

Evoking Emotions in a Story Using Tactile Sensations as Pseudo-body Responses with Contextual Cues

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Abstract. In this paper, we propose a method to evoke multiple emotions by presenting a combination of some tactile sensations in the contextual situation of others' experience. Recent psychological researchers have argued that some sort of emotion evokes through recognizing not only change in real body reactions but also feedback of sensory stimuli that resemble the change in somebody reaction. On the other hand, evoked emotion varies depending on a context of their experience, even if the change in bodily response is same. Based on the knowledge, we hypothesize that providing a variety of pseudo-physiological responses with a controlled context can evoke various emotions, even when the pseudo-physiological responses are the same. In order to test this hypothesis, we made a system named "Comix: beyond," which evokes seven types of emotion using three tactile sensations as pseudo physiological responses associated with the context of the story of the comic.

Keywords: Emotion, Evoking emotion, two-factor theory of emotion, comic, context.

1 Introduction

In every museum, the information on a past event is conveyed to present through exhibiting extensive historic materials. In order to convey and promote understanding toward the past, curators have been trying to convey not only the detail of exhibited historical materials but also background information concerning the materials. The background information includes information of historical backdrop such as the reason why the materials were made, people's lives at the day and relationships between people or countries. Such background information is not easy to convey. The reason is that it is difficult to replay all backdrop since the amount of information is unduly extravagant. Besides, such information is formless. Existing ways to describe background information rely on text or visual expression such as pictures, movies and 3D models. However, there is a limit in information that can be described using only these.

On the other hand, conveying the background information by reaching five senses through introduction of digital technologies has been attempted recently. This enables the visitors to experience the past event. Nevertheless, it is hard to re-create past people's subjective information, such as atmosphere of the past and past people's feeling.

We focus on human emotion, as one of the background information that is representing is not easy. The human history has been driven by human emotion. Knowing contextual the past people's emotion would enable imagining oneself in the position of the people and re-experiencing others' thinking or behavior. We think that the realization of the technology to replay contextual past people's emotion would promotes understanding of information, for example, why the past event happened and why the people took action at that time.

Then this paper discusses on methods to experience others' emotion in some context. As an experimental technique to give contextual cue and others' emotional experience, we propose a method to present the experience of a character of comics associated with the context of the comics. Comic is a medium that can present context simplistically, whether the time that is flowing depicted in the story is long or short. In this paper, we propose and make a VR system to evoke multiple emotions that is the same as emotions that the character experiences in the comic taking this advantage of the comic.

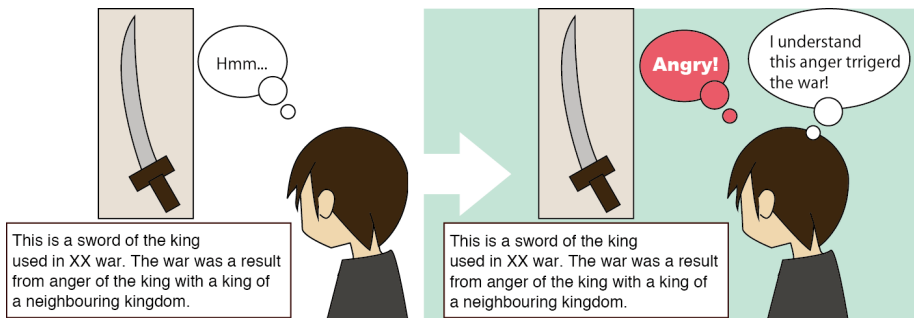


Fig. 1. Understanding the past by knowing the past others' emotion

2 Evoke Emotions Using Virtual Reality

2.1 Emotion

Emotions are the observable expressions of the movement of mind, such as pain, joy, disgust, surprise and anger. "Affect" and "feeling" are used as words with a similar connotation. In this paper, "emotion" is treated as the term referring to one's mind that includes "affect" and "feeling."

Emotion and physiological response have a close relationship. It has been discussed whether evoking emotion or change in physiological response is prior.

Some theories advocated that changing in physiological responses occurs prior to changing in emotion have been propounded during about the last hundred years. Many researchers argued the theories. The typical example of the theories is James-Lange theory [1]. Also, it is clarified that some sort of emotion evokes through recognizing not only change in real body reactions but also feedback of sensory stimuli that resemble the change in some body reactions. Valins et al. confirmed this notion through the false heart-rate feedback study [2].

