Validation of Facial Action Unit for Happy Emotion Detection

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Abstract: One alternative to measure happiness is to use facial expression by measuring facial muscle movement namely facial coding unit or action unit. Rarely studies found to verify validity the action unit of happiness. Accordingly, we held one group pretest posttest experimental design to test the specificity and sensitivity facial expression of happiness. We applied a video experimental paradigm to stimulate facial happiness expression. Openface software was used to measure facial action unit. The participants of this research were 203 Indonesia university students. Happiness emotion stimuli was measured by single item with a scale 0-10. To calculate the specificity and sensitivity we employed ROC (Receiver Operating Curve) statistical technique. Our result shown inconsistent finding for AU6 and AU12 due to Facial Coding Unit System (FCUS) to detect happy emotion. The co-occurrence of other emotion and individual differences in interpreting stimuli influenced the validity of measurement.

1 INTRODUCTION

Facial action coding system is a system of human facial movement standard in emotional expression by facial appearance. This facial coding was applied in computer face recognition software to recognize human emotion by facial muscle observation or micro expression (Erkoç, Ağdoğan, & Eskil, 2018; Kotsia, Zafeiriou, & Pitas, 2008; Liong, See, Wong, & Phan, 2018; Smith & Windeatt, 2015).

Facial action coding is important for better understanding a real time emotion recognition. Application of facial action unit had been proposed for clinical area of psychosis, depression, anxiety and pain. (Pulkkinen et al., 2015; Sanchez, Romero, Maurage, & De Raedt, 2017)

This study focused on validity the use of Facial action unit to measure human emotion especially emotion of happy. Facial emotion of happy expression is important due to representation of mental illness at facial expression (Huang et al., 2013; Kerestes et al., 2016).

According to Facial Action Unit Coding System (FACS), the facial expression of happy emotion can be detected from Action Unit 6 (AU6) represented by cheek raiser (orbicularis oculi) and Action Unit 12 (AU12) represented by lip corner puller (zygomaticus major).

Rarely found studies in validation of using facial action unit to predict human emotion especially happy emotion. Accordingly, we held this research.

2 METHOD

The participants of this research were 203 Indonesian university students age 18-21. Happiness emotion was measured by single item 0-10 scale of happiness. Facial

Action Unit score measured by OpenFace (http://cmusatyalab.github.io/openface/). This research focused on AU6 and AU12 due to FACS for happy emotion. For the experimental procedure, participant was exposed a happy video stimulation for 30 seconds using computer screen. Participant Facial expression was recorded by a high definition video during the stimulation. The video processed at Openface software to calculate score movement unit of AU6 and AU12. At the end of presentation of video, participants were asked to fill the scale single item happiness on a scale of 0-10.

To calculate the specificity and sensitivity we employed ROC (Receiving Operator Curve) statistical technique. We define as true case if the score of happiness response was 8 till 10 on a scale of 10.

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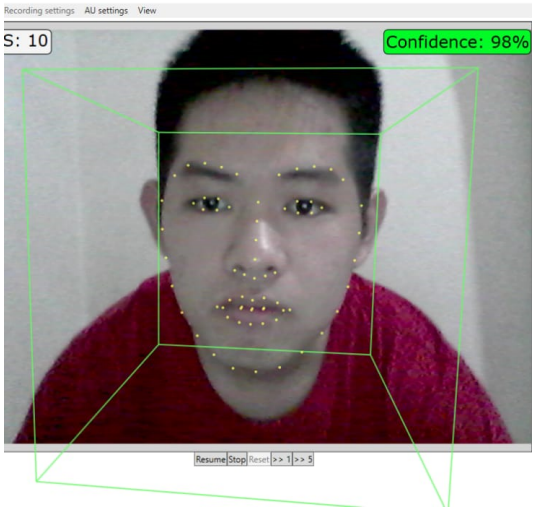
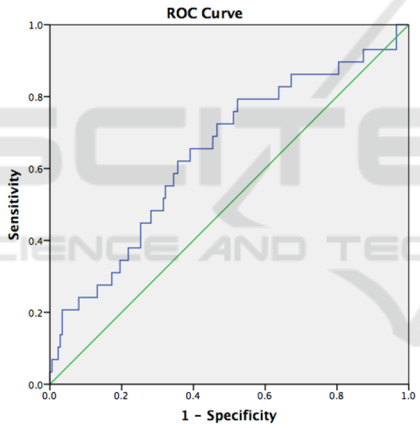
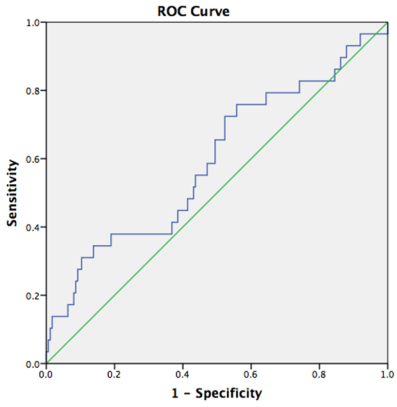


Figure 1: Landmark Facial Action Unit.

