Emotions: Methods of Assessment

Mortillaro, Marcello; Mehu, Marc

Emotions: Methods of Assessment

Marcello Mortillaro, Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland
Marc Mehu, Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland; and Webster Vienna, Private University, Vienna, Austria

Abstract

Emotions are brief episodes during which several functional components are synchronized in response to an eliciting event. Emotions can be assessed by measuring responses in each of these components: subjective feeling, physiology, expression, and motivation. In this article we review the most advanced methods that can be used to assess emotions in each of the four components: self-report measures and questionnaires, measures of physiological activation, instruments for the analysis of nonverbal expressive behavior, and behavioral tasks.

Introduction

Even if the exact definition of 'emotion' is still a matter of debate between theorists, there is general consensus about the main components of an emotion episode (Frijda and Scherer, 2009). An emotion episode is originated by the appraisal of an eliciting event that causes synchronized changes in four main components: a physiological component, an expressive component, a motivational component, and the subjective feeling (Mortillaro et al., 2013). The changes in these four components are, therefore, informative of the state of the person and can be used as indicators of an emotional experience. Emotion assessment methods, indeed, can be grouped based on which of these four components they target.

In this article we review some of the measures that have been proposed to assess emotions and group them according to the component to which they refer. We focus on methods that are elaborated for nonclinical adult human samples. We will not consider all the instruments that were used for the purpose of better understanding the key elements of an emotional experience, namely cognitive antecedents (e.g., the GRID questionnaire; Fontaine et al., 2007), correlates of emotions, and emotional personality traits.

Two components have received particular attention in the context of emotion assessment: subjective feeling, by means of questionnaires and self-report measures; and expression, by means of coding instruments built to objectively measure facial, vocal, and bodily expressions. Physiology has been the object of several studies but researchers mostly focused on the existence of emotion-specific physiological patterns and clear indications about how using physiology to assess emotions are yet to come. The motivational component is the least studied and we will discuss it only briefly.

Subjective Feeling: Emotion Assessment through Questionnaires and Self-Report Measures

The subjective feeling is the holistic cognitive representation of all the changes elicited by the emotional event; this representation allows the individual to be aware of his/her state and name it with a particular emotion label (Scherer, 2009). Self-report measures are probably the best (if not the only) way to get the individuals' conscious representation of their emotional experience. Nevertheless, when using a self-report measure, the researcher should always consider the risk of social desirability of the responses and the variability that exists between individuals with respect to the ability or the willingness to report on emotional states.

There is not one standard self-report measure or procedure that can be used for any purposes in any context, but rather there are several self-report measures, each of which has specific contexts of application, and theoretical implications. As a general remark, state of the art self-report measures are based on clear theoretical grounds, are empirically validated, and are used to assess current emotional experience rather than reports about past or future events, and stable emotion-related traits (Mauss and Robinson, 2009).

Instruments to assess the emotional subjective feeling can be divided into four groups, defined along two major axes. The first axis is the theoretical model they refer to emotions as discrete categories (Ekman et al., 1983; Izard, 1977) or emotions as states defined by dimensions (Russell, 1980). The second axis is the visual format of the instrument: purely verbal (only text) or instruments that include pictorial elements. Generally speaking, purely verbal measures – in the format of adjective checklists – have the advantage of being more specific and precise when measuring the individuals' subjective feeling. The pictorial instruments, however, are generally faster to administer and easier to understand for the respondents, and, more importantly, they do not rely on verbal knowledge and, therefore, do not need translation to be used in different cultures and can be administered to populations that do not possess complex verbal knowledge (e.g., children).

The discrete emotion approach is used to categorize the experience into separate states that are labeled with emotion words. Most frequently, this has been done through text-based instruments that ask people to rate the extent to which they experienced certain emotional state in a specific context, period of time, or in response to a stimulus. The exact form in which the ratings are given differs across instruments. Several studies assess emotions by simply asking to choose one emotion label from a predefined list of emotion words (nominal level). Some adjustments have been suggested in order to improve the

reliability of this procedure; in particular, respondents should have the possibility of choosing an option 'no emotion' and to be allowed to indicate another emotion label that is not included in the list (Bänziger et al., 2012; Scherer, 2005). One-item nominal answers provide quick access to a global estimate of the subjective feeling of the person, but the reliability remains rather low. Using multiple items to assess an emotional state has greater reliability and can assess a larger part of the emotional spectrum. These procedures require the respondents to rate on a scale (ordinal or interval level) the extent to which each one of a list of emotions was experienced. In the following paragraph we describe some of the most commonly used text-based measures that adopt a discrete perspective.

The most frequently used instrument in this tradition is the *Differential Emotion Scale* (DES; Izard, 1977; Izard et al., 1993). The DES "is a standardized instrument that reliably divides the individual's description of emotion experience into validated, discrete categories of emotion" (Izard, 1977: p. 124). Subjects indicate on 5-point scales (from 'not at all' to 'very strongly') the strength of their feelings using an adjective checklist made of 30 items. These 30 items are grouped in 10 discrete emotion categories, or factors, and were derived from cross-cultural studies on emotion–expression labeling (Izard, 1971). The 10 factors are: anger, surprise, interest, contempt, fear, guilt, shame/shyness, joy, sadness, and disgust. Other versions of the instrument have been proposed over the years. In the DES II, the item content was refined and the instructions changed to allow the assessment of emotions experienced over extended time periods (Izard, 1972, 1977). The DES III is a version of the DES adapted for children and adolescents and includes phrases that describe the subjective feeling associated with each primary emotion (Kotsch et al., 1982). The DES IV (Izard et al., 1993) includes 12 factors instead of 10, with separate scales for Shame and Shyness, and a new scale for Self-Hostility.

