A validated battery of vocal emotional expressions

Pierre Maurage [1] - **Frédéric Joassin** [1] - **Pierre Philippot** [1]
Salvatore Campanella [2]

[1] *Cognitive Neurosciences and Clinical Psychology Research units, Department of Psychology, Catholic University of Louvain, Louvain-la-Neuve, Belgium*

[2] *Department of Psychiatry, Brugmann Hospital, Free University of Brussels, Brussels, Belgium*

pierre.maurage@psp.ucl.ac.be

Abstract

For a long time, the exploration of emotions focused on facial expression, and vocal expression of emotion has only recently received interest. However, no validated battery of emotional vocal expressions has been published and made available to the researchers' community. This paper aims at validating and proposing such material. 20 actors (10 men) recorded sounds (words and interjections) expressing six basic emotions (anger, disgust, fear, happiness, neutral and sadness). These stimuli were then submitted to a double validation phase: (1) preselection by experts; (2) quantitative and qualitative validation by 70 participants. 195 stimuli were selected for the final battery, each one depicting a precise emotion. The ratings provide a complete measure of intensity and specificity for each stimulus. This paper provides, to our knowledge, the first validated, freely available and highly standardized battery of emotional vocal expressions (words and intonations). This battery could constitute an interesting tool for the exploration of prosody processing among normal and pathological populations, in neuropsychology as well as psychiatry. Further works are nevertheless needed to complement the present material.

Keywords: Emotional Vocal Expression; Prosody; Battery

1. Introduction

Every banal or crucial moment of our existence is associated with an emotional feeling. Indeed, emotions are an essential aspect of life, they influence

our behaviours, decisions, motivations and social interactions. Emotions have been explored since the early development of modern experimental psychology, and constituted a major field of investigation during the last decades. Nevertheless, the debate concerning the emotional phenomena is still brisk. Many models and interpretations have been proposed in social psychology (e.g. Leventhal, 1984), cognitive psychology (e.g. Frijda et al., 1989), and more recently in a neuroscience perspective (Davidson, 2003). Despite this theoretical disparity, a consensus progressively emerged concerning the global definition of emotion: A multidimensional concept (e.g. Scherer, 1984) including at least some physiological changes, an internal state (namely an "affect"), a cognitive behaviour, but also an overt behaviour.

Behaviours constitute a central aspect of emotion, and the behavioural correlates associated with every emotion thus became a central field of research. The expression of the emotional state and its corollary, the perception of emotions are crucial for the social life: emotions are communicative (Oatley & Johnson-Laird, 1987). Among the various modes of emotional expression (e.g. tears, cries, physical aggression, …), the face appears to be a central medium for communication, and it rapidly became the central focus of researchers. It has notably been shown that each basic emotion (mainly fear, anger, happiness, sadness, disgust and surprise) is associated with a specific activation pattern of the face's muscles (as described in the FACS, Ekman & Friesen, 1976) and that most of these facial expressions are expressed and recognized universally, regardless of the culture (Ekman et al., 1969; Izard, 1977). This research allowed the construction of standardized batteries of EFE (emotional facial expressions, e.g. Ekman & Friesen, 1976; Hess & Blairy, 1995; Matsumoto & Ekman, 1988). With the support of these validated stimuli, hundreds of studies related to the expression and recognition of emotional facial expression were carried out in various fields, such as social psychology (e.g. Ackerman et al., 2006), cognitive psychology (e.g. Campanella et al., 2002), neuroscience (e.g. Blair et al., 1999) or psychopathology (e.g. Minzenberg et al., 2006). Thus, the construction of reliable materials allowed the fast expansion of the studies exploring the EFE and facilitated the comparison among studies.

