(E)motion Style

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***Abstract*—This paper describes a computational experiment testing the hypothesis that people have their own way of facially expressing emotions and that style differs from other individuals even when expressing the same emotion. This experiment was conducted with five subjects, where they were recorded while expressing one of the basic emotions (e.g. happiness, fear, disgust, anger, surprise and sadness) through facial contractions. Subsequently, we analyze the videos in order to investigate whether there is a pattern of facial expression for the same person and whether there is a pattern for different people. We found evidence that indicates the presence of individuals emotion style in 4 of 5 subjects. So, it is plausible to say that an individual emotion style exists among human beings and it can be detectable by computer methodologies.**

***Keywords*-emotion; expression; motion style; styling.**

I. Introduction

Motion style is a topic that focuses on the relationship between two main aspects: content and style [1]. Content is related to the task performed with an objective purpose, e.g. walking, jumping, throwing a ball, etc. Style is how each individual executes such actions, i.e. how a person walks, jumps or throws a ball; and that style might differ from another individual's manner of performing said actions. Human beings emotions can be expressed via facial expressions in various ways. The concept of "emotion style" would be an individual's unique way to express an emotion, and how that style differs from other individual even when expressing the same emotion. This type of research is relevant in the context of interfaces for entertainment applications as games and gamified products, where the user emotion can be relevant for the included narrative.

In this work, with the goal to investigate the detection of facial emotion styles, we considered the acted content as a category of emotion, e.g. happiness, fear, disgust, anger, surprise and contempt; while "style" would be the variations observed within these families. Based on Ekman's universal emotions and on the Facial Action Coding System (FACS) [2], we performed an experiment with five different subjects who expressed facially different emotions as described in Section III. We propose the experiment and the method to investigate the similarity/ difference among the expressed emotions.

In this paper, we show a brief summary of some studies that have been developed on motion style in Section II and we explain the proposed experiment and methodology in Section III. In Section IV we analyze and interpret the results obtained with the defined experiment, and ponder on what would be some other applications for the study of emotion style. Finally, in Section V we discuss future aspects of this research.

II. Related Works

Thus far, studies on the subject of motion style have been done primarily on the whole body movement of human beings, as discussed in this paper. As far as we know, there is no studies regarding specifically the detection of different forms of expressing emotions, and only Wang et al. [3] discuss motion style associated with facial expression detection. Nonetheless, they do not focus on emotions, instead their method re-targets movements associated .

Elgammal and Lee [1] built a method to separate style and content on manifolds representing dynamic objects. They demonstrated that their method is capable of extracting the style of a person walking. Torresani et al. [4] proposes a system that applies style to movements that previously had only the content; i.e. actions, and that is useful for animation where different characters can have different styles. They do not, however, use this method on facial expressions and emotions but focus only on body movements like walking, running, etc. Wang et al. [3] created a method able to transfer a person's facial expression style to an animated model and thus is able to make virtual characters which seem to be much more realistic. Similarly, Queiroz et al. [5] propose a generic facial expression transfer from a face mesh to another, aiming to speed the process of generating facial animation for interactive applications.

Our intention is to investigate motion style of real people in video sequences in order to answer the question of whether it is plausible to assume the presence of motion style of people during emotions facial manifestations.

III. Method

This section describes the experiment performed with subjects in this work. Our goal was to have videos from people

expressing different emotions. The method is described in three steps: *i)* The experiment, *ii)* Data extraction and *iii)* Analyzed results.

A. The Experiment

At first, we tried to record the subjects reacting to videos that elicit specific emotions in order to obtain genuine expressions. However, even if we show a sad sequence, for example, some people react in a different way, for instance talking about the sequence instead expressing a facial emotion. Then, we decided to perform a different approach by asking the subjects to try to express some specific emotion on their own way in front of a camera. For each subject, 6 videos were recorded, one for each emotion, using a 720p/30fps camera. We began recording the subject in a neutral expression and then asked him/her to express a specific emotion and attempt to hold it for 5 seconds. Figure 1 shows a guideline that was presented to subjects who wished to see a reference of what the expression should look like, however we informed the subjects that they should be spontaneous and not attempt to mimic the pictures, doing facial expressions on their own way. We used a small group of 5 subjects, all male and around the same age group (ranging from 18 to 29 years old). This was done because it provides us an homogeneous sample of subjects regarding gender and age, so we hypothesyze that their difference, in terms of facial expression, should not be due these two characteristics [1].

