

EFFECTIVENESS OF AVATARS FOR SUBJECTIVE ANNOTATION

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Abstract: Consumer Generated Media (CGM) is growing rapidly and the amount of content is increasing. However, it is often difficult for users to extract important contents and the existence of contents recording their experiences can easily be forgotten. As there are no methods or systems to indicate the subjective value of the contents or ways to reuse them, subjective annotation appending subjectivity, such as feelings and intentions, to contents is needed. Representation of subjectivity depends on not only verbal expression, but also nonverbal expression. Linguistically expressed annotation, typified by collaborative tagging in social bookmarking systems, has come into widespread use, but there is no system of nonverbally expressed annotation on the web. We proposed the use of controllable avatars as a means of nonverbal expression of subjectivity, and confirmed the consistency of feelings elicited by avatars over time for an individual and in a group. In addition, we compared the expressiveness and ease of subjective annotation between collaborative tagging and controllable avatars. The result indicated that the feelings evoked by avatars are consistent in both cases, and using controllable avatars is easier than collaborative tagging for representing feelings elicited by contents that do not express meaning, such as photos.

1 INTRODUCTION

There has been an increase in development and utilization of social software that shares private information such as photos and diaries, among a community or the general public. As each user publishes their own contents on the web, the amount of web content has increased rapidly. Therefore, it has become difficult to extract necessary information and much of the information that is available is left unused. The current mainstream method of information retrieval is to use keywords for the contents, but searching by subjective information, such as feelings or intention, is expected to allow users to find forgotten information. Therefore, we propose gsubjective annotationh in which users annotate contents with subjective information, and construct a content management system to store and browse the contents based on the subjective annotation.

Preliminary experimental results on expressiveness and ease of subjective annotation by collaborative tags used for classification in social bookmarking

systems and blogs suggested that it may be difficult to express subjectivity by verbal expression, such as tags. In this paper, we propose the usage of avatars as a means of nonverbal expression of subjectivity, and report verification of its validity by experiments on the consistency of feelings elicited by avatars over time for an individual or a group of people. We also compare the expressiveness and ease of subjectivity between avatars and tags.

2 WEB CONTENT MANAGEMENT AND ANNOTATION

Consumer Generated Media (CGM), such as weblogs (commonly referred to as "blogs") and photos, which are published by users have increased rapidly because the contents previously stored on local terminals are now available on the web. To manage this large amount of web content, social bookmarking services

have appeared.

Social bookmarking services manage their contents from the bottom-up by sharing annotations, such as tags or keywords, which are added to the contents by users (Mathes, 2004). This enables the discovery of related contents through tags, and users can reach information that would otherwise be difficult to find.

However, increasing the number of tags makes it difficult for users to keep track of their tags. Social software stores the contents that are important to users, but there are few chances to browse these contents again. Even if tags are added to ease content searching, users will not search the contents without a clear purpose, and many of the contents that may be important for users may be left unused in social software.

3 SUBJECTIVE ANNOTATION

3.1 What is Subjective Annotation?

We propose "subjective annotation," which involves adding subjective information, such as feeling or intention, to the contents. Currently, it is common to annotate web contents using a number of tags. Most of these tags explain the contents objectively, and only a few tags indicate subjective information. The social bookmarking service del.icio.us¹ has some tags that indicate subjectivity, such as "to be read," which make it easier for users to determine how to use the contents. At the photo sharing service Flickr², some photos are tagged "cute" or "cool", and users can search and classify photos according to their own impressions and values (Golder and Huberman, 2006). Therefore, subjective annotation can assist users to make efficient use of web contents.

3.2 Contents Management System based on Subjectivity

Here, we constructed a content management system based on subjective annotation that helps users to discover knowledge from their past experiences. The proposed system recreates their past feelings and excitement by using subjective annotation over a wide variety of contents and reminds users of their behaviors. The system targets the web contents of social software, such as photo sharing, social bookmarking, and schedule sharing services that are browsed only

¹<http://del.icio.us/>

²<http://flickr.com/>

when users need them. To utilize wasteful accumulated contents, the system accumulates the contents with subjective annotation in social software and provides a content browsing environment based on subjectivity.

