Exploring the Possibilities of Combining Facial Expression and EEG in Acquaintance Test and Concealed Information Test (CIT)

Chul Min Kim, Tae Ryoun Kim, and Man-Sung Yim*

Abstract— **We measured facial expression and EEG in acquaintance and CIT. Results indicated the evidence of arousal inhibition in facial actions and larger P300 peak-to-peak power, envisioning the possibility of effective deception detection.**

I. INTRODUCTION

Acquaintance tests and concealed information tests (CIT) could be used to investigate crime-relevant knowledge. CIT is a method of detecting deception using memory and recognition instead of directly detecting a lie. Previous studies were based on the difference of P300 event-related potential (ERP) between probe and irrelevant [1]. Lie detection studies using facial expressions distinguished the participants' liars during the interview process [2]. Although the two cues of recognition/deception could be used together, it has received relatively little attention. In this study, we introduce the deception detection methodology by measuring and analyzing both P300 ERP and facial expression using acquaintance tests and CIT paradigm.

II. METHODS

First, the participants distinguished the faces of 5 acquaintances from 20 unknown people. A trial consists of two stimuli, a 300ms picture and a 1500ms plus sign. Twenty-five faces appeared in random order in a session for 30 times each (total 750 trials). Then they committed a mock crime, picking up one out of five items (SD card, key, wallet, USB drive, and credit card) on the desk in the experiment room. Then, their knowledge were tested by CIT Complex Trial Protocol (CTP) [3]. Each item appeared in random order for 60 times (total of 360 trials). Eight participants voluntarily participated in the experiment. Their EEG signals were recorded with 500 Hz, 21-channel international 10-20 system Ag/AgCl electrode cap and Neuron-spectrum 4/P (Neurosoft Ltd., Russia) software. EEG signals were preprocessed to reject artifacts, and the trials exceed 100 μV were also manually rejected. ERPs were calculated for each stimulus type, based on the stimulus-locked average value of (FZ+CZ+PZ)/3. Their faces were recorded using Samsung Galaxy A50 super slow-motion camera (480 fps), and the facial action units (AUs) were analyzed using OpenFace [4]. Facial AUs were also calculated based on the stimulus-locked average value for each stimulus type.

*Corresponding author

Chul Min Kim is with the Department of Nuclear and Quantum Engineering, Daejeon 34141 South Korea. e-mail: usekim00@kaist.ac.kr

Tae Ryoun Kim is with the Department of Nuclear and Quantum Engineering, Daejeon 34141 South Korea. e-mail: bkteddy00@kaist.ac.kr

Man-Sung Yim is with the Department of Nuclear and Quantum Engineering, Daejeon 34141 South Korea. e-mail: msyim@kaist.ac.kr

III. RESULTS

Results showed evidence of arousal inhibition in facial expression: AU01 (inner brow raiser) and AU45 (eye blink).
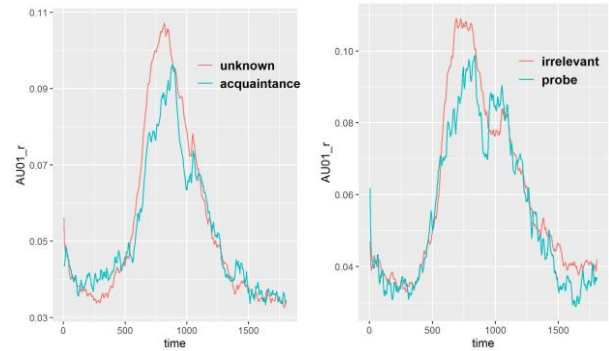

Figure 1. All participants averaged, stimulus-locked AU01 in acquaintance test (left) and CIT (right)

As shown in Figure 1, the averaged stimulus-locked value of AU01 and AU45 were lower in acquaintances and probes. ERPs also showed larger P300 peak-to-peak values in acquaintances (except one participant) and probes (all participants), compared to unknowns and irrelevants.

IV. DISCUSSION & CONCLUSION

The results indicate the possibility of using both EEG and facial expression for acquaintance tests and CITs. Future works could combine the two cues of deception to achieve higher classification accuracy by a deep learning approach.

ACKNOWLEDGMENT

REFERENCES

[1] E. H. Meijer et al., *The P300 is sensitive to concealed face recognition*. International Journal of Psychophysiology, 66(3), 231-237.

[2] V Pérez-Rosas et al., *Deception detection using real-life trial data*. ACM on International Conference on Multimodal Interaction, 2015.

[3] J. P. Rosenfeld et al., *The Complex Trial Protocol (CTP): A new, countermeasure-resistant, accurate, P300-based method for detection of concealed information*. Psychophysiology, 45(6), 906-919, 2008.

[4] T. Baltrušaitis et al., *OpenFace 2.0: Facial Behavior Analysis Toolkit*. IEEE International Conference on Automatic Face and Gesture Recognition, 2018.