THE INFLUENCE OF INDIVIDUAL DIFFERENCE VARIABLES ON VOCAL EMOTION PROCESSING

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ABSTRACT

Extensive research has been done on vocal emotion processing and it has been repeatedly argued that individual difference variables can influence emotion processing. Few studies have, however, examined these differences systematically and comprehensively in the vocal emotion domain. Thus, three studies using different research paradigms were performed to explore how individual differences might impact on vocal emotion perception; Study 1 examined influences of individual differences on vocal emotion recognition accuracy of emotionally intoned, semantically neutral sentences, as well perceived speaker intensity; Study 2 examined the time-course of vocal emotion processing using pseudo-utterance stimuli. Finally, Study 3 studied event-related brain potentials (ERPs) to examine brain responses to vocal emotions. In all three studies, self-reports were collected on individual differences (stable personality traits, short-term fluctuations in mood, differences in affect intensity, and general life satisfaction). Results from all three studies showed that there was no systematic relationship between vocal emotion processing and the various self-reported measures. The current project is the first attempt to explore the relationship between vocal emotion processing and individual differences in a systematic and comprehensive manner; combined results suggest that the continuously proposed influence of individual differences might have been overemphasised in the previous literature at least for the vocal domain.

1. GENERAL INTRODUCTION

The ability to communicate emotions is highly important in social settings and the development of emotions can be explained in an evolutionary context; the ability to accurately produce and perceive emotions enables individuals to interact and cooperate (Buck, Savin, Miller, & Caul, 1972). Emotion processing is highly complex and requires individuals to integrate information obtained from different modalities, such as facial and vocal expressions. Considering the large amount of emotional information that must be quickly and accurately integrated across different communication channels on a daily basis, it can be assumed that humans are incredibly good at processing emotional information.

This rapid and dynamic integration process of emotional information can however be influenced by a great variety of factors, including both internal and external variables. For example, research has shown that highly stressful situations can have detrimental effects on the en- and decoding ability of vocal emotions (Paulmann, Nilsen, & Bøkenes, in review). Internal factors, or inter-individual differences, might also have a great impact on emotion processing (e.g. Davitz, 1964; Hamann & Canli, 2004; Matsumoto et al., 2000; Schirmer & Kotz, 2006). In fact, some emotion researchers have even argued that individual differences in emotion-processing abilities are the rule rather than the exception, emphasising that future research should focus on the influence of inter-individual variability in emotion processing to complement group data analyses (Eugene et al., 2003). There is an obvious lack of research in the vocal emotion domain, as only a few studies have examined the influence of inter- and intra-individual differences on vocal emotion processing (Brück, Kreifelts, &

Wildgruber, 2011). Thus, the present investigations set out to systematically and comprehensively explore whether and how individual differences can predict variation in vocal emotion processing by employing different research paradigms in a complementing series of three studies.

Vocal emotion processing

Vocal emotion perception studies focusing on group data analyses typically examine how accurately listeners can identify emotions from speech (see e.g. Scherer, 1989 for an extensive early review). In his review, Scherer (1989) reports an overall average recognition rate of 60% across 28 perception studies, suggesting that emotions can be recognised from speech much better than expected by chance alone. Investigations of vocal emotion perception have also been compared across countries. For example, Scherer, Banse and Wallbot (2001) compared recognition rates of five emotions (anger, fear, joy, sadness and neutral) across nine countries (France, Germany, Great Britain, Indonesia, Italy, Netherlands, Spain, Switzerland, and United States) and found an overall recognition accuracy of 66%.

Furthermore, the literature provides substantial evidence for universal and culture-specific vocal emotion recognition. More specifically, non-native listeners can recognise vocal emotions well above chance, suggesting that they can recognise emotions conveyed by the tone of voice in a foreign language, but an in-group advantage is found for native listeners (e.g. Paulmann & Uskul, 2014; Pell, Monetta, Paulmann, & Kotz, 2009a; Pell et al., 2009b). Furthermore, vocal emotion researchers have also begun to examine the *explicit, or off-line,* time course processing of vocal emotions. Research has established that distinct emotion categories unfold at different rates (Pell & Kotz, 2011), in which some emotions are recognised, not only more accurately, but also quicker than other emotions (e.g. Cornew, Carver & Love, 2010; Rigoulot, Wassiliwizky, & Pell, 2013).

In addition to behavioural analyses of vocal emotion perception, recent neuroimaging advances has allowed investigations of how the brain process vocal emotions. fMRI/PET techniques have been employed to uncover the neuroanatomical networks responsible for vocal emotion processing (see e.g., Schirmer & Kotz, 2006, for a review). There seems to be a general consensus that the two anatomically similar hemispheres show functional differences with regard to vocal emotion processing (e.g. Adophs, 2002; Buchanan et al., 2000; Morris, Scott, & Dolan, 1999). Processing of pitch, for example, seems to be lateralised to the right hemisphere (George et al., 1996; Schirmer & Kotz, 2006), while the left hemisphere has been argued to engage in temporal processes (Schirmer & Kotz, 2006). In short, authors have argued that the left hemisphere seems to be more sensitive to linguistic features of vocal expressions, while the right hemisphere seems to be more sensitive to paralinguistic features (Schirmer & Kotz, 2006).

However, investigations of neuroanatomical components involved in vocal emotion processing do not provide information on the temporal dynamics of vocal emotions. Thus, in addition to fMRI and PET techniques, event-related potentials (ERPs) can be examined to reveal the *implicit, or on-line*, temporal processing of vocal emotions (Paulmann, Ott, & Kotz, 2011). For example, group data analyses of ERP responses to vocal emotions have revealed that emotions can be differentiated approximately 200 ms after stimuli onset as indicated in different P200 amplitudes. This component is often argued to reflect the detection of emotional salience (e.g. Paulmann et al., 2011; Paulmann, Bleichner, & Kotz, 2013). Further, more meaningful and elaborate processing of vocal emotions is argued to occur between 400 and 750 ms after stimulus onset (Paulmann et al., 2013). Although a few studies have examined ERPs in response to vocal emotions on an inter-individual difference level, such as sex differences (Schirmer, Kotz, & Friederici, 2002; Schirmer & Kotz, 2003), there is still an obvious lack of a comprehensive and systematic investigation of how several inter-individual differences, such as personality and mood can influence the temporal dynamics of vocal emotions (Brück et al., 2011).

The influence of individual differences on emotion perception

Various inter-individual differences have been argued to influence emotion processing. As a practical example, imagine watching a sad movie with a friend. At the final scene, the main character dies dramatically and while your friend cries loudly you do not feel particularly affected by the tragedy. What makes people respond so differently to the same emotional stimuli? Current mood state and stable personality traits have been repeatedly emphasised as important variables that influence cognition, affect and behaviour. In fact, two of the most influential hypotheses examining differences in emotion processing have been the mood-congruency hypothesis and the trait-congruency hypothesis (see Rusting, 1998 for a review).

Mood and emotion recognition

Bower (1981) suggested that mood-congruent retrieval could be explained in terms of associative networking: memory is organised as a network consisting of nodes that are related to specific emotions. Once an emotion is evident, relevant nodes will be activated, which in turn influence retrieval of mood-congruent information. Although it has been emphasised that this network theory of affect needs refinement (e.g Bower, 1987; Singer & Salovey, 1988), it has still generated much research examining the mood-congruency hypothesis.

In the emotion recognition domain, most studies examining current mood effects have used mood induction procedures, such as inducing mood by listening to music (Bouhuys, Bloem, & Groothuis, 1995), watching film clips (Niedenthal, Halberstadt, Margolin, & Innes-Ker, 2000) or by asking participants to recall personal events with a particular emotional content (Chepenik, Cornew, & Farah, 2007). For example, Lee, Ng, Tang and Chan (2008) induced participants to feel sad, neutral or happy and asked them to rate mood levels in morphed facial expressions. They found evidence for a negativity bias in the sad condition, in which participants rated ambiguous faces as sadder than participants in the neutral and happy conditions. This is consistent with the mood-congruency hypothesis and has been confirmed by several other studies (e.g. Bouhuys et al., 1995; Niedenthal et al., 2000; Schmid & Schmid Mast, 2010).

Although mood induction procedures can provide information on how *temporary* emotional states can affect emotion recognition, results from these studies are not necessarily transferable to short-term mood fluctuations experienced by different individuals in everyday situations. It is likely that everyday mood fluctuations are less extreme than the categorical mood states that are experimentally induced and it is thus questionable whether these results can be generalised to other situations. Another concern with induction procedures is that specific personality characteristics have been shown to influence susceptibility to mood induction. More specifically, extraverted and neurotic individuals tend to be more susceptible to inducement of positive and negative moods, respectively (Larsen & Ketelaar, 1989, 1991; Rusting & Larsen, 1997; Gomez, Cooper, & Gomez, 2000).

Still, surprisingly fewer studies have examined the relationship between self-reported fluctuations in mood and emotion recognition ability, although standardised questionnaires are available to test this. For instance, PANAS-X (Positive and Negative Affective Schedule – Expanded Form, Watson & Clark, 1999) is a highly reliable measure of short-term fluctuations in mood and has been used for this purpose, either alone (e.g. Winoto & Tang, 2010), in combination with personality trait measures (e.g. Gomez & Gomez, 2002), or in addition to mood induction procedures (e.g. Moore, Gorodnitsky, & Pineda, 2012). To examine whether short-time fluctuations in mood, in contrast to experimentally induced mood, influence vocal emotion processing, the present studies will examine whether individual differences in PANAS-X scores can predict variation in vocal emotion processing.

Personality and emotion recognition

The Big Five (McCrae & John, 1992) is one of the most well established models of personality structure and it has generated considerable amounts of research. The factors identified (agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) have consistently been found cross-culturally, although there is some disagreement of factor labelling (John & Srivastava, 1999). Schema theories or extensions of the associative network theory used to explain mood-congruency effects are often proposed as explanations of how personality characteristics influence emotion processing (Rusting, 1998).

Consistent with the trait-congruency hypothesis, stable personality traits have been shown to influence selective processing of emotional stimuli. For example, extraversion and neuroticism have been extensively linked to processing of positive and negative emotions, respectively (e.g. Gomez, Gomez, & Cooper, 2002; Larsen & Ketelaar, 1989, 1991; Robinson, Ode, Moeller & Goetz, 2007). For example, individuals scoring high on emotional intelligence (EI) have shown to be quicker at recognising facial emotions (Petrides, & Furnham, 2003), while individuals with high trait-anxiety tend to be better at recognising fearful faces compared to other emotional faces (angry, disgusted, happy, neutral, sad and surprised) (Surcinelli et al., 2006).

Although some evidence points towards a relationship between selective emotional processing and certain personality characteristics, the literature from the last decades has been continuously contradictive (Matsumoto et al., 2000). For example, Rubin, Munz and Bommer (2005) found a link between better facial recognition and transformational leadership style, which they defined as the most active and efficient leadership style. Transformational leaders, as rated by their subordinates, also tended to score higher on agreeableness and positive affect compared to leaders with a different leadership style. Further, extraversion tended to moderate the relationship between emotion recognition and transformational leadership and Rubin et al. (2005) argued that extraverts seem to be better able to engage others. In conclusion, results obtained by Rubin et al. (2005) suggest that there is a relationship between agreeableness, extraversion, leadership style, and facial emotion processing.

Other studies investigating the relationship between the personality and emotion recognition have provided other results. For example, Matsumoto et al. (2000) found a positive relationship between facial emotion recognition and openness to experience and conscientiousness. They argued that individuals scoring high on openness to experience might be more perceptive of others emotions, while individuals high on conscientiousness might be better to attend to facial expression details. It should be noted that both Rubin et al. (2005) and Matsumoto et al. (2000) used the same personality inventory (the Big Five Inventory (BFI); John, Donahue & Kentle, 1991; John, Neumann & Soto, 2008), yet they implicate completely different personality dimensions influencing facial emotion recognition.

When using a different personality inventory, (Eysenck Personality Inventory (EPI); Eysenck & Eysenck, 1964), Matsumoto et al. (2000) found a positive relationship between extraversion and facial emotion recognition and a negative relationship between neuroticism and facial emotion recognition. In yet another study using BFI and NEO-PI-R (Neuroticism-Extraversion-Openness Personality Inventory Revised, Costa & McCrae, 1995), Matsumoto et al. (2000) used morphed facial expressions and replicated the findings of the positive relationship between emotion recognition and openness to experience and conscientiousness. In addition, a relationship between BFI's agreeableness and facial emotion recognition was also found, but, as this relationship was not found in their previous studies, and this relationship was not evident using the NEO-PI-R, they concluded that this result was not reliable.

In summary, all five personality dimensions have been implicated in facial emotion recognition; agreeableness and extraversion (Rubin et al., 2005), and openness to experience and conscientiousness (Matsumoto et al., 2000), have been linked to better facial emotions recognition, while neuroticism has been linked to poorer facial emotion recognition (Matsumoto et al., 2000). In contrast, some studies failed to find any relationship between emotion recognition and all five personality variables (e.g. Elfenbein et al., 2007; Bänziger, Grandjean, & Scherer, 2009). These contradictive findings create a confusing picture of the relationship between personality traits and emotion recognition accuracy. If all personality traits influence facial emotion recognition in a consistent manner, then all traits should be consistently identified across studies, at least when the same personality questionnaire is used and the sample sizes are reasonable. Thus, it seems like the literature on personality and facial emotion perception is still far from a general consensus, at least in the facial emotion domain.

Personality styles and emotion recognition

Examining personality dimensions allows investigations of inter-individual differences. In contrast, one of the recent advances in the field of personality is the emphasis on the interaction of trait combinations (McCrae & Sutin, 2007), which allows explorations of differences at an intra-individual level. That is, there is a distinction between examining between-trait differences as opposed to within-person differences (Asendorpf, 2003). Several studies have tried to identify the specific trait combinations or *personality styles* that are related to various personality disorders (see Saulsman & Page, 2004 for a review). Widiger and Costa (1994) emphasise that personality disorders are the mental disorders that are most closely related to personality, which is based on the assumption that extreme variants of personality traits may result in personality disorders when they become maladaptive (Widiger & Trull, 1992; Wiggins & Pincus, 1989).

Hyer et al. (1994) found that detached personalities exhibited patterns of low openness to experience and extraversion, while individuals with dependent personalities score high on agreeableness and conscientiousness (see Hyer et al., 1994 for a description of all personality disorder scales). Thus, it seems reasonable to argue that certain trait combinations might make individuals more prone to certain psychopathological difficulties, which again might be related to emotion recognition impairments. However, it is yet unexplored whether certain personality styles in the normal population will predict different patterns of emotion recognition ability. Thus, as intra-individual differences allows exploration of how patterns among individuals, rather than patterns among variables, differ (Costa et al., 2002), then examining personality styles in addition to personality traits can increase our understanding of how personality may influence vocal emotion processing.

The problem of independent investigations of mood and personality variables

Rusting (1998) argues that, although there is evidence for both the mood- and trait-congruency hypotheses, one of the main challenges in the literature is that findings on current mood and stable personality traits in relation to emotion processing are not well integrated, which is a consequence of them being studied separately. However, some researchers have emphasised a relationship between positive and negative affect and personality traits (e.g. Yik & Russell, 2001). Others have examined the combined influence of mood and personality on emotion processing by employing a mood induction paradigm while collecting information on personality characteristics (e.g. Ciarrochi, Caputi & Mayer, 2003; Smith & Petty, 1995; Rafienia, Azadfallah, Fathi-Ashtiani & Rasoluzadeh-Tabatabaiei, 2008). However, no previous studies have examined both the influence of short-time fluctuations of mood and stable personality traits on vocal emotion processing, which is the overall motivation of the present studies.

Other important individual difference variables

Affect intensity is considered to be a stable characteristic of how an individual tends to respond emotions, irrespective of emotion valence. Individuals scoring high on affect intensity tend to regularly experience both positive and negative emotions more strongly than those scoring low on affect intensity (Larsen & Diener, 1987). The Affect Intensity Measure (AIM: Larsen 1985, cited in Larsen &

Diener, 1987) has been created to measure how intensely individuals respond to emotions. It has been argued that affect intensity might influence emotion processing (Eugene et al., 2003), however it is yet unexplored, to my knowledge, whether and how different levels of affect intensity influence processing of vocal emotions.

While positive and negative affect is related to the emotional aspects of well-being (which is covered by the AIM and PANAS-X measures), Pavot & Diener (1994) emphasise that life satisfaction is a cognitive-judgmental process where individuals consciously judge their life quality based on a self-imposed standard. It is argued that general life satisfaction is influenced by social relationships, work or school performance, personal satisfaction (satisfaction with the self, learning and growth, and religious life) and goals deriving from own values (Diener, Emmons, Larsen, & Griffin, 1985). In a screening study by Diener and Seligman (2002), they found that very happy people tended to score high on extraversion and agreeableness, while scoring low on neuroticism and psychopathology. Very happy people also tended to score very high on The Satisfaction with Life Scale (SWLS; Diener et al., 1985), with a mean score of 29.4 (scale ranging from 5 to 35). Assuming that emotions are processed in a mood-congruent manner, it is possible that very happy individuals scoring high on the SWLS tend to be better at recognising positive emotions. However, this is, to my knowledge, yet unexplored.

The present investigations

The present investigations are the first attempt to provide a systematic and comprehensive exploration of whether and how inter- and intra-individual differences influence the ability to accurately identify vocal emotions, and will examine two main topics. Firstly, vocal emotion processing will be analysed at a group level, ensuring that the collected data is a good representation of findings from the vocal emotion literature in general. Secondly, these data will then be used to comprehensively and systematically examine vocal emotion processing at an inter- and intra-individual level, in which the present studies aim at exploring several hypotheses. Firstly, it will be explored whether short-time fluctuations in mood influence vocal emotion processing in a similar manner as induced mood, with a special interest in the relationship between positive and negative affect variables and vocal emotion processing. The second aim is to further examine the contradictive and confusing findings obtained in the personality and emotion literature, including the first attempt to explore whether and how personality styles influence vocal emotion processing. Thirdly, it will be examined whether vocal emotion processing is influenced by individual differences in affect intensity and life satisfaction. To enable a holistic understanding of whether and how individual differences influence vocal emotion processing, three independent but related studies were designed that allowed exploring this ability with different research paradigms.

Study 1 examines the relationship by investigating whether *recognition accuracy* of various vocal emotions (anger, disgust, fear, happiness, neutral, sad, surprise) is related to the inter- and intra-individual differences presented. In addition, intensity ratings for each sentence stimulus will be collected to examine whether individual differences can predict the subjective *experience of emotion intensity*. Study 2 investigates the influence of inter- and intra-individual differences on *explicit, or off-line, time course processing* of vocal emotions by examining how and when changes in the speaker's voice lead to identification of the intended emotion. That is, the study explores how much vocal information is required to enable the listener to identify an emotion and whether this is affected by inter- and intra-individual differences. The third study explores ERP correlates, thus the *implicit, or on-line, time course processing* of vocal emotions, and the influence of individual differences on them.

A. STUDY 1- EMOTION RECOGNITION ACCURACY AND INDIVIDUAL DIFFERENCES

1A. Introduction

The literature on emotion perception has mainly focused on group data, examining average recognition rates across large samples (Scherer, 1989). Some studies have also examined emotion perception differences in distinct groups. For example, in the vocal domain, studies have compared how recognition rates differ between countries (Scherer et al., 2001) and between native and non-native listeners (e.g. Pell et al., 2009a, 2009b; Paulmann & Uskul, 2014). However, few studies actually control for the effect of inter-individual differences, such as personality and mood, when examining group differences in emotion perception.

There is however a growing literature on how clinical populations and healthy individuals differ in emotion perception, at least in the facial emotion domain. In contrast to healthy individuals, research has consistently found facial recognition impairments in clinically depressed individuals (Leppänen et al., 2004; Surguladze et al. 2004; Zuroff & Colussy, 1986) and individuals suffering from schizophrenia (Kohler et al. 2003; Tsoi et al. 2008; Johnston, Katsikitis & Carr, 2001). Perhaps these findings reflect a growing interest in how various inter-individual factors influence emotion perception. However, the literature on *vocal* emotion perception and how it is influenced by inter-individual variables such as mood and personality is still in its infancy.