3.3 Collaborative Tags for Subjectivity Expression

The expression of subjectivity must be considered to implement subjective annotation. Most annotations describe the contents in some way, and the expressiveness of the current annotation methods regarding subjectivity and user stress must be assessed. First, we adopted collaborative tagging, which is commonly used as a means of annotation of web contents, as an expression of subjectivity and performed an exploratory experiment on the expressiveness of subjectivity and user stress.

In the experiment, 20 participants tagged 10 photos with subjective information, such as feelings and impressions, and answered a questionnaire survey. A wide variety of subjectivity, such as intention, feelings, and imagery unclear, were used as tags. However, participants reported feelings of stress regarding the difficulty of verbalizing subjectivity.

The questionnaire survey indicated that it is difficult to verbalize subjectivity with tags. Therefore, subjectivity must be expressed by a nonverbal method. We adopted an avatar for this purpose, as it seemed suitable to express subjectivity such as feelings. It is easy to deal with avatars on computers and users often identify themselves with avatars. Therefore, avatars allow users to express their feelings naturally and they are able to express their feelings with gestures. In addition, recognition of avatars is consistent from person to person, even with different nationalities (Ekman and Friesen, 1971).

4 AVATARS AS NONVERBAL EXPRESSION OF SUBJECTIVITY

4.1 Controllable Avatars for Subjective Annotation

We adopted a controllable avatar to express a wide variety of feelings. The avatar has a variety of patterns of facial expressions, and arm and leg positions. Figure 1 shows examples of avatars and Figure 2 shows all parts of the avatars. Users combine these face, arm, and leg parts to express their feelings.



Figure 1: The examples of the avatar.

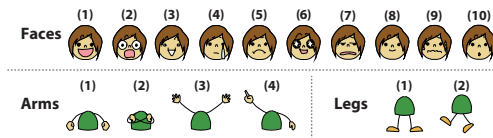


Figure 2: The avatar consists of faces, arms and legs.

The avatar used for nonverbal expression of subjectivity is shown in Figure 1 as a cartoon character. There are three reasons why we use this type of avatar. Firstly, We think Japanese show a preference for animated illustrations rather than realistic figures like Second Life³'s avatars. Secondly, Takahashi et al. (Takahashi et al., 2005) used two different cartoon imaginary characters which are neither human nor animals. On the other hand, a human character is adopted as an avatar in this research, and enables the users' identities to be expressed by changing hairstyles or hair colors. This is so that the avatar of each user can be recognized by their looks. However, our avatars don't emphasize the users' identities such as changing clothes and accessories, because the main focus of our avatars is feeling expression by faces and body movement. This is the last reason. Thus, our avatars are different from the avatars of Yahoo!Avatars⁴. Also we will not refer to hairstyles of avatars in this paper.

4.2 Validity of Avatars for Nonverbal Expression of Subjectivity

The subjective information that is added by subjective annotation will be used as queries to search and classify contents. Furthermore, information filtering based on subjectivity of other users is possible by sharing subjective annotation among communities or the general public, similar to collaborative tags. To achieve this, the following factors must be assessed by experiments.

- Consistency of feelings elicited by avatars for an individual over time.
- Consistency of feelings elicited by avatars in a group of people.
- Comparison of feeling expressiveness between avatars and collaborative tags.

³<http://secondlife.com/>

⁴<http://avatars.yahoo.com/>

It is necessary to assess whether subjectivity, particularly feelings, elicited by avatars changes significantly over time for an individual, and also within groups of people. Moreover, the comparison of feeling expressiveness, satisfaction level of their own expression, and adaptability on of contents must be conducted between avatars and collaborative tags.

5 CONSISTENCY OF FEELINGS ELICITED BY AVATARS FOR AN INDIVIDUAL OVER TIME

5.1 Experimental Overview

To facilitate use of avatars for personal information retrieval and experience browsing, the consistency of feelings elicited by the avatars over time was assessed based on a semantic differential method. Moreover, features of feelings over time for each avatar pattern are also discussed.

