frameworks of verbal communication are available (Searle et al., 1980; Habermas, 1984), but their detailed discussion is not in the focus of this study. For pragmatic reasons we decided to employ the model of Schulz (1981) since it appears well suited to describe utterances in asynchronous online communities. Following this theory the expressions of the avatars should cover all four features of human communication: facts, relationship, appeal and self-revelation. The facts feature contains the content of the message and the relationship feature contains the sender's opinion of the receiver and the sender–receiver relationship. The appeal feature contains the information on what the sender wants the receiver to do (intention), and the self-revelation feature contains information on the state of the sender, in particular his or her emotional state. The relationship, appeal and self-revelation features are usually not communicated through what is said but through how it is said.

The sender encodes all four features into his or her message and the receiver interprets the four features of the perceived message. Successful communication requires that the sent features of a message be similar to the interpreted features. A mismatch between the sent and interpreted features of the message can explain many failures of communication.

The TelMeA system enables the user to communicate facts through the spoken content of the messages. The relationship of the users toward each other can be expressed through the relative spatial distance and position of their avatars. The user might, for example, stand right next to a befriended user. The spatial distance might be a good indication of social distance. The appeal feature might be expressed through the various performative verbs, such as asks, agrees and declares. The self-revelation feature is communicated through the emotional expressions of the avatars, such as happiness, sadness and anger.

2.2.3. Expressive repertoire

Humans have a wide repertoire of conversational and emotional expression, ranging from subtle frowns to ecstatic dances of joy. Avatars need to cover the entire scale of expression to become believable entities. Unfortunately, many of the current implementations of avatars exaggerate their emotional expressions or do not have enough variations in their expressions and are therefore perceived as comic characters.

The TelMeA system employs 35 performative verbs (explains, agrees, complains, etc.), 48 emotional expressions (likes, sadly, worries, etc.), and 13 interpersonal attitudes (yes, I know, forgotten, etc.). This variety should enable to the users to find a suitable expression for almost any situation. The 30 animations were mapped to the performative verbs, emotional expressions and interpersonal attitudes in which multiple mappings were allowed. A single animation might be connected to several verbs, emotional expressions and interpersonal attitudes.

The animations consisted on average of about seven frames (minimum 4 and maximum 20), which result into an animation durations of on average of 0.6 s (minimum 0.06 and maximum of 1.6). This is the time necessary for the avatar to get into its most extreme expression (see Figs. 3 and 4). Then, it will speak out the text or simply wait, until it moves back into its neutral expression. Printed images are insufficient representations of animations. We therefore created a test web page in which the interested reader can view TelMeA's animations: http://www.mis.atr.co.jp/~toru/TelMeA/AnimationTest.html.

However, the TelMeA avatars cannot yet express all the nuances and blends a natural human face is able to produce. Computer animations reached a level that makes artificial faces almost indistinguishable from natural ones (Wachowski and Wachowski, 2003), but they require advanced computing power and high bandwidth and are therefore not suitable yet for an online community.

In addition, the TelMeA system has certain conversational expressions to direct attention, such as pointing to objects and the distances of avatars from each other

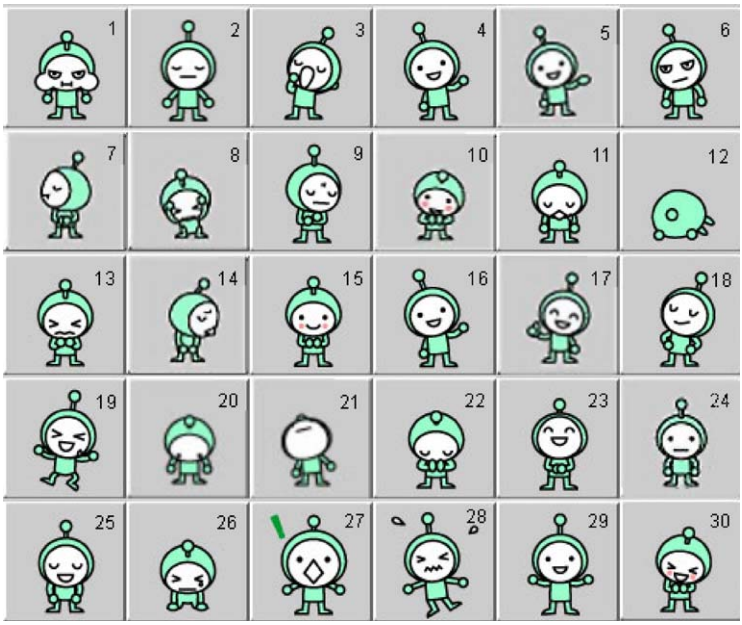

Fig. 3. The 30 animations for the round avatar.