The influence of mood on emotion perception

The literature on mood and emotion perception is surprisingly scarce. The few published studies on this topic tend to focus on how mood induction and mood disorders influence facial emotion perception. For example, Bouhuys et al. (1995) found that individuals who had listened to sad music judged ambiguous faces as sadder than individuals who had listened to elated music. Further, McClure et al. (2014) examined facial emotion recognition in young individuals suffering from mood and anxiety disorders. They found evidence of recognition impairment in individuals suffering from bipolar disorder when judging emotional faces. More specifically, they tended to misinterpret sad, fearful, and happy faces as angry faces. Interestingly, these findings were only evident when judging faces of children, in contrast to judging faces of adults. Thus, it is possible that mood can influence emotion perception, at least in the facial emotion domain. However, to my knowledge, it is yet unexplored whether vocal emotion perception is influenced by short-time fluctuations in mood.

The influence of personality on emotion perception

Some studies have examined the influence of personality traits on vocal emotion perception, however results are confusing and contradictive, as in the facial emotion literature. For example, Cunningham (1977) examined production and perception of emotions expressed through the face, voice and body channels. Results showed that high levels of extraversion seem to enhance emotion *production* ability while high levels of neuroticism seem to enhance emotion *perception*. Further, Terracciano, Merritt, Zonderman, & Evans (2003) examined the relationship between the Big Five and recognition of facial and vocal emotions in African Americans with low socioeconomic status and Caucasians with a higher socioeconomic status. They found that performance was significantly poorer on both the facial and vocal emotion recognition task for the African American sample. However, a serious methodological flaw should be noted, as Caucasian faces were used as stimuli, creating a possible in-group advantage for the Caucasian participants. More importantly, they found that facial and vocal recognition ability was related to openness to experience in both groups and concluded that this personality dimension is important for affective processing.

Burton et al. (2013) examined how the Big Five and aggression relates to vocal emotion perception in men and women. They concluded that, for males, better vocal emotion recognition is related to higher scores on extraversion and conscientiousness. In contrast, no such relationship was found for females. However, care should be taken when considering these data, given that their participant sample was slightly imbalanced as they tested more females (73) than males (42). Further, Scherer and Scherer (2011) found a positive relationship between extraversion and vocal emotion perception and between emotional stability and vocal emotion perception.

In summary, studies examining the relationship between vocal emotion perception and personality traits reveal contradictive findings. For example, while Scherer and Scherer (2011) found a positive relationship between extraversion and recognition of vocal emotions, this relationship was only evident for male participants in the study by Burton et al. (2013). In addition, while Cunningham (1977) argued that neuroticism enhances vocal emotion perception, Scherer and Scherer (2011) argue the opposite; neurotic individuals tend to be worse at recognising vocal emotions compared to emotionally stable individuals. To complicate matters even more, some studies even fail to find any relationship between personality and vocal emotion recognition (e.g. Elfenbein et al., 2007; Bänziger et al., 2009). Thus, comparable to the personality and facial emotion literature, a better understanding of whether and how personality influences vocal emotion perception is badly needed.

Overall aim of Study 1

To examine whether inter- and intra-individual differences influence vocal emotion perception, self-report measures of short- and long-term individual characteristics will be collected and analysed in relation to vocal emotion perception. More specifically, measurements of *short-term mood states* (PANAS-X) and *personality characteristics* (BFI) and are included. Also, ten possible combinations of personality styles will be generated from the Big Five personality dimensions to examine whether personality styles can predict vocal recognition accuracy. Due to the obvious lack of research on vocal emotion perception and short-time fluctuations in mood, combined with the contradictive findings in the previous personality and emotion literature, specific predictions are difficult to make. However, based on past results (e.g. Rusting, 1998; Rusting & Larsen, 1997), it is reasonable to assume that recognition of positive and negative vocal emotions may be influenced by positive and negative mood and by extraversion and neuroticism, respectively.

If so, this would be consistent with the assumptions made by the mood- and trait-congruence hypotheses.

Furthermore, measures of *affect intensity* (AIM: Affect Intensity Measure: Larsen 1985, cited in Larsen & Diener, 1987) and *general life satisfaction* (SWLS: Satisfaction With Life Scale: Diener et al., 1985) are also included, as it is yet unexplored whether and how differences in affect intensity and life satisfaction influence vocal emotion perception. Participants will also be asked to indicate how intensely they perceive the speech stimuli. Thus, it is possible to examine whether *subjective interpretation* of emotion intensity differs between individuals, which adds to the information obtained from self-reported affect intensity levels. If affect intensity can predict differences in vocal emotion perception, then this relationship, irrespective of direction, should be comparable across positive and negative emotions. That is, if individuals scoring high on affect intensity are better at judging vocal emotions, then better recognition rates should be evident for all emotion categories. Further, if consistent with congruency hypotheses, it is also likely that individuals scoring high on life satisfaction should be better at recognising vocal emotions with a positive valence.

2A. Methods

2A.1. Participants

Ninety-five (75 females, mean age: 19.5, SD (standard deviation): 3.09) undergraduate Psychology students at the University of Essex participated and gave their written consent. They received credits for participation as part of a module requirement. Sixty-three participants were native speakers of English. All participants reported normal or corrected to normal hearing and vision.

2A.2. Apparatus

iMacs running SuperLab 5.0 were used to present the sentence stimuli. Participants listened to sentences, either through headphones (Sennheiser HD 495 and Sennheiser HD 580) or through speakers present in individual testing booths.

2A.3. Stimulus materials

2A.3.1. Sentence stimuli

The general approach when generating sentence stimuli in vocal perception studies is the of use professional actors to portray the emotional categories (e.g. Airas & Alku, 2006; Bänziger & Scherer, 2005; Graham, Hamblin & Feldstein, 2001; Toivanen et al, 2006), which is based on the assumption that professional actors are better able to portray unambiguous emotions (Williams & Stevens, 2005). It has however been argued that professional actors may produce stereotypical portrayals (e.g. Juslin & Laukka, 2001; Scherer, 1995), which again result in lack of ecological validity (Scherer, 1989) and problems with generalising findings (Greasley, Sherrard and Waterman, 2000). Paulmann et al. (in review) attempted to overcome this problem by using untrained speakers to portray the emotional categories and this approach will be adopted in the present study. Sentence stimuli were taken from this previous inventory (Paulmann et al., in review).

Fifteen semantically neutral sentences (e.g. "The fence was painted brown") were portrayed by nine female speakers in seven emotional tones (anger, disgust, fear, happiness, neutral, sad, and surprise). For each emotional category, 40 sentences were presented resulting in 280 sentences in total (see Paulmann et al., in review for more details on stimuli). The 280 sentences were randomly allocated into seven blocks consisting of 40 sentences. Sentence stimuli are outlined in *Appendix A*.

2A.3.2. Questionnaire measures

2A.3.2.1. Positive and Negative Affect Schedule – Expanded Version (PANAS-X)

The PANAS-X (Watson & Clark, 1999) is an extension of the original Positive and Negative Affect Schedule (PANAS: Watson, Clark & Tellegen, 1988), which is a two 10-item measure of the broad two higher order dimensions of general positive affect (PA) and general negative affect (NA). The PANAS-X further measures specific affect, including second-order dimensions (basic PA and basic NA and other affective states that do not consistently define the second-order factors as they load on both general factors). PANAS-X can be used with different temporal instructions (e.g. right now, today, past few weeks), however the "past few weeks" instructions were employed in the present study to examine short-term state affect rather than long-term, stable affect (e.g. "past year").

Regarding validity, PANAS-X correlates strongly with other measures of state affect, but seems to be superior on some instances. For example, PANAS-X is a comparable measure to POMS (Profile of Mood States; McNair, Lorr & Droppleman, 1971), but yields better discriminant validity (Watson & Clark, 1999). In addition, the general PA and general NA scales correlate with other measures of state affect and psychiatric symptomology, e.g. Beck Depression Inventory (Beck, Ward & Mendelson, 1961), which is arguably the most widely used measure of depressive symptoms (Rubin, 2011). High external validity is also evident, as significant correlations are achieved between self-ratings and peers (see Watson et al., 1988 and Watson & Clark, 1999 for more detailed analysis of reliability and validity of the scales).

2A.3.2.2. The Big Five Inventory (BFI)

The BFI (John et al., 1991; John et al., 2008) is a 44-item questionnaire assessing the Big Five (A, C, E, N, O) personality characteristics. These five factors have been replicated across languages and cultures although some inconsistencies are found, for example on number of factors and factor labelling (see Ashton et al., 2004 for a review on seven languages). Arguably, one of the most famous versions of the Big Five is called the NEO-PI-R (Costa & McCrae, 1995). To overcome the problematic inconsistencies in factor labelling, prototypical traits, i.e. traits with high agreement (90% or more) across several expert judges reviewing several studies on the Big Five (see John et al, 2008 for an extensive discussion), can be used to ensure consistency. In contrast to the NEO-PI-R, the BFI is a shorter version frequently used in research settings that assesses prototypical traits of the Big Five. In addition, BFI share high reliability and validity when compared to other Big Five measures, e.g. Trait-Descriptive Adjectives (TDA) (Goldberg, 1992) and NEO-FFI (a shorter 60-item version of the NEO-PI-R) (Costa & McCrae, 1989, 1992).

2A.3.2.3. Affect intensity Measure (AIM)

The AIM (Larsen, 1985, cited in Larsen & Diener, 1987) is a 40-item measure of how intensely emotions are experienced and responded to, irrespective of emotion valence. Thus, the AIM measure complement measures of negative and positive affect, in which the frequency of positive and negative emotions experienced may vary. Larsen (1985, cited in Larsen & Diener, 1987) provides evidence of a test-retest reliability of .81 after 3 months and .75 after 2 years.

2A.3.2.4. Satisfaction with life Scale (SWLS)

It is argued that subjective well-being consists of positive affect, negative affect, and satisfaction with life (Andrews & Withey, 1976, cited in Diener et al., 1985). Diener et al (1985) constructed the "Satisfaction with Life Scale" (SWLS) to assess global life satisfaction. The scale has shown to have high internal consistency and high temporal reliability (Diener et al, 1985), and to have discriminant validity to emotional well-being (Pavot & Diener, 1994).

2A.3.3. Calculating personality styles

Personality styles were generated using the five personality dimensions from the Big Five, agreeableness (A), conscientiousness (C), extraversion (E), neuroticism (N), and openness to experience (O), resulting in 10 possible trait combinations: AC, AE, AN, AO, CE, CN, CO, EN, EO, and NO. Participant membership was calculated into personality styles following the procedure outlined in Weiss et al. (2009). First, raw scores for each personality dimension were converted into *T*-scores. Then, participant membership was assigned to five possible groups; individuals scoring high-high, low-low, low-high, or high-low in two dimensions. No style was assigned when participants scored 0.5 SD above or below the mean. Next, to visualise the data, each participant was plotted into a personality style graph. Each graph consists of two personality dimensions (see *Figure 1*). For more details on the procedure, see Weiss et al. (2009).

2A.4. Design

A cross-sectional design was used, in which measures of personality traits (BFI), susceptibility to positive and negative affect (PANAS-X), levels of affect intensity (AIM), and general life satisfaction (SWLS) were used as predictor variables, while the criterion variable was vocal emotion recognition accuracy and subjective intensity ratings for each sentence stimuli.

2A.5. Procedure

Participants were seated in front of a computer and listened to the sentence stimuli. They were informed of the experimental procedure, both by experimenter and by instructions on the screen. Five practice trials were included to ensure that participants fully understood the task. For each trial, a fixation cross appeared on the center of the screen before stimulus onset and remained visible while participants listened to each sentence stimuli. They were asked to indicate which emotion the speaker intended to convey using a forced-choice format, in which seven emotion boxes (anger, disgust, fear, happy, neutral, pleasant surprise, sad) appeared on the screen after sentence offset. After the emotion response was provided, an intensity scale ranging from 1 (not intense at all) to 7 (very intense) appeared on the screen and asked participants to rate their perception of the speaker's emotional intensity. After the second response was given, there was an inter-stimulus interval of 1500 ms before the next sentence stimulus was presented. Pauses of self-determined duration were given after each block. The total run-time of the computerised task was approximately 30 minutes. After finishing the experiment, participants completed a questionnaire booklet containing the individual difference measures (BFI, PANAS-X, AIM, SWLS) before they were debriefed about the study purpose.

3A. Results

3A.1. Behavioural analyses

Participants reporting suffering from mental disorders were excluded from the analysis, as several studies shows impaired vocal recognition in clinical populations such as depression (e.g. Leppänen et al., 2004), schizophrenia (e.g. Kohler et al. 2003), and borderline personality disorder (e.g. Unoka et al, 2011). Non-native speakers were also excluded, as the literature has argued that native speakers have an in-group advantage (e.g. Paulmann & Uskul, 2014; Pell et al., 2009a; Pell et al., 2009b) and thus different recognition rates might be evident when non-native listeners are asked to recognise stimuli in a non-native language. Thus, 53 participants were included in the statistical analyses. Additional analyses were performed to ensure that gender did not influence results due to imbalanced sample and to examine whether increasing sample size would influence results (i.e. increasing power by including non-native listeners). Thus, *Appendix B* lists correlations between recognition accuracy and individual difference variables in the female sample and correlations between recognition accuracy and individual difference variables when non-native listeners were included.

3A.1.1. Accuracy rates

For each participant, an accuracy score in percentage was calculated for each emotion and then averaged across participants, giving a recognition accuracy score for each emotion (anger, disgust, fear, happy, neutral, pleasant surprise, and sad), and finally a recognition average score across emotions. These results are presented in *Table 1*.

Table 1: Mean recognition accuracy in percentage and SD for each emotional category and average emotion accuracy across emotions (Pls.sur = pleasant surprise).

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Recognition accuracy	64.8	42.6	33.7	35.4	68.5	76.5	69.3	55.8
SD	0.16	0.16	0.15	0.15	0.18	0.11	0.13	0.08

As can be seen from *Table 1*, recognition accuracy is well above chance for all emotions (7 emotions = 14.28% chance level). The average recognition rate is 55.8%, which is comparable to the previous literature (e.g. Scherer, 1989). Pleasant surprise sentences are recognised best with an average recognition rate of 76.7%, while fear sentences are least recognised with a recognition rate of 33.3%. The pattern of recognition rates is also comparable to Paulmann et al. (in review), who used the identical stimuli.

3A.1.1.1. Error patterns

Overall, as evident in *Table 1*, each emotional category is most frequently identified correctly with the target emotion. However, the confusion matrix presented in *Table 2* provides a more detailed description of the error patterns of responding. More specifically, the error confusion pattern reveals that anger is most often confused with disgust, while disgust is often confused with neutral. Further, fear sentences are most often confused with sad sentences. It is also evident that happy is confused with neutral, while pleasant surprise is confused with happy. Sad and neutral sentences are often confused with each other.

Table 2: Average recognition accuracy in percentage for each emotional category and confusion patterns of error responding. Missing percentages to 100% is due to invalid responses

	RESPONSE GIVEN						
Expression	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad
Anger	**64.8**	14.4	1.7	1.7	10.4	5.4	1.3
Disgust	7.0	**42.6**	1.6	6.2	18.4	17.2	6.4
Fear	6.4	3.1	**33.7**	5.0	12.9	11.3	27.1
Happy	1.5	0.8	1.0	**35.4**	40.9	18.3	1.6
Neutral	1.7	2.6	1.0	2.0	**68.5**	0.9	22.6
Pls.sur	0.8	1.9	1.7	15.7	2.7	**76.5**	0.3
Sad	1.5	5.0	2.5	0.7	19.8	0.7	**69.3**

3A.1.1.2. Unbiased hit rates

Raw hit rates (i.e. calculated by dividing number of correct responses by total number of target stimuli, here presented as emotion accuracy in percentage) might be problematic to evaluate, as stimulus and response biases (e.g. response frequency) is not controlled for. For example, participants might have specific patterns of recognition error, such as confusing happy sentences with pleasant surprise sentences. Thus, unbiased hit rates (H_u scores) were calculated by combining the probability of hit rates with the probability of differential accuracy (i.e. dividing the number of correct responses by the total number of responses given for that emotion category) (Wagner, 1993). A score of zero is equivalent to chance performance while a score of one is evident when emotion stimuli are always correctly identified with target emotion, i.e. perfect performance. Further, as H_u scores are proportional scores they were then arcsine-transformed to stabilise variance and normalise data, as recommended for proportional data (Wagner, 1993). The unbiased recognition accuracy (H_u scores) is presented in *Table 3*. Further, the outlier labelling rule (Hoaglin, Iglewich, & Tukey, 1986; Hoaglin & Iglewich, 1987) was used to examine whether there were any outliers, however no outliers were identified.

Table 3: H_u scores and SD for each emotion and averaged across emotion

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Recognition accuracy	0.54	0.28	0.28	0.20	0.30	0.48	0.40	0.35
SD	0.15	0.15	0.15	0.12	0.10	0.10	0.11	0.08

Interestingly, when comparing the unbiased recognition accuracy (H_u scores) in *Table 3* to recognition accuracy scores (raw hit rates) presented in *Table 1,* it is evident that the most important difference is that pleasant surprise is no longer the best recognised emotion, but rather anger is now the best recognised emotional category. Happy sentences are now the least recognised emotional category. The H_u scores presented in *Table 3* are comparable to the H_u scores that are reported by Pell et al. (2009a). They reported an average H_u score of 0.37 (for English listeners) and with highest H_u score for angry sentences and lowest H_u score for joy sentences, which is comparable to the H_u scores obtained in the present study.

3A.1.1.3. Analysis of Variance (ANOVA)

A one-way ANOVA was conducted to examine whether some emotions are easier to identify than others. A modified Bonferroni procedure was used to correct for multiple comparisons (Keppel, 1991). This resulted in a change of the alpha level for significance testing from $p<.05$ to $p<.017$. A significant main effect was found for Emotion, $F(6,312)=75.832$, $p<.001$, suggesting that some emotions are indeed better recognised than others. *Post hoc* comparisons revealed that all emotion contrasts were significantly different from each other, with the exception of the contrast between disgust and fear, disgust and neutral, and fear and neutral. As can be seen in *Table 3*, anger is the emotion category recognised most accurately, while happy is the poorest recognised emotion.

3A.1.1.4. Individual difference variables

Means and SDs were calculated for all the individual difference variables and compared to the previous literature to ensure that the present sample was a valid representation of general findings. These data are listed in *Table 4*. Previous findings on BFI variables were adapted from Srivastava, John, Gosling and Potter (2003). In their study, they examined age and gender effects on the five personality variables (they converted raw scores into POMP (percentage of maximum possible) scores, thus raw scores from their study was retrieved at https://www.ocf.berkeley.edu/~johnlab/bfi.htm). They broke down means and SDs for all five personality variables into one-year age groups (age 21-60). *Table*

4 lists overall means and SDs for age group 21, which is the closest age group to the mean age of the sample in the present study (19.5). Means and SDs on AIM is adapted from Bryant, Yarnold and Grimm (1996) while previous findings on the SWLS is retrieved from Diener et al. (1985). Both studies collected data on age groups comparable to the present study (i.e. undergraduate students). Previous findings on PANAS-X scores (i.e. last few weeks) were retrieved from the PANAS-X manual (Watson & Clark, 1999).

Table 4: Means and SDs from the present study for each variable in each questionnaire (BFI, AIM, SWLS, and PANAS-X) including means and SDs obtained for the same variables in previous research.