Avatars. In this experiment, the variety of avatar faces was limited to face parts from (1) to (6) shown in Figure 2 that were frequently used in a preliminary experiment of feeling expression. Leg parts were fixed to leg parts(1), because participants reported a greater effect of the arms than the legs in the preliminary experiment. A total of 24 avatars (6 face parts × 4 arm parts) were presented to the participants.

Participants. Two men and 2 women ranging in age from 23 to 25 years participated in this experiment. All participants were Japanese university students.

Measurement. In this experiment, participants rated the feelings elicited by the avatars using a semantic differential method based on the two-dimensional model of emotion proposed by Lang (Lang, 1995). Participants rated the arousal and the valence from 0 (lowest) to 100 (highest) for each of avatar pattern on six continuous-valued scales. A total of 144 stimuli (24 avatar patterns × 6 scales) were presented to the participants.

Each scale was anchored with a pair of antonymous words in Japanese, which were determined hierarchically. In the preliminary experiment, participants labeled each avatar pattern with various words indicating feelings. Then, pairs of antonymous words were made from frequently used words. The pairs of words were reduced to the six pairs shown below, which are frequently used in the areas of social psychology and personality psychology, according to the survey results of scale construction of pairs of Japanese antonymous words in a semantic differential



Figure 3: The experimental setup.

method reported by Inoue et al (Inoue and Kobayashi, 1985). The approximate translations to English are as follows:

- Arousal
 - scale 1 (intension) : intense - calm
 - scale 2 (activeness) : active - passive
 - scale 3 (strength) : strong - weak
- Valence
 - scale 4 (joy) : joyful - sad
 - scale 5 (amusement) : amusing - boring
 - scale 6 (favor) : likable - dislikable

Process.

1. After receiving instructions, participants were trained to evaluate feelings.
2. Avatars were presented on the computer screen (see Figure 3). Moreover, the order of presentation of faces and arms is counterbalanced across the trials.
3. Participants evaluated the feelings elicited by the avatars on each scale. The order of scales was randomized for each avatar. The time limit was set to 40 s for each avatar pattern to induce an intuitive response.
4. Twenty-four avatars were presented by iterating steps 2 and 3. After evaluation, participants answered the questionnaire.
5. From step 1 to 4 was defined as a trial. Six trials were conducted at the following intervals: 1 h, 2 h, 1 day, 2 days, 4 days.
6. More than 2 weeks after step 5, participants were presented with all avatars and means of their evaluated values for each scale. Participants indicated their satisfaction level from 0 to 100.

5.2 Results and Discussion

We evaluated the standard deviation of the spread in the evaluated values for feelings elicited by each avatar pattern and defined that as the statistical value. Feelings elicited by the avatar pattern that are more than $\text{mean}+1SD$ were particularly inconsistent. Conversely, feelings elicited by the avatar pattern that

Table 1: Amount of avatar patterns outside the $\text{mean}\pm 1SD$ range.

Participant	$>+1SD$		$<-1SD$	
	Arousal	Valence	Arousal	Valence
A	17	2	5	14
B	9	9	7	12
C	17	9	2	14
D	14	8	5	15

are less than $\text{mean}-1SD$ were particularly consistent. There were average of 21 avatar patterns that are more than $\text{mean}+1SD$ for participants. These patterns corresponded to only about 14% of the entire 144 stimuli (24 avatar patterns \times 6 scales). Therefore, feelings elicited by avatars are generally consistent over time for individuals. Moreover, Table 1 shows the amounts of avatar patterns outside the $\text{mean}\pm 1SD$ range of arousal and valence.

There were more avatar patterns that are more than $\text{mean}+1SD$ in scales of arousal (see Table 1). On the other hand, there were more patterns that are less than $\text{mean}-1SD$ in scales of valence (see Table 1). Therefore, valence elicited by avatars is more consistent over time than arousal for an individual.