Another 'text-only' instrument is the emotion part of the *Stress Questionnaire* by Foikman and Lazarus (1985). This questionnaire was developed in the context of stress research and includes a section about emotion. The subjects are asked to indicate on a 5-point Likert scale the extent to which they felt each of 15 emotions, grouped in 4 scales. The score for each scale is computed by summing the ratings for each item. The four scales are based on the main appraisal theme of the emotions: Threat emotions (worried, fearful, and anxious); Challenge emotions (confident, hopeful, and eager); Harm emotions (angry, sad, disappointed, guilty, and disgusted); and Benefit emotions (exhilarated, pleased, happy, and relieved).

Discrete emotions can also be assessed through instruments that include graphical elements that are designed to simplify the task for the respondents. The Geneva Emotion Wheel (GEW; Scherer, 2005; Scherer et al., 2013a) consists of several discrete emotion labels arranged in a circle. The disposition of the labels is determined by the position of the emotions in a two-dimensional space defined by valence and control/power according to both theoretical modeling and empirical data (Scherer et al., 2013a). The intensity of the emotion is mapped on the distance between the center and the rim of the wheel. Respondents can choose the emotion and indicate its intensity by choosing one of the circles that connect the emotion label to the center of the wheel: the size of each circle corresponds to the intensity of the respective emotion. The specific choice of emotions included in the GEW is not fixed. Users can modify the choice of terms for their specific research purposes but they should respect the underlying theoretical structure.

An example of a purely pictorial instrument to assess discrete emotions is The Product Emotion Measuring Instrument, an instrument that was specially developed for measuring emotional responses to products (PrEmo; Desmet et al., 2007). PrEmo is a self-report instrument that uses cartoon characters to represent emotions. The character expresses seven positive emotions (inspiration, desire, satisfaction, pleasant surprise, fascination, amusement, and admiration), and seven negative emotions (disgust, indignation, contempt, disappointment, dissatisfaction, boredom, and unpleasant surprise.) The interface includes still pictures of the character's animations with a three-point scale: "I feel the emotions," "to some extent I feel the emotion," and "I do not feel the emotion."

The measures built on the basis of a dimensional account describe the emotion experience on a number of underlying dimensions. The specificity of the instruments that adopt a dimensional approach is in the output that they provide more than in their format – adjective checklist. These instruments vary in terms of the emotional dimensions that they are targeting.

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) is the most frequently used adjective checklist in the dimensional tradition. The PANAS is an adjective checklist made of 20 emotion items that are used to estimate the emotional experience of the respondents in terms of two orthogonal dimensions: Positive Affect and Negative Affect. Positive Affect represents the extent to which a person is enthusiastic, active, and alert; Negative Affect represents general distress and unpleasant engagement. Respondents are asked to use a 5-point unipolar intensity scale for each of the 20 items to describe their emotional experience. The PANAS has published normative and clinical data; it provides an interval scale level, and has been used in several research domains. A more recent version is the PANAS-X, which includes 60 items that measure the same two higher order scales of the original PANAS (Positive Affect and Negative Affect) in addition to 11 specific affects (Fear, Sadness, Guilt, Hostility, Shyness, Fatigue, Surprise, Joviality, Self-Assurance, Attentiveness, and Serenity; Watson and Clark, unpublished manuscript).

An alternative dimensional model is the Pleasure-Arousal-Dominance model (PAD), which assumes that these three independent dimensions are necessary and sufficient to describe emotional states (Mehrabian and Russell, 1974; Russell and Mehrabian, 1977). Unlike the PANAS, the PAD model considers valence as one dimension. Mehrabian and Russell (1974) devised semantic differential scales to directly assess these three dimensions. Each of these three scales is made of six bipolar adjective pairs that are rated using a 9-point scale. More recently, Russell et al. (1989) suggested a single-item scale to measure two of the three dimensions of the PAD model, pleasure and arousal. This instrument, called Affect Grid, is a 9 by 9 grid in which the horizontal dimension represents pleasure and the vertical dimension

arousal: the respondents check one of the 81 cells to report their level of arousal and pleasure.

The Brief Mood Introspection Scale is an instrument that integrates both dimensional perspectives in the same adjective checklist (BMIS, Mayer and Gaschke, 1988). Indeed, the BMIS can be used to measure the mood in four continuous scales: Pleasant-Unpleasant scale; Arousal-Calm scale; Positive-Tired scale; and Negative-Relaxed scale. The checklist consists of 16 adjectives, 2 from each mood states: happy, loving, calm, energetic, fearful/anxious, angry, tired, and sad. The respondents rate each adjective using a 4-point scale.

Researchers in the dimensional approach frequently use the Self-Assessment Maniking (SAM; Bradley and Lang, 1994), a nonverbal pictorial assessment technique that directly measures pleasure, arousal, and dominance. The SAM is both a computerized and paper-and-pencil instrument that consists of three sets of graphic illustrations for each of the three major dimensions. The pleasant dimension is represented by 5 illustrations, with at one extreme a smiling figure and at the other end a frowning and inverted-U mouth shaped figure; the arousal dimension ranges from a wide-open-eyed 'excited' figure to a sleepy one (i.e., eyes are closed); the Dominance dimension is metaphorically represented in terms of the size of the figure (the bigger the size, the higher the feeling of dominance, control).

