Emotional episodes, facial expressions, and reported feelings in human-computer interactions.[1]

Kaiser, S. Wehrle, T., & Schmidt, S. University of Geneva, Switzerland, (1998)

In A. H. Fischer (Ed.), *Proceedings of the Xth Conference of the International Society for Research on Emotions* (pp. 82-86).Würzburg: ISRE Publications.

Introduction

This paper presents some results from our research using human-computer interactions to study the dynamics and interactive nature of emotional episodes. For this purpose, we developed the *Geneva Appraisal Manipulation Environment* (GAME; Wehrle 1996), a tool for generating experimental computer games that translate psychological theories into specific micro world scenarios (for details about theoretical and technical embedding of GAME see Kaiser & Wehrle, 1996). GAME allows automatic data recording and automatic questionnaires. While playing the experimental game, subjects are videotaped and these tape recordings enable an automatic analysis of the subject's facial behavior with the *Facial Expression Analysis Tool* (FEAT; Kaiser & Wehrle, 1992; Wehrle, 1997). With FEAT, facial actions are categorized in terms of FACS (Ekman & Friesen, 1978). These facial data can be automatically matched to the corresponding game data (using vertical time code as a refererence for both kinds of data).

The micro world scenarios developed for the study to be presented here are based on theoretical predictions concerning *emotion antecedent appraisal*, as postulated by different cognitive emotion theorists (Scherer, 1988; Frijda, 1986). Furthermore, game scenarios have been related to *prototypic emotion antecedent events*, as postulated by Ekman & Friesen (1975). 18 female French speaking psychology students participated in the study. Two prior studies had shown that the scenarios and game manipulations are apt to induce specific emotional reactions, including different types of positive (happiness, pride, relief) and negative emotions (anger/irritation, anxiety/fear, sadness/disappointment, embarrassment/shame) (Kaiser & Wehrle, 1996; Schmidt, Wehrle, & Kaiser, 1997). One goal of the current study was to analyze the participants' facial behavior during these specified emotional episodes. Participants' facial behavior was analyzed during 14 episodes. For each episode a 5-second window was defined for coding the facial behavior in reaction to and/or in anticipation of a specified event.

In the first part of the paper we present some quantitative results about the frequency and distribution of facial actions observed during these episodes. On the basis of these results, we briefly discuss two theoretical approaches to interpreting the relation between facial expressions and emotion labels. In the last part we present some qualitative results, in order to illustrate specific methodological and theoretical problems we have to solve if we want to extend our knowledge about the functions and meaning of facial expressions in spontaneous interactions.

Individual differences in facial expressivity

First analyses show a large inter-individual variance in facial expressivity. We could divide our subjects into a low-expression group (N = 5; total amount of Action Unit Activity = 27 – 30) and a high-expression group (N = 13; total amount of Action Unit Activity = 44 – 68). Within both groups subjects differed according to the variability of the expressions shown, i.e. some subjects showed a variety of facial expressions and situation specific repertories, whereas other subjects showed a kind of "typical" facial expression pattern (examples can also be found in Kaiser, Wehrle & Edwards, 1994). Figure 1 shows a high-expressive subject reacting to the unexpected and sudden appearance of a unknown enemy that roars like a lion. Figure 2 shows another expressive subject who is confronted with a new game level that is much faster than those she had already passed. In both situations, which elicit facial reactions in most of the subjects, the least expressive subject does not react at all. However, this lack of expressivity does not mean that she is less, or not at all involved or emotionally aroused. She has the 3rd highest involvement score of all subjects (a mean score of several items asking how involved the subjects were during the game and how much they appreciated the game). A further indication of emotional involvement is that she is the only person reporting to have been scared/afraid (apeuré/effrayé) by the fast level situation, whereas the vast majority of the participants reported to have been anxious/alarmed (inquiet/alarmé; N = 15), which is, at least in French, a less intense emotional state.

[1] This project is supported by grants from the Swiss National Science Foundation (FNRS 11-39551.93/11-049629.96 "Dynamic man-computer interactions as a paradigm in emotion research").

Figure 1: Game situation: The unexpected and sudden appearance of a unknown enemy that roars like a lion.