Figure 4 shows the transition of the total evaluated values for each participant throughout all trials. The figures show that the total evaluated values of arousal changed more drastically than valence throughout all trials.

The evaluated values of valence, such as "joy" and "favor", were simply increased and evaluated more positively due to the mere exposure effect (Zajonc, 1968). However, the evaluated values of arousal decreased from the first to the third trial, which may have been due to loss of novelty with three trials in one day.

Furthermore, two weeks after the experiment, participants reported the satisfaction level of each avatar pattern and its average evaluation value throughout all trials. The satisfaction level was defined as the statistical value, and we inspected the frequencies of face parts and arm parts in avatar patterns that are less than $\text{mean}-1SD$. Face parts (2) (see Figure 2) appeared frequently in avatar patterns that are less than $\text{mean}-1SD$. The satisfaction level of face parts (2) tended to be low, as it was difficult for participants to determine whether the feeling was positive or negative from the surprised face and the evaluation of valence was inconsistent. On the other hand, arm parts (3) (see Figure 2) appeared frequently in avatar patterns that are more than $\text{mean}+1SD$. The satisfaction level of arm parts (3) tended to be high, as waving arms emphasized the feeling expressed by avatars and made a deep impression on the participants.

Taken together, these observations indicated that

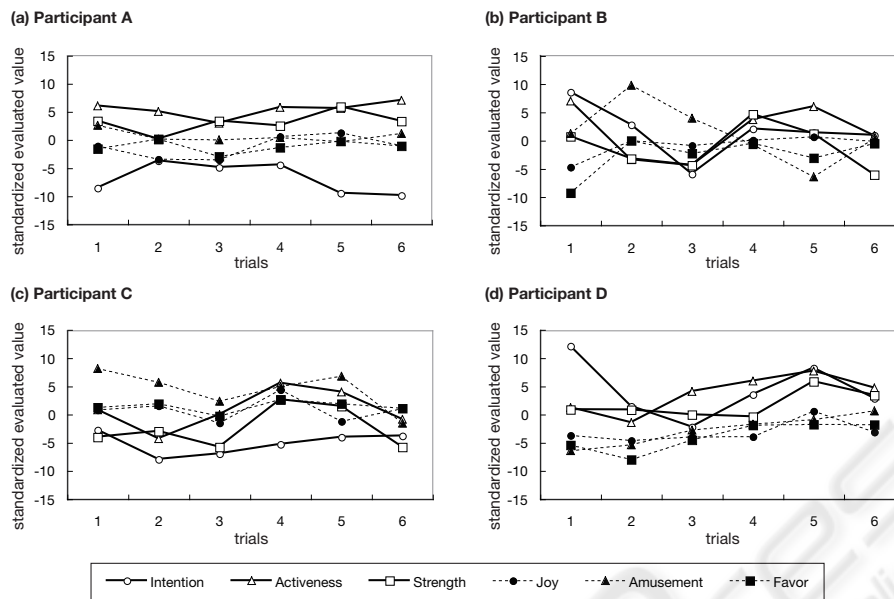


Figure 4: Total evaluated value of each scales.

feelings elicited by avatars are consistent over time for an individual.

6 CONSISTENCY OF FEELINGS ELICITED BY AVATARS IN A GROUP OF PEOPLE

6.1 Experimental Overview

We examined use of an avatar as a query for information filtering in a group of people as with collaborative tags. The consistency of feeling elicited by avatars in a group of people was assessed based on a semantic differential method in the same way as in the experiment described in Chapter 5. Features of feelings generated by participants are also discussed.

Design. A 6(faces) \times 4(arms) within-subject experiment was performed. The avatar parts used in this experiment were the same as those described in Chapter 5. Overall, 24 avatars were presented to the participants.

Participants. Twenty men and 4 women ranging in age from 21 to 27 years participated in this experiment. All participants were Japanese university students.

