Development of Estimation Method for Learner's Emotional Concealment During Learning Using Biometric Information and Feedback Model

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Abstract: Although it is important to understand learners' emotional situations in teaching and learning processes, learners sometimes do not express negative emotions intentionally. This study has termed this intentional non-expression of negative emotions "emotional concealment," and examined its estimation from learners' biometric information. In particular, we focused on learners' facial features, and attempted to clarify their relationship with emotional concealment. Using these results, we attempted to quantify emotional concealment from the time-series data of biometric information and detect it as an outlier. Additionally, we attempted to develop a feedback generation system to inform teachers about emotional concealment.

Keywords: Emotional concealment, learning, estimation, feedback, micro-expression

1. Introduction

Inability to understand the content of another person's speech is common in communication. However, continuing a conversation without resolving this situation will result in deterioration in its quality. Since the teaching-learning process can be considered communication between a teacher and learner, the same can happen during learning. In an asymmetrical relationship between the teacher and learner, the learner often does not consciously express negative feelings, such as not understanding (Shinto, 2016). The persistence of this state of mind ultimately leads to a decline in learning quality. This study terms this act of unconscious non-expression of negative emotions as "emotional concealment" (Gross, 2015). Thus, emotional concealment is defined as consciously not expressing one's negative emotions even though one is aware of them. We hypothesized that emotional concealment could be estimated using biometric information. Furthermore, we attempted to quantify emotional concealment based on biometric information and detected it as an outlier. We created a feedback model for the teacher based on the results. It is expected that the teacher will be able to understand the learner's mental state more accurately by estimating the emotions that the learner has concealed. As a result, higher-quality learning will be realized.

2. Overview of the Study

This study aimed to develop a method for the quantification and estimation of emotional concealment using biometric information, and generate a feedback model. In Study 1, we conducted an experiment to determine whether emotional concealment occurs during

learning, and if so, what kind of biometric information it relates to. The results suggest that emotional concealment occurs during learning, and that respiration and pulse wave values are higher during emotional concealment. Additionally, facial expressions of the learners differed between emotional concealment and normal conditions. In Study 2, we conducted an experiment to investigate the differences in facial expressions during learning between emotionally concealed and normal conditions. We analyzed the intensity of facial feature points, called Action Units. Results showed that the number of Action Units around the mouth was higher during emotional concealment. In Study 3, we analyzed the time-series data of the Action Units obtained in Study 2 using an outlier detection method, assuming a relationship between the time interval showing the outlier and emotion concealment. We were able to detect anomalous values, but were unable to derive a significant relationship with the emotional concealment time interval reported in the learners' reflection reports. The detailed methods and results of Study 4 are described below.

3. Analyzing the Feature Points of Learners' Faces in Emotional Concealment and Normal Situations during Learning

From the discussion in Studies 1 to 3 (Shinohara, Muramatsu & Matsui, 2021), it was not possible to derive a significant relationship between the time interval showing abnormal values and emotional concealment in the Action Unit time-series data. Therefore, in Study 4, we conducted an additional experiment in which we asked the learners to watch on-demand content, and captured their facial expressions. Furthermore, we reanalyzed 67 facial landmark outputs from Open Face. The experiment was conducted with 26 Waseda University students (19 men and 7 women). As specific instructions for the experiment, learners were given the definition of emotional concealment, were told that they would be photographed during the experiment, and that they would attend the class twice, once to conceal their emotions when negative emotions occurred and the second time as usual. We obtained biometric data from learners who were watching 25-minute on-demand content on knowledge representation. We asked the learners to report whether they experienced emotional concealment during learning, and if so, at what time of day, while watching the video recordings after the experiment. Learners were asked to report their reflections on each slide of the experimental stimulus. The results showed a difference between emotional concealment and normal conditions around the mouths of all the learners (Figures 1, 2, and 3). They further suggested that the characteristic values around the mouth in the emotional concealment interval repeatedly rose and fell, as reported in all learners' reflection reports. However, for feature points other than the lower lip, some of them, such as those that rise after falling during the emotion concealment interval, do not appear in the emotion concealment interval. Figure 4 shows a graph of the characteristic values of the upper lip. It suggests that the upper lip rises and falls not only during emotional concealment, but also during normal conditions, with no common tendency among many learners. We hypothesized a relationship between emotional concealment and micro-expressions around the mouth (Ekman & Friesen, 1987).

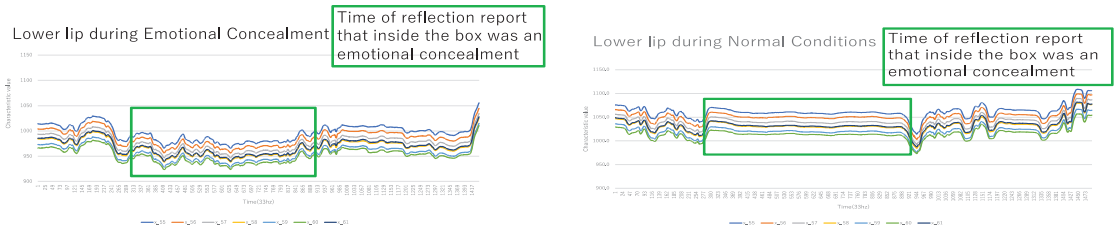

Figure 1. Characteristic score graph of the lower lip of learner A.