Figure 1. A graphic representation of the emotions used in the experiment.

Five subjects were recorded while watching the images from Figure 1 and reacting in terms of facial expressions. They expressed six different emotions: happiness, fear, disgust, anger, surprise and sadness, always starting from a neutral facial pose.

In order to obtain the footage, we utilized the Affectiva software [6], which detects 20 different expressions, as explained in the next section.

B. Data extraction

Affectiva [6] is a software capable of identifying macro expressions in videos and photos utilizing machine learning and deep learning techniques that are able to ascertain in real time which expressions and emotions a person is expressing in a certain frame.

After data capturing, we mapped extracted micro and macro expressions to their respective codes on the Facial Action Coding System (FACS), which allowed us to do objective analysis on the emotion expressions. Table I shows each of the captured facial expressions and their equivalent Action Unit (AU) according to the FACS.

Table I
TABLE PRESENTING ALL 20 EXPRESSIONS DETECTED BY AFFECTIVA AND THEIR RESPECTIVE CODE (ACTION UNIT) IN THE FACIAL ACTION CODING SYSTEM

Expression	FACS
Jaw Drop	AU26
Lip Stretch	AU20
Dimpler	AU14
Lid Tighten	AU7
Cheek Raise	AU6
Eye Widen	AU5
Eye Closure	AU43
Smirk	AUL12 / AUR12
Mouth Open	AU27
Lip Suck	AU28
Lip Press	AU24
Lip Pucker	AU18
Chin Raise	AU17
Lip Corner Depressor	AU15
Upper Lip Raise	AU10
Nose Wrinkle	AU9
Brow Furrow	AU4
Brow Raise	AU2
Inner Brow Raise	AU1
Smile	AU12

Once all extracted information is mapped, we proceed with data analysis, as described in next section.

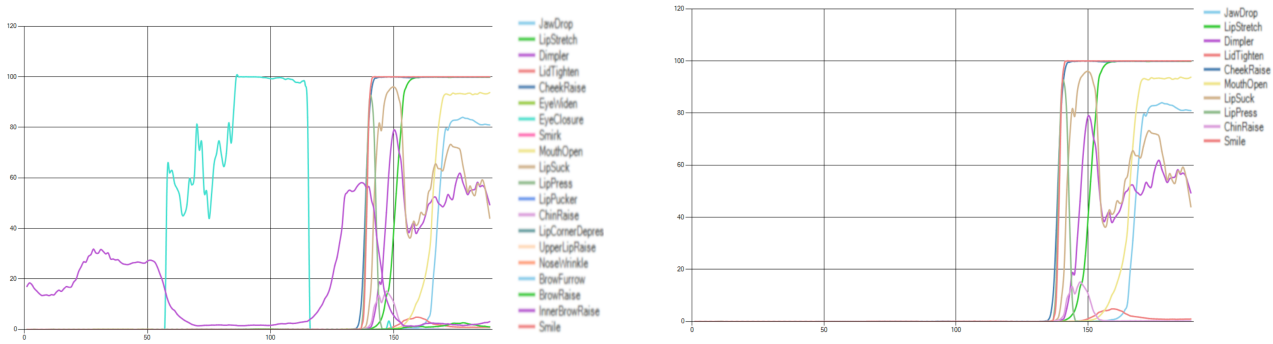
C. Analyzed Data

We plotted charts for each video showing the intensity of each facial expression at each frame of the video. In the graphics in this section, the X-axis represents the frames of the video, while the Y-axis represents the intensity of each facial expression.

Figure 2 presents an example of a graph containing the intensity of all facial expressions the software can detect in a video sequence of subject 2 (from Figure 3) performing the happiness emotion. Figure 2(a) shows all expressions that were detected in the entire video, while in Figure 2(b) we removed sequences from the graph containing expressions that showed a less than 2% intensity during the time frame that an emotion was occurring and events that happened while the subject was in their neutral state (in this case, expressions that were detected before frame 130).