More recently, notably with the development of crossmodal explorations (e.g. Calvert, 2001), a growing interest has been directed towards other sensory modalities. Concerning emotional processing, studies have been carried out to explore the perception of olfactory (e.g. Hermans et al., 2005), tactile (Montoya & Sitges, 2006) and gustatory (Greimel et al., 2006) stimuli, but the most flourishing domain concerns the auditory stimulations. Indeed, the emotional valence conveyed by sounds recently gave rise to various studies, mainly exploring prosody among normal (see Ethofer et al., 2006 for a review) and pathological populations (e.g. Monnot et al., 2002). Despite

this growing interest for the auditory expression of emotion, and despite a great amount of earlier works on emotional prosody (e.g. Banse & Scherer, 1996; Kappas et al., 1991; Hess et al., 1989), no study has yet been conducted to construct a standardized, validated and freely available battery of emotional auditory words and interjections. Actually, the existing sets of stimuli are, to our knowledge, either partials (i.e. not proposing the complete range of emotions), or only partially validated and standardized (e.g. Fecteau et al., 2005; Golan et al., 2006; 2007; Pourtois et al., 2005). As a consequence, most of the studies on emotional prosody have been based on ad hoc constructed stimuli, which constitutes undoubtedly a loss of time and makes difficult the comparison among studies.

It thus appears crucial, in order to facilitate future studies and to propose a common reference freely and easily available, to construct a standardized and validated battery, following the example of what has been done concerning the EFE. This study aims at proposing an emotional auditory battery using various actors, stimuli and emotions. This validated auditory battery is made freely accessible to all researchers via the Internet.

2. Methods

2.1. Stimuli construction

2.1.1. Actors, emotions and stimuli

Twenty actors (10 men and 10 women) were recruited in Louvain-la-Neuve, Belgium. All actors were native French speakers. It was decided to record the five of the most used basic emotions (namely anger, fear, happiness, sadness and disgust), and the neutral state. Short emotional scripts were built in order to ensure that emotions were clearly defined. Before the recording of each emotion, actors read a brief text describing a situation eliciting this emotion. Two types of stimuli were chosen: One consisted in a meaningless sound (namely the interjection "ah") and the other in a semantically neutral word (namely the French word "papier", i.e. "paper").

2.1.2. Design and recording

Each actor produced two times each emotion and stimulus type, leading to the recording of 480 voice samples: 10 (actors) X 2 (sex of actor) X 6 (emo-

tions) X 2 (kinds of stimulus) X 2 (samples). The session took place at the Auditory Lab of the Faculty of Psychology in Louvain-la-Neuve, and the sounds were recorded on a high-quality microphone with Goldwave 4.25 (Goldwave Inc., 2001). Before the recording of each stimulus, actors were asked to read the emotional script associated with the emotion and to imagine experiencing the situation. Each stimulus was recorded at least two times, and more if the actor or the researcher decided that the sound quality was not satisfying. There was no time limit for the recording session. After recording, a standardization of duration was imposed with Goldwave 4.25 in order to have a common length (initially varying from 630 to 792 ms) of 700 ms for all records.

2.1.3. Expert rating

Before the beginning of the experimental validation of the battery per se, a preselection was carried out on the basis of expert rating. In order to select the best recordings among each pair (as every stimulus was recorded twice) and to eliminate obviously invalid samples, three experts (researchers chosen on the basis of their knowledge on emotional prosody) inspected the 480 recordings. The three experts heard the 480 sounds and were asked on the one hand to decide which emotion was expressed (namely to detect the emotion mainly depicted in the stimulus) and on the other hand to rate them on two Lickert scales (from 1 to 7) respectively evaluating the quality of the recording and the recognizability of the emotion. The sounds were chosen if they met the following criteria: (a) The stimulus was identified by the three experts as mainly depicting the correct emotion; (b) The mean quality rating was at least of 4; (c) The mean recognizability rating was at least of 5. On this basis, 220 sounds were selected for the experimental validation, performed by 9 female and 8 male actors.