Measurement. This experiment was performed based on the semantic differential method in the same way as the experiment described in Chapter 5. The pairs of antonymous words anchored on the six scales

were also the same as those in Section 5.1. A total of 144 stimuli (24 avatar patterns \times 6 scales) were presented to the participants.

Process.

1. After receiving instructions, participants were trained to evaluate feelings.
2. Avatars were presented on the computer screen. Moreover, the order of presentation of faces and arms is counterbalanced across the participants.
3. Participants evaluated the feelings elicited by the avatars on each scale. The order of scales was randomized for each avatar. The time limit was set to 40 s.
4. Twenty-four avatars were presented by iterating steps 2 and 3. After evaluation, participants answered the questionnaire.

6.2 Results and Discussion

We evaluated the semi inter-quartile range of standardized evaluated values for each scale, for each avatar to inspect the spread of feelings, and defined that as the statistical value. The feelings elicited by avatar patterns that are more than $\text{mean}+2SD$ were particularly inconsistent. Conversely, the avatar patterns that are less than $\text{mean}-2SD$ were very consistent. There were 7 avatar patterns that are more than $\text{mean}+2SD$. These patterns accounted for only about 7% of the total of 144 stimuli (24 avatar patterns \times 6 scales). Therefore, feelings elicited by avatars were consistent in a group of people as a whole.

Table 2: Amount of avatar patterns outside the mean \pm 2SD range.

>+2SD		<-2SD	
Arousal	Valence	Arousal	Valence
7	0	0	2

Meanwhile, the amounts of patterns outside the mean \pm 2SD range of the semi inter-quartile range were summarized for arousal and valence (see Table 2). There were more patterns that are more than mean+2SD in scales of arousal. On the other hand, there were more patterns that are less than mean-2SD in scales of valence. There are two reasons why valence elicited by avatars was more consistent than arousal. First, scales of valence are nominal, and users could recognize feelings from facial expressions. The other reason is that arousal is an interval scale and its degree is inconsistent even within an individual.

Avatar patterns and scales that are more than mean+2SD are discussed in detail. Valence showed a much wider spread than arousal when the avatar consisted of face parts (3), because it is difficult to determine between pleasure and displeasure from the excited face. Moreover, the evaluation of scale for joy was particularly consistent as compared to other scales.

Two-way ANOVA of the 6(faces) \times 4(arms) patterns was conducted for each of the following scales to inspect the features and effects of feelings elicited by avatars.

Intension. The interaction between faces and arms was marginally significant ($F(15, 345) = 1.58, p < .1$). Fisher's least significant difference (LSD) post hoc test was used to test the differences in pairwise comparisons. The face parts (2), (3), and (5) were different from (1), (4), and (6) ($p < .05$). Therefore, these face parts increased arousal. Meanwhile, arm movement also affected intention, and arm part (3) was significantly different from arm parts (1), (2), and (4) ($p < .05$).

Activeness. The main effects of faces and arms were significant ($F(5, 115) = 38.42, p < .01$; $F(3, 69) = 23.53, p < .01$, respectively). However, there was no significant interaction between faces and arms ($F(15, 345) = 1.13, n.s.$).

Strength. The interaction between faces and arms was marginally significant ($F(15, 345) = 1.74, p < .1$). On LSD post hoc test, face part (4) was significantly different from the other face parts ($p < .05$).

Joy. The interaction between faces and arms was significant ($F(15, 345) = 2.18, p < .05$). On LSD post

hoc test, the face parts (1) and (3) were significantly different from the other face parts ($p < .05$).

Amusement. The interaction between faces and arms was significant ($F(15, 345) = 2.31, p < .01$). On LSD post hoc test, face parts (1) and (3) were significantly different from the other face parts ($p < .05$).

Favor. The interaction between faces and arms was significant ($F(15, 345) = 2.25, p < .01$). On LSD post hoc test, arm parts (3) was significantly different from arm parts (1) and (2) when face parts was (3) or (6) ($p < .05$).

Taken together, these observations indicated that feelings elicited by avatars are consistent in a group of people and facial expressions affect valence, while arm movements affect arousal, although face parts (2), (3), and (5), which expressed surprise, excitement, and anger, respectively, increased arousal.