		PRESENT STUDY		PREVIOUS LITERATURE	
Measure	Variable	Mean	SD	Mean	SD
BFI	Agreeableness	3.54	0.33	3.64	0.72
	Conscientiousness	3.38	0.45	3.45	0.73
	Extraversion	3.38	0.38	3.25	0.90
	Neuroticism	3.10	0.49	3.32	0.82
	Openness to Experience	3.37	0.52	3.92	0.66
AIM	Affect Intensity Measure	3.70	0.41	3.70	0.50
SWLS	Satisfaction with Life Scale	22.06	6.80	23.50	6.43
PANAS-X	General NA	19.34	7.39	20.20	7.20
	General PA	27.98	6.92	32.60	7.10
	Basic NA	10.79	3.64	-	-
	Basic PA	16.58	4.15	-	-
	Fear	11.89	3.98	12.30	4.90
	Hostility	11.09	3.76	12.90	5.00
	Guilt	9.68	4.91	12.00	5.20
	Sadness	10.51	4.95	11.70	4.80
	Joviality	24.53	6.91	26.80	6.60
	Self Assurance	13.92	4.69	17.70	4.70
	Attentiveness	11.30	3.12	13.50	2.90
	Shyness	8.55	3.84	7.70	3.10
	Fatigue	13.96	3.93	12.70	3.90
	Serenity	8.75	2.60	8.90	2.60
	Surprise	6.62	2.78	6.80	2.80

Note: The PANAS-X manual do not list results for Basic NA and Basic PA, as these are averages of second-order dimensions (i.e. Basic NA is averaged across fear, sadness, guilt and hostility scores while Basic PA is averaged across joviality, self assurance and attentiveness scores). Scores on Basic NA and Basic PA is however included in the present study due to research interest.

As can be seen in *Table 4*, means and SDs obtained in the present study for all individual difference variables are in line with previous findings, indicating that present findings is a good representation of the variation in individual differences in general.

3A.1.1.5. Correlational analysis

For the ease of reading, all significant correlations are not outlined in the text. Rather, focus has been on reporting the main findings that are of special interest (i.e. overall findings for each measure), while all correlations and *p*-values that have been examined are included in the tables. This strategy is also evident for all subsequent correlational analyses performed throughout all studies.

Pearson's correlations were conducted to examine the relationship between unbiased hit rates (H_u scores) and individual difference variables. *Table 5* presents the correlations obtained between vocal emotion recognition accuracy and the scores achieved on BFI, AIM, and SWLS. SWLS was positively associated with recognition of positive emotions, r=.297, p=.031, suggesting that individuals scoring high on general life satisfaction tended to be better at recognising positive emotions, on average. Further, *Table 6* lists the correlations between recognition accuracy and the self-reported scores on PANAS-X. In general, the only relationship that was found between PANAS-X and overall emotion recognition accuracy was the negative association with serenity, r=-.293, p=.033. Thus, individuals who tend to score high on serenity also tend to have lower emotion recognition ability.

*Table 5: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and individual difference variables.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
Agreeableness	*r*-value	-0.043	0.111	-0.080	0.062	-0.030	0.117	-0.193	-0.011	-0.006	-0.053	0.112
	p-value	0.760	0.428	0.570	0.657	0.834	0.404	0.167	0.938	0.963	0.707	0.425
Conscientiousness	*r*-value	-0.097	0.050	-0.024	0.066	0.237	0.085	0.170	0.079	0.042	0.016	0.096
	p-value	0.492	0.725	0.862	0.640	0.088	0.545	0.223	0.575	0.763	0.911	0.495
Extraversion	*r*-value	0.067	-0.033	-0.175	-0.255	-0.130	-0.032	-0.087	-0.128	-0.117	-0.069	-0.199
	p-value	0.631	0.813	0.209	0.066	0.353	0.818	0.534	0.359	0.404	0.621	0.152
Neuroticism	*r*-value	-0.023	0.084	0.101	-0.055	0.204	0.189	0.010	0.096	0.067	0.058	0.070
	p-value	0.869	0.550	0.474	0.696	0.143	0.176	0.943	0.494	0.632	0.681	0.618
Openness to experience	*r*-value	-0.130	-0.070	-0.032	-0.256	-0.091	0.074	-0.225	-0.154	-0.152	-0.138	-0.139
	p-value	0.355	0.619	0.821	0.065	0.517	0.598	0.105	0.272	0.277	0.323	0.322
Affect Intensity Measure	*r*-value	0.165	0.089	0.114	0.081	0.100	0.218	0.086	0.177	0.177	0.152	0.183
	p-value	0.238	0.526	0.418	0.566	0.475	0.117	0.539	0.204	0.206	0.278	0.190
Satisfaction with Life Scale	*r*-value	0.045	0.073	-0.028	.277*	-0.075	0.174	0.041	0.102	0.126	0.042	.297*
	p-value	0.751	0.602	0.841	0.045	0.595	0.213	0.771	0.469	0.368	0.765	0.031

Note: The table lists correlations between H_u scores for each emotion category (Pls.sur = pleasant surprise) and the average for all emotions (EmoAve). It also shows correlations between all emotions except neutral (AveNotNeu: anger, disgust, fear, happy, pls.sur (pleasant surprise), and sad), all negative emotions (AveNegEm: anger, disgust, fear, and sad) and all positive emotions (AvePosEm: happy and pls.sur). The individual difference variables are Big Five Inventory (BFI: agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) the Affect Intensity Measure and the Satisfaction with Life Scale.

*Table 6 (on following page): Correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and PANAS-X (Positive and Negative Affect Schedule, Expanded Version). Basic NA is the average score of fear, hostility, guilt and sadness scores, while Basic PA is average score of joviality, self-assurance, and attentiveness. Other abbreviations are identical to Table 4.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
General NA	*r*-value	0.007	-0.117	0.118	0.217	0.024	-0.050	-0.036	0.036	0.035	-0.006	0.125
	p-value	0.960	0.405	0.399	0.119	0.866	0.724	0.798	0.800	0.804	0.969	0.372
General PA	*r*-value	0.131	-0.181	0.086	0.007	-0.068	0.009	0.036	0.009	0.022	0.024	0.011
	p-value	0.350	0.194	0.538	0.959	0.628	0.946	0.798	0.951	0.873	0.863	0.940
Basic NA	*r*-value	0.039	-0.083	0.066	0.150	0.044	-0.110	-0.006	0.025	0.019	0.007	0.043
	p-value	0.780	0.555	0.637	0.284	0.756	0.433	0.965	0.860	0.892	0.959	0.761
Basic PA	*r*-value	0.142	-0.154	0.088	0.006	-0.047	-0.011	-0.005	0.011	0.021	0.028	-0.002
	p-value	0.312	0.272	0.531	0.969	0.738	0.939	0.971	0.936	0.880	0.842	0.987
Fear	*r*-value	-0.013	-0.204	0.191	0.167	-0.002	0.047	-0.096	0.018	0.020	-0.033	0.145
	p-value	0.927	0.142	0.171	0.233	0.991	0.738	0.492	0.900	0.888	0.815	0.299
Hostility	*r*-value	-0.016	-0.119	-0.016	0.149	0.099	-0.168	0.030	-0.013	-0.032	-0.045	0.008
	p-value	0.908	0.397	0.911	0.288	0.480	0.230	0.830	0.929	0.817	0.750	0.952
Guilt	*r*-value	0.064	-0.041	0.134	0.076	-0.080	-0.095	-0.045	0.018	0.035	0.045	-0.001
	p-value	0.647	0.773	0.338	0.590	0.567	0.497	0.749	0.899	0.804	0.749	0.992
Sadness	*r*-value	0.074	0.051	-0.079	0.119	0.134	-0.139	0.081	0.050	0.030	0.037	0.004
	p-value	0.597	0.718	0.572	0.397	0.337	0.319	0.563	0.720	0.829	0.791	0.979
Joviality	*r*-value	0.053	-0.210	0.065	-0.050	-0.156	-0.079	-0.084	-0.086	-0.066	-0.051	-0.081
	p-value	0.709	0.132	0.643	0.725	0.264	0.575	0.551	0.539	0.640	0.715	0.566
Self Assurance	*r*-value	0.107	-0.098	0.007	-0.006	0.075	-0.043	0.056	0.020	0.008	0.022	-0.030
	p-value	0.447	0.486	0.961	0.964	0.594	0.757	0.688	0.888	0.956	0.877	0.833
Attentiveness	*r*-value	.288*	-0.001	0.196	0.141	0.046	0.197	0.081	0.206	0.219	0.193	0.214
	p-value	0.036	0.996	0.159	0.313	0.745	0.157	0.566	0.138	0.115	0.166	0.124
Shyness	*r*-value	0.023	-0.132	-0.013	0.047	0.244	-0.130	0.050	0.009	-0.036	-0.029	-0.042
	p-value	0.871	0.347	0.926	0.736	0.079	0.352	0.724	0.950	0.798	0.835	0.767
Fatigue	*r*-value	0.015	-0.036	-0.175	0.015	0.145	-0.187	0.164	-0.022	-0.052	-0.027	-0.098
	p-value	0.916	0.796	0.211	0.917	0.301	0.179	0.241	0.874	0.712	0.848	0.486
Serenity	*r*-value	-0.117	-0.230	-0.256	-.281*	-0.138	-0.110	-0.252	-.293*	-.297*	-.274*	-0.263
	p-value	0.404	0.098	0.065	0.041	0.323	0.432	0.069	0.033	0.031	0.048	0.057
Surprise	*r*-value	0.096	-0.235	0.024	0.001	-0.020	-0.182	-0.058	-0.071	-0.074	-0.052	-0.105
	p-value	0.494	0.090	0.867	0.995	0.885	0.191	0.678	0.615	0.598	0.709	0.455

3A.1.2. Intensity ratings

For each participant, intensity scores given in response to each sentence stimulus were averaged for each emotion. Further, intensity ratings for each emotion were then averaged across participants, and finally an intensity average score was calculated across all emotions. Intensity scores are presented in *Table 7*.

Table 7: Mean intensity rating (on a scale from 1 to 7) and SD for each emotional category and average intensity score across emotions (Pls.sur = pleasant surprise).

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Intensity ratings	5.22	4.11	4.30	3.69	3.50	5.04	3.69	4.22
SD	0.66	0.89	0.89	0.81	1.15	0.65	0.94	0.69

As can be seen in *Table 7*, highest intensity ratings were given for angry sentences while the lowest intensity ratings were given for neutral sentences. This seems reasonable, as anger is an emotion that potentially displays threat. It is also reasonable that neutral sentences should obtain the lowest intensity score, as neutrality does not convey any emotionality. Further, disgust and fear information conveyed by the voice might also reveal possible threat, which is also experienced more intensely than neutral.

3A.1.2.1. Analysis of Variance (ANOVA)

A one-way ANOVA was conducted to examine whether intensity ratings differed between the emotion categories. A significant main effect was found for Emotion, $F(6,306)=69.924$, $p<.001$. *Post hoc* comparisons revealed that intensity ratings for each emotion category were significantly different, with the exception of intensity ratings obtained for stimuli expressing anger and pleasant surprise. Also, intensity ratings for sad sentences did not differ from ratings for happy or neutral sentences, and happy did not differentiate from neutral sentences. As can be seen in *Table 7*, intensity ratings were highest for anger, followed by pleasant surprise and fear, while the emotion category rated as the least intense emotion is neutral.

3A.1.2.2. Correlational analysis

Pearson's correlations were conducted to examine the relationship between intensity ratings given for each emotional category and individual difference variables. *Table 8* presents the correlations between intensity ratings and scores on the BFI, AIM, and SWLS. Not surprisingly, individuals scoring high on affect intensity also tend to rate negative emotions as more intense, r=.324, p=.019, and vocal emotions in general, r=.282, p=.043. Further, individuals that are more satisfied with their life in general (SWLS) tend to perceive positive vocal emotions as more intense, r=.335, p=.014.

The correlations between intensity ratings and PANAS-X are listed in *Table 9*. Overall, intensity ratings do not seem to be strongly related to self-reported general mood, however some specific mood categories seem to share a relationship with intensity ratings given for some specific emotions. For example, when looking at intensity ratings for neutral sentences, lower intensity ratings tends to be related to higher scores on shyness, r=-.273, p=.048, and fatigue, r=-.299, p=.030, while higher intensity ratings tends to be given by individuals scoring high on attentiveness, r=.309, p=.024.

*Table 8: Correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between intensity ratings for the emotion categories and individual difference variables.*

		INTENSITY RATING										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	IntAve	IntAveNotNeu	IntAveNegEm	IntAvePosEm
Agreeableness	*r*-value	-0.048	0.054	0.101	0.219	0.080	-0.017	0.151	0.106	0.101	0.084	0.123
	p-value	0.733	0.701	0.477	0.115	0.568	0.905	0.281	0.456	0.476	0.554	0.379
Conscientiousness	*r*-value	-0.087	-0.137	-0.077	-0.095	-0.206	-0.048	-0.032	-0.132	-0.097	-0.101	-0.080
	p-value	0.538	0.328	0.586	0.497	0.138	0.731	0.822	0.350	0.495	0.475	0.568
Extraversion	*r*-value	0.019	-0.069	0.014	-0.116	0.092	-0.050	0.038	-0.003	-0.030	0.012	-0.094
	p-value	0.893	0.623	0.922	0.406	0.512	0.721	0.788	0.982	0.831	0.932	0.504
Neuroticism	*r*-value	-0.125	-0.007	0.047	-0.107	-0.121	0.027	0.044	-0.045	-0.019	-0.003	-0.051
	p-value	0.373	0.960	0.741	0.445	0.388	0.848	0.753	0.752	0.896	0.985	0.715
Openness to experience	*r*-value	-.394**	-0.172	-0.171	-0.128	-0.081	-0.249	0.060	-0.181	-0.189	-0.171	-0.196
	p-value	0.004	0.219	0.226	0.361	0.567	0.072	0.669	0.199	0.180	0.227	0.159
Affect Intensity Measure	*r*-value	0.267	.331*	0.220	0.173	0.128	0.196	0.249	.282*	.294*	.324*	0.198
	p-value	0.053	0.016	0.117	0.215	0.363	0.160	0.073	0.043	0.034	0.019	0.155
Satisfaction with Life Scale	*r*-value	.296*	0.205	0.132	.355**	0.126	0.254	-0.013	0.228	0.231	0.171	.335*
	p-value	0.031	0.142	0.350	0.009	0.367	0.067	0.929	0.105	0.099	0.226	0.014

Note: Intensity ratings are presented for each emotional category and also averaged across all emotions (IntAve). Average intensity ratings are also calculated for each emotion except neutral (IntAveNotNeu), intensity ratings for all negative emotions (IntNegAve), and intensity ratings for all positive emotions (IntNegAve). The individual difference variables are BFI, AIM, and SWLS. Abbreviations are identical to Table 4.

*Table 9 (on following page): Correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between intensity ratings for the emotion categories and PANAS-X. Abbreviations are identical to Table 5 and Table 7.*

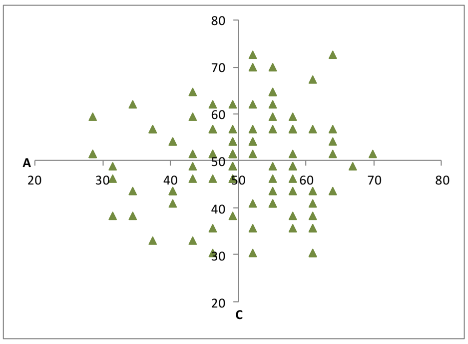
		INTENSITY RATING										
Measure		Anger	Disgust	Fear	Happy	Neutral	Sad	Pls.sur	IntAve	IntAveNotNeu	IntAveNegEm	IntAvePosEm
General NA	*r*-value	0.153	.309*	0.232	0.167	-0.015	0.202	0.210	0.214	0.255	0.263	0.201
	p-value	0.274	0.025	0.098	0.231	0.918	0.146	0.131	0.127	0.068	0.059	0.148
General PA	*r*-value	0.213	0.161	0.176	0.206	0.268	0.064	0.128	0.225	0.187	0.180	0.185
	p-value	0.126	0.251	0.212	0.140	0.052	0.648	0.359	0.109	0.183	0.202	0.185
Basic NA	*r*-value	0.154	0.230	0.190	0.102	-0.042	0.186	0.194	0.169	0.210	0.221	0.154
	p-value	0.271	0.097	0.177	0.465	0.764	0.183	0.164	0.232	0.136	0.115	0.270
Basic PA	*r*-value	0.249	.273*	0.212	0.146	0.234	0.099	0.133	0.245	0.221	0.243	0.151
	p-value	0.072	0.048	0.131	0.298	0.091	0.482	0.343	0.080	0.115	0.083	0.280
Fear	*r*-value	0.151	.289*	0.254	0.200	0.071	0.177	0.219	0.237	0.258	0.259	0.225
	p-value	0.280	0.036	0.069	0.150	0.611	0.206	0.115	0.091	0.065	0.064	0.105
Hostility	*r*-value	0.178	0.226	0.089	0.024	-0.152	0.064	0.128	0.080	0.137	0.155	0.076
	p-value	0.203	0.103	0.531	0.864	0.277	0.647	0.359	0.572	0.334	0.272	0.588
Guilt	*r*-value	0.106	0.189	0.222	0.156	0.055	0.268	0.214	0.212	0.233	0.234	0.196
	p-value	0.449	0.175	0.114	0.264	0.695	0.052	0.124	0.131	0.096	0.095	0.159
Sadness	*r*-value	0.091	0.085	0.067	-0.033	-0.121	0.089	0.085	0.035	0.074	0.094	0.021
	p-value	0.518	0.546	0.635	0.814	0.389	0.526	0.547	0.807	0.600	0.509	0.883
Joviality	*r*-value	.276*	.308*	0.264	0.135	0.230	0.087	0.115	0.257	0.236	0.271	0.136
	p-value	0.045	0.025	0.059	0.337	0.098	0.534	0.413	0.066	0.092	0.052	0.332
SelfAssurance	*r*-value	0.120	0.127	0.052	0.018	0.078	0.063	0.043	0.090	0.084	0.104	0.031
	p-value	0.394	0.364	0.716	0.898	0.580	0.654	0.762	0.526	0.556	0.462	0.824
Attentiveness	*r*-value	0.204	0.215	0.184	0.256	.309*	0.105	0.212	0.273	0.232	0.210	0.255
	p-value	0.143	0.122	0.191	0.064	0.024	0.453	0.128	0.050	0.097	0.136	0.065
Shyness	*r*-value	0.139	0.137	0.079	-0.103	-.273*	-0.029	0.094	-0.017	0.058	0.091	-0.017
	p-value	0.320	0.328	0.578	0.462	0.048	0.839	0.505	0.907	0.683	0.519	0.904
Fatigue	*r*-value	0.032	-0.101	-0.127	-0.142	-.299*	-0.108	-0.063	-0.163	-0.107	-0.095	-0.115
	p-value	0.819	0.474	0.371	0.312	0.030	0.442	0.654	0.248	0.452	0.504	0.412
Serenity	*r*-value	0.039	-0.134	-0.055	-0.113	0.086	-0.242	-0.216	-0.105	-0.147	-0.127	-0.171
	p-value	0.782	0.337	0.699	0.422	0.539	0.081	0.121	0.460	0.298	0.369	0.221
Surprise	*r*-value	0.065	0.160	0.202	0.103	0.068	0.114	0.191	0.158	0.166	0.160	0.154
	p-value	0.642	0.253	0.150	0.462	0.630	0.418	0.171	0.264	0.241	0.258	0.272

3A.1.3. Personality styles

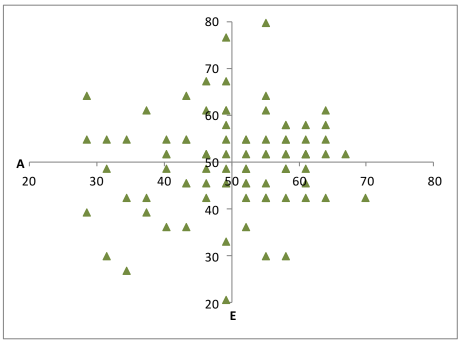
All tested participants were included when generating personality style graphs. Calculation of participant membership into 10 possible personality styles is explained in section *2A.3.3.* (see Weiss et al., 2009 for details on procedure). All 10 possible combinations of personality styles were used to generate style graphs to visually represent the distribution of personality styles in the participant sample. These style graphs are presented in *Figure 1*. It can be seen that, for each style graph, the number of participants in each style group is roughly equally distributed.