Fig. 4. The 30 animations of the square avatar.

and objects. The possibly relatively higher importance of the conversational expressions, such as glance and nods, over emotional expressions (Cassell and Thorisson, 1999) might not be the same in the TelMeA system since turn taking is regulated automatically.

2.2.4. Communication modalities

Avatars should express their emotions consistently through all modalities available to them to ensure high believability (Gong, 2000). It would not be convincing if the avatar showed a sad face but talked with a neutral voice. Systematical manipulation of emotions in speech remains difficult, and unfortunately the speech synthesizer used for TelMeA is not able to perform this task. Therefore, we are planning to make some rough manual adjustments in the pitch and speed of the synthesized speech to acquire a minimum level of consistency.

2.2.5. Logging and analysis

The TelMeA community enables its participants to use rich avatars for their messages. As mentioned above, all messages are encoded in our proprietary XML-based script language and stored in log files on the TelMeA server. The highly structured nature of this scripting language is optimized comprehensive analyses of the messages, including their content, performative verbs, emotional words and

animations. Ideally, such analysis will enable us to gain a better understanding of social communication.

2.3. Usability test

A qualitative usability test of the TelMeA system was performed at the Technical University of Eindhoven, Holland, in December 2002. The goal of the test was to identify major usability problems and suggest design solutions. Five participants were given the representative task to show their favorite website to another user. The other user was the second experimenter, located in Kyoto, Japan. The experimenter played the conversation partner of the participant. He took a passive role and thus only reacted to the messages of the participant. A videoconference link connected the experiment room in Eindhoven with the experimenter in Kyoto and enabled him to observe the progress from a distance and gain insight into the activities of the user. Only when he observed that the participant appeared to be stuck would he take the initiative and send a new message. Two cameras filmed the participants and their screen activities. The participants used the "Thinking-out-loud" method (Dumas and Redish, 1993) to allow the experimenter to gain insight into their goals and activities. The experimenter in Eindhoven also observed the participants and made notes during the experiment. Afterwards he reviewed the videotapes to cross check the initial notes. Several usability problems could be identified and classified into general graphical user interface (GUI) problems, technical problems, and communication problems.

The GUI problems included problems with missing or unclear labels, wrong visualization of buttons, and redundant interface elements. Most of these problems were easily resolved by a redesign of the respective elements. The technical problems of the system consisted of excessively long response times, instability of the servers, and scripting problems in the client software. If the user, for example, wanted to compose a new message he or she would click on the compose button, which would bring up a composer window. The loading of all elements of this window took several seconds, and the window was only operational if the loading was complete. Many participants clicked on elements before the completion of the loading process and hence caused a scripting error that in some cases disabled the entire interface. As the result, the participant would have to go back to the login screen and start over.

The most interesting but also most difficult to solve problems were the communication problems. Several participants had problems understanding that TelMeA is an asynchronous communication system (forum) and not a synchronous system (chat). They tried to use the system as they would use chat systems, which resulted in several process problems. The replies to their messages, for example, appeared too late. We believe that the participants might have been misled by the constant presence of the avatars. Since the avatars of the other user was visible all the time, the participants assumed that the other user himself or herself was online all the time and hence that they could chat with the other user. The constant presence also had the effect of making the participant believed that they could literary show a certain webpage to the other user by showing it to his or her avatar. They put the

other user's avatar on top of a page and scrolled it up and down to show it to the other user. The participants assumed that the interface would be a shared space and that the other user could see exactly what they themselves saw on the screen. Another problem was the expectations of the participants toward the conversational abilities of the avatars. Due to the anthropomorphic gestalt of the avatar and their ability to synthesize speech, they expected the avatar to also be able to recognize speech. The participants started to talk back to the avatars after they finished their utterances.

2.4. TelMeA system

Based on the result of the usability test we created a new version of TelMeA. A great effort was made to technically improve the system. Many bugs have been removed and an ongoing effort is made to make the system more stable and robust. Most of the GUI problems have been resolved by changing the layout and labels and the buttons.

Several communication problems have been solved by removing the default web browser window. Web references are now only shown when they are explicitly mentioned in the messages of the users. Furthermore, status messages are now being used to provide feedback during the execution of long tasks. For example, during the initialization of an avatar, which might take up to one minute, a message "calling character" is being displayed.