3 RESULT



Graph 1: Area under curve AU6.



Graph 2: Area under ROC AU 12

Table 1: Area ROC.

Facial Action Unit	Muscular bases	Area Under RoC		
		Score 10	Score 10,9	Score 10,9,8
AU 1	Inner brow raiser (frontalis (pars medialis)	0.567	0.558	0.544
AU 2	Outer brow raiser (rontalis (pars lateralis)	0.515	0.530	0.492
AU 4	Brow lower (depressor glabellae, depressor supercilii, corrugato r supercilii)	0.570	0.525	0.518
AU 5	Upper lid raiser (levator palpebrae superioris, superior tarsal muscle)	0.572	0.581	0.525
AU 6	Chick raiser (orbicularis oculi (pars orbitalis)	0.644	0.627	0.498
AU 7	Lid tighten (rbicularis oculi (pars palpebralis))	0.529	0.523	0.544
AU 9	Nose wrinkle (levator labii superioris alaeque nasi)	0.557	0.508	0.501
AU10	Upper lip raiser (levator labii superioris, caput infraorbitalis)	0.569	0.578	0.519
AU 12	Lip corner puller (zygomaticus major)	0.594	0.584	0.539
AU 14	Dimple (buccinator)	0.521	0.561	0.524
AU 15	Lip corner depressor (depressor anguli oris)	0.543	0.547	0.443
AU17	Chin raiser (mentalis)	0.603	0.574	0.453
AU 20	Lip stretcher (risorius w/ platysm a)	0.551	0.566	0.481
AU23	Lip tighten (orbicularis oris)	0.475	0.525	0.507
AU 25	Lips part (depressor labii inferioris)	0.577	0.642	0.447
AU 26	Jaw drop (masseter)	0.541	0.597	0.470
AU 45	Blink	0.566	0.579	0.587

Graph 1 and 2 shown the statistical power differentiated using area under ROC between participant who are felt happy with score of happiness 10,9 and 8 on a scale 0-10. All the area under curve shown a negative finding or below 0.7.

Reliability for the video stimulation calculated by tes-retest reliability for 22 participants two months after the experiment. The result shown 0.684 for the test-retest reliability. This result indicated a low reliability for the response of video stimulation. Mean and standard deviation of first measurement were 8.05±1.32 and second measurement were 7.45±1.67 These result implicated a learning bias for the video stimulation.

4 DISCUSSION

Our result indicated AU6 and AU 12 did not support the hypothesis that happy emotion can be detected from facial expression. Facial emotion expression was formed by neck and muscular movement which is influence by sympathetic and parasympathetic nervous system. Thus psychological state in our central and peripheral nervous system influence the facial expression (Meier et al., 2016).

We found negative findings or low differentiated power for AU6 and AU12 to dissociate happy facial expression. Two main factors influenced this result. Firstly, The Individual differences in stimuli interpretation and individual facial emotion expression. (Maoz et al., 2016). However, at trend level we found the higher score of happiness of the participant the higher power of area under ROC for AU6 and AU12 (Table 1).

Secondly, the co-occurrence of other emotion in the same time during the experiment procedure influenced the AU12 muscle of zygomaticus major. This study did not control the other emotions during in stimuli presentation.

The low power to dissociate between the conditions also occurred from the reliability and sensitivity of the computer software. (Menzel, Redies, & Hayn-Leichsenring, 2018). Validity and reliability by replication study and by comparison with human observer are needed.

Theoretical implication of this finding suggested evaluation of psychological emotion measurement from facial muscular emotion or facial action unit. Happiness may a complex emotions and should be detect with multi action unit and multi-modality parameter (head pose, gaze or other action unit).

Practical implication of our finding supported the use of development the use of FACS in human emotion detection for a real time detection system of human emotion.

5 CONCLUSION

Our research finding shown lack of validation measurement using Facial Action Unit. Our study is limited to use AU6 and AU12 due to Ekman's FACS. Other modality measurement of gaze and head posed and other facial action unit may involve in facial happy emotion. Due to limitation of reliability of the video stimulation, experimental design and variation facial expression, further replication studies on validation facial action unit to measure emotion especially happiness is worth to held.

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