The distribution of trait combinations in the participant sample

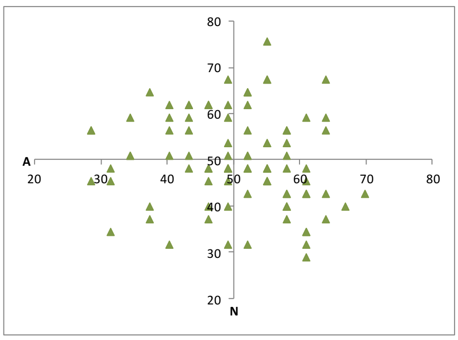
A-C personality style distribution



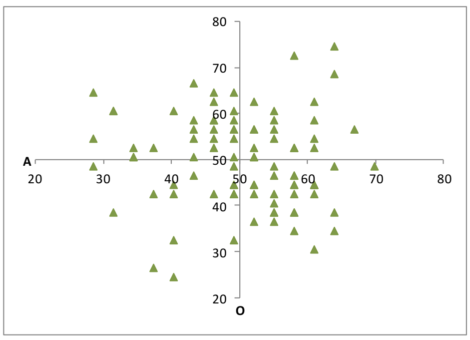
A-E personality style distribution



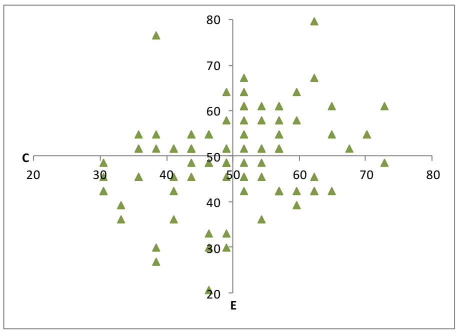
A-N personality style distribution



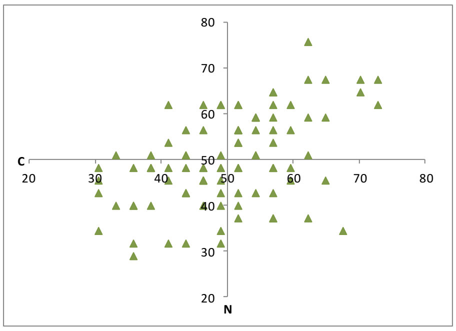
A-O personality style distribution



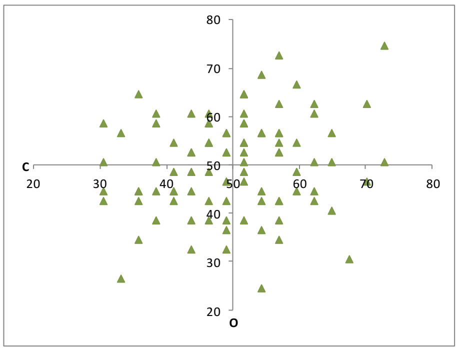
C-E personality style distribution



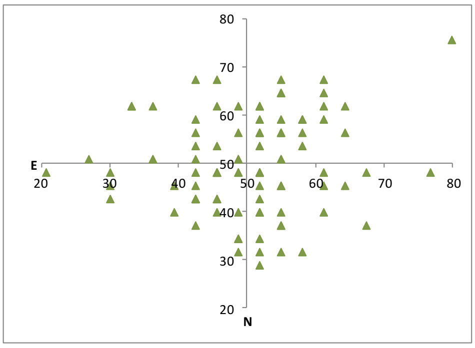
C-N personality style distribution



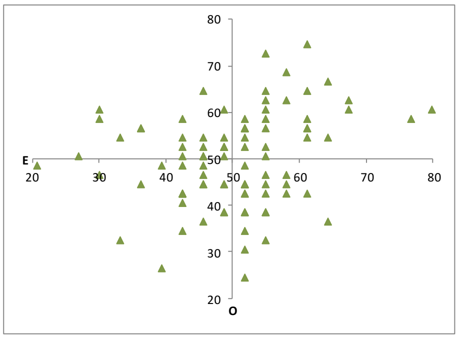
C-O personality style distribution



E-N personality style distribution



E-O personality style distribution



N-O personality style distribution

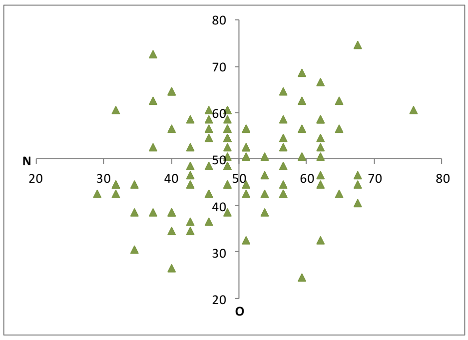


Figure 1. Ten style graphs of all possible personality style combinations (AC, AE, AN, AO, CE, CN, CO, EN, EO, NO) where each point represents one participant.

3A.1.3.1. Analysis of variance (ANOVA)

Ten repeated-measures ANOVAs were conducted to examine whether different personality styles could predict differing patterns of vocal emotion recognition accuracy. In each individual ANOVA, Emotion was used as a within-subject variable while Personality Style (AC, AE, AN, AO, CE, CN, CO, EN, EO, and NO) was treated as a between-subject variable. A main effect of Emotion was found for all ANOVAs conducted (F's > 56.813, p's <.001), suggesting that emotion categories could be differentiated by all personality styles. No main effect was found for Personality Style (F's > .302, p's < .875). None of the interactions between personality styles (10 possible combinations) and vocal emotion recognition (H_u scores) were significant (F's > 1.067, p's < .381).

4A. Discussion

The present study is the first attempt to examine whether and how inter- and intra-individual differences influence vocal emotion perception. Group data analyses replicated findings previously reported in the vocal emotion literature, confirming that the data are in line with results previously observed in the vocal emotion literature. However, when examining the relationship between vocal emotion perception and inter- and intra-individual differences, there were no noteworthy relationships evident between vocal emotion perception and variables of special interest, such as positive and negative affect, and extraversion and neuroticism.

Vocal emotion perception

When examining vocal emotion perception in general, an overall recognition rate of 55.8% was found. This is comparable to results reported previously, in which Scherer (1989) reported an overall recognition rate of 60% across 28 perception studies. Importantly, the present study used untrained speakers to convey the vocal emotions, suggesting that portrayals produced by untrained speakers provide as a good alternative to portrayals produced by professional actors, which suffers from lack of ecological validity (Scherer, 1989) and problems with generalising findings (Greasley et al., 2000). Further, the pattern of recognition rates was comparable to Paulmann et al. (in review), which used the same stimuli materials. Error patterns and unbiased hit rates were also comparable with previous findings (e.g. Pell et al. 2009a), in which anger is the emotion category that is recognised most accurately, while happy is the most poorly recognised emotion category. Thus, group-level analyses of vocal emotion processing is in line with the general vocal emotion literature, suggesting that the data is very suitable to further analyse vocal emotion perception at an inter- and intra-individual level in a systematic and comprehensive manner.

Vocal emotion perception and individual difference variables

Mood and vocal emotion perception

One of the main aims of the present study was to explore whether there is a systematic difference in vocal emotion perception that could be related to short-time mood fluctuations, with special interest in general and basic positive and negative affect. However, no such relationship was found, although individuals scoring high on serenity tended to be poorer at recognising vocal emotions. In general, this is in contrast to the assumptions made by the mood-congruent hypotheses, which argues that current mood can influence emotion processing (Bower, 1981). It is also inconsistent with studies reporting a relationship between emotion processing and induced mood (e.g. Bouhuys et al., 1995; Lee et al., 2008). However, as mentioned previously, findings from studies where individuals are induced with categorical mood states are not necessarily transferable to the less extreme short-time mood fluctuations that are experienced in everyday situations. Thus, it seems reasonable to assume that short-time fluctuations in everyday mood do not heavily influence listeners' ability to perceive emotions conveyed vocally in the same manner as induced mood.

Personality and vocal emotion perception

The present study also aimed at exploring whether inter- and intra-individual differences in personality could predict variation in vocal emotion perception. However, neither between-trait nor within-person differences in personality influenced perception of vocal emotions, which is inconsistent with the predictions made by the trait-congruency hypothesis. Considering analyses on a trait level, these results are in line with studies that also fail to find a systematic relationship (Bänziger et al., 2009). However, other studies have reported significant findings, although continuously confusing and contradictive; while Cunningham (1977) argued that neuroticism enhances emotion perception, Scherer and Scherer (2011) argues the opposite. Further, both Scherer and Scherer (2011) and Burton et al. (2013) suggest that extraverted individuals are better at vocal emotion recognition, the latter study only finds this effect for males.

This raises the question of why it seems so difficult to obtain similar findings and whether personality traits actually do influence vocal emotion perception in a systematic manner. One important point to mention is the difficulty of finding null results in the literature. Known as the drawer problem, or publication bias, (Rosenthal, 1979), it is possible that there are several unpublished studies suggesting that there are no relationship between personality traits and vocal emotion perception. This is supported by the fact that published studies actually showing null results are often reporting other results in relation to other findings. For example, the study by Elfenbein et al. (2007) focused mainly on the relationship between facial emotion recognition and effectiveness of negotiation, arguing that better facial emotion recognition could indeed influence negotiation performance. More importantly, personality traits did not seem to influence emotion recognition accuracy.

Further, all studies finding a significant relationship between emotion recognition and vocal emotion perception tend to provide an explanation for why this relationship is evident. For example, while Cunningham (1977) argues that neuroticism enhances emotion perception because discomfort is a motivating factor to perceive emotions. Scherer and Scherer (2011), who found the opposite pattern, argue that neurotic and anxious individuals might pay less attention to emotional cues from others. Thus, it seems easy to find plausible explanations, irrespective of the direction of the relationship. Future research should firstly focus on the discrepant results obtained in the personality and vocal emotion literature, and then try to gain a better understanding of the underlying reasons for the potential relationship(s).

Turning to analyses on an intra-individual level, personality styles did also not predict any consistent differences in vocal emotion recognition. It has been reported in the relatively scarce literature on personality styles that some trait combinations might make individuals more prone to pathological personality types, or personality disorders (e.g. Hyer et al., 1994; Saulsman & Page, 2004). However, an important distinction from the previous literature and the present study is that the trait combinations examined here are still adaptive for the individuals; no mental disorder or psychological difficulties are reported in the sample included. Thus, at first glance it seems like trait combinations do not interfere with vocal emotion perception in healthy individuals. However, care should be taken when considering these data. As participants are split into five personality style groups, power decreases as sample size in each group decreases.

The relationship between vocal emotion perception and subjective intensity ratings, affect intensity, and life satisfaction

With regard to the average intensity ratings given for each emotion category, the highest intensity ratings (on a 1 to 7 scale) were found for angry sentences, while neutral is the emotion category that obtained the lowest intensity ratings. Correlational analyses showed that, not surprisingly, individuals scoring high on affect intensity also tend to rate vocal emotions as more intense, irrespective of emotion category. This is consistent with the literature, stating that individuals scoring high on affect intensity tend to experience emotions more strongly, irrespective of emotion valence (Larsen, 1985; Larsen & Diener, 1987). However, affect intensity did not predict differences in vocal emotion perception. Further, individuals who judge themselves as being more satisfied with life also tends to be more accurate and to give higher intensity ratings of positive emotions, as predicted. Thus, individuals who are happy with their life situation, in which they tend to judge their social relationships and work situation as satisfactory (Diener et al., 1985), tend to have a positivity-bias in processing of vocal emotions.

Rationale for Study 2

Although the present study did not find a systematic relationship between inter- and intra-individual difference variables and vocal emotion recognition accuracy, these factors still may play a role. For example, individual difference variables might not influence emotion accuracy, but they might influence the *temporal* processing of vocal emotions, i.e. when/at which time point emotions are accurately recognised. Thus, Study 2 aims to extend Study 1 by exploring whether individual differences influence the time course processing of vocal emotions.

B. STUDY 2 - THE TIME COURSE OF VOCAL EMOTION PROCESSING AND INDIVIDUAL DIFFERENCES

1B. Introduction

Although there is an extensive literature on vocal emotion recognition, less is known about the time-course processing of vocal emotions. Imagine sitting in a group discussion at work, trying to find a common solution to a problem of high relevance to everyone. One of your colleagues is taking the lead in the heated conversation and while he presents his argument his voice becomes increasingly louder and his speech rate increases. A few minutes into his monologue he stands up and shouts his final sentence. It is now obvious to everyone that he is very angry but, importantly, at what point did people reach this conclusion? The literature of temporal dynamics of *explicit, or off-line,* (i.e. when the emotion category is consciously recognised) vocal emotions is still scarce and, to my knowledge, it is yet unexplored whether and how inter- and intra-individual differences can predict differences in time-course processing of vocal emotions. That is, do individuals differ in how much acoustic information they require to draw valid conclusions about vocal emotion displays?

The auditory gating paradigm

The auditory gating paradigm is often employed when examining *how much* acoustic-phonetic information is required to accurately identify a spoken stimulus and can be used to examine any linguistic stimulus (e.g. word, syllable, sentence) of interest (Grosjean, 1996). For example, a spoken word can be divided into smaller segments and listeners are then presented with segments of increasing duration starting at stimulus onset. The first segment is thus very brief while the final segment corresponds to the complete stimulus word (Grosjean, 1996). After listening to each segment listeners are asked to propose the target word and rate how confident they are that their response is accurate. This enables calculation of isolation point, or the size of the segment needed for accurate identification (Grosjean, 1996). Similarly, as vocal emotions unfold over time, the auditory gating paradigm is often employed when examining the time-course processing of vocal emotions.

Investigations of the temporal processing of vocal emotions provide crucial information on when distinct emotion categories are recognised and how much acoustic information is needed to recognise the emotional state of a speaker (Pell & Kotz, 2011). Employing the gating paradigm, auditory stimuli can be divided, or gated, into intervals of increasing length. Listeners are then asked to indicate which emotion is being portrayed and rate how confident they are that they identified the intended emotion (c.f. Grosjean, 1996). Importantly, by controlling precisely how much acoustic information is presented to listeners, it is possible to determine how much acoustic information is needed before the listeners is able to identify the correct emotional category (Grosjean, 1996). The vocal emotion stimuli are either gated on a syllable (e.g Pell & Kotz, 2011) or millisecond basis (Cornew, Carver, and Love, 2010).

The time course processing of vocal emotion perception

Vocal emotion research has revealed that different emotion categories are expressed through distinct acoustical patterns. For example, while anger is characterised by high pitch and quicker articulation rate, sadness shows the opposite pattern with decreased pitch and speech rate (Banse and Scherer, 1996). As each emotional category has a distinct acoustical profile, it is suggested that different emotion categories might unfold at different rates (Pell & Kotz, 2011). Pell and Kotz (2011) have argued that the biological significance of the emotion category might also influence the time of recognition. For example, as fear signals a threatening situation, which requires an immediate behavioural response, this emotion category should be recognised faster than a less significant emotion, such as happiness.

Cornew et al. (2010) examined this point by presenting listeners with pseudo-utterances (i.e. semantically-anomalous) intoned in an angry, happy, and neutral tone of voice, which were spliced into 250 ms gate intervals. In contrast to their prediction, in which they suggested that an emotional bias should be observed, they found a neutral bias; neutral utterances were identified more rapidly than angry utterances, which were identified more rapidly than happy utterances. They concluded that the temporal processing of vocal emotions differs between distinct emotion categories, in which neutral is processed more rapidly than emotional utterances. Pell and Kotz (2011) also found emotion-specific patterns of recognition, but the pattern observed was somewhat different. They found that anger, sadness, fear, and neutral were recognised at comparable rates, while happiness and sadness were harder to detect accurately at early intervals.

These findings deserve some attention. While results by Cornew et al. (2010) suggest a neutral bias, Pell and Kotz (2011) argue for an emotional bias. A possible reason for this discrepancy is simply that speakers in the former study uttered neutral more quickly than anger and happiness, providing listeners with more varied acoustical information during the first 250 ms. Another possibility is that results are influenced by the number of emotion categories included. Cornew et al. (2010) only included two emotion categories in addition to neutral. It is thus possible that, rather than focusing on recognising the utterance presented, listeners tried to discriminate non-emotional content from emotional content. Thus, it would be easier for listeners to identify neutral than to distinguish between anger and happiness, at least early in the utterance. In contrast, Pell and Kotz (2011) examined five emotion categories, and found that fear was the quickest recognised emotion, which support their argument that emotions of high biological significance should be processed more rapidly. However, a closer examination of the results shows that they are not disturbingly different. For example, anger is the second quickest identified emotion in Cornew et al (2010), while Pell and Kotz (2011) report that neutral is identified at comparable rates as anger and fear. Crucial factors that possibly can influence the temporal processing of vocal emotions are inter- and intra-individual differences, both in the speaker and receiver.

In contrast to the traditional gating procedure, in which the first gate represents the stimuli *onset* and the final gate corresponds to the full stimuli utterance, Rigoulot et al. (2013) presented their gated utterances to the listeners in the opposite order. That is, the first gate corresponded to the last segment before the sentence *offset*, while the final gate corresponded to the full utterance presented backwards. The overall aim of their study was based on a closer inspection of the findings of Pell and Kotz (2011), in which recognition accuracy of happiness and disgust continued to improve at the end of the utterances. As a result, recognition rates of happiness and earlier detected emotion categories (anger, fear, and sadness) were comparable when full utterances were presented. Rigoulot et al. (2013) suggested that, in addition to the amount of acoustic information presented, the position of salient acoustic features might also play a role, at least for some emotion categories.

Overall, Rigoulot et al. (2013) report a similar pattern of recognition accuracy as Pell and Kotz (2011); fear is the best recognised emotion while disgust is the least recognised emotion, irrespective of the number of gates presented. Also, in line with Pell and Kotz (2011), fear was best recognised at the shortest gate interval. However, importantly, a significantly earlier emotion identification point was evident for both happiness and disgust when gated from utterance *offset*, compared to when gated from utterance *onset*. Thus, the findings from Rigoulot et al. (2013) show that the position of acoustical cues also plays a vital role in the decoding process of vocal emotions. Thus, this adds to the list of variables that can influence the temporal processing of vocal emotions.

The time course processing of vocal emotions and individual differences

The literature on the explicit, or offline, time course processing of vocal emotions is still in its infancy. Currently, research on how inter- and intra-individual differences influence temporal processing of vocal emotions is absent. The only study, to my knowledge, that has examined differences in temporal processing of vocal emotions, although on a group level, is the study by Jiang, Paulmann, Robin, and Pell (2015). They examined the time course of vocal emotions across cultures and reported an in-group advantage, i.e. quicker and more accurate recognition of stimuli, when English and Hindi listeners were presented with emotionally intoned vocal utterances presented in their own language, compared to utterances presented in a foreign language (English for Hindi listeners and Hindi for English listeners). This is consistent with findings from the vocal emotion accuracy literature (e.g. Paulmann & Uskul, 2014). However, it is yet unexplored how the temporal dynamics of vocal emotions are influenced by inter- and intra-individual differences.

Overall aim of Study 2

The present study will further build on the findings of Study 1. Specifically, the paradigm applied here will allow looking at recognition of vocal emotions similar to Study 1, but will also allow exploring the explicit time course of vocal emotion processing. Crucially, the present study will also be able to test whether stimuli properties influenced findings in Study 1. Thus, rather than using semantically neutral stimuli, semantically anomalous pseudo-utterances (e.g. Klaff the frisp dulked lantary) will be presented, which allows to test whether recognition of prosodic information presented in isolation (i.e. with no influence from lexical semantic cues) is more susceptible to influences of individual differences. Also, in the present study, a professional actress was used to intone materials to control for speaker variability. Utterances will be gated into six intervals on a syllable basis and, based on the previous literature, it is reasonable to assume that the recognition or identification points will differ between distinct emotion categories. More specifically, it is predicted that less acoustical information is required to accurately identify anger, fear, sadness, and neutral utterances compared to utterances intoned in a happy or disgusted voice. No clear predictions are made for the temporal unfolding of pleasant surprise, as this is the first study to examine this emotion using a gating paradigm.

Further, as research on temporal processing of vocal emotions and individual difference variables are absent, no clear predictions can be made. However, Study 1 found a negative relationship between overall emotion recognition and short-time fluctuations in serenity. If this finding should be considered meaningful, it should also be observed in the present examination, at least at the final gate (full utterance) identification. It is also possible that other inter- and intra-individual differences examined might influence the explicit temporal processing of vocal emotions at different time-points. Again, it will be examined whether the mood- and trait- congruence hypotheses can explain a potential relationship. Further, based on results from Study 1, it is assumed that individuals who are satisfied with their life should be better at processing positive emotions, at least at the final gate. Finally, if affect intensity influences how quickly individuals can identify vocal emotions, this should be found for all emotions, irrespective of valence.

