COMPARISON BETWEEN TWO FACE MOBILITY INDEXES FOR HYPOMIMIA ASSESSMENT IN PARKINSON'S DISEASE

Elena Pegolo (1), Gloria Boldrini (1), Lucia Ricciardi (2) and Zimi Sawacha (1,3)

1. Department of Information Engineering, University of Padova, Padova, Italy, 2. Molecular and Clinical Sciences Research Institute, St. George's University, London, UK; 3. Department of Medicine, University of Padova, Padova, Italy

Introduction

Parkinson's Disease (PD) is a neurodegenerative disorder characterized by motor and non-motor symptoms. One of the clinical hallmarks of PD is hypomimia, *i.e.*, a condition that leads to a reduction of face expressivity [1]. In order to provide an anatomic description of muscular movements during facial expressions and their subdivision depending on the displayed emotions, the Facial Action Coding System (FACS) was developed that describes facial expressions by means of action units [2]. One of the most used software embedding the FACS is OpenFace (OF) [3]. Recently the authors have developed a face mobility index (FMI), based on anatomical face landmarks, with the aim to provide a quantitative measure of hypomimia through an easy-to-interpret and intra-subject metric of face mobility normalized to the neutral expression.

The aim of this study was to compare two indexes of face mobility in a cohort of PD and healthy subjects: a functional one (FMI) [4] whose metric is purposely devised to capture the physiological aspects of face mobility regardless emotions, since landmarks detection is driven by face muscle insertion points, with an OF based one (FMI_OF), which addresses emotions production from a cognitive point of view, being driven by action units. These different approaches could be combined in order to improve our understanding of PD hypomimia aetiology.

Methods

Videos of the basic emotions and the neutral expressions were acquired by means of a commercial camera (30 fps) on two cohorts of subjects: healthy controls (HC) (n = 17, age = 65.83±8.25 years) and PD (n = 29, age = 68.48±7.81 years). The frames corresponding to the peaks of emotions were extracted and two sets of facial landmarks were tracked. The FMI approach included 40 points determined as the points of insertion of facial muscles; landmarks were tracked with a self-developed software (TrackOnField). Whereas in the FMI_OF the 68 landmarks available in the software, commonly used in face recognition and emotion classification tasks were employed. From the tracked points, two sets of distances were defined as described in Figure 1 and the two indexes computed as in [4]. Finally, in order to compare the two approaches, Pearson correlation was employed at $p<0.05$ significance level.

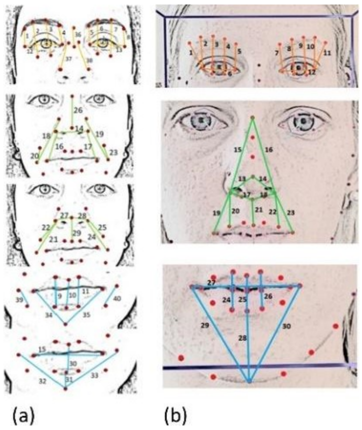

Figure 1: Distances description for the two approaches. (a) FMI (b) FMI_OF

Results

Results of the present study are reported in Table 1. Statistically significant correlations are found in the HC population for certain emotions. No statistically significant correlations were found in the PD cohort of subjects. Our results seem to indicate that the two indexes are capturing different aspects of face mobility that for some specific expressions (*i.e.*, disgust, fear, sadness and surprise) are overlapping. However, when the results are translated to PD individuals this relationship is lacking.

Emotion	ρ HC	p-value HC	ρ PD	p-value PD
Anger	0.1335	0.6638	0.0821	0.6718
Disgust	0.6014	0.0297	0.0459	0.8132
Fear	0.6667	0.0128	0.3453	0.0665
Happiness	0.0287	0.9259	-0.1344	0.4868
Sadness	0.6279	0.0216	-0.0154	0.9367
Surprise	0.5967	0.0313	0.1146	0.5540

Table 1: ρ and p-values of correlation between FMI and FMI_OF per emotion and cohort of subjects

Conclusions

It can be speculated that the two indexes measure different facets of hypomimia and might be complementary in PD. Future developments are needed to validate these measures through surface electromyography.

References

1. Ricciardi et al., *PLoS One*, 12(1):e0169110, 2017.
2. Ekman et al., *Consulting Psychologists Press*, 1978.
3. Amos et al., *CMU*, 6(2): 20, 2016.
4. Pegolo et al., *Sensors*, 22(4): 1358, 2022.