In the paper-and-pencil version of the SAM, the respondents can, for each dimension, mark one of the pictures or the space between any two of them to report about their feeling – resulting in a 9-point scale. This instrument is relatively easy to understand and faster to use compared to any adjective checklist. However, the output of this scale is based on a single item response per dimension.

Physiology: Autonomic Measures of Emotion

All emotion theories postulate that physiological changes are an inherent aspect of the emotional experience (Frijda and Scherer, 2009). Physiological changes happen in different organismic subsystems, but it is the autonomic nervous system (ANS) that attracted most of the researchers' attention. The ANS is the set of peripheral nerves and ganglia that modulate peripheral functions and it is made of two branches, the sympathetic system – generally associated with activation, – and the parasympathetic system – generally associated with relaxation. The activity of the ANS is implicated in several bodily functions that are not related to the emotion process per se; however, the emotional state of the individual can alter some physiological indices.

Most physiological measures used as indicators of emotion can be grouped in three functional groups: respiratory functioning (e.g., respiration rate), cardiac functioning (e.g., heart rate), and electro-dermal activity (e.g., galvanic skin response). Several studies followed the pioneering work of Ekman et al. (1983; Levenson et al., 1990) and aimed at identifying emotion-specific autonomic patterns. Recent reviews, however, do not explicitly confirm the existence of emotion specificity (Kreibig, 2010; Larsen et al., 2008). Although stable differences can be found between pairs of emotions (e.g., anger is associated to higher diastolic blood pressure than fear), the search for emotion-specific autonomic patterning is still inconclusive. Kreibig (2010) proposed that findings should be interpreted in the light of the motivational dispositions underlying the emotions. For example, decreased cardiac activity was associated with emotions characterized by an approach motivation, while an increase is found in emotions that are related to an active coping response to negative situations. Similarly, increased electro-dermal response happens in almost all emotions and may be a symptom of the motor preparation that is an integral part of the emotion episode (action tendency, Frijda, 1986), while decrease is found for all emotions in which passivity is the shared motivational state.

Researchers who did not focus on the specific associations between discrete emotion and physiological signals investigated, instead, physiological correlates of emotional dimensions like arousal and valence. Several studies found that physiological indices can be reliably used under controlled conditions to estimate the level of arousal/activation associated with an emotional experience. In particular, electro-dermal response was repeatedly suggested as a proxy to estimate the arousal level of the person experiencing an emotion: for example, in one very influential study, Bradley, Lang, and colleagues (2000) showed that the level of skin conductance is linearly correlated to the perceived arousing properties of emotional stimuli. In connection to the valence dimension, research findings seem to be less consistent. Several studies used facial Electromyography (EMG) to assess valence: In these cases, researchers placed electrodes on muscles that are supposedly involved in valenced responses, namely *zygomaticus mayor*, the muscle that pulls the lip corners upward producing a smile (usually associated with positive responses), and the *corrugator*, the muscle that lowers the eyebrow while pulling them together, producing the frown (usually associated with negative responses).

Expression: Emotion Assessment from Nonverbal Behavior

The study of nonverbal behavior has a particular status in emotion research, as it is at the core of some of the most influential emotion theories. For example, basic emotion theory (e.g., Ekman, 1992) was largely inspired by Darwin's (1872) seminal work on the evolutionary bases of emotional expression. Dimensional models of affect derived from studies on the perception of facial behavior (Schlosberg, 1952; Russell and Bullock, 1985), and componential theories of emotion view nonverbal emotional expression as a major component of affect (Scherer and Ellgring, 2007a; Smith and Scott, 1997). The dynamic systems approach of socio-emotional development is based on the study of nonverbal exchanges between infants and caretakers (Fogel et al., 1992). The study of nonverbal behavior also fueled major controversies about the role of emotion in communication and about the universality of emotional expressions (Fridlund, 1994; Owren and Bachorowski, 2003; Russell, 1994; Scherer, 1992).

To understand the connection between emotion and nonverbal behavior, it is useful to consider the former as a process of interrelated changes in several components of

psychobiological functioning (Frijda, 2007; Roseman and Smith, 2001; Scherer, 2001; Smith, 1989). In this view, emotional communication belongs to the motor expression component and would function to convey reactions and behavioral intentions to conspecifics (Scherer, 2005). Emotional expressions could also function to modify the internal states of perceivers in a way that is advantageous to signalers (Owren and Bachorowski, 2003), or to ensure the honesty of social signals as indicators of adaptive dispositions (Brown et al., 2003; Mehu and Scherer, 2012). It is believed that, from an evolutionary point of view, the function of emotional expression is better served by multimodal patterns of behavioral cues including facial, vocal, and bodily signals (Mortillaro et al., 2013; Scherer and Ellgring, 2007b). The measurement of these signals may therefore provide an objective, though indirect, basis to assess emotional experience (Ekman et al., 1980).

Face

Facial behavior has dominated the research on emotional communication, and different models have been proposed to account for the association between the face and affect.