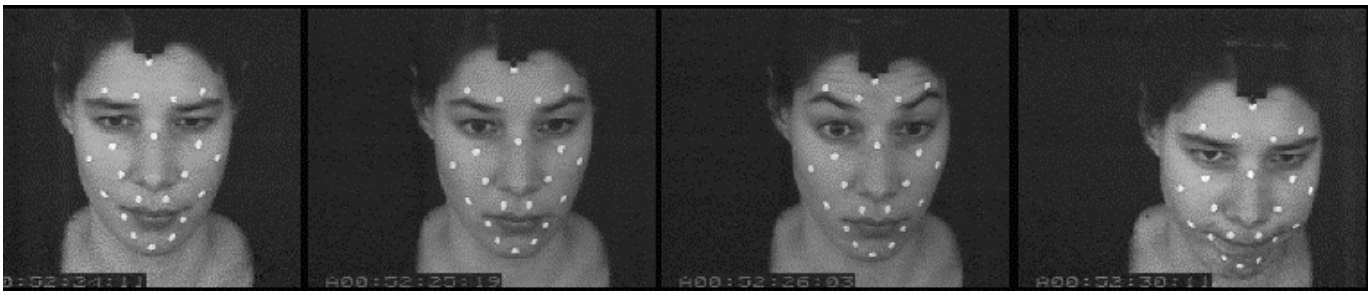

Figure 2: Game situation: Start of a new game level that is much faster than those before.

Prototypical patterns or single Action Units related to appraisal checks?

With respect to possible interpretations of the meaning and function of the facial expressions shown during the 14 emotional episodes, we refer to two theoretical positions. The first, advocated by Ekman and other discrete emotion theorists (Ekman, Izard), postulates that there is only a limited number of fundamental or "basic emotions" and that for each of them there exists a prototypical, innate, and universal expression pattern. This pattern cannot be reduced to more elementary movements. In this tradition, a process of blending or mixing the basic expression patterns explains the variability of emotion expression patterns commonly observed. The second, advocated by Scherer (for details see Kaiser & Scherer, 1998), assumes that the facial muscle configuration which is activated as the result of a particular emotional state, is the result of a combination of effects linked to emotion-antecedent cognitive appraisal and associated action tendencies. Rather than assuming that appraisal processes will evoke one of several basic emotions with their specific response patterning, component process theory suggests that the result of each stimulus evaluation check will have a direct effect on each of the other emotion components, such as autonomic nervous system functioning and motor expression. Along the same line, Smith and Ellsworth (1985) and Ortony and Turner (1990) have proposed that elements of facial expression configurations can be directly linked to individual appraisals. Some initial empirical evidence for the presumed link between the evaluation of a stimulus as being obstructive to a goal and corrugator innervation, resulting in a frown, has been provided by Smith (1989).

One of the authors, Susanne Schmidt, is comparing the predictive validity of both approaches in her doctoral dissertation. At the current state of data analysis, we can only say that the prototypical patterns described by Ekman and Friesen in the Emotion Prediction Tables in the FACS manual quite rarely occur[2].

If we look at the distribution of single Action Units, we find a) Action Units that differ between positive and negative emotions (see figure 3), and b) Action Units that differ between distinct negative emotions (see figure 4). AU6 (orbicularis occuli) and AU12 (zygomaticus major, lip corner puller) occur more often with positive than with negative emotions. AU6 produces crows-feet wrinkles at the eyecorners and is said to be a prerequisite for differentiating a felt smile from a phoney smile. As can be seen in figure 4, AU1 + 2 (brow raising) are found more often with anxiety and fear than with sadness and anger. AU20 (lip stretcher) is found more often only in fear. AU4 (brow lowerer) is less often seen in anxiety and fear than in anger and sadness. Sadness is different from all other negative emotions showing more AU15 (lip corner depressor) and AU54 (head down).

[2] Ekman informed us that we cannot use these predictions and that we should send our data to be analyzed with the FACSAID data base provided recently by Ekman, Rosenberg, & Hager. In Ekman & Rosenberg (1997) he says that these tables "are by no means comprehensive and leave out many, perhaps the majority, of the combinations of AUs that, though not prototypic, have been found to be signs of each emotion." (p.481). However, this database has been accessible on the Internet only since July 1998.