On the other hands, what kind of emotions evoke is determined by not only bodily responses change but also recognition of causal attribution. Schachter et al call this for Two-factor theory of emotion [3]. The term “causal attribution” is the occasion that is earned recognition as the reason for the bodily responses changes. This theory is experimentally confirmed by Dutton et al.’s “Capilano Suspension Bridge experiment” [4]. In this study, male subjects misattributed the physiological strain resulting from going across a scary bridge to the emotional excitement of meeting an attractive woman. Causal attribution is determined by the context that the person experienced. That is to say, an evoked emotion varies depending on a context experienced even if bodily response change is the same.

2.2 Evoking Emotion Using Virtual Reality

Recently, based on above-mentioned knowledge in psychology, some HCI techniques are focused on trying to evoke and enhance a particular emotion. There are mainly two approaches for evoking and enhancing emotions.

One is an approach to evoke emotions with a feedback of specific sensory stimulus. For example, Nishimura et al. created a tactile device that attempts to control affective feelings through artificial autonomous physiological reactions [5]. Fukushima et al. proposed an interface that tries to enhance chilly feeling by raising their body-hair with static electricity during watching a scary movie [6]. Yoshida et al. showed that letting people recognize slightly deformed their face in the mirror-like system as a change in their own facial expression can evoke pleasant and unpleasant feelings [7]. “Tear Machine” is a piece of interactive artwork that can induce a powerful distressed emotional state [8]. These means control virtual bodily responses that human cannot control consciously or pay no attention normally.

Another is an approach to evoke emotions by letting users change physiological responses related to particular emotions consciously by their own. For instance Tsujita et al. propose a system that evoke pleasant mood by letting the user make smiling face intentionally by presenting a picture, which represents a face that reflects the user’s facial expression [9]. Sakurai et al. created an artwork, which evokes the tense feeling by movement of a balloon in conjunction with a respiratory condition controlled actively by the user [10]. Shifting the corresponding of respiratory condition and the movements brings the situation that the user gird for what happened s/he cannot understand and the tense feeling evokes and enhances. In these ways, specific emotion evokes by replacing recognized causal attribution from the user’s intention to external stimuli, such as changed face and unintended movement of the balloon.

The latter approach requires active controlling of own physiological responses. However, many of the bodily responses related to various emotions are not easy to alter, because these are automatic responses, such as heart-rate and bodily temperature. Also it is difficult to make people change any move actively in similar fashion in large space where the general public exist, like museums. Therefore, we have an approach to represent others' emotions in line with the context of the others' experience according to above the former method.

Existing ways to evoke or enhance any emotions aim to evoke a single-species emotion using a single species sensory stimulus. However, more than one bodily responses change when an emotion evokes. Also, evoked emotions vary associated with the context of the experience even if same bodily reactions change as noted before. Based on the knowledge, we hypothesis that adequately combining sensory stimuli that is recognized as change in own bodily reactions in the context of others' experience would be able to evoke the same emotions as the others' experienced.

According to the hypothesis, we propose a method to evoke multiple emotions using limited number of pseudo-bodily responses associated with the contextual other's experience.

3 Evoking Multiple Emotions Using Limited Number of Pseudo-body Responses with Contextual Cues

3.1 Evoking Multiple Emotions Using the Combination of Tactile Sensations

As previously mentioned, there are many physiological reactions that relate to emotion. Among them, we focus on heart-rate, vital warmth and chest pressure. The reason why we focus on heart-rate is that heart-rate has a close relationship with various emotions [11]. Also the reason why we take notice of vital warmth is that there is an available knowledge that the sensation is linked with pleasant-unpleasant feeling [12]. As concerns the chest pressure, although having said that it made us feel a tightening in one's chest, whether artificial chest pressure influences on both positive and negative emotion if the pressure is applied around the breast.

We developed a prototype system to present 3 sensory stimuli that resemble heartbeat, vital warmth and chest pressure. The system presents vibration as the pseudo-heartbeat with a speaker. This speaker is attached to the left side of the chest and provides tactile sensation resembling heartbeat. The configuration and the method to present the tactile sensation refers to a method proposed by Nishimura et al. [5]. The rate of pseudo-heartbeat is 96bpm.

This system also provides pseudo-vital warmth, with two Peltier devices. The Peltier devices are attached at the center of the chest and the broad on the back. Also the devices give the warm sensation / cold sensation to the body. The temperature to present each sensation is 45 / 25 degrees in Celsius. These temperatures bring pleasant / unpleasant to human [13]. The each Peltier device is covered with thin aluminum plates to spread the temperature to whole chest.