The continuous development of coding schemes for the systematic measurement of facial movements testifies of the great interest in this research area. The most recent coding scheme to date, the Facial Action Coding System (or FACS, Ekman and Friesen, 1978), is a comprehensive, anatomically based system to measure facial behavior, which allows researchers to compare their results across individuals and cultures. Each functional muscular movement that happens on the face can be labeled with a specific code (Action Unit, AU). Combinations of action units can be used to describe, unequivocally, any possible facial expression. In addition, explicit rules for the coding of action units boundaries and phases (onset, apex, and offset) are included in the coding system. Because the use of FACS does not require interpretation about the mechanisms responsible for the activation of facial muscles, all researchers can use it, independently of their attachment to particular theoretical frameworks.

The most influential theory in facial expression research postulates that a limited number of discrete emotions – or families of emotion – have specific signatures in configurations of facial movements (Basic Emotion Theory; Ekman, 1992; Izard, 1971; Tomkins and Carter, 1964). In this view, specific configurations of facial actions indicate the presence of discrete basic emotions such as joy, anger, fear, or disgust, to name a few. The reliability of emotional signaling would be ensured by the presence, within these facial configurations, of movements that are not easy to manipulate voluntarily (Ekman, 2003; Mehu et al., 2012). Researchers who adopted this approach developed the Emotion FACS (EMFACS) in which coding is directly related to the facial movements and configurations that are considered signals of discrete emotions. Despite the popularity of the evidence in support of Basic Emotion Theory, a recent review suggests that the coherence between discrete emotions and facial behavior is relatively weak (Reisenzein et al., 2013).

Dimensional models of affect (e.g., Russell, 1980) postulate that facial movements are indicative of fundamental affective dimensions such as valence and arousal. In this view, specific facial movements do not represent discrete emotion categories but underlying dimensions of affect. For example, the pulling of lip corners (most commonly known as smiling) indicates positive valence, whereas eyebrow raise and eye opening would reflect emotional arousal (Snodgrass, 1992). Recent research has extended the number of underlying dimensions to four: valence, arousal, power/control, and predictability/novelty (Fontaine et al., 2007), and the association between these dimensions and facial behavior remains to be systematically tested. The links between emotional dimensions and facial action units are, however, unlikely to be specific, as a single facial movement may be associated with several dimensions (Mehu and Scherer, under review).

A third group of theoretical models, called Componential Models, suggests that the different elements of facial behavior (action units) reflect the outcome of cognitive appraisal processes, such as the evaluation of novelty, pleasantness, or coping potential (Scherer and Ellgring, 2007b; Smith and Scott, 1997). Appraisal models of facial expressions received empirical support in several studies. For example, the eyebrow frown is related to perceived goal-obstacles (Smith, 1989), and movements related to eye opening (such as eyebrow raise, and upper eyelid raise) are associated with the appraisal of novelty or unpredictability, namely, greater eye opening indicates perceived novelty (Mortillaro et al., 2011). The later study also revealed that cheek raise is associated with the appraisals of intrinsic pleasantness and goal conduciveness. Evidence in support of this model also comes from psychophysiological research in which a variety of AUs have been related to the outcome of appraisal processes (for a brief review of this literature, see Scherer et al., 2013b).

Voice

Voice has always been considered an important channel of emotional communication (Scherer, 1986). Research shows that infants as young as 5 months of age can discriminate happy from sad voices (Caron et al., 1988). People are able to reliably infer valence of nonlinguistic vocalizations (Fecteau et al., 2005), acoustic properties of speech can be used as an index of emotional intensity (Bachorowski and Owren, 1995), and mood change can be traced using vocal cues (Ellgring and Scherer, 1996). The voice is a powerful medium to communicate emotion, as it has a larger reach than signals that require the visual attention of perceivers in order to operate.

Although the relationship between voice and discrete emotion categories has not been researched extensively, a recent study suggests that basic emotions might have distinct vocal signatures (Sauter and Scott, 2007). People have been shown to accurately discriminate among different emotion categories on the basis of vocal cues only (Bänziger et al., 2012; Hawk et al., 2009), and there is some evidence that vocal emotional expressions are universal (Bryant and Barrett, 2008). The acoustic information used by perceivers to classify emotions is extremely varied and includes different measures of pitch (the proximal percept of fundamental frequency), vocal intensity, spectral measures, speech rate, and the duration of voiced periods (Banse and Scherer, 1996; Scherer, 1986). It is likely that the computation of new vocal parameters will,

ultimately, enlarge the list of vocal features related to emotional experience.

Like for faces, vocal expressions also convey information related to underlying dimensions of emotional experience. Arousal or activation is the main dimension that has been linked to voice (Banse and Scherer, 1996; Goudbeek and Scherer, 2010) and acoustic of speech can be used as an index of emotional intensity (Bachorowski and Owren, 1995). The vocal channel is also believed to convey information relative to the 'power dimension,' that is, the ability to control environmental situations (Goudbeek and Scherer, 2010). Emotion expressed in the voice varies according to the circumstances in which the emotion is produced as well as dispositional differences in positive and negative emotionality (Bachorowski and Owren, 1995), suggesting that cognitive appraisal of situations as well as emotional valence are connected to the vocal channel. Finally, it appears that the acoustic parameters involved in the production and perception of emotion share a common basis with sounds used in musical performance to express and elicit emotions (Juslin and Laukka, 2003).