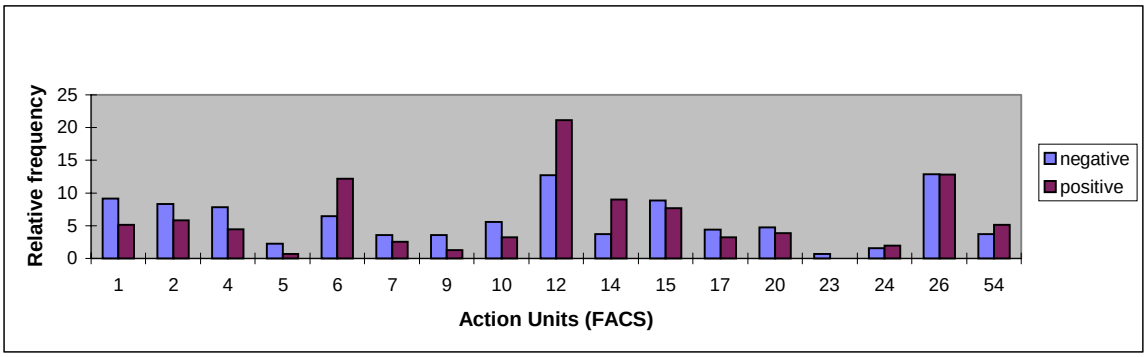

Figure 3: Facial expression according to valence of reported emotion

Anger is different from the other negative emotions showing more AU24 (lip press) and AU7 (lid tightener). All the mentioned AUs are part of the respective prototypical emotion patterns but according to distinct emotion theorists, an interpretation of facial expressions must rely on the postulated configurations and not on single AUs (for details of Ekman's argument here, see Ekman & Rosenberg 1997, p. 477). However, for the analysis of possible links between AUs and appraisal checks, this procedure is appropriate.

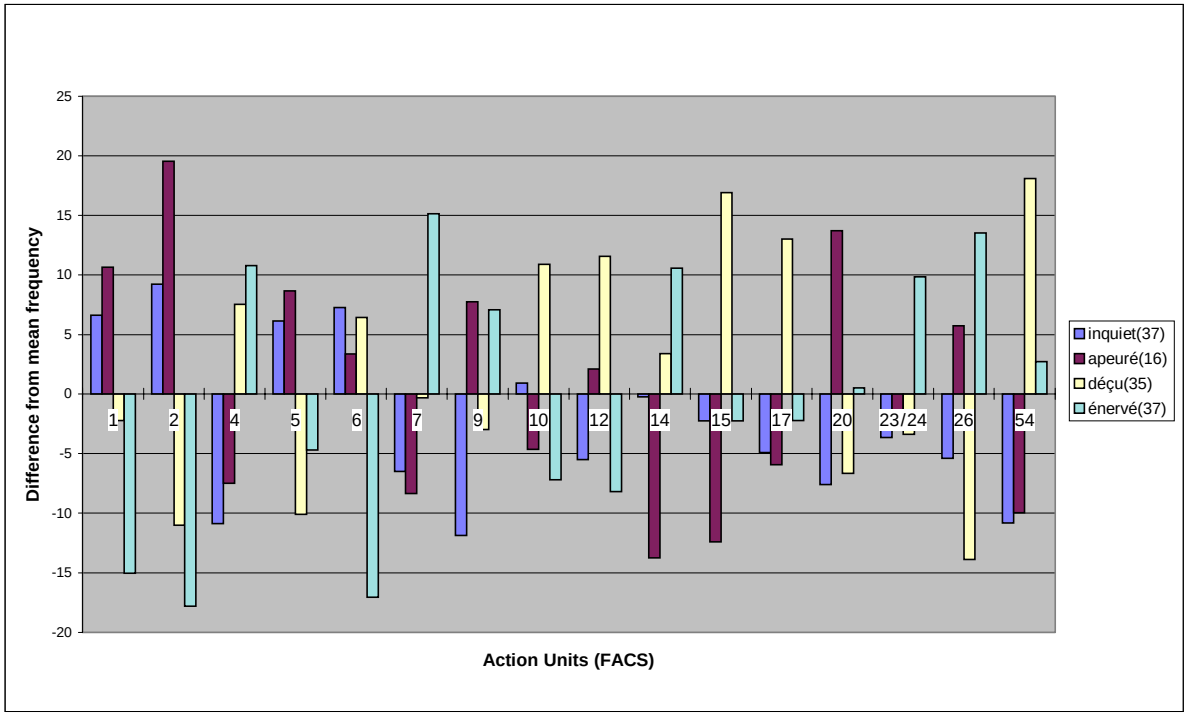

Figure 4: Facial expression of negative emotions (Note: inquiet/alarmé=anxious/alarmed, apeuré=scared, deçu/triste=disappointed/sad, énervé=irritated)