2.2. Stimuli validation

70 undergraduate psychology students at the University of Louvain (39 women and 21 men, mean age: 19.6 years) took part in the stimuli validation phase. Six sessions were conducted, each one with 10 students. The 220 stimuli were randomly presented with professional quality speakers. Each stimulus was presented once. After each presentation, participants had to report which emotion(s) were displayed in the record, with 8 points Lickert scales (from 0 “Absolutely not” to 7 “Totally”) which had to be completed on

the basis of the following general question: "Is this emotion expressed in this sound?". Ten scales were proposed, reflecting emotions actually displayed in several stimuli (anger, fear, sadness, happiness, disgust) or other emotions (shame, boredom, surprise, contempt, annoyance) chosen for their proximity with the emotions actually expressed.

3. Results

3.1. Preselection

A first preselection was conducted. It was decided to exclude from the final battery any stimulus that had not been correctly identified by at least 90% of the participants. An identification was considered as correct when the emotion displayed by the actor obtained the highest score on the Lickert scale as compared to other emotional scales. On this basis, 25 sounds were excluded.Brain and the final battery is thus composed of 195 stimuli, each one correctly identified as depicting the expected emotion.

3.2. Basic emotion ratings

While the correct identification of each sound could be considered as a sufficient criteria to validate the battery (e.g. Banse & Scherer, 1996), this study aimed at conducting a sharper analysis. We computed the overall mean of the ratings for each stimulus on each scale. This procedure first allowed to determine the intensity of the emotion rating (namely the mean score for the expected emotion). Nevertheless, a high intensity score is insufficient to conclude that a stimulus is valid, as it could be that a stimulus is highly rated on the depicted emotion, but also on scales linked to irrelevant emotions. In order to take into account the difference between the relevant score and the other scores,Brain anda second factor was computed, namely the specificity of the emotion rating (i.e. the percentage stemming from the mean score for the expected emotion divided by the mean global scoring for the five scales associated with the basic emotions). Concerning the neutral stimulus, a sound was considered as neutral when the mean rating was lower than 1.5 for each scale associated with a basic emotion (anger, disgust, fear, happiness, sadness). On this basis we obtained, for each emotion, a set of stimuli depicting this emotion: 32 anger stimuli, 30 disgust stimuli, 34 fear stimuli,

27 happiness stimuli, 38 neutral stimuli and 34 sadness stimuli A ranking of the stimuli for each emotional category was then carried out. The intensity and specificity of the ten best sounds for each emotional category are reported in Table 1. These intensity (higher than 4.9) and specificity (higher than 75 percent) appear satisfying, with very low confusion between the six basic emotions. Moreover, Table 2 presents for each emotional set of stimuli, the mean intensity values obtained on each emotion scale (namely the emotion rating for the depicted emotion but also for the other irrelevant emotions). This Table thus shows the distinctive emotional features for each set, and the specificity of the stimuli: high ratings for the depicted emotion (mean intensity higher than 3.3) and low ratings for the other emotion scales (mean intensity lower than 0.9).

Finally, two complementary measures were computed in order to confirm the (1) the specificity of each emotional set as compared to other ones and (2) the internal consistency of each emotional set. First, two-tailed Pearson's correlations have been computed between the mean ratings for each emotion scale among the different emotion sets. As expected, no significant correlations have been detected ($p > .40$ for every correlation), showing a high independence between the ratings in the different emotion sets, and thus the specificity of each emotion set. Second, Cronbach's alphas have been computed to test the internal consistency of each emotional set on each emotion scale across participants. High values ($\alpha > 0.82$) were found for the relevant emotion scale of each emotion set (e.g. the emotion scale of anger for the anger set of stimuli), but also for the irrelevant ones ($\alpha > 0.74$), thus reinforcing the validity of the battery.