Table 1. The combination of pseudo physiological responses to evoke each emotion

Pseudo- physiological responses	heart-rate	vital warmth	chest pressure
Throb	ON	ON (warm)	OFF
Impatience	ON	OFF	ON
Tense feeling	ON	ON (warm)	ON
Fear	ON	ON (warm)	OFF
Heart ache	ON	OFF	ON
Feeling of going pale	OFF	ON (cold)	ON
Sense of security	OFF	ON (warm)	OFF

The device to present chest pressure consists of an air-bag and an air-pump. The air-bag is attached around whole chest. The air-bag inflates by taking the air in the air- bag to present the pressure. Contrarily, the air comes out from the air-bag when pressure is not required. The time from when the air begin to inflate till when the air-bag is filled up is about 10 seconds.

In this study, based on the knowledge of the relationship between body reactions and emotions, and the result of a preliminary study, we decided to evoke following 7 emotions using the devices: throb (Excitement for others or things,) tense feeling, fear, feeling of a heartache (by sadness or by affection), the feeling of going pale and sense of security. Table 1 shows parameters of tactile sensation and combinations of the sensations as pseudo-physiological responses to evoke each emotion.

To express in the change in physiological responses with a most simple combination these stimulus, this system switch pseudo heart-rate and chest pressure only on or off. Also the temperature changes to only warm condition or cold condition.

It is clarified that it is important to give the user a realization of sensory stimuli as real change in own bodily responses. In order to let the user recognize that provided sensory stimuli as own body changes and to reduce a feeling of strangeness, the devices are embedded into a cloth (a parka.) This configuration and how to attach these devices inside of a cloth are shown in Figure 2.



Fig. 2. The Configuration of wearable system to present tactile sensations as pseudo heart-rate, body temperature and chest pressure

3.2 Comix: Beyond: An Artwork to Evoke Emotions Depending on the Context of the Story of the Comic

As previously mentioned, a context that a user experiences influences on an evoked emotion. As the contents can provide any context, we focused on the comic. The comic is skilled at communicating formless information, such as emotion of the characters and the ambience in each scene.

How people emphasize with the characters and go into the world of the comic is depending on the expressive power of the authors. This is a limit of the paper media. Meanwhile, the knowledge about how to express the character's face and effects in order to depict any character's affects is systematized [14, 15]. Thus, anyone who has the knowledge is possible to select pseudo-body reactions for evoking and enhancing the emotion that is same as the depicted character's affect. The readers can understand the context of the content, since the comic is able to extract essence of context and express the essence briefly with highly formalized depiction.

We decided to use the comic as a tool to present the contextual cue, and made an artwork named "Comix: beyond, " which presenting the contextual cue and sensory stimuli to evoke the same emotions as the character experience in the story of the comic (Fig. 3).

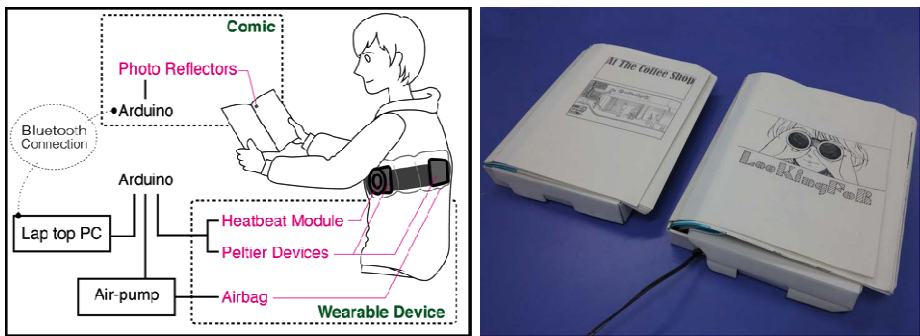


Fig. 3. System configuration of Comix: beyond

Normally various emotions or the ambience is depicted in a page of the comic. In this case, we create a comic includes a story in which a character experience 7 types of emotions above-mentioned in 3.1 as the most simplified context. The comic is designed to contain a scene that a main character has one of the 7 types of emotion in center page spread. This system detects the page, which is read by the user using photo-interrupters embedded in every page of the paper comic. By specifying the emotions as same as the central character in each scene, pseudo-body reactions are provided for evoking and enhancing the emotion associated with the context of the comic.



Fig. 4. The example of the pages of a comic we created

4 Case Study through Exhibiting Comix: Beyond

4.1 Exhibition

We showcased “Comix: beyond” in Siggraph Asia 2013 held at Hongkong from Nov. 19 to 22, 2013 [16]. We observed over 50 visitors who experience the work and investigated their responses. Also we obtained feedback from the visitors about this work. Figure 4 shows the scenes of the exhibition.