2B. Methods

2B.1. Participants

Hundred-and-one (86 females, mean age: 19.4, SD: 2.45) undergraduate Psychology students at the University of Essex participated as part of a module requirement, in which they received credits in exchanged for participation. All participants gave their written informed consent and reported normal or corrected to normal hearing and vision. Seventy-six participants were native speakers of English.

2B.2. Apparatus

Same apparatus employed as in Study 1.

2B.3. Stimulus materials

2B.3.1. Sentence stimuli

Semantically-anomalous pseudo-utterances (utterances with meaningless content, such as "Klaff the frisp dulked lantary") were selected from previous inventory (Paulmann & Uskul, 2014). A professional female actress portrayed 14 utterances in seven emotional categories (anger, disgust, fear, happy, neutral, pleasant surprise, sad). Utterances were edited into six gate intervals using *Praat* (Boersma & Weenink, 2009) on a syllable basis with increasing duration, in which the final (6^{th}) gate corresponded to a full utterance. The first gate consisted of two syllables while the other gates consisted of one syllable. The same 14 utterances were presented in each of the six blocks, with increasing syllable length per block, and utterances were randomly allocated for each individual participant. See *Appendix C* for full list of pseudo-utterances included.

2B.3.2. Questionnaire measures

The same individual difference questionnaires were employed as in Study 1.

3B.3.3. Calculating personality styles

Personality styles were calculated employing the same procedure used in Study 1.

2B.4. Design

A cross-sectional design was used, in which predictor variables were identical to Study 1 (BFI, AIM, PANAS-X, and SWLS) while the criterion variable was recognition accuracy (and confidence ratings) at each gate interval and identification point of the intended emotion (in ms).

2B.5. Procedure

The experimental procedure was identical to Study 1; however participants now listened to segments of each gate or complete utterance (in the last block) rather than only complete sentences. Also, rather than rating stimulus intensity, they were asked to indicate how confident they were that they had identified the correct emotion. The confidence scale ranged from 1 (not confident at all) to 7 (very confident) and was presented after each utterance stimulus offset. The procedure employed was identical to the one employed in Pell & Kotz (2011).

3B. Results

3B.1. Behavioural analyses

Participants suffering from a mental disorder were again, as in Study 1, excluded from the analysis due to possible vocal emotion recognition impairments (e.g. Leppänen et al., 2004). Further, non-native speakers of English were again excluded due to English listeners possibly having an in-group advantage (e.g.

Paulmann & Uskul, 2014). Thus, 60 participants were included in the final analyses. For each participant, recognition scores were averaged for each emotion at each gate, and then averaged across participants. As for Study 1, correlational analyses between recognition accuracy and individual difference variables were performed when male listeners were excluded to see whether the gender imbalance influenced results. Furthermore, correlations between recognition accuracy and individual difference variables were also performed when non-native listeners were included. These data are listed in *Appendix D*.

3B.1.1. Accuracy rates at each gate interval

Accuracy rate (in percentage) and SD was calculated for each emotion category at each gate interval. Further, an average accuracy score and SD was then calculated for each emotion category across gates and for each gate across emotion. These data are presented in *Table 10.*

Table 10: Recognition accuracy in percentage and SD for each emotion (pls.sur = pleasant surprise) at each gate, and average recognition for each emotion and each gate.

	GATE IDENTIFICATION						
Expression	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6	Average
Anger	60.2	73.2	75.7	78.9	86.1	87.1	76.9
SD	0.20	0.17	0.16	0.18	0.17	0.16	0.17
Disgust	25.0	32.5	42.0	47.5	51.0	62.4	43.4
SD	0.14	0.18	0.21	0.24	0.26	0.25	0.21
Fear	41.9	42.7	45.2	46.7	47.1	43.3	44.5
SD	0.18	0.19	0.18	0.22	0.19	0.21	0.19
Happy	17.7	23.2	31.6	31.7	37.3	40.1	30.3
SD	0.11	0.14	0.17	0.19	0.20	0.21	0.17
Neutral	70.7	74.8	81.9	81.8	82.1	80.8	78.7
SD	0.18	0.18	0.16	0.18	0.17	0.16	0.17
Pls.sur	48.8	45.7	47.3	46.6	48.5	48.3	47.5
SD	0.15	0.16	0.18	0.17	0.19	0.18	0.17
Sad	52.3	65.4	65.6	68.8	68.8	70.6	65.2
SD	0.19	0.21	0.21	0.21	0.23	0.22	0.21
Average	45.2	51.1	55.6	57.4	60.1	61.8	

As can be seen in *Table 10,* overall recognition across emotions improves at successive gate intervals, i.e. overall recognition at Gate 1 and Gate 6 (full utterance) is 45.2% and 61.8%, respectively. The most accurately recognised emotion category at Gate 1 is neutral (70.7%), followed by anger (60.2%) and sadness (52.3%). However, at Gate 6 (full utterance), anger is the most accurately recognised emotion (87.1%), followed by neutral (80.8%) and sadness (70.6%). Happy is the poorest recognised emotion at Gate 1 (17.7%) and remains the poorest recognised emotion at Gate 6 (40.1%).

3B.1.1.1 Error patterns

Error confusion patterns were calculated for each emotion category at each gate interval, which is presented in *Table 11.*

Table 11: Error patterns for each emotion at each gate interval

		RESPONSE GIVEN						
	Expression	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad
Gate 1	Anger	**60.2**	7.4	5.0	4.2	11.3	10.5	1.4
	Disgust	6.1	**25.0**	3.2	9.0	27.1	17.7	11.8
	Fear	2.1	2.4	**41.9**	8.9	12.3	15.1	17.3
	Happy	1.2	2.0	8.3	**17.7**	44.2	11.8	14.8
	Neutral	7.5	6.4	1.8	5.5	**70.7**	3.7	4.4
	Pls.sur	1.2	3.9	16.1	19.0	6.9	**48.8**	4.0
	Sad	0.2	1.7	18.3	3.1	21.5	2.9	**52.3**
Gate 2	Anger	**73.2**	8.0	2.4	4.6	6.0	4.6	1.2
	Disgust	5.1	**32.5**	2.5	8.1	24.2	19.4	8.2
	Fear	3.2	2.6	**42.7**	7.9	11.8	9.8	22.0
	Happy	1.0	3.3	6.1	**23.2**	46.8	10.2	9.4
	Neutral	8.0	5.6	2.3	4.3	**74.8**	3.5	1.7
	Pls.sur	2.4	3.8	8.1	27.4	10.1	**45.7**	2.5
	Sad	0.1	1.2	14.2	1.1	15.7	2.4	**65.4**
Gate 3	Anger	**75.7**	8.2	1.7	4.9	4.4	4.6	0.5
	Disgust	3.2	**42.0**	2.7	8.2	16.7	22.5	4.6
	Fear	3.3	2.7	**45.2**	7.0	10.1	8.6	23.0
	Happy	2.4	3.8	4.2	**31.5**	38.7	12.3	7.1
	Neutral	3.9	4.9	0.7	4.3	**81.9**	2.1	2.1
	Pls.sur	1.2	1.4	7.9	31.2	8.2	**47.3**	2.9
	Sad	0.5	1.5	13.8	2.5	14.0	2.0	**65.6**
Gate 4	Anger	**78.9**	9.6	2.6	2.1	3.3	2.7	0.6
	Disgust	3.9	**47.5**	3.3	8.0	14.8	19.3	3.2
	Fear	4.2	2.9	**46.7**	6.7	8.0	7.1	24.5
	Happy	2.0	4.9	3.1	**31.7**	37.9	11.9	8.6
	Neutral	4.4	5.1	1.4	3.6	**81.8**	1.7	2.0
	Pls.sur	0.7	2.0	5.8	34.0	9.8	**46.5**	1.1
	Sad	0.7	1.7	13.5	1.9	11.0	2.5	**68.8**
Gate 5	Anger	**86.1**	6.5	0.8	1.8	3.0	1.2	0.6
	Disgust	4.9	**51.0**	2.6	6.3	12.0	20.1	3.1
	Fear	5.1	3.0	**47.1**	6.5	8.3	7.9	22.0
	Happy	3.6	4.3	2.9	**37.3**	33.8	13.0	5.2
	Neutral	3.9	4.8	1.9	2.7	**82.1**	2.3	2.3
	Pls.sur	1.0	1.2	3.3	37.4	6.9	**48.5**	1.8
	Sad	0.8	2.0	14.4	2.9	9.2	1.9	**68.8**
Gate 6	Anger	**87.1**	6.2	0.5	1.2	3.5	1.1	0.5
	Disgust	1.0	**62.4**	1.9	5.8	8.2	19.0	1.7
	Fear	5.0	4.9	**43.3**	7.5	9.8	8.2	21.3
	Happy	1.3	4.3	3.3	**40.1**	33.5	13.1	4.4
	Neutral	3.9	6.0	1.2	3.7	**80.8**	2.1	2.3
	Pls.sur	0.0	2.0	1.5	42.5	5.0	**48.3**	0.6
	Sad	0.4	2.1	14.6	1.0	10.2	1.1	**70.6**

As can be seen in *Table 11,* each emotion category is most frequently identified with the intended emotion, except for happy, which is consistently confused with neutral across the first four gates, and disgust, which is mostly confused with neutral at Gate 1. Further, several emotion categories, anger, disgust, happiness, and sadness, are mostly confused with neutral at Gate 1. Fear is most often confused sad, pleasant surprise is most often confused with happiness, and neutral is most often confused with anger. The confusion pattern at Gate 2 is similar to the confusion pattern at Gate 1, however anger is now mostly confused with disgust.

Confusion pattern at Gate 3 is similar to Gate 1 and Gate 2, with the exception of disgust now being most often confused with pleasant surprise and neutral is mostly confused with disgust. Gate 4 is comparable to the previous gates, however neutral is now most often confused with anger and sad is confused mostly with fear. With the exception of neutral now being mostly confused with disgust, Gate 5 is comparable to Gate 4. Finally, error confusion pattern at Gate 6 is comparable to Gate 5. Importantly, all emotion categories are now most frequently recognised with the intended emotion. Thus, it is evident that error confusion patterns are, overall, comparable across gates. In addition, error pattern at Gate 6 is comparable to error patterns observed in Study 1 (see *Table 2*).

3B.1.1.2. Unbiased hit rates

Similarly to Study 1, unbiased hit rates were calculated and arcsine transformed to control for response biases (Wagner, 1993). *Table 12* presents the unbiased hit rates and SD for each emotion category at each gate interval. Also, average H_u scores are also given for each gate across emotion and for each emotion across gates. Again, the outlier labelling rule (Hoaglin et al., 1986; Hoaglin & Iglewich, 1987) was employed, but no outliers were identified.

Table 12: Mean H_u scores and SD for each emotion at each gate. Gate 6 corresponds to a full utterance. Average recognition at each gate and for each emotion category is included.

	GATE IDENTIFICATION						
Expression	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6	Average
Anger	0.51	0.65	0.29	0.76	0.86	0.94	0.67
SD	0.20	0.21	0.14	0.24	0.29	0.27	0.23
Disgust	0.15	0.23	0.24	0.39	0.45	0.56	0.34
SD	0.11	0.17	0.12	0.28	0.33	0.35	0.22
Fear	0.20	0.27	0.65	0.33	0.36	0.34	0.36
SD	0.12	0.16	0.30	0.21	0.21	0.24	0.21
Happy	0.06	0.08	0.23	0.13	0.16	0.18	0.14
SD	0.06	0.07	0.18	0.10	0.12	0.13	0.11
Neutral	0.28	0.32	0.28	0.48	0.53	0.52	0.40
SD	0.10	0.12	0.17	0.22	0.25	0.21	0.18
Pls.sur	0.24	0.24	0.33	0.26	0.29	0.29	0.28
SD	0.11	0.14	0.13	0.14	0.17	0.16	0.14
Sad	0.28	0.43	0.08	0.50	0.52	0.56	0.40
SD	0.14	0.22	0.07	0.25	0.26	0.26	0.20
Average	0.25	0.32	0.30	0.41	0.45	0.48	

It is evident from *Table 12* that overall recognition increases incrementally at each gate, with the exception from Gate 2 to Gate 3. Thus, on average, when listeners are provided with more acoustical information, they become better at identifying the intended emotion category. It is also evident that, at Gate 1, anger is the most accurately recognised emotion category while happy is the least recognised emotion category. This pattern is consistent across gates, in which anger is still the best recognised emotion at Gate 6 and happy is still the least recognised emotion. These findings are consistent with the recognition pattern found in Study 1 (see *Table 3*) and with the literature in general (e.g. Pell *et al.*, 2009a).

3B.1.1.3. Analysis of Variance (ANOVA)

A repeated-measures ANOVA was used to examine how vocal emotion recognition unfolds over time. Significance level was again adjusted using Keppel's rule (new p=.017) (Keppel, 1991). Emotion (anger, disgust, fear, happy, neutral, pleasant surprise and sad) and Gate (Gate 1, Gate 2, Gate 3, Gate 4, Gate 5, Gate 6) were treated as within-subject variables. A significant main effect was found for Emotion, $F(6,354)=151.580$, $p<.001$, suggesting that emotion categories could be successfully distinguished from each other. *Post hoc* comparisons showed that all individual contrasts, except disgust and fear, and neutral and sad, are significantly different. As shown in *Table 12*, anger is the most accurately recognised emotion while happy is the emotion category that is most poorly recognised. A significant main effect was also found for Gates, $F(5,295)=101.162$, $p<.001$, suggesting that recognition accuracy differed across gates. *Post hoc* comparisons revealed that recognition accuracy were significantly different at all gate intervals, with the exception of Gate 5 and Gate 6. *Table 12* lists the overall mean recognition accuracy at each gate, showing that correct identification of emotion increases for each successive gate, overall.

A significant Gate by Emotion interaction was also found, $F(30,1770)=45.989$, $p<.001$, indicating that recognition accuracy for emotion categories differ across gates. Post hoc comparisons of simple main effects at Gate 1 revealed that all contrasts were significantly different except disgust and fear (although approaching significance, p=.018), fear and pleasant surprise, neutral and pleasant surprise, neutral and sad, and pleasant surprise and sad. At Gate 2, all contrasts were significantly distinguished with the exception of disgust and fear, disgust and pleasant surprise, and fear and pleasant surprise. At Gate 3, anger was only significantly distinguished from disgust and sad, while disgust were not significantly distinguished from happy and neutral. Further, happy was not significantly distinguished from neutral, and neutral were not successfully distinguished from pleasant surprise. At Gate 4, all individual contrasts were distinguished from each other, with the exception of disgust and fear, fear and pleasant surprise, and neutral and sad.

Disgust was not significantly distinguished from fear (although approaching significance, p=.019), neutral, and sad at Gate 5. Fear was significantly distinguished from all emotion categories except pleasant surprise, and the only emotion category that neutral was not significantly distinguished from was sad. Finally, at Gate 6, all contrasts were significantly distinguished except disgust and neutral, disgust and sad, fear and pleasant surprise, and neutral and sad. Overall, it is thus clear that some emotions are frequently problematic to distinguish from each other. For example, disgust and fear are not significantly distinguished at Gate 1, Gate 2, and Gate 4. A similar pattern is also found for fear and pleasant surprise, which is only successfully distinguished at Gate 3, and neutral and sad, which is only successfully distinguished at Gate 2 and Gate 3.

3B.1.1.4. Individual difference variables

Means and SDs were calculated for all individual difference variables and compared to the previous literature, which is listed in *Table 13*. Similarly to Study 1, previous findings on BFI variables were retrieved for group age 20 (Srivastava et al., 2003), as mean age of the present sample was 19.4. Again, findings obtained in the present study are comparable to previous findings for all variables.

Table 13: Means and SDs from the present study for each variable in each questionnaire (BFI, AIM, SWLS, and PANAS-X) including means and SDs obtained for the same variables in previous research.

		PRESENT STUDY		PREVIOUS LITERATURE	
Measure	Variable	Mean	SD	Mean	SD
BFI	Agreeableness	3.83	0.58	3.64	0.72
	Conscientiousness	3.41	0.60	3.45	0.73
	Extraversion	3.14	0.78	3.25	0.90
	Neuroticism	3.13	0.73	3.32	0.82
	Openness to Experience	3.15	0.61	3.92	0.66
AIM	Affect Intensity Measure	3.66	0.41	3.70	0.50
SWLS	Satisfaction with Life Scale	22.22	6.28	23.50	6.43
PANAS-X	General NA	19.28	6.90	20.20	7.20
	General PA	29.92	6.93	32.60	7.10
	Basic NA	11.04	3.56	-	-
	Basic PA	18.53	4.20	-	-
	Fear	11.73	3.77	12.30	4.90
	Hostility	11.60	4.72	12.90	5.00
	Guilt	9.53	4.59	12.00	5.20
	Sadness	11.30	4.79	11.70	4.80
	Joviality	24.85	6.38	26.80	6.60
	Self Assurance	14.83	4.74	17.70	4.70
	Attentiveness	15.92	3.84	13.50	2.90
	Shyness	8.02	3.20	7.70	3.10
	Fatigue	13.57	3.54	12.70	3.90
	Serenity	8.92	2.56	8.90	2.60
	Surprise	6.50	2.94	6.80	2.80

Note: Previous literature on BFI was adapted from Srivastava et al. (2003) while findings on AIM was retrieved from Bryant et al. (1996). Further, previous findings on SWLS was reported by Diener et al. (1985) while the PANAS-X manual (Watson & Clark, 1999) was used for previous results on mood variables (i.e. fast few weeks). Basic NA and Basic PA were not reported in the manual but are included in the present study.

As evident in *Table 13*, results on individual difference variables are comparable with findings reported previously. This is consistent with findings from Study 1.

3B.1.1.5. Correlational analysis

Pearson's correlations were used to examine the relationship between unbiased hit rates (H_u scores) at each gate interval and individual difference variables BFI, AIM, SWLS, and PANAS-X. *Table 14* to *Table 19* lists all the findings at each gate interval.