Table 1. Intensity and specificity of the ten best stimuli for each basic emotion [mean values (SD)]

Emotion type	Mean intensity[a]	Mean specificity[b]
Anger	5.44 (0.25)	83.2 (8.87)
Disgust	5.45 (0.41)	88.6 (7.08)
Fear	5.59 (0.20)	75.1 (6.97)
Happiness	5.36 (0.36)	97.6 (2.36)
Sadness	4,86 (0.68)	76.3 (9.92)
Neutral	0,09 (0.04)	/

[a] Mean score for the expected emotion, from 0 (emotion absolutely not depicted in the stimulus) to 7 (emotion fully depicted in the stimulus).

[b] Mean percentage stemming from the mean score for the expected emotion divided by the mean global scoring for the five scales associated with the basic emotions.

Table 2. Mean intensity ratings on each emotional scale for each emotion set [mean values (SD)]

Emotion Scale / Emotional Set	Anger	Disgust	Fear	Happiness	Sadness
Anger (32[a])	**4.26 (1.20)**[b]	0.89 (0.58)	0.26 (0.31)	0.08 (0.29)	0.18 (0.21)
Disgust (30)	0.36 (0.40)	**3.60 (1.54)**	0.36 (0.37)	0.37 (0.48)	0.23 (0.32)
Fear (34)	0.17 (0.22)	0.89 (0.68)	**4.61 (0.91)**	0.12 (0.28)	0.88 (0.73)
Happiness (27)	0.04 (0.07)	0.39 (0.55)	0.24 (0.41)	**3.78 (1.40)**	0.12 (0.20)
Sadness (34)	0.10 (0.15)	0.48 (0.49)	0.74 (0.59)	0.13 (0.24)	**3.33 (1.25)**
Neutral (38)	0.13 (0.17)	0.18 (0.21)	0.09 (0.14)	0.14 (0.25)	0.47 (0.34)

[a] Number of stimuli in this emotional set.

[b] The score for the emotion scale associated with the depicted emotion is presented in bold type.

3.3. Secondary emotion ratings

Moreover, we explored the most frequent confusions in the emotional rating. Indeed, if there were very few misinterpretations among the six emotions depicted by the stimuli (as shown above), which was the central aim of this study, it was still possible to find more mistakes in the ratings associated with other emotions (namely shame, boredom, surprise, contempt and annoyance), as these secondary emotions are known to be often confused with the basic ones. Nevertheless, we found globally low ratings for these secondary emotions: Global mean rating was lower than 0.8 on each secondary emotion scale, and no stimulus was rated higher on a secondary scale than on the correct scale (i.e. the scale associated with the emotion actually depicted). This confirmed the specificity of the stimuli. Actually, the more frequent errors were, as expected, to confound (1) annoyance with anger (annoyance mean rating for anger stimuli was 2.9), (2) contempt with disgust (mean: 1.2), (3) surprise with fear (mean: 1.4) or happiness (mean: 1.4), (4) boredom with neutral (mean: 1.8) or sadness (mean: 1.2). However, these erroneous ratings stay relatively low, and all the other mean ratings for the secondary emotion are lower than 1, which confirms the validity of this battery.

The complete results are presented in Annex 1 that gives an exhaustive description of each stimulus: number, emotion depicted, type (word or interjection), actor, mean rating for each emotional scale, ranking and specificity percentage for each emotion.