Table II shows all facial expressions that were selected after the filtering process for each subject (from 1 to 5) during the time frame each emotion was being expressed. This table was later analyzed in order to detect the following events:

[1]Future work should consider different population.



(a) Unfiltered plotting of Subject 2 expressing happiness.

(b) Filtered plotting of Subject 2 expressing happiness.

Figure 2. An example of the filtering done in order to find the most relevant expressions.

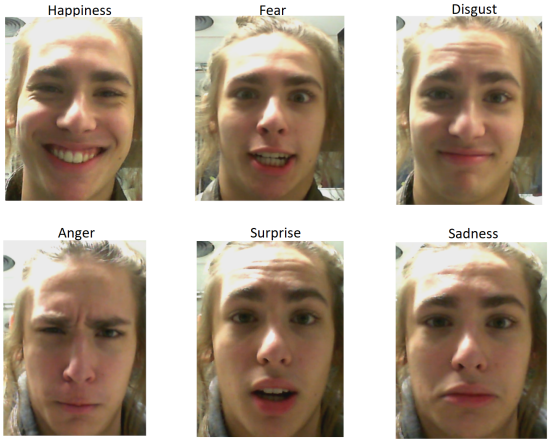


Figure 3. Subject 2 posing for the six different emotions.

- Subjects presenting similar facial expression in different emotions;
- Different subjects expressing the same emotion through different manners; and
- Subjects being more or less expressive, i.e the software detecting many or few expressions on the video.

IV. Results

This section presents some qualitative analysis of extracted data from facial expressions. After going through each of 5 individual's results, we were able to extract some specific emotion styles, as discussed below. Firstly, it is important to highlight that all extracted data used in this section regards to emotions correctly detected according to the asked task to be executed by the subjects. It means that when the subjects performed any of 6 emotions, the system agrees with the classification.

We noticed what we called motion style in subject 1 with respect to eyelid tighten expression. It is interesting to see that in 5 of 6 emotions (except surprise), this individual always presented such expression, that could be eligible to be part of his facial motion style. Another characteristic easy to remark is that Subject 5 wrinkled his nose when expressing all negative emotions, i.e. fear, disgust, anger, surprise and sadness. It can be considered as a motion style of subject 5. When expressing happiness, all of the subjects expressed this emotion in a quite similar manner. Subjects 1 and 2 had their lids tightened, subject 3 raised one of his lips corners more than the other, resulting in a smirk, and subject 5 did not open his mouth while smiling, for example. While expressing fear, although all of them had their mouth open, brows raised and jaw dropped, there were two main differences among subjects: some individuals widened their eyes while others, on the contrary, tightened their lids. For disgust, subjects 1 and 2 had very similar forms of expressing this emotion: they both pressed their lips, raising and furrowing their brows. Subjects 4 and 5 both had their upper lip raised, and Subject 3 was one who seemed to express his emotions in a more subtle form. Subject 4 also smiled when expressing disgust. When subjects where asked to express anger, all expressions were very similar, except for subject 3, who only moved his eyebrows. Something akin to that happened when subjects showed surprise: subject 4 was the only one who did not open his mouth. Lastly, when expressing sadness, most subjects depressed the corners of their lips, while others stretched them more or did not even move their mouth.

In summary, the styles that were perceived among the subjects other than 1 and 5 were that subject 2 showed greater pattern of expressions, i.e. he presented a higher number and variety of facial action units, which may indicate that this subject presented a more "visual" emotion style. Subject 3, on the other hand, was the one whose expressions were fewer in quantity, but intense enough for the emotion to be properly conveyed. This shows that he has a more subtle emotion style. With this first experiment, however, we were unable to find an emotion style for subject 4.