A comprehensive help documents is now available which can easily be accessed from a button in the interface. It explains the principle of asynchronous communication through avatars but also practical issues, such as how to create a message in the editor window. In addition, several examples threads and messages are now available in every new TelMeA community. They demonstrate TelMeA's functions and help users to start a lively discussion.

3. Evaluation of the expressive animations

A professional designer created a set of 30 animations for both types of TelMeA avatars (round and square) and the users of TelMeA are limited to these animations (see Figs. 3 and 4). Therefore it is important that the animations offer a wide repertoire of expressions. With an empirical study we want to answer the first two research questions:

1. Does TelMeA's avatars offer a full repertoire of expressive animations?
2. Does the form of avatars influence how people perceive an animation?

3.1. Method

A 30 (animation) × 2 (avatar) within subjects experiment was conducted at ATR, Kyoto, Japan. 13 men and 14 women ranging from 18 to 25 years of age participated in the experiment. They were all university students and were paid for their participation.

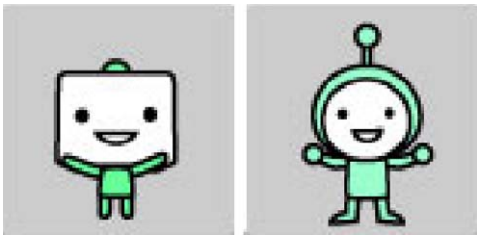

Fig. 5. Example stimuli of the two avatars.

Two of TelMeA's green avatars in round and square shape performed each 30 animations. Fig. 5 shows an example animation of the square and the round avatar.

The participants were asked to rate the arousal and valence of the animation on six 5-point scales. The scales were anchored with a pair of antonymous words in Japanese language. The approximate translation into English is as follows:

Arousal

- Rough behavior–gentle behavior.
- Excited behavior–calm behavior.
- Aware behavior–numb behavior.

Valence

- Cooperative behavior–counter-cooperative behavior.
- Behavior of agreement–behavior of disagreement.
- Permitting behavior–denying behavior.

After a training session the participants had the opportunity to ask questions about the process of the experiment before they would start with the experiment. The 180 stimuli were presented in random order and the participants could replay the animation as often as they wanted by pressing the "replay" button (see Fig. 6). They had to mark each scale before they could press the "okay" button to continue to the next stimuli. The whole process took 1 h.

3.2. Results

A 30 (animation) × 2 (avatar) repeated measures ANOVA was conducted. The animations had a significant effect on arousal ($F(29, 754) = 79.049$, $p < 0.001$) and valence ($F(29, 754) = 91.889$, $p < 0.001$). The arousal ($F(1, 26) = 10.754$, $p < 0.003$) and valence ($F(1, 26) = 1.533$, $p < 0.003$) ratings differed significantly between the round and square avatar (see Fig. 7).

To evaluate if the 30 animations offer a wide enough repertoire of expression we created a scatter plot (see Fig. 8). The plot reveals that the animations spread out nicely over the valence dimension, but only a few have very low arousal. However,

Fig. 6. The experimental setup.

the number of animations in the positive and negative sections of arousal and valence was divided evenly. 16 animations were rated with positive arousal and 14 with negative arousal. The same even split occurred on the valence dimension.

3.3. Discussion

The result suggests TelMeA offers a wide repertoire of expression along the valence dimension. However, on the arousal dimension more expressions should be available on the low end. Overall the repertoire appeared to be sufficient.

Surprisingly the avatar had a significant influence on how user perceived the expression, even though the animations were designed to be similar. A possible reason for this result could be the different shapes of the head and face of the avatars. Facial expressions are a key factor for the expression of emotions and slight differences in shape could have an effect. It appears difficult to create two avatars that have the exact same repertoire of expressions.

4. Case study

The majority of human face-to-face interaction does not involve extreme expressions. In less direct and more anonymous communication channels, such as