7 COMPARISON OF FEELING EXPRESSIVENESS BETWEEN AVATARS AND TAGS

7.1 Experimental Overview

The expressiveness, gap in expression according to the contents, ease, and satisfaction of expression were compared between avatars and collaborative tags representing nonverbal and verbal expression, respectively. In this experiment, participants expressed their feelings elicited by contents, which consisted of articles as verbal contents and photos as nonverbal contents, using avatars or tags.

This experiment was performed using all of the avatar parts shown in Figure 2. The participants expressed their feelings elicited by contents with a combination of these avatar parts. The format of collaborative tags was open-ended, and participants were permitted to use multiple tags for a single content. Furthermore, participants were allowed to skip the expression if they felt difficulty in expressing their feelings.

The contents were articles and photos on the web. Practically, top 10 bookmarked articles in Yahoo!Japan News⁵ as of September 5th, 2007 and top 10 bookmarked photos in Zorg⁶ (photo sharing service) as of August 1st, 2007 were chosen for this experiment.

⁵<http://headlines.yahoo.co.jp/>

⁶<http://www.zorg.com/>

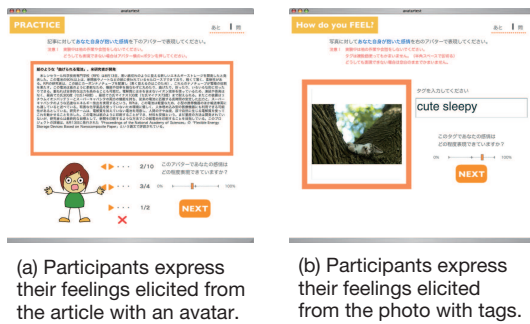


Figure 5: The experimental setups.

Participants. Twenty men and 4 women ranging in age from 21 to 27 years participated in this experiment. All participants were Japanese university students.

Process.

1. After an instruction, the participants are trained to express their feelings using avatars or tags to the sample article and the sample photo. Moreover, the order of using avatars and tags is counterbalanced across the participants.
2. Ten articles and 10 photos were presented on the computer screen (see Figure 5). The participants expressed their feelings regarding the contents using avatars or tags, respectively. The presentation order of articles and photos was counterbalanced across participants.
3. The participants expressed their feelings regarding the same contents in the same way as in steps 1 and 2 using tags or avatars that have not been used before.
4. After evaluation, participants answered the questionnaire about their satisfaction.

7.2 Results and Discussion

Figure 6 shows the results of 3 questionnaires on the satisfaction of feelings expression by avatars and tags. The participants responded regarding which of the two expression methods they preferred. Each questionnaire was about the entire contents, articles, and photos. In all questionnaires, none of the participants indicated a preference for tags over avatars.

With regard to all contents, more than 70% of the participants indicated a preference for expressing their feelings using avatars (see Figure 6(a)). This may have been because an avatar can express feelings that are difficult to verbalize, and an avatar can describe the degree or strength of a feeling.

On the other hand, 58% and 67% of participants indicated a preference for avatars for expression of feelings regarding articles (see Figure 6(b)) and for photos (see Figure 6(c)), respectively. Moreover, 38% and 8% of participants indicated that tags are better than avatars for articles and for photos, respectively. Based on the opinions of the participants, it is not difficult to express feelings with tags in the case of articles, as articles themselves are in verbal format. However, the meanings of photos cannot be defined clearly, and it is difficult to verbalize feelings elicited by photos.

In this experiment, participants were allowed to skip expression of feelings if they decided that expression with the suggested method was impossible. The number of skips was 21 times using avatars and 42 times with tags. Thus, it seemed to be easier for users to use avatars than tags.