Table II
TABLE SHOWING WHICH EXPRESSION EACH SUBJECT EXPRESSED DURING EACH EMOTION

Subject N°	Emotion	Expressions
1	Happiness	Lip-Stretch Lid-Tighten Cheek-Raise Nose-Wrinkle Smile
2	Happiness	Jaw-Drop Lip-Stretch Dimpler Lid-Tighten Cheek-Raise Lip-Suck Lip-Press Chin-Raise Smile
3	Happiness	Cheek-Raise Smirk Smile
4	Happiness	Lip-Stretch Cheek-Raise Chin-Raise Nose-Wrinkle Smile
5	Happiness	Lip-Stretch Dimpler Cheek-Raise Smile
1	Fear	Jaw-Drop Lid-Tighten Mouth-Open Nose-Wrinkle Brow-Furrow Inner-Brow-Raise
2	Fear	Jaw-Drop Eye-Widen Mouth-Open Inner-Brow-Raise
3	Fear	Jaw-Drop Eye-Widen Mouth-Open Brow-Raise Inner-Brow-Raise
4	Fear	Jaw-Drop Eye-Widen Brow-Raise
5	Fear	Jaw-Drop Lid-Tighten Mouth-Open Upper-Lip-Raise Nose-Wrinkle Brow-Furrow
1	Disgust	Lip-Stretch Dimpler Lid-Tighten Cheek-Raise Lip-Press, Nose-Wrinkle Brow-Furrow
2	Disgust	Lip-Stretch Dimpler Cheek-Raise Eye-Widen Lip-Suck Lip-Press Chin-Raise Brow-Raise Inner Brow-Raise
3	Disgust	Lid-Tighten Lip-Corner-Depressor Brow-Furrow-Inner Brow-Raise
4	Disgust	Lid-Tighten Cheek-Raise Eye-Widen Mouth-Open Nose-Wrinkle Brow-Furrow Brow-Raise Smile
5	Disgust	Lid-Tighten Mouth-Open Upper-Lip-Raise Nose-Wrinkle Brow-Furrow Brow-Raise
1	Anger	Lid-Tighten Nose-Wrinkle Brow-Furrow
2	Anger	Lid-Tighten, Lip-Suck Brow-Furrow
3	Anger	Brow-Furrow Brow-Raise Inner-Brow-Raise
4	Anger	Lid-Tighten Lip-Suck Lip-Press Chin-Raise Nose-Wrinkle Brow-Furrow
5	Anger	Lid-Tighten Lip-Suck Chin-Raise Nose-Wrinkle Brow-Furrow
1	Surprise	Jaw-Drop Eye-Widen Mouth-Open Brow-Raise
2	Surprise	Jaw-Drop Eye-Widen Upper-Lip-Raise Brow-Furrow Brow-Raise
3	Surprise	Jaw-Drop Eye-Widen Lip-Corner-Depressor Brow-Raise
4	Surprise	Eye-Widen Brow-Raise Inner-Brow-Raise
5	Surprise	Jaw-Drop Eye-Widen Mouth-Open Brow-Raise
1	Sadness	Lid-Tighten Brow-Furrow Brow-Raise Inner-Brow-Raise
2	Sadness	Lip-Corner-Depressor Brow-Raise Eye-Widen
3	Sadness	Dimpler Lip-Pucker Brow-Raise Inner-Brow-Raise
4	Sadness	Lip-Stretch Dimpler Lip-Press Chin-Raise Inner-Brow-Raise
5	Sadness	Chin-Raise Lip-Corner-Depressor Nose-Wrinkle Brow-Furrow

V. FINAL CONSIDERATIONS

In conclusion, we believe that we found evidences that a concept such as "emotion style" does exist among human beings specifically in the facial expressions. Although the experiment described in this paper had a very small dataset of 30 videos portraying only five subjects which were of the same sex and similar age groups, we are able to find evidence that same person can have an "emotion style" as the example of Subject 1. In addition, some emotions, e.g. happiness presented similar characteristics even expressed by different individuals.

In current development, we are investigating styles of emotion in different age groups, different genres and cultures. In addition, we could study whether individuals who present disorders that impair their ability to express themselves emotionally, such as autistics, have a different style of emotion from those without these characteristics, with the intention of helping others to better understand what these individuals are feeling. In the future, we could also replicate Ekman's experiment, which consisted of showing footage meant to induce specific emotions instead of just asking the subjects to express them without any stimuli. We believe that all of these investigations can be very useful in providing more specialized and customized interfaces to gaming applications.

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