4. Discussion

The aim of this study was to design a validated battery of emotional auditory stimuli. Indeed, the exploration of the behavioural, electrophysiological and neuroanatomical (e.g. Everhart et al., 2006; Kotz et al., 2006) correlates of emotional sound processing became a central field of interest during the last decade. Nevertheless, while a wide range of reliable materials exist for the visual emotional stimuli (e.g. Ekman & Friesen, 1976; Hess & Blairy, 1995) and while some preliminary works have been conducted to validate prosody batteries (Borod et al., 1990; Pell, 2002), only some partial or specific materials exist. For example, Fecteau et al. (2005) only used non-linguistic vocalizations; Pourtois et al. (2005) proposed only two emotions (i.e. fear and happiness); Golan et al. (2006; 2007), in the Cambridge Mindreading Face-Voice Battery, presented a battery based on emotional sentences, specifically dedicated to autistic populations and focusing on complex emotions; finally Banse and Scherer (1996) only described a partial validation of their results, with low recognition rates for certain emotions (e.g. 14% for disgust). Moreover, in most of the studies using emotional auditory stimuli, the first aim was not to present an auditory battery per se, but rather to explore various processing on the basis of auditory stimuli. These studies were thus not precisely describing the characteristics (validation, standardization, …) of the stimuli used, and did not put their stimuli at the researchers' community's disposal. As a consequence, to our knowledge, no complete, validated and free auditory emotional battery has been published up to now. This surprising absence of available material dampens the development of the field (as every researcher has to build and validate his/her own stimuli), and hamper the comparison among studies (as the specificity and intensity of the auditory emotions highly varies across experiments). This paper is thus a first attempt to develop a validated and standardized auditory battery of emotional sounds.

The advantages of this battery are the following: First, it proposes a complete and various set of stimuli, as the final battery presents 195 stimuli depicting the six basic emotions (anger, disgust, fear, happiness, neutral and sadness), with two types of stimuli (word and interjection) and a wide range of voices (eight male and nine female actors). Second, the 195 stimuli have standardized duration (700ms), which is crucial in studies where the timing of stimulation is important (e.g. studies based on reaction times recording, electrophysiological and neuroimagery studies). Third, the battery is highly validated, as the large qualitative validation (70 participants) with 10 emotional scales led to a precise ranking, based on specificity and intensity of each stimulus. This ensures a one-to-one relation associating each stimulus with a precise emotion. Finally, the battery proposes a ranking of the

stimuli among each emotion set (from the most obvious to the most ambiguous), which allows for choosing the emotional clarity of each stimulus included in a study, according to the desired difficulty of the task. To summarize, this battery is large (with various emotions, stimulus types and actors), highly validated (on the basis of an expert analysis followed by a large validation), highly standardized (controlled duration and intensity of the stimuli) and based on a qualitative evaluation (allowing a precise distinction between stimuli concerning the emotional intensity and specificity).

The potential applications of this battery are large and various. In the field of neuropsychology, it could be a useful tool to explore (by means of behavioural but also neuroimagery approaches) the cerebral correlates of emotional prosody, and for example (1) the dissociation between identity and emotion processing in the voice (e.g. Bedart & Belin, 2004), or (2) the dissociation between the processing of different emotions (e.g. Harciarek et al., 2006). Moreover, this battery, furnishing an auditory matching piece to the existing EFE batteries, could be a helpful tool to investigate the neuropsychological dissociations between visual and auditory processing of emotions, and particularly to explore the crossmodal processing of emotions (e.g. Grossman et al., 2006). Finally, as the exploration of emotional processing is a flourishing field in psychiatry, this battery could lead to several applications among clinical populations (e.g. Maurage et al., in press). These examples are of course not exhaustive, as this battery is designed to become a multi-purpose tool, potentially useful in a wide range of studies.

Nevertheless, this study is a first step in developing a more complete and global battery of emotional vocal expressions, and further works should develop this project in at least three directions. First, while the meaningless stimuli (i.e. interjections) are already suitable for studies in other languages, their validity among non French-speaking populations should be ascertained. Second, it should be noted that our semantic stimuli (i.e. words) can be used as emotional non-words among non-French speaking subjects, as the emotional features of the word are contained in the prosody and not in the word "paper" (which has a neutral meaning). Nevertheless, new single-word stimuli should be recorded in different countries, in order to obtain a comparable material in different languages. Finally, new stimuli, notably expressing other emotions, could be recorded and validated to expand the battery. We thus appeal to researchers studying emotional prosody in other languages, in order to develop this battery and we propose to include, in the material proposed on our website, any material validated in other languages, constructed according to the same procedure as presented in this paper.