8 RELATED WORKS

There has been a lot of studies using avatars: creation of co-presence in online communication (Ishii

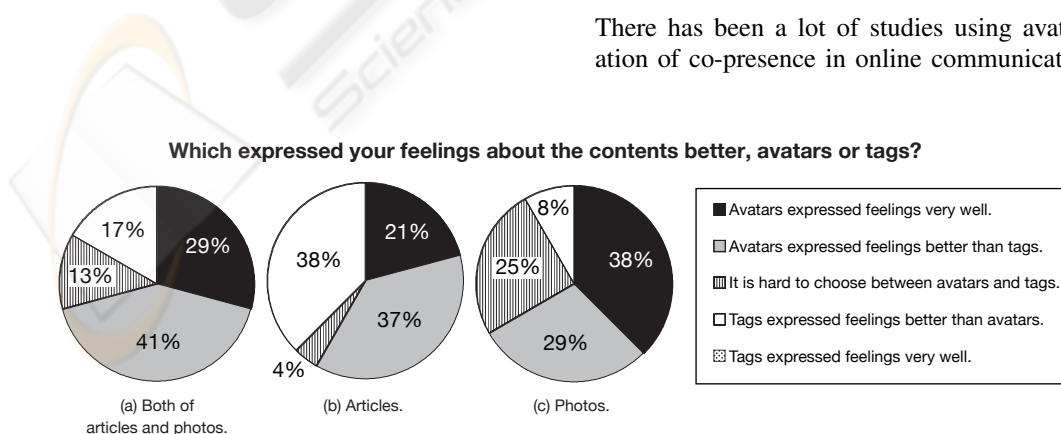


Figure 6: Results of questionnaires about satisfaction level of feeling expression.

and Watanabe, 2003), interpretation of avatar's facial expressions (Koda and Ishida, 2006), description language for avatar's multimodal behavior (Prendinger, 2004) and so on. However, there has been a few cases using avatars for feeling extraction. In this section, we will mention representative studies that use avatars for feeling extraction.

Takahashi et al. (Takahashi et al., 2005) constructed TelMeA, an asynchronous communication support system, which presents the relations among participants and the relations between contents and conversations by the behavior of static avatars. The purpose of TelMeA is similar to ours, because TelMeA was designed to ease interpretation of feelings difficult to express verbally, by combining the the contexts and the behaviors of avatars. However, we defined feeling expressions by avatars as a part of subjective annotation, and planned to use them like collaborative tags for information retrieval and classification in contents sharing. For this reason, we verified the consistency of feelings elicited by avatars. Moreover, our avatars could express feeling towards the contents not only with clear context, but also with unclear context such as photos.

Another case, PrEmo (Desmet, 2003), is a tool to assess emotional responses toward consumer products. In PrEmo, avatars have 14 behaviors, which consisting of 7 positive and 7 negative behaviors. Users rate each avatar based on the feelings elicited by the products. This tool enables product impression analysis based on user's feelings. The purpose of PrEmo is similar to ours because it was designed to analyze feelings elicited by targets. However, the results of feeling analysis for each product using PrEmo were mapped all together in the emotion space structured by 14 avatar behaviors. Therefore, users cannot easily share their feelings elicited by each product. Moreover, in PrEmo, the rating for each avatar only indicates that the feeling that each avatar represents is present in the user's feeling elicited by products. On the other hand, our avatar can express not only the presence of feelings, but also degrees of them.

9 CONCLUSIONS

We proposed subjective annotation where users add subjective information, such as feelings and intention, to the contents. As it is particularly difficult to verbalize a feeling, we adopted avatars to express feelings. To use an avatar as the interface of subjective annotation, the consistency of feelings elicited by avatars over time for an individual, and also the consistency in a group of people were assessed. The results indi-

cated consistency for both cases, although the variation of arousal was wider than that of valence.

In addition, a comparison was conducted regarding feeling expressiveness and satisfaction level between avatars and collaborative tags. The results indicated that avatars are more suitable than tags for expression of feelings, particularly in cases with contents that include no context and no message, such as photos. Overall, avatars could be used for expression of subjective annotation. In future studies, we will improve the control interfaces of avatars to make them more intuitive and continue to verify the practical usefulness of subjective annotation with avatars.

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