Body

Body movements are of prime importance in the judgments of emotional experience (Montepare et al., 1999; Wallbott, 1998), psycho-affective disorders (Ekman and Friesen, 1974; Wallbott, 1985), and emotional arousal (Mehu and van der Maaten, 2014). Two aspects are important in the evaluation of bodily cues: Static configurations (or body postures) and movement quality. Body postures can be relatively stable over time and change much more slowly than facial and vocal cues. As a result, they have been considered as indicators of 'gross affective states' such as the feeling of pleasantness (Ekman and Friesen, 1969). On the other hand, the complexity of movement offered by the different body parts (e.g., hand and head movements) makes the body an important hub for the communication of subtle and transient emotional states. These ideas suggest that different properties of bodily cues could reflect different emotional information.

Despite the idea that the body is a rich source of emotional information (Darwin, 1872; Ekman, 1965), research on bodily cues of affect has been much less frequent than research on facial and vocal cues. The difficulty inherent to the development of systematic coding systems for bodily cues is probably the main reason for the paucity of research on body-affect relationships (Harrigan, 2005). In recent years, however, we have assisted new attempts at developing comprehensive coding schemes for body movements and postures, notably the Body Action and Posture coding system (BAP; Dael et al., 2012a). The BAP, inspired by the FACS, adopts an integrative approach to the dynamic description of body movement on an anatomical level (different articulations of body parts), a form level (direction and orientation of movement), and a functional level (communicative and self-regulatory functions).

In the same manner as in facial and vocal expression research, scholars interested in bodily cues of emotion have tried to isolate movements that are specific to discrete emotional states (Coulson, 2004; Tracy and Robins, 2008; Wallbott, 1998). However, specificity in movement patterns to emotional categories has not received conclusive support, as the same combination of movements often occurs in different emotional states (Dael et al., 2012b). For example, raising the arms up is found in expressions of both pride (Tracy and Robins, 2008) and joy (Boone and Cunningham, 1998; Wallbott, 1998). Instead, recent evidence suggests that patterns of body movements are associated with functional components of emotions (e.g., modes of appraisal and action readiness) that show considerable overlap between emotion categories (Dael et al., 2012b). Details about the bodily cues associated with emotion categories can be found in several studies (Dael et al., 2012b; Montepare et al., 1999; Wallbott, 1998).

Motivational Component: Assessing Emotions through Motor Actions

Despite the importance that all theories attribute to the motivational and action component of emotions (Frijda, 1986), there are very few studies that suggested to use motor actions (that are not considered as communicative units) to assess emotions.

Russell and Mehrabian (1978) suggested that the behavior of a person changes as a function of the emotion-eliciting quality of the environment, but did not consider the issue of emotion assessment. Motivational behaviors such as approach and avoidance are frequently used to estimate whether a stimulus is positive or negative and indirectly the valence of the reaction of the person (Chen and Bargh, 1999). However, several authors suggested that anger, a negative emotion, is also characterized by an approach motivation (e.g., Carver and Harmon-Jones, 2009; Wilkowski and Meier, 2010) and, therefore, motivational direction and affective valence should be dissociated (Coombes et al., 2007).

The most frequently used paradigm to estimate approach and avoidance reactions uses the movements of the arm of the respondent. Approach is associated with moving objects closer to a person, while avoidance is associated with pushing them away. For example, Marsh et al. (2005) found that angry facial expressions facilitated avoidance behavior that is, pushing a joystick away from oneself more quickly than pulling it closer.

In another version of the paradigm, the effect of pulling the joystick closer to the self or pushing it away from the self has the consequence to, respectively, magnify (i.e., increase the size) or shrink (i.e., reduce the size) the picture that is observed (Rinck and Becker, 2007). The perceptual effect is that the pictures are coming closer or moving away depending on the movement of the joystick. Nevertheless, recent work questioned the absolute validity of such tasks by showing that a modification in the instructions would cause different results than predicted (Eder and Rothermund, 2008). This led these authors to argue that evaluative implications of the instructions assign affective codes to motor behavior that interact with stimulus evaluation.

Conclusion

Past research showed that several instruments can be used to assess the emotional state of a person. Nevertheless, our review

showed there is not one single method for emotion assessment that is ideal under all circumstances. The choice of the method depends on the research question and on the resources available for the realization of specific research designs. Most importantly, researchers should look for the method that best allows them to test their hypotheses, and consider using multiple assessment measures at the same time in order to increase the internal validity of their studies.

Acknowledgments

This research was supported by the National Centre of Competence in Research (NCCR) Affective Sciences financed by the Swiss National Science Foundation (51NF40–104897) and hosted by the University of Geneva.

See also: Culture and Emotion; Early Emotional Development and Cultural Variability; Emotion and Expression; Emotion in Cognition; Emotion, Perception and Expression of; Emotional Intelligence and Competencies; Emotional Regulation; Emotions and Aging; Emotions and Health; Emotions, Psychological Structure of; Facial Emotion Expression, Individual Differences in; Selfconscious Emotions, Psychology of.

Bibliography

Bachorowski, J.-A., Owren, M.J., 1995. Vocal expression of emotion: acoustic properties of speech are associated with emotional intensity and context. Psychological Science 6 (4), 219–224.

Banse, R., Scherer, K.R., 1996. Acoustic profiles in vocal emotion expression. Journal of Personality and Social Psychology 70, 614–636.

Bänziger, T., Mortillaro, M., Scherer, K.R., 2012. Introducing the Geneva Multimodal Expression corpus for experimental research on emotion perception. Emotion 12 (5), 1161–1179.

Boone, R.T., Cunningham, J.G., 1998. Children's decoding of emotion in expressive body movement: the development of cue attunement. Developmental Psychology 34 (5), 1007.