To sum up, it appears crucial to develop a global, validated and freely available pool of emotional vocal stimuli, as the interest for the exploration

of auditory processing of emotions increased exponentially during the last years, in normal as well as pathological populations. This study intend to be the first step towards this direction, by proposing a validated and standardized battery of emotional vocal stimuli (word and interjection), which could facilitate future studies using emotional vocal expressions, after the fashion of what has been conducted in the domain of the emotional facial expressions.

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References

Ackerman, J.M., Shapiro, J.R., Neuberg, S.L., Kenrick, D.T., Becker, D.V., Griskevicius, V., Maner, J.K., & Schaller, M. (2006). They all look the same to me (unless they're angry): From out-group homogeneity to out-group heterogeneity. *Psychological Science*, 17, 836-840.

Banse, R., & Scherer, K.R. (1996). Acoustic profiles in vocal emotion expression. *Journal of Personality and Social Psychology*, 70, 614-636.

Bedard, C., & Belin, P. (2004). A "voice inversion effect?". *Brain and Cognition*, *55*, 247-249.

Blair, R.J., Morris, J.S., Frith, C.D., Perrett, D.I., & Dolan, R.J. (1999). Dissociable neural responses to facial expressions of sadness and anger. *Brain*, 122, 883-893.

Borod, J.C., Welkowitz, J., Alpert, M., Brozgold, A.Z., Martin, C., Peselow, E., & Diller, L. (1990). Parameters of emotional processing in neuropsychiatric disorders: Conceptual issues and a battery of tests. *Journal of Communication Disorders*, 23, 247-271.

Calvert, G.A. (2001) Crossmodal processing in the human brain: Insights from functional neuroimaging studies. *Cerebral Cortex*, 11, 1110-1123.

Campanella, S., Gaspard, C., Debatisse, D., Bruyer, R., Crommelinck, M., & Guérit, J.M. (2002). Discrimination of emotional facial expressions in a visual oddball task: An ERP study. *Biological Psychology*, 59, 171-186.

Davidson, R.J. (2003). Affective neuroscience and psychophysiology: Toward a synthesis. *Psychophysiology*, 40, 655-665.

Ekman, P., & Friesen, W.V. (eds.) (1976). *Pictures of Facial Affect*. Palo Alto, CA: Consulting Psychologists Press.

Ekman, P., Sorenson, E.R., & Friesen, W.V. (1969). Pan-cultural elements in facial displays of emotions. *Science*, 164, 86-88.

Ethofer, T., Pourtois, G., & Wildgruber, D. (2006). Investigating audiovisual integration of emotional signals in the human brain. *Progress in Brain Research*, 156, 345-361.

Everhart, D.E., Demaree, H.A., & Shipley, A.J. (2006). Perception of emotional prosody: moving toward a model that incorporates sex-related differences. *Behavioural Cognitive Neuroscience Review*, 5, 92-102.

Fecteau, S., Armony, J.L., Joanette, Y., & Belin, P. (2005). Judgment of emotional nonlinguistic vocalizations: Age-related differences. *Applied Neuropsychology*, 12, 40-48.

Frijda, N.H., Kuiper, P., & Terschure, L. (1989). The relationships between emotion appraisal and emotion action readiness. *Journal of Personality and Social Psychology*, 57, 212-220.

Golan, O., Baron-Cohen, S., & Hill, J. (2006). The Cambridge Mindreading (CAM) Face-Voice Battery: Testing complex emotion recognition in adults with and without Asperger syndrome. *Journal of Autism and Developmental Disorders*, 36, 169-183.

Golan, O., Baron-Cohen, S., Hill, J.J., & Rutherford, M.D. (2007). The "reading the mind in the voice" test-revised: A study of complex emotion recognition in adults with and without autism spectrum conditions. *Journal of Autism and Developmental Disorders*, 37, 1096-1106.