*Table 14: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 1 and individual difference variables.*

		EMOTION RECOGNITION ACCURACY AT GATE 1							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.031	-0.062	0.044	-0.133	0.061	0.181	0.086	0.079
	p-value	0.811	0.639	0.736	0.310	0.643	0.167	0.516	0.548
Conscientiousness	*r*-value	-0.198	-0.036	-0.105	-0.051	0.100	.343**	-0.054	-0.018
	p-value	0.129	0.784	0.423	0.700	0.445	0.007	0.682	0.893
Extraversion	*r*-value	-0.081	0.077	-0.096	0.133	0.167	0.181	-0.023	0.059
	p-value	0.537	0.559	0.464	0.310	0.202	0.165	0.864	0.657
Neuroticism	*r*-value	.332**	-0.006	-0.025	0.043	0.210	0.030	0.204	0.241
	p-value	0.010	0.963	0.850	0.747	0.107	0.820	0.118	0.063
Openness to experience	*r*-value	-0.065	0.198	-0.017	.313*	0.047	0.014	0.028	0.074
	p-value	0.621	0.130	0.898	0.015	0.719	0.916	0.832	0.575
Affect Intensity Measure	*r*-value	.259*	0.008	-0.020	0.060	0.253	.301*	.298*	.327*
	p-value	0.046	0.950	0.878	0.649	0.052	0.019	0.021	0.011
Satisfaction with Life Scale	*r*-value	0.083	0.077	0.087	.268*	-0.025	-0.217	0.089	0.062
	p-value	0.531	0.558	0.511	0.038	0.848	0.096	0.501	0.640
GeneralNA	*r*-value	-0.200	-0.197	-0.163	.259*	-0.112	-0.023	-0.174	-0.210
	p-value	0.125	0.130	0.215	0.046	0.393	0.861	0.185	0.107
GeneralPA	*r*-value	0.075	0.031	0.046	.265*	-0.025	-.254*	0.067	0.022
	p-value	0.568	0.815	0.727	0.041	0.851	0.050	0.610	0.869
BasicNA	*r*-value	-.261*	-0.068	-0.088	.266*	-0.142	-0.006	-0.160	-0.185
	p-value	0.044	0.607	0.504	0.040	0.280	0.963	0.221	0.156
BasicPA	*r*-value	0.057	0.014	0.087	.340**	0.074	-0.130	-0.034	0.063
	p-value	0.665	0.913	0.509	0.008	0.575	0.321	0.795	0.630
Fear	*r*-value	-0.015	0.097	-0.007	.267*	-0.035	-0.248	0.045	-0.021
	p-value	0.908	0.460	0.958	0.039	0.788	0.056	0.734	0.874
Guilt	*r*-value	0.112	0.082	0.145	0.104	-0.131	-0.215	0.049	0.038
	p-value	0.394	0.533	0.268	0.429	0.317	0.099	0.707	0.775
Hostility	*r*-value	0.087	-0.094	-0.064	0.159	0.029	-0.204	0.135	-0.001
	p-value	0.510	0.476	0.629	0.225	0.826	0.119	0.303	0.994
Sadness	*r*-value	-0.200	-0.020	-0.083	0.220	-0.113	0.074	-0.033	-0.094
	p-value	0.125	0.879	0.529	0.092	0.389	0.573	0.803	0.477
Attentiveness	*r*-value	-.289*	-0.025	-0.044	.278*	-0.249	-0.175	-0.235	-.264*
	p-value	0.025	0.849	0.740	0.031	0.055	0.182	0.071	0.041
Joviality	*r*-value	-0.169	-0.158	-0.097	0.164	0.030	0.072	-0.182	-0.127
	p-value	0.198	0.228	0.462	0.210	0.818	0.584	0.164	0.335
SelfAssurance	*r*-value	0.025	-0.037	0.044	.259*	0.036	-0.184	0.058	0.015
	p-value	0.852	0.779	0.738	0.046	0.784	0.159	0.660	0.911
Fatigue	*r*-value	0.237	0.009	0.196	-0.019	-0.195	-0.169	-0.013	0.056
	p-value	0.068	0.943	0.134	0.884	0.135	0.198	0.924	0.668
Serenity	*r*-value	-.289*	-0.117	-0.097	0.194	0.034	0.068	-0.119	-0.151
	p-value	0.025	0.371	0.462	0.138	0.796	0.607	0.363	0.250
Shyness	*r*-value	-0.025	-0.053	0.012	0.194	-.337**	-0.191	-0.054	-0.135
	p-value	0.851	0.690	0.927	0.138	0.008	0.144	0.683	0.302
Surprise	*r*-value	-0.223	0.122	-0.134	-0.109	0.023	0.151	0.020	-0.063
	p-value	0.087	0.355	0.306	0.406	0.862	0.249	0.881	0.635

Note: The individual difference variables are BFI, AIM, SWLS, and PANAS-X. Abbreviations are identical to Table 4 and Table 5.

*Table 15: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 2 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 2							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.170	0.090	-0.111	0.046	0.117	0.136	0.013	0.121
	p-value	0.194	0.494	0.400	0.726	0.374	0.300	0.921	0.357
Conscientiousness	*r*-value	0.049	0.045	-0.023	0.091	0.011	0.032	-0.018	0.039
	p-value	0.708	0.731	0.859	0.487	0.931	0.807	0.889	0.765
Extraversion	*r*-value	0.184	.276*	0.039	0.211	0.173	-0.038	-0.027	0.170
	p-value	0.159	0.033	0.766	0.106	0.186	0.774	0.839	0.194
Neuroticism	*r*-value	0.056	-0.112	0.127	0.004	0.041	0.174	0.097	0.101
	p-value	0.672	0.393	0.335	0.978	0.759	0.184	0.459	0.442
Openness to experience	*r*-value	-0.017	0.140	-0.005	-0.138	-0.037	-0.111	0.155	0.003
	p-value	0.895	0.287	0.967	0.293	0.777	0.398	0.236	0.979
Affect Intensity Measure	*r*-value	0.127	0.083	0.104	0.120	0.144	0.200	0.039	0.194
	p-value	0.335	0.526	0.428	0.363	0.271	0.126	0.767	0.138
Satisfaction with Life Scale	*r*-value	-0.074	-0.108	0.120	-0.019	-0.132	0.098	0.017	-0.013
	p-value	0.572	0.412	0.362	0.884	0.314	0.458	0.898	0.923
GeneralNA	*r*-value	0.017	-0.043	0.037	-0.009	-0.097	-.274*	-0.227	-0.149
	p-value	0.895	0.744	0.776	0.947	0.462	0.034	0.081	0.256
GeneralPA	*r*-value	-0.043	-0.128	0.157	-0.029	-0.033	0.024	-0.001	-0.011
	p-value	0.746	0.329	0.231	0.826	0.800	0.856	0.996	0.935
BasicNA	*r*-value	0.049	0.004	0.048	0.053	-0.092	-.273*	-0.198	-0.112
	p-value	0.713	0.976	0.718	0.688	0.483	0.035	0.129	0.395
BasicPA	*r*-value	0.091	0.011	.270*	0.065	-0.014	0.062	0.045	0.126
	p-value	0.489	0.936	0.037	0.624	0.917	0.636	0.734	0.336
Fear	*r*-value	-0.118	-0.177	-0.005	-0.075	-0.180	-0.073	0.019	-0.141
	p-value	0.369	0.176	0.968	0.569	0.169	0.577	0.887	0.281
Guilt	*r*-value	0.042	0.029	0.029	0.105	0.057	0.130	-0.109	0.067
	p-value	0.749	0.828	0.827	0.425	0.665	0.324	0.409	0.608
Hostility	*r*-value	-0.123	-0.243	0.232	-0.164	0.034	-0.030	0.049	-0.057
	p-value	0.351	0.061	0.074	0.211	0.798	0.822	0.713	0.668
Sadness	*r*-value	0.122	0.073	0.030	0.122	0.021	-0.169	-0.084	0.008
	p-value	0.354	0.578	0.823	0.352	0.875	0.196	0.523	0.955
Attentiveness	*r*-value	-0.071	-0.114	0.053	-0.075	-.295*	-.344**	-.363**	-.282*
	p-value	0.592	0.388	0.689	0.568	0.022	0.007	0.004	0.029
Joviality	*r*-value	0.044	0.031	0.042	0.064	0.027	-0.188	-0.063	-0.031
	p-value	0.739	0.811	0.750	0.629	0.839	0.149	0.630	0.814
SelfAssurance	*r*-value	-0.002	-0.115	0.181	-0.165	-0.023	-0.064	-0.030	-0.036
	p-value	0.986	0.381	0.167	0.208	0.863	0.628	0.822	0.784
Fatigue	*r*-value	-0.250	-0.197	0.110	-0.177	-0.055	-0.023	-0.041	-0.145
	p-value	0.054	0.131	0.402	0.175	0.675	0.861	0.754	0.268
Serenity	*r*-value	0.025	0.112	-0.037	0.067	0.033	-0.096	-0.109	-0.013
	p-value	0.852	0.393	0.777	0.610	0.800	0.466	0.406	0.923
Shyness	*r*-value	-0.123	-0.103	-0.118	-0.121	-.254*	-0.231	-0.142	-0.251
	p-value	0.351	0.432	0.370	0.358	0.050	0.076	0.280	0.053
Surprise	*r*-value	0.129	0.222	0.059	.287*	0.113	0.140	-0.090	0.186
	p-value	0.326	0.088	0.657	0.026	0.392	0.285	0.495	0.155

*Table 16: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 3 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 3							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.180	0.087	-0.080	0.094	-0.112	0.045	0.123	0.050
	p-value	0.168	0.510	0.545	0.476	0.393	0.732	0.351	0.704
Conscientiousness	*r*-value	.341**	-0.051	-0.228	0.049	-0.026	0.089	0.014	-0.019
	p-value	0.008	0.700	0.080	0.712	0.844	0.498	0.916	0.883
Extraversion	*r*-value	0.185	-0.020	-0.047	.277*	0.036	0.211	0.174	0.176
	p-value	0.158	0.880	0.720	0.032	0.785	0.105	0.185	0.179
Neuroticism	*r*-value	0.027	0.200	0.115	-0.116	0.130	0.006	0.040	0.113
	p-value	0.841	0.126	0.381	0.379	0.323	0.962	0.764	0.392
Openness to experience	*r*-value	0.012	0.026	0.008	0.134	-0.003	-0.139	-0.035	0.028
	p-value	0.930	0.846	0.954	0.307	0.981	0.288	0.790	0.834
Affect Intensity Measure	*r*-value	.297*	.300*	0.078	0.083	0.104	0.120	0.148	.271*
	p-value	0.021	0.020	0.551	0.528	0.431	0.362	0.258	0.036
Satisfaction with Life Scale	*r*-value	-0.219	0.086	0.051	-0.117	0.120	-0.016	-0.134	-0.044
	p-value	0.092	0.514	0.698	0.374	0.359	0.900	0.308	0.739
GeneralNA	*r*-value	-0.021	-0.172	-0.095	-0.044	0.037	-0.010	-0.095	-0.111
	p-value	0.874	0.189	0.471	0.737	0.780	0.941	0.472	0.400
GeneralPA	*r*-value	-.256*	0.064	0.006	-0.139	0.158	-0.027	-0.037	-0.056
	p-value	0.048	0.625	0.961	0.289	0.227	0.839	0.782	0.669
BasicNA	*r*-value	-0.005	-0.157	-0.178	0.001	0.047	0.051	-0.091	-0.121
	p-value	0.971	0.230	0.173	0.993	0.721	0.701	0.489	0.359
BasicPA	*r*-value	-0.133	-0.036	0.102	-0.002	.271*	0.067	-0.017	0.092
	p-value	0.312	0.784	0.436	0.990	0.036	0.609	0.900	0.486
Fear	*r*-value	-0.250	0.042	-0.127	-0.184	-0.004	-0.073	-0.182	-0.221
	p-value	0.054	0.750	0.333	0.160	0.978	0.580	0.165	0.089
Guilt	*r*-value	-0.216	0.048	0.166	0.019	0.025	0.107	0.057	0.078
	p-value	0.098	0.716	0.206	0.886	0.848	0.418	0.667	0.554
Hostility	*r*-value	-0.206	0.132	-0.095	-0.250	0.237	-0.163	0.029	-0.096
	p-value	0.115	0.314	0.469	0.054	0.068	0.214	0.826	0.464
Sadness	*r*-value	0.075	-0.030	-0.215	0.072	0.029	0.119	0.023	-0.046
	p-value	0.569	0.817	0.099	0.587	0.827	0.364	0.864	0.728
Attentiveness	*r*-value	-0.172	-0.232	-0.152	-0.117	0.051	-0.077	-.296*	-.257*
	p-value	0.190	0.075	0.246	0.375	0.699	0.559	0.022	0.047
Joviality	*r*-value	0.072	-0.179	-0.039	0.029	0.044	0.063	0.029	-0.002
	p-value	0.586	0.171	0.765	0.827	0.740	0.633	0.826	0.987
SelfAssurance	*r*-value	-0.185	0.057	0.004	-0.125	0.182	-0.166	-0.029	-0.046
	p-value	0.157	0.663	0.974	0.342	0.164	0.205	0.826	0.729
Fatigue	*r*-value	-0.169	-0.016	0.062	-0.199	0.113	-0.176	-0.059	-0.077
	p-value	0.197	0.904	0.638	0.128	0.389	0.180	0.655	0.559
Serenity	*r*-value	0.068	-0.118	-0.198	0.117	-0.039	0.064	0.038	-0.064
	p-value	0.604	0.369	0.129	0.375	0.769	0.625	0.773	0.626
Shyness	*r*-value	-0.183	-0.053	-0.128	-0.104	-0.115	-0.122	-.254*	-0.252
	p-value	0.161	0.688	0.329	0.429	0.384	0.354	0.050	0.052
Surprise	*r*-value	0.145	0.020	0.154	0.225	0.058	.287*	0.121	.262*
	p-value	0.270	0.879	0.241	0.084	0.661	0.026	0.358	0.043

*Table 17: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 4 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 4							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.066	0.141	0.023	-0.048	0.081	0.107	0.227	0.132
	p-value	0.615	0.283	0.860	0.718	0.537	0.414	0.081	0.315
Conscientiousness	*r*-value	-0.012	-0.028	0.043	0.057	0.151	0.104	0.129	0.081
	p-value	0.925	0.834	0.742	0.665	0.250	0.429	0.327	0.538
Extraversion	*r*-value	0.161	0.048	0.030	0.080	0.170	-0.005	0.214	0.132
	p-value	0.218	0.717	0.818	0.545	0.193	0.971	0.101	0.314
Neuroticism	*r*-value	0.117	-0.021	-0.012	0.044	-0.121	0.198	-0.208	0.018
	p-value	0.371	0.875	0.930	0.740	0.356	0.130	0.111	0.894
Openness to experience	*r*-value	0.046	0.102	0.064	-0.078	-0.025	0.079	0.104	0.074
	p-value	0.725	0.436	0.629	0.556	0.850	0.551	0.430	0.572
Affect Intensity Measure	*r*-value	.265*	0.007	0.177	0.113	0.219	.309*	0.002	0.238
	p-value	0.041	0.959	0.177	0.390	0.092	0.016	0.990	0.067
Satisfaction with Life Scale	*r*-value	-0.013	0.032	0.165	-0.041	-0.210	0.104	-0.047	0.011
	p-value	0.920	0.806	0.207	0.758	0.107	0.428	0.723	0.935
GeneralNA	*r*-value	-0.099	-0.103	0.076	-0.006	0.069	-0.087	0.060	-0.035
	p-value	0.452	0.434	0.564	0.963	0.603	0.511	0.648	0.791
GeneralPA	*r*-value	-0.042	-0.005	0.158	-0.102	-0.251	0.081	-0.083	-0.034
	p-value	0.748	0.972	0.229	0.436	0.053	0.541	0.531	0.797
BasicNA	*r*-value	-0.073	-0.056	0.040	-0.029	0.074	-0.090	0.075	-0.023
	p-value	0.581	0.670	0.759	0.826	0.572	0.492	0.570	0.861
BasicPA	*r*-value	0.094	0.089	.261*	0.007	-0.149	0.137	0.007	0.106
	p-value	0.476	0.499	0.044	0.960	0.254	0.297	0.955	0.421
Fear	*r*-value	-0.101	-0.134	0.045	-0.140	-0.250	-0.020	-0.080	-0.136
	p-value	0.443	0.307	0.731	0.286	0.054	0.879	0.544	0.300
Guilt	*r*-value	0.038	0.160	0.135	-0.066	-0.121	0.174	-0.068	0.083
	p-value	0.770	0.222	0.304	0.617	0.356	0.184	0.606	0.529
Hostility	*r*-value	-0.138	-0.105	0.090	-0.109	-.265*	-0.015	-0.108	-0.130
	p-value	0.295	0.425	0.496	0.407	0.041	0.911	0.413	0.322
Sadness	*r*-value	0.081	0.057	0.008	0.031	0.167	-0.024	0.184	0.096
	p-value	0.540	0.668	0.952	0.814	0.202	0.854	0.160	0.466
Attentiveness	*r*-value	-.282*	-0.188	0.023	-0.172	-0.152	-0.163	-0.168	-0.229
	p-value	0.029	0.149	0.864	0.188	0.246	0.215	0.200	0.078
Joviality	*r*-value	-0.024	-0.046	0.092	0.066	0.154	-0.056	0.147	0.048
	p-value	0.853	0.728	0.486	0.617	0.239	0.672	0.261	0.717
SelfAssurance	*r*-value	-0.062	0.096	0.032	-0.005	-0.152	0.054	-0.112	-0.017
	p-value	0.641	0.465	0.807	0.971	0.247	0.680	0.394	0.898
Fatigue	*r*-value	-.320*	-0.048	-0.078	-0.246	-.320*	-0.044	-.264*	-0.248
	p-value	0.013	0.714	0.553	0.058	0.013	0.740	0.042	0.056
Serenity	*r*-value	-0.118	0.013	0.033	-0.015	0.157	0.057	0.022	0.032
	p-value	0.370	0.923	0.803	0.909	0.231	0.666	0.869	0.809
Shyness	*r*-value	-.321*	-0.243	-0.156	-.256*	-.316*	-0.248	-0.143	-.353**
	p-value	0.012	0.061	0.233	0.048	0.014	0.056	0.276	0.006
Surprise	*r*-value	0.124	0.148	-0.058	0.063	0.079	0.174	.265*	0.163
	p-value	0.346	0.260	0.659	0.633	0.548	0.184	0.041	0.214

*Table 18: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 5 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 5							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.172	0.045	-0.012	0.007	0.032	0.100	0.127	0.109
	p-value	0.190	0.733	0.929	0.958	0.810	0.447	0.335	0.408
Conscientiousness	*r*-value	0.049	-0.009	0.004	-0.064	0.084	0.020	-0.001	0.028
	p-value	0.711	0.947	0.976	0.628	0.522	0.881	0.997	0.831
Extraversion	*r*-value	-0.066	-0.027	0.030	0.054	0.163	0.043	0.032	0.038
	p-value	0.618	0.839	0.822	0.682	0.214	0.744	0.809	0.773
Neuroticism	*r*-value	0.141	0.083	0.029	0.094	0.060	0.133	-0.069	0.113
	p-value	0.283	0.530	0.829	0.473	0.651	0.310	0.602	0.391
Openness to experience	*r*-value	0.011	0.027	-0.068	-0.102	-0.003	-0.103	0.008	-0.037
	p-value	0.932	0.841	0.607	0.438	0.980	0.433	0.952	0.779
Affect Intensity Measure	*r*-value	0.188	-0.017	0.159	0.106	.290*	0.207	0.000	0.203
	p-value	0.150	0.895	0.225	0.420	0.025	0.113	0.997	0.121
Satisfaction with Life Scale	*r*-value	-0.081	0.148	0.142	0.112	-0.105	0.040	0.034	0.054
	p-value	0.537	0.259	0.279	0.396	0.423	0.764	0.794	0.685
GeneralNA	*r*-value	-0.130	-0.079	-0.001	0.001	-0.006	-0.117	-0.089	-0.102
	p-value	0.323	0.550	0.995	0.995	0.961	0.371	0.497	0.439
GeneralPA	*r*-value	-0.087	0.134	0.084	0.086	-0.097	0.034	0.014	0.031
	p-value	0.506	0.308	0.523	0.516	0.460	0.795	0.914	0.815
BasicNA	*r*-value	-0.111	-0.035	-0.066	0.005	-0.020	-0.145	-0.023	-0.095
	p-value	0.397	0.789	0.617	0.968	0.879	0.269	0.861	0.469
BasicPA	*r*-value	-0.005	0.186	0.179	0.133	-0.071	0.086	-0.020	0.105
	p-value	0.971	0.154	0.172	0.310	0.591	0.514	0.877	0.423
Fear	*r*-value	-0.211	-0.008	-0.011	0.066	-0.068	0.026	-0.045	-0.071
	p-value	0.105	0.951	0.931	0.619	0.608	0.844	0.732	0.591
Guilt	*r*-value	0.034	.270*	0.145	0.037	-0.126	0.072	0.111	0.129
	p-value	0.794	0.037	0.268	0.777	0.337	0.584	0.398	0.326
Hostility	*r*-value	-0.081	0.001	-0.018	0.049	-0.046	-0.060	-0.004	-0.045
	p-value	0.538	0.996	0.890	0.709	0.728	0.647	0.977	0.732
Sadness	*r*-value	0.027	-0.005	-0.101	0.069	0.053	-0.092	0.072	-0.005
	p-value	0.836	0.967	0.445	0.600	0.686	0.484	0.585	0.969
Attentiveness	*r*-value	-.384**	-0.071	-0.063	-0.114	-0.186	-0.154	-0.186	-.257*
	p-value	0.002	0.592	0.631	0.386	0.154	0.240	0.156	0.048
Joviality	*r*-value	0.063	-0.019	0.029	0.043	0.076	-0.132	0.034	0.013
	p-value	0.633	0.883	0.827	0.742	0.564	0.313	0.797	0.924
SelfAssurance	*r*-value	-0.095	0.147	0.054	0.064	-0.001	0.034	-0.019	0.041
	p-value	0.470	0.263	0.681	0.625	0.994	0.794	0.888	0.754
Fatigue	*r*-value	-0.170	-0.060	0.039	-0.086	-0.144	-0.141	-0.136	-0.153
	p-value	0.193	0.649	0.769	0.515	0.271	0.281	0.300	0.244
Serenity	*r*-value	-0.131	-0.124	-0.160	-0.017	0.120	-0.011	-0.087	-0.095
	p-value	0.318	0.346	0.221	0.895	0.360	0.934	0.507	0.471
Shyness	*r*-value	-0.247	-0.071	-0.202	-0.177	-0.232	-.308*	-0.178	-.300*
	p-value	0.057	0.590	0.122	0.176	0.074	0.017	0.175	0.020
Surprise	*r*-value	0.021	-0.009	-0.125	0.116	0.211	-0.042	0.112	0.047
	p-value	0.876	0.948	0.341	0.379	0.105	0.753	0.392	0.724