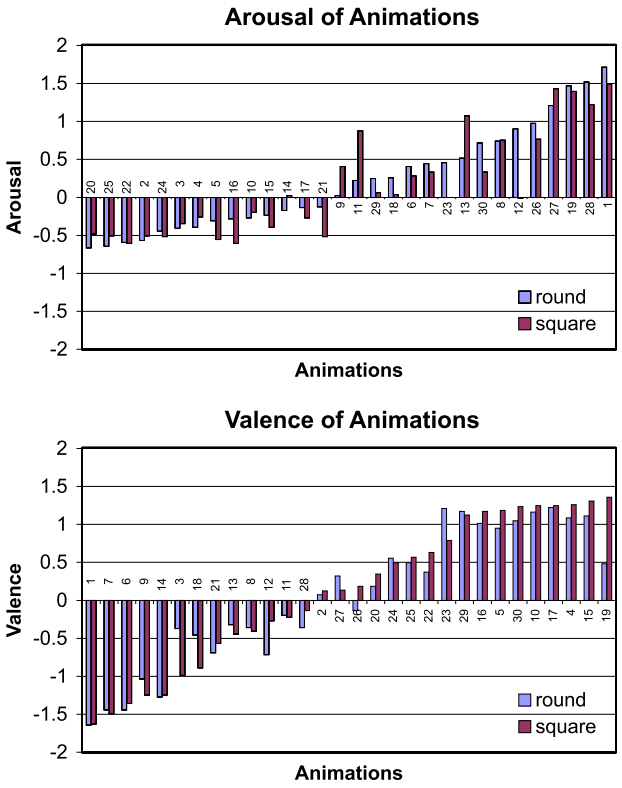

Fig. 7. Arousal and valence for both characters.

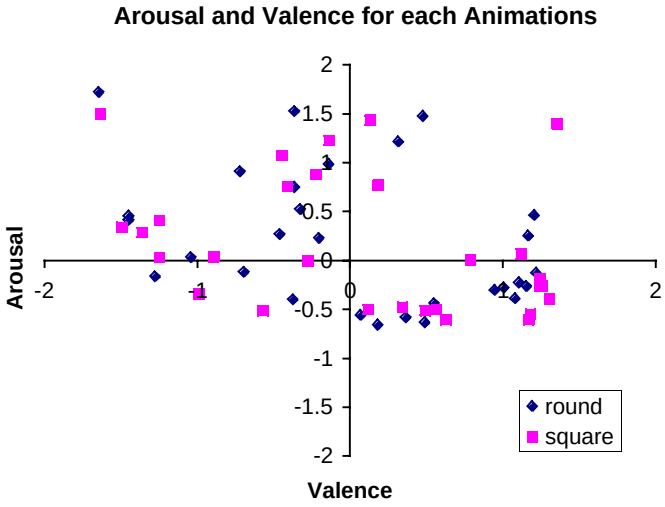

Fig. 8. Scatter plot of all animations.

email or chat, extreme expressions are more common and can even lead to a "flame war". In such a flame war, people exchange angry and insulting text messages with each other. Given the expressive repertoire of TelMeA's avatars the question arises how actual users communicate with them. Will they use the subtle expressions common in human–human communication or do they prefer the exaggerated expressions often used in cartoons (Thomas and Johnson, 1981). We defined subtle expressions as animations that were rated in our previous experiment (see above) as having a $-1 > \text{valence} < 1$ and an $\text{arousal} < 0$. We conducted a case study to address our third research question: Do people prefer to use subtle expressions in their messages?

4.1. Method

TelMeA was published on the e-kyoshitsu website (http://www.e-kyoshitsu.org/) from January 18th until May 29th 2002. e-kyoshitsu is a non-profit online education community created by Noriko Arai of the National Institute of Informatics, Tokyo. Young students and teachers can log into this community to talk about problems and experiences. 68 students and staff members between the age of 10 and 42 created an account in TelMeA and 26 of them actively participated in the discussion resulting in 23 threads with together 307 utterances. Also teachers contributed to these discussions. The participation in TelMeA was completely voluntarily and the students and teachers accessed TelMeA from their home computers. All utterances were logged automatically on the central message server in the TelMeA log (see Fig. 1) and form the basis of our analyses.

The TelMeA version used for the case study has a set of eight avatars available for the user. They are based on the round and square shape (see Fig. 5) and only differ in color. We assumed that the different avatars' colors counterbalanced a possible effect of the color itself and therefore did not consider them as different conditions.

4.2. Results

The square avatar type was preferred over the round one. Eight users chose for a round avatar type and created 169 utterances while 18 users selected the square avatar type and created 1031utterances. Fig. 9 shows the usage of the two avatars types.

To evaluate if the users had a preference for subtle expression we divided the 30 animations into high and low arousal groups based on the data of our first experiment. The 15 positive and the 15 negative animations each formed one group. The animations belonging to the low and high group were identical for both avatar types and therefore the type (round or square) could be neglected for the analyses. The high arousal animations were used significantly ($X^2(1) = 65.33$, $p < 0.01$) more often than the low arousal animations (see Fig. 10).