Bradley, M.M., Lang, P.J., 1994. Measuring emotion: the self-assessment manikin and the semantic differential. Journal of Behavior Therapy and Experimental Psychiatry 25 (1), 49–59.

Bradley, M.M., Lang, P.J., 2000. Measuring emotion: behavior, feeling and physiology. In: Lane, R., Nadel, L. (Eds.), Cognitive Neuroscience of Emotion. Oxford University Press, New York, pp. 242–276.

Brown, W.M., Palameta, B., Moore, C., 2003. Are there nonverbal cues to commitment? An exploratory study using the zero-acquaintance video presentation paradigm. Evolutionary Psychology 1, 42–69.

Bryant, G.A., Barrett, H.C., 2008. Vocal emotion recognition across disparate cultures. Journal of Cognition and Culture 8, 135–148.

Caron, A.J., Caron, R.F., MacLean, D.J., 1988. Infant discrimination of naturalistic emotional expressions: the role of face and voice. Child Development 59 (3), 604–616. http://dx.doi.org/10.2307/1130560.

Carver, C.S., Harmon-Jones, E., 2009. Anger is an approach-related affect: evidence and implications. Psychological Bulletin 135 (2), 183–204.

Chen, M., Bargh, J.A., 1999. Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. Personality and Social Psychology Bulletin 25, 215–224.

Coombes, S.A., Cauraugh, J.H., Janelle, C.M., 2007. Emotional state and initiating cue alter central and peripheral motor processes. Emotion 7 (2), 275–284.

Coulson, M., 2004. Attributing emotion to static body postures: recognition accuracy, confusions, and viewpoint dependence. Journal of Nonverbal Behavior 28 (2), 117–139.

Dael, N., Mortillaro, M., Scherer, K.R., 2012a. The body action and posture coding system (BAP): development and reliability. Journal of Nonverbal Behavior 36 (2), 97–121. http://dx.doi.org/10.1007/s10919-012-0130-0.

Dael, N., Mortillaro, M., Scherer, K.R., 2012b. Emotion expression in body action and posture. Emotion 12 (5), 1085–1101.

Darwin, C., 1872. The expression of the emotions in man and animals. John Murray, London, England. http://dx.doi.org/10.1037/10001-000.

Desmet, P.M.A., Porcelijn, R., van Dijk, M., 2007. Emotional design; application of a research based design approach. Journal of Knowledge, Technology & Policy 20 (3), 141–155.

Eder, A.B., Rothermund, K., 2008. When do motor behaviors (mis)match affective stimuli? An evaluative coding view of approach and avoidance reactions. Journal of Experimental Psychology – General 137 (2), 262–281.

Ekman, P., 1965. Differential communication of affect by head and body cues. Journal of Personality and Social Psychology 2 (5), 726–735.

Ekman, P., 1992. An argument for basic emotions. Cognition & Emotion 6 (3/4), 169–200.

Ekman, P., 2003. Darwin, deception, and facial expression. In: Campos, J.J., Davidson, R.J., de Waal, F.B. (Eds.), Emotions inside out, vol. 1000. New York Academy of Sciences, New York, pp. 205–211.

Ekman, P., Friesen, W.V., 1969. The repertoire of nonverbal behavior: categories, origins, usage, and coding. Semiotica 1 (1), 49–98.

Ekman, P., Friesen, W.V., 1974. Nonverbal behavior and psychopathology. The Psychology of Depression: Contemporary Theory and Research 203–224.

Ekman, P., Friesen, W.V., 1978. The Facial Action Coding System, first ed. Consulting Psychologists Press, Palo Alto, CA.

Ekman, P., Friesen, W.V., O'Sullivan, M., Scherer, K., 1980. Relative importance of face, body, and speech in judgments of personality and affect. Journal of Personality and Social Psychology 38 (2), 270–277.

Ekman, P., Levenson, R.W., Friesen, W.V., 1983. Autonomic nervous system activity distinguishes among emotions. Science 227 (4616), 1208–1210.

Ellgring, H., Scherer, K.R., 1996. Vocal indicators of mood change in depression. Journal of Nonverbal Behavior 20 (2), 83–110.

Fecteau, S., Armony, J.L., Joanette, Y., Belin, P., 2005. Judgement of emotional nonlinguistic vocalizations: age-related differences. Applied Neuropsychology 12 (1), 40–48.

Fogel, A., Nwokah, E., Dedo, J.Y., Messinger, D., Dickson, K.L., Matusov, E., Holt, S.A., 1992. Social process theory of emotion: a dynamic systems approach. Social Development 1 (2), 122–142. http://dx.doi.org/10.1111/j.1467-9507.1992.tb00116.x.

Foikman, S., Lazarus, R.S., 1985. If it changes it must be a process: a study of emotion and coping during three stages of a college examination. Journal of Personality and Social Psychology 48, 150–170.

Fontaine, J.R.J., Scherer, K.R., Roesch, E.B., Ellsworth, P.C., 2007. The world of emotions is not two-dimensional. Psychological Science 18, 1050–1057.

Fridlund, A.J., 1994. Human Facial Expression: An Evolutionary View. Academic Press, San Diego, CA.

Frijda, N.H., 1986. The Emotions. Cambridge University Press, Cambridge, UK.

Frijda, N.H., 2007. The Laws of Emotion. Erlbaum, Mahwah, NJ.