*Table 19: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 6 (full utterance) and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 6							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	-0.014	0.057	0.201	-0.053	0.133	.310*	0.080	0.160
	p-value	0.915	0.667	0.124	0.689	0.313	0.016	0.545	0.223
Conscientiousness	*r*-value	0.107	0.006	0.007	0.037	0.197	.274*	0.093	0.149
	p-value	0.415	0.962	0.957	0.781	0.132	0.034	0.480	0.257
Extraversion	*r*-value	0.046	-0.025	0.147	0.197	0.165	0.053	0.129	0.120
	p-value	0.727	0.848	0.262	0.131	0.207	0.687	0.326	0.359
Neuroticism	*r*-value	0.162	0.104	0.081	0.082	0.047	0.068	-0.092	0.110
	p-value	0.217	0.429	0.539	0.532	0.724	0.605	0.485	0.402
Openness to experience	*r*-value	0.002	0.152	0.051	0.058	0.056	-0.132	.274*	0.084
	p-value	0.987	0.247	0.701	0.658	0.670	0.314	0.034	0.525
Affect Intensity Measure	*r*-value	0.163	0.094	0.247	0.204	.278*	0.213	0.098	.263*
	p-value	0.212	0.473	0.057	0.118	0.031	0.103	0.456	0.043
Satisfaction with Life Scale	*r*-value	-0.146	0.083	0.079	-0.021	-0.191	-0.078	-0.023	-0.053
	p-value	0.265	0.529	0.546	0.875	0.144	0.551	0.862	0.686
GeneralNA	*r*-value	-0.181	-0.171	-0.046	-0.024	0.040	-0.115	-0.079	-0.140
	p-value	0.166	0.193	0.728	0.858	0.764	0.381	0.547	0.286
GeneralPA	*r*-value	-0.173	0.005	0.043	-0.123	-0.213	-0.094	-0.125	-0.127
	p-value	0.185	0.970	0.747	0.347	0.102	0.476	0.340	0.335
BasicNA	*r*-value	-0.234	-0.156	-0.136	-0.001	0.005	-0.116	-0.039	-0.166
	p-value	0.073	0.234	0.299	0.995	0.969	0.376	0.766	0.206
BasicPA	*r*-value	-0.057	0.095	0.159	0.097	-0.135	-0.045	-0.061	0.016
	p-value	0.663	0.470	0.225	0.462	0.305	0.731	0.645	0.903
Fear	*r*-value	-0.186	-0.061	-0.079	-0.163	-0.188	-0.143	-0.113	-0.185
	p-value	0.156	0.644	0.550	0.214	0.150	0.277	0.390	0.156
Guilt	*r*-value	-0.144	0.131	0.175	-0.158	-0.222	-0.038	-0.077	-0.038
	p-value	0.271	0.317	0.181	0.229	0.088	0.772	0.557	0.771
Hostility	*r*-value	-0.150	-0.126	-0.089	-0.132	-0.130	-0.066	-0.140	-0.170
	p-value	0.254	0.338	0.501	0.314	0.322	0.615	0.288	0.194
Sadness	*r*-value	-0.119	-0.117	-0.088	0.059	0.071	-0.074	0.028	-0.076
	p-value	0.367	0.374	0.503	0.655	0.592	0.575	0.832	0.562
Attentiveness	*r*-value	-.405**	-0.212	-0.216	-0.227	-0.198	-0.178	-0.210	-.346**
	p-value	0.001	0.103	0.097	0.082	0.129	0.173	0.107	0.007
Joviality	*r*-value	-0.069	-0.056	-0.034	0.179	0.144	-0.039	0.085	0.011
	p-value	0.600	0.673	0.796	0.170	0.271	0.767	0.521	0.936
SelfAssurance	*r*-value	-0.148	-0.015	-0.033	-0.085	-0.104	-0.046	-0.123	-0.106
	p-value	0.258	0.910	0.801	0.517	0.427	0.726	0.350	0.420
Fatigue	*r*-value	-0.249	-0.065	-0.093	-0.208	-.283*	-0.124	-.292*	-0.249
	p-value	0.055	0.622	0.481	0.111	0.029	0.344	0.023	0.055
Serenity	*r*-value	-0.213	-0.119	-0.081	-0.073	0.083	-0.064	0.052	-0.106
	p-value	0.102	0.364	0.537	0.581	0.528	0.627	0.693	0.419
Shyness	*r*-value	-.410**	-0.218	-.295*	-0.198	-.319*	-.326*	-0.241	-.424**
	p-value	0.001	0.095	0.022	0.130	0.013	0.011	0.064	0.001
Surprise	*r*-value	0.095	0.029	0.135	0.155	0.220	0.227	0.080	0.186
	p-value	0.470	0.826	0.305	0.237	0.091	0.081	0.545	0.155

Visual inspection of the data suggests that the clearest trend that is evident across all gates, with the exception of Gate 4, is the negative relationship between attentiveness and emotion recognition overall. Thus, it seems reasonable to assume that individuals scoring high on attentiveness also tend to be quicker at recognising vocal emotions. A somewhat weaker trend evident at Gate 1, Gate 3 and Gate 6 is the positive relationship between AIM and overall emotion recognition, in which individuals scoring high on affect intensity tend to be slower at recognising vocal emotions. No other clear trends between speed of recognition and individual difference variables appeared, as other correlations across gates fail to consistently show the same pattern.

<u>*3B.1.2. Accuracy analysis by identification point (in ms)*</u>

The emotion identification point (EIP) was calculated for each emotion category to establish how much acoustical information that is needed for the listener to successfully identify the intended emotion category. For each participant, EIP was first calculated for each vocal stimulus and then averaged across each emotion category (see Jiang et al., 2015 for a similar calculation procedure). Further, EIP was averaged for each emotion category across participants. These data are presented in *Table 20*.

Table 20: Identification point in seconds and SD for each emotion category and average identification point across all emotions.

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Identification point (ms)	0.89	1.57	1.19	1.30	0.89	1.01	1.06	1.13
SD	0.22	0.28	0.26	0.22	0.25	0.22	0.28	0.14

As evident from *Table 20,* the amount of acoustical information required identifying the intended emotion varied between the distinct emotion categories. While anger and neutral are the emotion categories that were recognised quickest, i.e. required less acoustical information before they were accurately recognised, disgust and happy are the emotion categories that were identified most slowly.

3B.1.2.1. Analysis of Variance (ANOVA)

A one-way ANOVA was conducted to examine whether emotion identification point (EIP) differed for emotion categories, and significance level was adjusted to .017 to correct for multiple comparisons (Keppel, 1991). A significant main effect was found for EIP, $F(6,354)=76.697$, $p<.001$. *Post hoc* comparisons revealed that all EIPs were significantly different from each other for all emotion categories, except for contrasts between anger and sadness, and pleasant surprise and sadness. *Table 20* lists EIPs for each emotion. It is evident that anger and neutral are the emotion categories that are recognised quickest, while disgust is the emotion category that is recognised slowest.

3B.1.2.2. Correlational analysis

Pearson's correlations were used to examine the relationship between EIPs and individual difference variables. *Table 21* lists the correlations between EIPs and BFI, AIM, and SWLS, while *Table 22* lists the correlations between EIP and PANAS-X. No clear trends appeared between EIPs and any of the individual difference measures. The only variable that was positively associated with overall EIP was surprise, in which individuals scoring high on surprise tends to be slower at identifying vocal emotions in general, $r=.259$, $p=.046$. However, the relationship between individual differences and EIPs for individual emotions was evident. For example, indicating that neurotic individuals tend to be quicker at recognising angry emotions expressed vocally, $r=-.260$, $p=.045$, while individuals scoring high on affect intensity (AIM) tends to be quicker at identifying sad utterances, $r=-.343$, $p=.007$. Further, fear utterances tend to be quicker recognised by individuals scoring high on basic negative emotions, r=-.262, p=.043, fear, r=-.255, p=.049, and guilt, r=-.273, p=.035.

*Table 21: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between identification point in ms and individual difference variables.*

		IDENTIFICATION POINT (MS) FOR EACH EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
Agreeableness	*r*-value	-0.005	-0.071	0.220	0.147	-0.057	-0.097	-0.133	-0.005	0.010	-0.002	0.032
	p-value	0.968	0.589	0.091	0.264	0.667	0.460	0.312	0.968	0.941	0.988	0.809
Conscientiousness	*r*-value	0.100	0.018	0.085	0.026	0.041	0.003	-0.204	0.009	-0.001	-0.010	0.019
	p-value	0.446	0.894	0.519	0.845	0.757	0.980	0.118	0.944	0.994	0.941	0.885
Extraversion	*r*-value	0.025	-0.068	-0.012	-0.120	-0.112	0.023	-0.019	-0.070	-0.047	-0.030	-0.064
	p-value	0.849	0.607	0.929	0.361	0.392	0.864	0.885	0.594	0.723	0.822	0.627
Neuroticism	*r*-value	-.260*	-0.031	0.001	-0.102	-0.106	0.011	-0.193	-0.164	-0.153	-0.164	-0.060
	p-value	0.045	0.816	0.994	0.437	0.422	0.935	0.139	0.209	0.244	0.210	0.649
Openness to experience	*r*-value	0.132	0.003	-0.009	0.221	-0.103	0.136	0.171	0.125	0.166	0.103	0.235
	p-value	0.316	0.985	0.945	0.090	0.432	0.300	0.191	0.343	0.204	0.435	0.070
Affect Intensity Measure	*r*-value	-0.242	-0.075	-0.006	-0.032	-0.107	-0.016	-.343**	-0.207	-0.199	-0.235	-0.032
	p-value	0.062	0.570	0.962	0.805	0.417	0.905	0.007	0.113	0.127	0.071	0.810
Satisfaction with Life Scale	*r*-value	0.021	-0.140	0.141	-0.080	0.073	-0.125	-0.139	-0.062	-0.089	-0.051	-0.136
	p-value	0.876	0.286	0.283	0.541	0.578	0.341	0.290	0.637	0.499	0.701	0.302

Note: Individual difference variables are BFI, AIM, and SWLS. Abbreviations are identical to Table 4.

*Table 22 (on following page): Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between identification point in ms and PANAS-X. Abbreviations are identical to Table 4 and Table 5.*

		IDENTIFICATION POINT (MS) FOR EACH EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
General NA	*r*-value	-0.228	-0.007	-0.225	0.008	0.066	0.043	0.044	-0.070	-0.096	-0.135	0.034
	p-value	0.079	0.956	0.084	0.954	0.618	0.744	0.736	0.594	0.467	0.304	0.799
General PA	*r*-value	0.222	0.120	-0.058	0.091	0.085	0.186	0.206	0.204	0.202	0.172	0.183
	p-value	0.089	0.362	0.662	0.491	0.520	0.155	0.115	0.118	0.121	0.190	0.163
Basic NA	*r*-value	-0.203	0.031	-.262*	-0.027	-0.011	0.106	0.041	-0.078	-0.083	-0.127	0.052
	p-value	0.119	0.816	0.043	0.838	0.932	0.422	0.757	0.555	0.529	0.333	0.692
Basic PA	*r*-value	0.167	0.011	-0.126	0.027	0.156	0.087	0.136	0.109	0.077	0.063	0.075
	p-value	0.201	0.934	0.337	0.836	0.235	0.509	0.301	0.409	0.559	0.635	0.566
Fear	*r*-value	-0.251	-0.031	-.255*	-0.023	-0.031	0.086	-0.069	-0.142	-0.148	-0.204	0.042
	p-value	0.053	0.813	0.049	0.861	0.813	0.512	0.601	0.280	0.258	0.117	0.750
Hostility	*r*-value	-0.195	0.102	-0.171	-0.052	0.119	0.032	0.097	-0.006	-0.040	-0.044	-0.012
	p-value	0.135	0.439	0.190	0.696	0.364	0.807	0.463	0.963	0.763	0.737	0.925
Guilt	*r*-value	-0.210	-0.096	-.273*	-0.032	-0.076	0.120	-0.010	-0.145	-0.139	-0.201	0.058
	p-value	0.108	0.468	0.035	0.809	0.564	0.361	0.941	0.269	0.288	0.124	0.657
Sadness	*r*-value	-0.014	0.107	-0.149	0.019	-0.054	0.100	0.090	0.025	0.043	0.019	0.079
	p-value	0.913	0.415	0.255	0.885	0.685	0.448	0.494	0.847	0.745	0.888	0.551
Joviality	*r*-value	0.047	-0.090	-0.038	-0.051	0.083	-0.082	-0.001	-0.032	-0.059	-0.034	-0.088
	p-value	0.719	0.495	0.771	0.696	0.530	0.532	0.997	0.807	0.657	0.798	0.502
Self Assurance	*r*-value	0.231	0.090	-0.231	0.001	.289*	.293*	.265*	0.225	0.169	0.124	0.195
	p-value	0.075	0.496	0.075	0.994	0.025	0.023	0.041	0.084	0.197	0.344	0.136
Attentiveness	*r*-value	0.185	0.075	-0.064	0.174	0.017	0.060	0.119	0.132	0.141	0.108	0.154
	p-value	0.156	0.570	0.626	0.184	0.895	0.648	0.365	0.314	0.281	0.411	0.240
Shyness	*r*-value	-0.039	-0.024	-0.189	-0.044	-0.112	0.168	0.043	-0.053	-0.028	-0.071	0.082
	p-value	0.766	0.856	0.148	0.736	0.395	0.199	0.745	0.688	0.834	0.588	0.532
Fatigue	*r*-value	-0.010	0.149	-0.108	0.065	0.014	0.070	0.180	0.093	0.099	0.084	0.089
	p-value	0.942	0.257	0.413	0.622	0.917	0.593	0.170	0.478	0.450	0.521	0.497
Serenity	*r*-value	.326*	0.056	0.062	-0.038	-0.028	0.228	0.002	0.138	0.160	0.144	0.126
	p-value	0.011	0.672	0.638	0.773	0.831	0.079	0.989	0.294	0.222	0.273	0.337
Surprise	*r*-value	0.032	0.146	0.063	0.200	.286*	-0.035	.326*	.259*	0.207	0.211	0.108
	p-value	0.810	0.265	0.634	0.125	0.027	0.788	0.011	0.046	0.112	0.106	0.412

3B.1.3. Confidence ratings

Confidence ratings (on a 1-7 point scale) and SD were calculated for each emotion category at each gate interval. Further, confidence scores and SD were then calculated for each emotion category across gates and for each gate across emotions. These data are presented in *Table 23.*

Table 23: Average confidence score and SD at each gate interval

	CONFIDENCE RATINGS						
Expression	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6	Average
Anger	5.18	5.62	5.77	5.90	6.04	6.19	5.78
SD	0.85	0.84	0.84	0.84	0.81	0.79	0.83
Disgust	4.70	4.84	4.96	5.09	5.17	5.56	5.06
SD	0.83	0.93	0.83	0.86	0.91	0.89	0.87
Fear	4.99	5.01	4.95	5.05	5.12	5.08	5.03
SD	0.80	0.84	0.89	0.83	0.84	0.82	0.84
Happy	4.69	4.83	4.80	4.83	4.88	5.17	4.86
SD	0.83	0.84	0.84	0.79	0.71	0.81	0.80
Neutral	4.85	5.04	5.08	5.16	5.21	5.34	5.11
SD	0.86	0.87	0.96	0.92	1.01	1.00	0.94
Pls.sur	4.97	5.12	5.17	5.15	5.24	5.50	5.19
SD	0.87	0.85	0.88	0.85	0.84	0.89	0.87
Sad	5.32	5.20	5.27	5.26	5.46	5.72	5.37
SD	0.81	0.85	0.78	0.77	0.82	0.79	0.80
Average	4.96	5.09	5.15	5.21	5.30	5.51	

As can be seen in *Table 23*, anger is the emotion category that achieved the highest confidence score overall, followed by sadness. The lowest confidence ratings are given for happy utterances. At Gate 1, sad and anger receives the highest confidence ratings while the lowest confidence ratings are given to happy and disgust utterances. Further, anger, disgust, and sad achieves the highest confidence score at Gate 6, while fear and happy receives the lowest confidence ratings. These patterns of confidence ratings are comparable to accuracy scores, indicating that confidence judgments given by listeners are related to their actual vocal emotion recognition ability.

3B.1.3.1. Correlational analysis

Pearson's correlations were conducted to examine the relationship between average confidence ratings at each gate and individual difference variables. *Table 24* lists the correlations between confidence ratings at each gate and BFI, AIM, SWLS, and PANAS-X. As can be seen from the table, no significant correlations were obtained.

*Table 24: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between confidence ratings at each gate interval and individual difference variables (BFI, AIM, SWLS, and PANAS-X). It also shows the average confidence score across all gates. Abbreviations are identical to Table 4 and Table 5.*

		AVERAGE CONFIDENCE RATINGS AT EACH GATE INTERVAL						
Measure		Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6	Average
Agreeableness	*r*-value	0.106	-0.017	-0.007	0.021	0.019	-0.063	0.011
	p-value	0.421	0.900	0.956	0.874	0.888	0.633	0.936
Conscientiousness	*r*-value	0.161	0.139	0.052	0.102	0.061	0.073	0.107
	p-value	0.218	0.291	0.695	0.437	0.641	0.582	0.416
Extraversion	*r*-value	0.179	0.161	0.088	0.107	0.021	0.120	0.123
	p-value	0.171	0.219	0.502	0.414	0.873	0.361	0.348
Neuroticism	*r*-value	-0.031	0.008	0.037	0.037	0.111	0.051	0.038
	p-value	0.814	0.949	0.779	0.778	0.399	0.697	0.771
Openness to Experience	*r*-value	-0.042	-0.009	-0.081	-0.040	0.022	0.061	-0.016
	p-value	0.751	0.945	0.541	0.763	0.869	0.643	0.905
Affect Intensity Measure	*r*-value	0.233	0.139	0.099	0.154	0.216	0.217	0.192
	p-value	0.073	0.289	0.453	0.240	0.098	0.096	0.142
Satisfaction with Life Scale	*r*-value	0.146	0.054	0.010	0.019	-0.088	-0.107	0.007
	p-value	0.266	0.680	0.941	0.883	0.504	0.414	0.960
General NA	*r*-value	0.015	0.071	0.110	0.158	0.178	0.125	0.118
	p-value	0.912	0.592	0.401	0.229	0.174	0.340	0.369
General PA	*r*-value	0.210	0.145	0.037	0.097	-0.005	0.097	0.106
	p-value	0.107	0.267	0.782	0.462	0.969	0.462	0.421
Basic NA	*r*-value	0.036	0.079	0.123	0.136	0.141	0.109	0.113
	p-value	0.786	0.548	0.349	0.299	0.281	0.408	0.392
Basic PA	*r*-value	0.185	0.157	0.106	0.162	0.033	0.116	0.138
	p-value	0.157	0.231	0.422	0.215	0.800	0.376	0.293
Fear	*r*-value	0.117	0.121	0.165	0.185	0.171	0.181	0.170
	p-value	0.373	0.357	0.208	0.157	0.190	0.167	0.194
Hostility	*r*-value	-0.077	0.000	0.100	0.153	0.171	0.117	0.083
	p-value	0.561	0.998	0.446	0.242	0.191	0.375	0.528
Guilt	*r*-value	0.046	0.016	0.024	-0.007	0.003	0.006	0.016
	p-value	0.730	0.901	0.856	0.956	0.979	0.963	0.903
Sadness	*r*-value	0.046	0.124	0.114	0.116	0.114	0.061	0.104
	p-value	0.725	0.346	0.384	0.377	0.386	0.646	0.429
Joviality	*r*-value	0.121	0.100	0.090	0.144	0.025	0.092	0.104
	p-value	0.358	0.448	0.493	0.271	0.851	0.484	0.431
Self Assurance	*r*-value	0.158	0.177	0.118	0.158	0.039	0.087	0.134
	p-value	0.227	0.175	0.368	0.229	0.770	0.507	0.308
Attentiveness	*r*-value	0.211	0.130	0.051	0.098	0.021	0.121	0.115
	p-value	0.105	0.320	0.700	0.454	0.874	0.357	0.380
Shyness	*r*-value	0.029	0.014	0.016	0.011	0.013	-0.036	0.008
	p-value	0.826	0.914	0.902	0.933	0.923	0.782	0.949
Fatigue	*r*-value	-0.141	-0.026	-0.047	-0.052	-0.069	-0.065	-0.073
	p-value	0.281	0.844	0.721	0.694	0.601	0.622	0.581
Serenity	*r*-value	0.199	0.129	0.069	0.100	0.051	0.052	0.109
	p-value	0.128	0.328	0.601	0.446	0.698	0.691	0.407
Surprise	*r*-value	-0.143	-0.101	-0.101	-0.109	-0.158	-0.059	-0.121
	p-value	0.276	0.443	0.442	0.407	0.229	0.656	0.356

Further, Pearson's correlations were also conducted to examine the relationship between average confidence ratings for each emotion category across gates and individual difference variables. *Table 25* lists correlations between confidence ratings for each emotion category across gates and BFI, AIM, and SWLS. A significant positive correlation was found between confidence ratings for angry utterances and AIM, r=.260, p=.045, indicating that individuals scoring high on affect intensity also tended to give high confidence ratings for angry utterances. *Table 26* lists correlations between confidence ratings for each emotion category across gates and PANAS-X. No significant correlations were obtained.