Function and meaning of facial expressions in spontaneous interactions

When studying the relation between facial behavior and subjective feeling in spontaneous interactions, we are confronted with a series of methodological and theoretical problems. One problem is that while facial behavior accompanies the emotional episodes as they unfold, the verbal report only gives an emotion label for the "summarized state" felt in this episode. As can be seen in figure 5, the sequence of facial expressions indicates a process of evaluation and reevaluation steps that only in the end seem to correspond with the emotion label (anger) given by the subject. In this situation, AMIGO, an animated helpful agent in the game, has asked the subject to collect magic potions in the maze in order to enable him to keep on helping. AMIGO asks each player to do this two times during the experimental game. Figure 6 shows an example of the subject's reaction to AMIGO's first intervention (level 6). Here, AMIGO thanks her for successfully having collected all the magicpotions. In figure 5 however, AMIGO tells her that she arrives too late and that he will disappear (level 9). The second image in figure 5 shows signs of sadness/disappointment (the "target" emotion reported by most of the subjects) but then it seems that she reevaluates the situation. The movement of the head and the changes in

her facial expression seem to indicate some kind of consternation which corresponds to her reported anger. In figure 6 we also see a sequence of facial expressions showing signs of embarrassment in the beginning (smile controls in terms of Keltner, 1997), ending with a “proud smile”. Pride is also the label she uses to describe her feeling in this situation.

Figure 6 illustrates another important aspect of facial expressions in interactive contexts, i.e., the regulative function of controlling facial expressions. Here, smiles play an important role. Although the interaction is only indirectly social, we find many smiles and smile controls (e.g., asymmetric smiles or smiles that occur with signs of negative emotions), similar to those found in human-human interactions. We are more interested to extend our knowledge about the role of emotions and facial expressions in interactive settings than to studying which facial expressions would occur as “pure” signs of emotions, i.e., without any social function. In our view, facial expressions do have the dual functions of communicative and intrapsychic regulation (See also Kaiser & Scherer, 1998). We have to extend our theoretical models to include these different functions. On the intrapsychic level, facial expressions are not exclusively indicators of emotional processes. We also find facial expressions that are signs of cognitive processes (a frown indicating perplexity), that might or might not be signs of an emotional reaction (anger) at the same time. If regularities in the relation between facial expressions and cognitive evaluation processes can be established, we can apply them to emotional as well as nonemotional facial expressions.

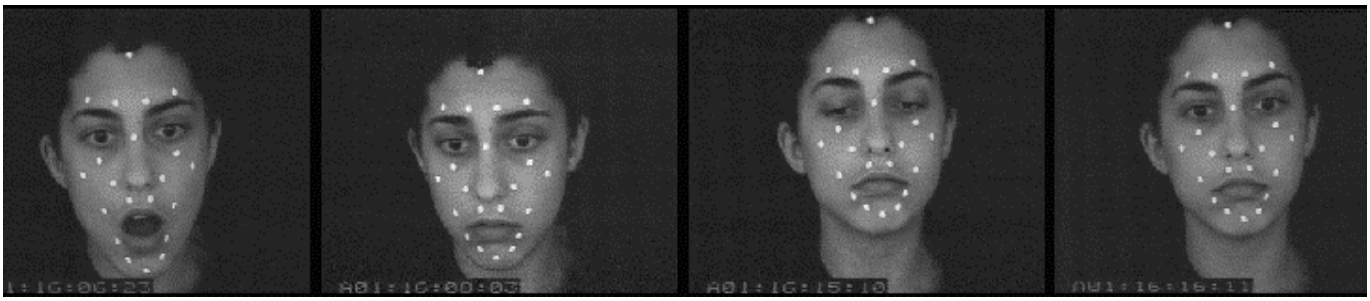

Figure 5: Game situation: At the end of level 9, message from AMIGO that he will disappear

Figure 6: Game situation: At the end of level 6, AMIGO gives thanks for having collected all magic potions

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