Frijda, N.H., Scherer, K.R., 2009. Emotion definitions (psychological perspectives). In: Sander, D., Scherer, K.R. (Eds.), The Oxford Companion to Emotion and Affective Sciences. Oxford University Press, New York, NY, pp. 142–144.

Goudbeek, M., Scherer, K.R., 2010. Beyond arousal: valence and potency/control cues in the vocal expression of emotion. Journal of the Acoustical Society of America 128 (3), 1322–1336.

Harrigan, J.A., 2005. Proxemics, kinesics, and gaze. In: Harrigan, J.A., Rosenthal, R., Scherer, K.R. (Eds.), The New Handbook of Methods in Nonverbal Behavior Research. Oxford University Press, New York, NY, pp. 137–198.

Hawk, S.T., van Kleef, G.A., Fischer, A.H., van der Schalk, J., 2009. "Worth a thousand words": absolute and relative decoding of nonlinguistic affect vocalizations. Emotion 9 (3), 293–305. http://dx.doi.org/10.1037/a0015178.

Izard, C.E., 1971. The Face of Emotion. Appleton-Century-Crofts, New York.

Izard, C.E., 1972. Patterns of Emotions: A New Analysis of Anxiety and Depression. Academic Press, San Diego, CA.

Izard, C.E., 1977. Human Emotions. Plenum Press, New York.

Izard, C.E., Libero, D.Z., Putnam, P., Hayes, O.M., 1993. Stability of emotional experiences and their relations to traits of personality. Journal of Personality and Social Psychology 64, 847–860.

Juslin, P.N., Laukka, P., 2003. Communication of emotions in vocal expression and music performance: different channels, same code? Psychological Bulletin 129 (5), 770–814. http://dx.doi.org/10.1037/0033-2909.129.5.770.

Kotsch, W.E., Gerbing, D.W., Schwartz, L.E., 1982. The construct validity of the differential emotions scale as adapted for children and adolescents. In: Izard, C.E. (Ed.), Measuring Emotions in Infants and Children. Cambridge University Press, New York, NY, pp. 251–278.