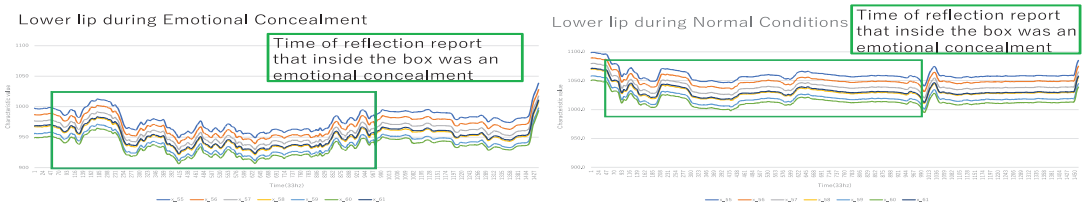

Figure 2. Characteristic score graph of the lower lip of learner B.

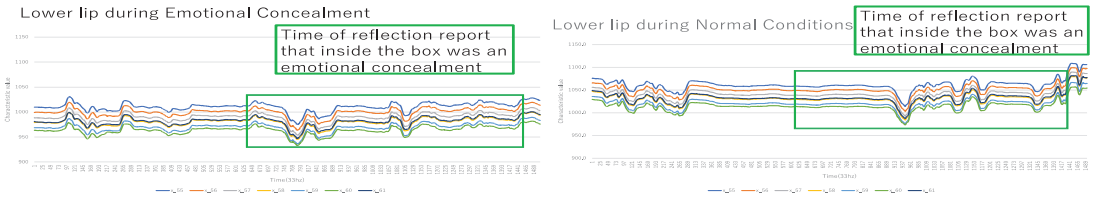

Figure 3. Characteristic score graph of the lower lip of learner C.

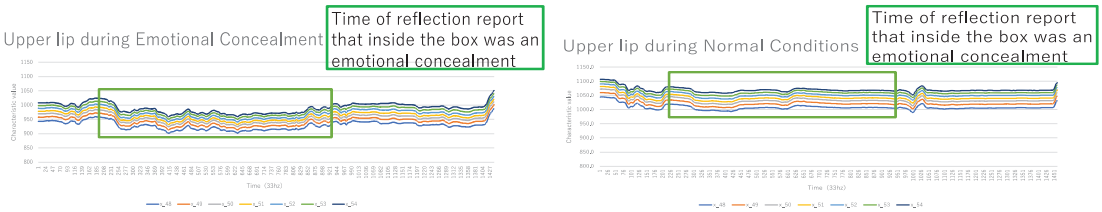

Figure 4. Characteristic score graph of the upper lip of learner A.

4. Summary and Future Tasks

This study aimed to estimate the emotional concealment state using the learner's biometric information, and generate feedback using the results. The results of Study 4 suggest that emotional concealment is related to the learners' facial expressions. The feature points around the mouth moved in detail when the learner was emotionally concealed. Future studies should develop a method for quantifying and estimating learners' emotional concealment, and create a feedback model based on the developed estimation method. Using the developed feedback model, it is necessary to verify whether learning effect improves in actual learning situations.

References

Baltrusaitis, T., Zadeh, A., Lim, Y. C., & Morency, L. P. (2018). Openface 2.0: Facial behavior analysis toolkit. *13th IEEE international conference on automatic face & gesture recognition,* 59-66.

Ekman, P., & Friesen, W. V. (2003). *Unmasking the face.* Malor Books.

Gross, J. J. (2015). *Handbook of Emotional Regulation.* Guilford Press.

Horiguchi, Y., Matsui, T., & Kojima, K. (2008). Detection of student's subconscious turns on studying in e-learning system. *The 22nd Annual Conference of the Japanese Society for Artificial Intelligence.* (in Japanese)

Kayatani, Y., Otani, M., Chu, C., Nakashima, Y., & Takemura, H. (2019). Predicting Laughters in Comedy Drama with Subtitles and Facial Expression. *The 33rd Annual Conference of the Japanese Society for Artificial Intelligence.* (in Japanese)

Shinohara, K., Muramatsu, K., & Matsui, T. (2021). Development of estimation method for Learner's emotional concealment during learning Using Biometric Information. *Japanese Society for Information and Systems in Education 2021 Student Research Presentation,* 53-54. (in Japanese)

Shinto, T. (2016). The Meaning of Negative Emotions in Learning Community: The Concept of Cognitive Apprenticeship. *Ritsumeikan teacher educational studies*, 91-100. (in Japanese)