The valence dimension needs to be split into two groups: extreme and subtle. Animations in the interval between -1 and 1 formed the subtle group and the rest the extreme group. Again, the groups were identical for both avatars and therefore the type of avatar (round or square) could be neglected. The extreme valence

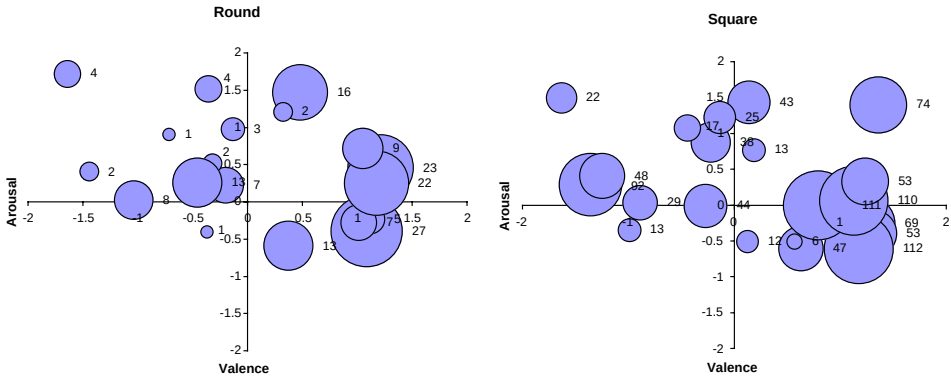

Fig. 9. Frequency of use of the two avatars.

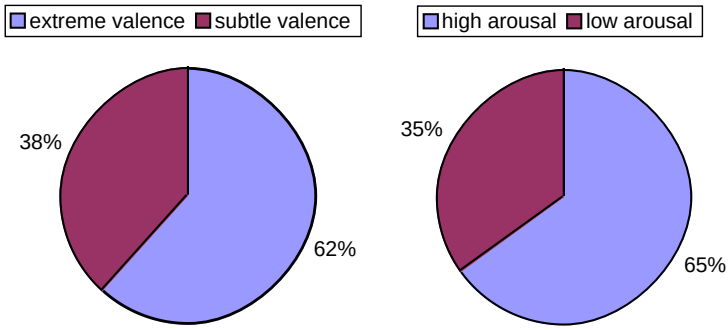

Fig. 10. Frequency of low/high arousal and subtle/extreme valence animations.

animations were used significantly ($X^2(1) = 106.80$, $p < 0.01$) more often than the subtle valence animations (see Fig. 10).

Seven of the animations were in both groups: low arousal and subtle valence. The participants used these animations in 8% of the cases.

4.3. Discussion

The users in the case study preferred high arousal expressions. A possible reason could be that users did not need to use low arousal expression to indicate that they are finished with their turn. Since TelMeA is asynchronous communication software, the turn taking develops automatically in the topic tree. The users can reply to messages at any time, even days after the original message. Another possible reason could be that the communication in TelMeA is more indirect and anonymous than face-to-face communication and users therefore use more intensive expressions.

Another possible reason could be that TelMeA was accepted as an entertainment media from users of the e-kyoshitsu community. As TelMeA employs cartoon-like animation characters, it has not only an aspect of a mere anonymous communication

tool but also of an entertaining presentation tool. Some messages even looked like the users tried to make an attractive "theatre play" with their avatars. Therefore many "cartoon-like" extreme animations are employed in their submissions even though "flaming wars" had not been occurred.

In any case, controlled experiment would be necessary to assess these interpretations. About one-third of all animations used were of low arousal or subtle valence. This is a considerable proportion and underlines the importance of subtle expressions.

5. Conclusions

We developed an enhanced internet forum that enables users to use expressive avatars to communicate their messages. Through an iterative cycle of prototyping and testing we were able to mature the system into a usable communication platform. We conducted an experiment to assess the repertoire of the avatars' expression. TelMeA offers a wide repertoire of expression along the valence dimension. However, on the arousal dimension more expressions should be available on the low end. Overall the repertoire appeared to be sufficient.

The evaluation also suggests that it is difficult to create two avatars that have the exact same repertoire of expressions. Iterative cycles of design and evaluation should be used to carefully design avatars.

The users in a Japanese case study actively used the system and had a preference for the high arousal and extreme valence expressions. Still around every third animation used was subtle. Subtle expressions play an important role in online communities. The repertoire of avatars should include a fair number of them.

The next step in the TelMeA project is to test the cultural dependency of the animations. Certain expressions and gestures might be only understandable for Japanese users. Therefore the described experiment and case study will be repeated in The Netherlands. Another interesting question we are going to address in the future is the temporal dimension. Do users of TelMeA change their usage of animations when they are familiar with the system and the other members of the community?

Acknowledgement

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