Kreibig, S.D., 2010. Autonomic nervous system activity in emotion: a review. Biological Psychology 84, 394–421.
Larsen, J.T., Berntson, G.G., Poehlmann, K.M., Ito, T.A., Cacioppo, J.T., 2008. The psychophysiology of emotion. In: Lewis, R., Haviland-Jones, J.M., Feldman-Barrett, L. (Eds.), The Handbook of Emotions, third ed. Guilford, New York.
Levenson, R.W., Ekman, P., Friesen, W.V., 1990. Voluntary facial action generates emotion-specific autonomic nervous system activity. Psychophysiology 27, 363–384.
Marsh, A.A., Ambady, N., Kleck, R.E., 2005. The effects of fear and anger facial expressions on approach- and avoidance-related behaviors. Emotion 5, 119–124.
Mauss, I.B., Robinson, M.D., 2009. Measures of emotion: a review. Cognition & Emotion 23 (2), 209–237.
Mayer, J.D., Gaschke, Y.N., 1988. The experience and meta-experience of mood. Journal of Personality and Social Psychology 55, 102–111.
Mehrabian, A., Russell, J.A., 1974. An Approach to Environmental Psychology. The MIT Press.
Mehu, M., Scherer, K.R., 2012. A psycho-ethological approach to social signal processing. Cognitive Processing 13 (2), 397–414. http://dx.doi.org/10.1007/s10339-012-0435-2.
Mehu, M., Scherer, K.R., n.d. Emotional categories and dimensions in the facial communication of affect: an integrated approach. Manuscript Under Review.
Mehu, M., van der Maaten, L.J., 2014. Multimodal integration of dynamic audio-visual cues in the communication of agreement and disagreement. Journal of Nonverbal Behavior 38, 569–597.
Mehu, M., Mortillaro, M., Bänziger, T., Scherer, K.R., 2012. Reliable facial muscle activation enhances recognizability and credibility of emotional expression. Emotion 12 (4), 701–715. http://dx.doi.org/10.1037/a0026717.
Montepare, J., Koff, E., Zaitchik, D., Albert, M., 1999. The use of body movements and gestures as cues to emotions in younger and older adults. Journal of Nonverbal Behavior 23, 133–152.
Mortillaro, M., Mehu, M., Scherer, K.R., 2011. Subtly different positive emotions can be distinguished by their facial expressions. Social Psychological and Personality Science 2 (3), 262–271.
Mortillaro, M., Mehu, M., Scherer, K.R., 2013. The evolutionary origin of multimodal synchronization in emotional expression. In: Altenmüller, E., Schmidt, S., Zimmerman, E. (Eds.), Evolution of Emotional Communication: From Sounds in Nonhuman Mammals to Speech and Music in Man. Oxford University Press, New York, pp. 3–25.
Owren, M.J., Bachorowski, J.-A., 2003. Reconsidering the evolution of nonlinguistic communication: The case of laughter. Journal of Nonverbal Behavior 27 (3), 183–200.
Reisenzein, R., Studtmann, M., Horstmann, G., 2013. Coherence between emotion and facial expression: evidence from laboratory experiments. Emotion Review 5 (1), 16–23.
Rinck, M., Becker, E.S., 2007. Approach and avoidance in fear of spiders. Journal of Behavior Therapy and Experimental Psychiatry 38, 105–120.
Roseman, I.J., Smith, C.A., 2001. Appraisal theory: overview, assumptions, varieties, controversies. In: Scherer, K.R., Schorr, A. (Eds.), Series in Affective Science: Appraisal Processes in Emotion: Theory, Methods, Research. Oxford University Press, London, pp. 3–19.
Russell, J.A., 1980. A circumplex model of affect. Journal of Personality and Social Psychology 39 (6), 1161–1178.
Russell, J.A., 1994. Is there universal recognition of emotion from facial expression? A review of the cross-cultural studies. Psychological Bulletin 115 (1), 102–141.
Russell, J.A., Bullock, M., 1985. Multidimensional scaling of emotional facial expressions: similarity from preschoolers to adults. Journal of Personality and Social Psychology 48 (5), 1290–1298. http://dx.doi.org/10.1037/0022-3514.48.5.1290.
Russell, J.A., Mehrabian, A., 1977. Evidence for a three-factor theory of emotions. Journal of research in Personality 11 (3), 273–294.
Russell, J.A., Mehrabian, A., 1978. Approach-avoidance and affiliation as functions of the emotion-eliciting quality of an environment. Environment and Behavior 10 (3), 355–387.
Russell, J.A., Weiss, A., Mendelsohn, G.A., 1989. Affect grid: a single-item scale of pleasure and arousal. Journal of Personality and Social Psychology 57 (3), 493–502.
Sauter, D., Scott, S., 2007. More than one kind of happiness: can we recognize vocal expressions of different positive states? Motivation and Emotion 31 (3), 192–199. http://dx.doi.org/10.1007/s11031-007-9065-x.
Scherer, K.R., Shuman, V., Fontaine, J.R.J., Soriano, C., 2013a. The GRID meets the wheel: assessing emotional feeling via self-report. In: Fontaine, J.R.J., Scherer, K.R., Soriano, C. (Eds.), Components of Emotional Meaning: A Sourcebook. Oxford University Press, Oxford, pp. 281–298.
Scherer, K.R., Mortillaro, M., Mehu, M., 2013b. Understanding the mechanisms underlying the production of facial expression of emotion: a componential perspective. Emotion Review 5 (1), 47–53.
Scherer, K.R., 1986. Vocal affect expression: a review and a model for future research. Psychological Bulletin 99 (2), 143–165. http://dx.doi.org/10.1037/0033-2909.99.2.143.
Scherer, K.R., 1992. What does facial expression express?. In: Strongman, K.T. (Ed.), International Review of Studies of Emotion, vol. 2. Wiley, Chichester, UK, pp. 139–165.
Scherer, K.R., 2001. Appraisal considered as a process of multilevel sequential checking. In: Schorr, A., Johnstone, T. (Eds.), Appraisal Process in Emotion: Theory, Method, Research. Oxford University Press, New York & Oxford, pp. 92–120.
Scherer, K.R., 2005. What are emotions? And how can they be measured? Social Science Information 44 (4), 695–729.
Scherer, K.R., 2009. The dynamic architecture of emotion: evidence for the component process model. Cognition & Emotion 23, 1307–1351.
Scherer, K.R., Ellgring, H., 2007a. Are facial expressions of emotion produced by categorical affect programs or dynamically driven by appraisal? Emotion 7 (1), 113–130.
Scherer, K.R., Ellgring, H., 2007b. Multimodal expression of emotion: affect programs or componential appraisal patterns? Emotion 7 (1), 158–171.
Schlosberg, H., 1952. The description of facial expressions in terms of two dimensions. Journal of Experimental Psychology 44 (4), 229–237. http://dx.doi.org/10.1037/h0055778.
Smith, C.A., 1989. Dimensions of appraisal and physiological response in emotion. Journal of Personality and Social Psychology 56 (3), 339–353. http://dx.doi.org/10.1037/0022-3514.56.3.339.
Smith, C.A., Scott, H.S., 1997. A componential approach to the meaning of facial expression. In: Russell, J.A., Fernandez-Dols, J.-M. (Eds.), The Psychology of Facial Expression. Cambridge University Press, Cambridge, UK, pp. 229–254.
Snodgrass, J.D., 1992. Judgment of Feeling States from Facial Behavior: A Bottom-up Approach. Ph.D. thesis. University of British Columbia.
Tomkins, S.S., Carter, R.M., 1964. What and where are the primary affects? Some evidence for a theory. Perceptual and Motor Skills 18, 119–158.
Tracy, J.L., Robins, R.W., 2008. The nonverbal expression of pride: evidence for cross-cultural recognition. Journal of Personality and Social Psychology 94 (3), 516–530.
Wallbott, H.G., 1985. Hand movement quality: a neglected aspect of nonverbal behavior in clinical judgement and person perception. Journal of Clinical Psychology 41 (3), 345–359.
Wallbott, H.G., 1998. Bodily expression of emotion. European Journal of Social Psychology 28 (6), 879–896. http://dx.doi.org/10.1002/(SICI)10990992(199811028:6<879::AID-EJSP901>3.0.CO;2-W.
Watson, D., Clark, L.A., 1994. The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded Form. University of Iowa, Iowa City. Retrieved online on 21.03.14 at: http://www2.psychology.uiowa.edu/faculty/Watson/PANAS-X.pdf.
Watson, D., Clark, L.A., Tellegen, A., 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of Personality and Social Psychology 54, 1063–1070.
Wilkowski, B.M., Meier, B.P., 2010. Bring it on: angry facial expressions potentiate approach-motivated motor behavior. Journal of Personality and Social Psychology 98 (2), 201–210.