Fig. 5. The visitors experienced “Comix: beyond” at Siggraph Asia 2013

4.2 Feedback

Feedback about Comix: beyond from the visitor are classified into 2 broad categories. One is the comment about our proposed method for evoking emotions. Another is the comment about the use of the comic as a medium to provide contextual cue to the user.

As concerns former, we received a lot of feedbacks indicated that the chest pressure provided from the air-bag is most effective to affect emotions, especially the tense feeling. About other emotions but the tense feeling, we receive comments that

the inflation of the air-bag affected for understanding what emotions evoked. In contrast, when the air-bag does not work correctly, the visitors said that it is difficult to distinguish the emotions.

Also the feedbacks indicated that vibration resembles heartbeat is relatively effectiveness to make the visitors understand the difference of depicted emotions. Meanwhile, some visitors said that depicted emotions are likely to be felt and distinguished if the provided vibration is more powerful.

Provided thermal sensation remains a matter of speculation of a relationship between temperature and emotions. Especially, cold sensation is found difficulty recognizing though warm sensation is likely to be felt, since the thermal sensation is provided on their clothes.

As for a whole our approach, we got following feedback: In contents like game or movie, the main methods for evoking multiple emotions is providing physical impact associated with the fixed context. The fresh and interesting thing about our approach is that various emotional experiences are provided by physical stimuli translated into psychological information.

As concerns latter, there were no people puzzled how to read the comic. On the other hand, people could not understand the story said the emotions aimed to evoke is incomprehensible compared with people could understand the story.

In this case, we create an original comic by ourselves. Most of half visitors experienced Comix: beyond said that they want to apply the system when they read existing or their favorite comics.

Comic requires the readers to turn the pages actively. This behavior is able to control the pace of development of the story, despite watching movie or TV programs. Some visitors remarked that the behavior or pace controlled on their own affect the emotions evoked to the readers.

4.3 Discussion

The feedbacks from the visitors indicated that they can feel and distinguish the depicted emotions if they can feel the provided stimuli as their own body reactions. In this system, we provided three kinds of stimuli; heart-rate, vital warmth, and chest pressure. According to the visitors' feedbacks, the chest pressure is the most powerful to evoke intended emotions. Using the chest pressure effectively evoked especially the tense feeling. This is thought to be due to the strength of the pressure feedback. On the other hand, according to the feedbacks, the vital warmth was not effective in this case. This is because the presented thermal sensation is too weak to feel over the clothes. Then we should reconsider the method to present this kind of pseudo-body reactions or parameters to feel the stimuli.

In this user study at the exhibition, the comic is designed to contain a scene that a main character has one of the 7 types of emotion in center page spread by ourselves. Meanwhile, normally various emotions are depicted in a page of the comic. To apply the proposed method to general comics, we should realize a method to design a timeline of emotions to depict based on the storyline in the contents. It is relatively

easy when we apply the proposed method to sequential contents such as movies since temporal progress in the contents is constant.

On the other hand, when we read a comic, we can control the temporal progress. Therefore we need to a complex method to design a timeline of emotions for interactive media whose temporal progress is controlled by a user. While although the user read a comic with the intention of controlling their pace, the design of the contents sometimes strongly affects the pace unintentionally. For example, arrangement of the panels in a comic affects the reading pace and limit it within confined pace. Then the reading pace could be assumed based on the analysis of the composition of the panels.

By comparing the estimated pace based on the contents analysis and the real pace measured by the system with sensors such as a photo reflector, the system could be design the timeline of sensory stimuli to evoke emotions adaptively in response to the type of the user. By using this adaptive method, we believe that we can realize a design method to estimate an appropriate timeline to present sensory feedbacks for evoking emotions in complex story.

5 Conclusion

In this study, we proposed a method to evoke multiple emotions by presenting contextual cue and limited number of tactile sensations that resembles heart-rate, body temperature and chest pressure. Also we created an artwork named “Comix: beyond” as a trial system to realize our proposed method. This work aims to trigger the same emotions as a character experiences in the comic that the user reads.

We exhibited “Comix: beyond” in an exhibition for a user study. The feedbacks from the visitors indicated that they can feel and distinguish the depicted emotions if they can feel the provided stimuli. On the other hand, we need to explore more detail about how combinations of presented sensory stimuli affect emotions. Also we will consider about how to design a timeline of emotions to apply our approach for evoking emotion to contents has complex context.

In this paper, we discuss about the method based on the comics. The proposed method, which enables us to let a user feel an intended emotion in accordance with the contents, can be applicable for museum exhibition that provides exhibits with emotions according to the user’s appreciation action. Moreover we believe the proposed method can be extended to general contents.

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