Greimel, E., Macht, M., Krumhuber, E., & Ellgring, H. (2006). Facial and affective reactions to tastes and their modulation by sadness and joy. *Physiology and Behavior*, 89, 261-269.

Grossmann, T., Striano, T., & Friederici, A.D. (2006). Crossmodal integration of emotional information from face and voice in the infant brain. *Developmental Science*, 9, 309-315.

Harciarek, M., Heilman, K.M., & Jodzio, K. (2006). Defective comprehension of emotional faces and prosody as a result of right hemisphere stroke: modality versus emotion-type specificity. *Journal of International Neuropsychology Society*, 12, 774-781.

Hermans, D., Baeyens, F., Lamote, S., Spruyt, A., & Eelen, P. (2005). Affective priming as an indirect measure of food preferences acquired through odor conditioning. *Experimental Psychology*, 52, 180-186.

Hess, U., & Blairy, S. (1995). *Set of Emotional Facial Stimuli*. University of Quebec at Montréal, Department of Psychology, Montreal, Canada.

Hess, U., Kappas, A., & Scherer, K.R. (1989). Multi-channel communication of emotion: Synthetic signal production. In: Scherer, K.R. (ed.), *Facets of Emotion*. Hillsdale, NJ: Lawrence Erlbaum Associate, pp. 161-182.

Izard, C.E. (1977). *Human Emotions*. New York: Plenum.

Kappas, A., Hess, U., & Scherer, K.R. (1991). Voice and emotion. In: Feldman, R.S., Rimé, B. (eds.), *Fundamental of Non-verbal Behaviour*. New York: Cambridge University Press, pp. 200-238.

Kotz, S.A., Meyer, M., & Paulmann, S. (2006). Lateralization of emotional prosody in the brain: An overview and synopsis on the impact of study design. *Progress in Brain Research*, 156, 285-294.

Leventhal, H. (1984). A perceptual-motor theory of emotion. In: Berkowitz, L. (ed.), *Advances in Experimental Social Psychology*. New York: Academic Press, pp. 117-182.

Matsumoto, D., & Ekman, P. (1988). Japanese and Caucasian facial expressions of emotion and neutral faces (JACFEE and JACNeuF). Available from www.paulekman.com.

Maurage, P., Campanella, S., Philippot, P., Pham, T., & Joassin, F. (in press). The crossmodal facilitation effect is disrupted in alcoholism: A study with emotional stimuli. *Alcohol.*

Minzenberg, M.J., Poole, J.H., & Vinogradov, S. (2006). Social-emotion recognition in borderline personality disorder. *Comprehensive Psychiatry*, 47, 468-474.

Monnot, M., Nixon, S., Lovallo, W., & Ross, E. (2001). Altered emotional perception in alcoholics: Deficits in affective prosody comprehension. *Alcoholism-Clinical and Experimental Research*, 25, 362-369.

Montoya, P., & Sitges, C. (2006). Affective modulation of somatosensory-evoked potentials elicited by tactile stimulation. *Brain Research*, 1068, 205-212.

Oatley, K.J., & Johnson-Laird, P.N. (1987). Towards a cognitive theory of emotions. *Cognition and Emotion*, 1, 29-50.

Pell, M.D. (2002). Evaluation of nonverbal emotion in face and voice: Some preliminary findings on a new battery of tests. *Brain and Cognition*, 48, 499-504.

Pourtois, G., de Gelder, B., Bol, A., & Crommelinck, M. (2005). Perception of facial expressions and voices and of their combination in the human brain. *Cortex*, 41, 49-59.

Scherer, K.R. (1984). Emotion as a multicomponent process: A model and some cross-cultural data. In: Shaver, P. (ed.), *Review of Personality and Social Psychology.* Beverly Hills, CA: Sage, pp. 37-63.

Scherer, K.R. (1986). Vocal affect expression: A review and a model for future research. *Psychological Bulletin*, 99, 143-165.