*Table 25: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between confidence ratings for each emotion and individual difference variables.*

		RECOGNITION OF EACH EMOTION ACROSS GATES										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
Agreeableness	*r*-value	0.015	0.049	0.004	-0.028	-0.082	0.040	0.078	0.011	0.029	0.040	0.006
	p-value	0.910	0.712	0.977	0.832	0.532	0.764	0.554	0.936	0.825	0.764	0.962
Conscientiousness	*r*-value	0.079	0.082	0.106	0.082	0.043	0.145	0.152	0.107	0.116	0.113	0.118
	p-value	0.546	0.535	0.420	0.534	0.746	0.270	0.247	0.416	0.377	0.391	0.369
Extraversion	*r*-value	0.084	0.121	0.030	0.139	0.178	0.137	0.089	0.123	0.108	0.088	0.143
	p-value	0.521	0.356	0.821	0.291	0.174	0.296	0.498	0.348	0.413	0.503	0.274
Neuroticism	*r*-value	0.091	0.002	0.051	0.020	-0.028	0.071	0.046	0.038	0.050	0.050	0.048
	p-value	0.489	0.990	0.699	0.877	0.834	0.588	0.726	0.771	0.703	0.702	0.716
Openness to Experience	*r*-value	-0.056	-0.017	-0.052	0.050	0.060	-0.025	-0.065	-0.016	-0.031	-0.051	0.013
	p-value	0.671	0.896	0.691	0.703	0.650	0.849	0.620	0.905	0.817	0.698	0.923
Affect Intensity Measure	*r*-value	.260*	0.165	0.163	0.064	0.149	0.210	0.210	0.192	0.194	0.214	0.143
	p-value	0.045	0.208	0.212	0.625	0.257	0.108	0.108	0.142	0.138	0.100	0.275
Satisfaction with Life Scale	*r*-value	0.065	0.023	-0.049	0.004	-0.050	0.058	0.001	0.007	0.018	0.011	0.032
	p-value	0.624	0.864	0.711	0.978	0.702	0.662	0.996	0.960	0.892	0.935	0.808

Note: The table lists correlations between average confidence ratings for each emotion category. The individual difference variables are BFI, AIM, and SWLS. Abbreviations are identical to Table 4.

*Table 26 (on following page): Correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between average confidence ratings and PANAS-X. Abbreviations are identical to Table 4 and Table 5.*

Measure		RECOGNITION OF EACH EMOTION ACROSS GATES										
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
General NA	*r*-value	0.142	0.124	0.166	0.071	0.018	0.097	0.146	0.118	0.134	0.142	0.113
	p-value	0.279	0.347	0.205	0.592	0.891	0.460	0.265	0.369	0.307	0.279	0.390
Positive PA	*r*-value	0.124	0.131	0.119	0.079	0.073	0.072	0.078	0.106	0.109	0.120	0.081
	p-value	0.345	0.318	0.364	0.550	0.581	0.584	0.556	0.421	0.408	0.360	0.537
Basic NA	*r*-value	0.126	0.112	0.172	0.075	0.036	0.087	0.118	0.113	0.124	0.133	0.100
	p-value	0.339	0.394	0.188	0.569	0.783	0.511	0.371	0.392	0.345	0.310	0.446
Basic PA	*r*-value	0.148	0.169	0.158	0.117	0.070	0.101	0.121	0.138	0.147	0.155	0.124
	p-value	0.258	0.197	0.228	0.375	0.593	0.444	0.357	0.293	0.264	0.237	0.347
Fear	*r*-value	0.194	0.175	0.203	0.138	0.071	0.135	0.177	0.170	0.184	0.190	0.164
	p-value	0.137	0.180	0.120	0.294	0.588	0.303	0.177	0.194	0.160	0.146	0.211
Hostility	*r*-value	0.092	0.064	0.120	0.065	0.032	0.038	0.128	0.083	0.090	0.084	0.100
	p-value	0.485	0.625	0.362	0.624	0.808	0.774	0.331	0.528	0.492	0.524	0.446
Guilt	*r*-value	0.117	0.022	0.048	-0.040	-0.043	0.011	-0.009	0.016	0.028	0.053	-0.025
	p-value	0.372	0.868	0.714	0.764	0.743	0.932	0.944	0.903	0.834	0.689	0.848
Sadness	*r*-value	0.018	0.111	0.189	0.089	0.062	0.103	0.094	0.104	0.109	0.113	0.095
	p-value	0.890	0.400	0.148	0.499	0.639	0.433	0.476	0.429	0.408	0.389	0.470
Joviality	*r*-value	0.161	0.123	0.115	0.047	0.022	0.104	0.093	0.104	0.116	0.135	0.073
	p-value	0.218	0.350	0.381	0.723	0.869	0.427	0.480	0.431	0.376	0.302	0.580
Self Assurance	*r*-value	0.059	0.190	0.174	0.182	0.070	0.058	0.129	0.134	0.142	0.130	0.161
	p-value	0.656	0.146	0.184	0.165	0.594	0.662	0.327	0.308	0.280	0.323	0.219
Attentiveness	*r*-value	0.146	0.115	0.112	0.081	0.108	0.086	0.084	0.115	0.113	0.123	0.086
	p-value	0.264	0.380	0.394	0.540	0.412	0.515	0.522	0.380	0.392	0.347	0.514
Shyness	*r*-value	-0.034	0.047	0.083	-0.005	-0.053	0.040	-0.020	0.008	0.021	0.037	-0.013
	p-value	0.794	0.719	0.531	0.969	0.690	0.763	0.878	0.949	0.876	0.781	0.920
Fatigue	*r*-value	-0.034	-0.043	-0.031	-0.046	-0.145	-0.108	-0.044	-0.073	-0.055	-0.058	-0.047
	p-value	0.796	0.743	0.817	0.725	0.267	0.413	0.741	0.581	0.675	0.658	0.723
Serenity	*r*-value	-0.021	0.188	0.095	0.123	0.114	0.131	0.058	0.109	0.104	0.107	0.094
	p-value	0.873	0.150	0.472	0.350	0.387	0.319	0.658	0.407	0.428	0.415	0.475
Surprise	*r*-value	-0.104	-0.024	-0.038	-0.110	-0.249	-0.149	-0.083	-0.121	-0.091	-0.084	-0.100
	p-value	0.427	0.859	0.775	0.403	0.055	0.256	0.529	0.356	0.490	0.521	0.446

3B.1.4. Personality styles

3B.1.4.1. Analysis of Variance (ANOVA)

Ten mixed-model ANOVAs were conducted to examine whether different personality styles could predict differences in the temporal processing of vocal emotions. Significance level was adjusted to correct for multiple comparisons (p=.017) (Keppel, 1991). Gate (Gate 1, Gate 2, Gate 3, Gate 4, Gate 5, and Gate 6) and Emotion (anger, disgust, fear, happy, neutral, pleasant surprise, and sad) were treated as within-subject variables for all ANOVAs while Personality Style (NC, AC, AE, AN, AO, CE, CO, EN, EO, NO) was used as a between-subject variable in each individual ANOVA. Calculation of personality styles was identical to the procedure employed in Study 1.

A significant main effect was found for Emotion for all ANOVAs, (F's> 89.291, p's< .001), indicating that all personality types could successfully distinguish between distinct emotion categories. A significant main effect of Gate was also found for all ANOVAs (F's> 58.487, p's<.001), indicating that recognition accuracy differs between gates for all personality styles explored. *Post hoc* comparisons revealed that, for all personality styles, recognition accuracy was significantly different at different gate intervals, with the exception of Gate 2 and Gate 3, and Gate 5 and Gate 6. Consistent with this finding, recognition accuracy increases incrementally for all gate intervals except from Gate 2 to Gate 3 (see *Table 12*). Also, Gate 5 and Gate 6 has the smallest recognition accuracy increment compared to other gate intervals.

Further, no main effect was found for any of the 10 Personality Styles (*F*'s> .032, *p*'s<.998) and all Gate by Personality Style interaction failed to reach significance (*F*'s>.450, *p*'s<.981). Neither was any of the Emotion by Personality Style interactions significant (*F*'s>.384, *p*'s<.997), and all Gate by Emotion by Personality Style three-way interactions were also not significant (*F*'s>.749, *p*'s<.979). All Gate by Emotion interactions were significant for all personality styles (*F*'s> 30.252, *p*'s<.001), but *post hoc* comparisons of simple main effects are not reported here as results obtained are comparable to those obtained in the Gate by Emotion interactions reported earlier (see section *3B.1.1.3.*).

4B. Discussion

The overall aim of Study 2 was to further examine whether inter-and intra-individual differences influence vocal emotion perception by examining the time course processing of vocal emotions. Similar to Study 1, group data results were consistent with the vocal emotion literature. Further, the findings obtained in Study 1, in which a positive relationship was found between general life satisfaction and recognition of positive emotions, and a negative relationship between overall emotion recognition and short-time fluctuations in serenity, were not replicated in the present study. However, other inter-individual variables, such as attentiveness and affect intensity, appear to influence the temporal processing of vocal emotions.

Time course processing of vocal emotions

Group analysis showed that, in general, recognition accuracy improved at successive gate intervals and, further, emotion-specific patterns of recognition was evident, in which the amount of acoustical information required to identify the intended emotion differed between distinct emotion categories. This is consistent with the previous literature (Cornew et al., 2010; Pell & Kotz, 2011, Rigoulot et al., 2013). Further, at both Gate 1 and Gate 6, anger and happy were the most accurately and most poorly recognised emotions, respectively. Again, this is comparable to past findings and findings from Study 1. More specifically, the present study found that less acoustic information is required to identify anger, fear, neutral, and sadness, compared to happy and disgust, which is exactly what Pell and Kotz (2011) and Rigoulot et al. (2013) found but here, different stimulus materials were used. Also, confidence ratings were congruent with accuracy rates, i.e. those emotions that were best recognised were also linked to higher confidence ratings, indicating that listeners are quite able to judge their own ability to decode emotions expressed vocally, similarly to previous findings.

Results from the present study are consistent with Pell and Kotz (2011) and Rigoulot et al. (2013), who argue for an emotional bias, in contrast to Cornew et al.'s (2010) findings, which suggested a neutral bias. However, in contrast to the present study, which identified anger as the most quickly recognised emotion category, both Pell and Kotz (2011) and Rigoulot et al. (2013) identified fear as the most accurately recognised emotion at the shortest gate interval. There are several plausible explanations for this. As mentioned, speaker variation may influence emotional portrayals, in which different speakers might differ in how much emphasis they place on salient acoustic features. In addition, inter-and intra-individual differences might also explain the discrepancy. However, importantly, quick detection of angry utterances is consistent with the biological significance hypothesis (Pell & Kotz, 2011). Both anger and fear signal a potential threat; a quick reaction time to threatening situations is highly important to make a quick and appropriate behavioural response (fight/flight mechanism).

An important observation that deserves attention is that emotion recognition seems to be somewhat problematic at Gate 3 (i.e. in the middle of an utterance), at least for some emotions. Specifically, for angry, neutral, and sad utterances recognition accuracy at Gate 3 actually decreased compared to Gate 2, which is reflected by the highest numbers of non-significant contrasts at Gate 3 when compared to other gate intervals. Interestingly, these emotions are the most accurately recognised emotion categories at Gate 1 and Gate 2. A closer examination of confusion error patterns actually shows that anger and neutral are most frequently confused with each other at Gate 1 and Gate 2, however, at Gate 3, both anger and neutral are most frequently confused with disgust. It is plausible that this confusion arises on an acoustical level, in which acoustical patterns for some emotions are more easily distinguished at early gate intervals compared to later gate intervals.

Perhaps acoustical ambiguity arises more easily when emotions that are generally identified quickly are presented in longer sentences or utterances. As mentioned, the present study and previous findings report that anger, sadness, and neutral require less acoustical information than happiness and disgust to be correctly identified. Studies analysing affect bursts rather than complete emotion utterances provide some support for this assumption. For example, Belin, Fillion-Bilodeau, and Gosselin (2008) report better recognition accuracy for negative affect bursts, including angry (78%) and sad (86%) bursts, compared to recognition rates for vocal emotions expressed in a sentence context, arguing that affect bursts are "a highly effective means of expressing vocal emotions" (Belin et al., 2008, p.535). Thus, when emotions that are naturally expressed with short bursts are presented in longer utterances it is likely that the acoustical patterns change at some point, which potentially influences perception judgments.

It is thus possible that, when speakers are asked to express emotions in complete sentences that are naturally expressed very well in short bursts, they emphasise the emotion category early on in the utterance, and then possibly again later in the utterance. It seems unlikely that the high pitch and high intensity level (Banse & Scherer, 1996) that defines the onset of angry utterances is maintained throughout a full utterance. Similarly, maintaining the low pitch and low intensity (Banse & Scherer, 1996) throughout longer sad utterances seems unlikely. Thus, at some point in the utterance, which is identified at Gate 3 in the present study, there is a change in the acoustical pattern that characterises these emotions, which confuses listeners' judgments. However, this cannot explain why neutral utterances are problematic at Gate 3. However, it should be emphasised that neutral is not an emotion category, but is rather included in vocal emotion research to function as a control condition. A possible explanation is that changes in the acoustical patterns of quickly identified emotions, such as anger and sad, regress towards the acoustical pattern of neutral emotions.

Emotion identification points

As discussed above, anger and neutral are recognised quickest while happiness and disgust are recognised slowest in the present study. In contrast, both Cornew et al. (2010) and Pell and Kotz (2011) found that fear obtained the lowest EIP. Reasons for this are discussed above. However, the actual EIPs reported across studies are quite similar; for angry utterances, 890 ms were needed to identify them correctly in the present study, 723 ms were reported to be needed in Cornew et al. (2010), and 710 ms reported in Pell and Kotz (2011). In contrast, average EIP for happy (1300 ms) and neutral sentences (890 ms) were somewhat higher for the present study, compared to Cornew et al. (2010) and Pell and Kotz (2011) (happy: 802 ms; neutral: 444 ms, and happy 977 ms; neutral: 510 ms, respectively). Again, speaker differences might influence these results. Similarly, sentence overall length (and thus the amount of syllables needed) can potentially impact on these patterns. Yet another possible reason why results somewhat differ is that all three studies differ in number of possible response alternatives; while Cornew et al. (2010) only examined three emotion categories, and Pell and Kotz (2011) only examined five emotion categories, the present study examined seven emotion categories. Arguably, when having more response options after stimuli offset, responses time take longer. This idea receives support by the fact that Cornew et al. (2010) had the shortest EIPs while the present study had the longest EIPs for both happy and neutral sentences.

The relationship between individual differences and time course processing of vocal emotions

Mood and temporal processing of vocal emotions

Again, similar to Study 1, there was no systematic relationship between positive and negative affect and vocal emotion processing. There is however a trend for attentive individuals to be quicker at recognising vocal emotions from short snippets (as reflected in significant correlations between accuracy and attentiveness at nearly all gate intervals). It could be argued that attentive individuals are quicker at recognising vocal emotions because they are better able to attend to and accurately process all cues presented. Surprisingly, attentiveness did, however, not correlate with the *overall* EIP, challenging the idea that attentive individuals are always quicker in recognising emotions. Thus, if attentiveness is indeed related to speed of vocal emotion recognition, future studies will have to replicate findings reported here. Further, the relationship between serenity and overall emotion recognition that was observed in Study 1 was not evident in the present study, questioning the reliability of the relationship between serenity and vocal emotion perception. Taken together, there is no clear evidence supporting the assumption that short-time fluctuations positive and negative affect can influence recognition accuracy and time course processing of vocal emotions, as predicted by the mood-congruency hypothesis.

Personality and temporal processing of vocal emotions

Similar to Study 1, both inter- and intra-individual differences in personality were examined in relation to vocal emotion processing. Again, there was no relationship evident between vocal emotion perception and between-person traits and within-person differences. More specifically, the present study failed to find any systematic relationship between overall recognition accuracy at gate intervals and personality traits. Neither did personality traits influence EIPs and confidence scores in a systematic manner. Similarly, personality styles, or intra-individual differences, did not predict differences in temporal processing of vocal emotions. This is consistent with results reported for accuracy in Study 1, suggesting that personality variables do not influence heavily on the temporal processing of vocal emotions. Again, this is inconsistent with predictions made by the trait-congruency hypothesis.

The influence of affect intensity and life satisfaction on the temporal processing of vocal emotions

Affect intensity does seem to influence the temporal processing of vocal emotions, in which individuals scoring high on affect intensity also tend to be slower at identifying vocal emotions overall. A positive relationship between affect intensity and overall emotion recognition was evident at Gate 1, Gate 3, and Gate 6. Further, affect intensity ratings were positively associated with slower recognition of some emotion categories at Gate 4 and Gate 5. As predicted, the influence of affect intensity is found irrespective of emotion valence, indicating that individuals scoring high on affect intensity tends to be slower at recognising both positive and negative vocal emotions. Further, general life satisfaction did not influence recognition accuracy at gate intervals, EIPs, or confidence ratings given for the utterance stimuli of different lengths. This is inconsistent with results found in Study 1, where a positive relationship between life satisfaction and perception of positive vocal emotions was observed. A possible reason for these inconsistencies might be differences in stimuli materials (semantically-anomalous vs. pseudo-utterances and trained vs. untrained speakers). Study 3 will explore this issue again, trying to shed some light on this inconsistency.

Rationale for Study 3

Results from Study 1 and Study 2 suggest that there are no systematic differences in either short-time mood fluctuations or personality variables that influence vocal emotion perception. This does not necessarily indicate that inter- and intra-individual differences do not influence vocal emotion perception, but rather suggests that the complexity of trait and mood combinations in each and every individual is so complex that a systematic pattern is unlikely to be observed, at least in the healthy population. However, recent advances in neuroimaging has allowed for investigations of brain activity in response to emotional stimuli, which might provide new insights into the relationship between vocal emotion processing and inter- and intra-individual difference variables. For example, behavioural studies do not allow looking at temporal unfolding of cognitive processing in a very specific manner.

However, as vocal emotion recognition is a multi-step process (Schirmer & Kotz, 2006), it is crucial to explore how vocal emotion processing unfolds online. Thus, Study 3 aims at exploring the *on-line* processing of vocal emotions, and to further examine whether inter-individual differences can influence the brain mechanisms underlying vocal emotion processing. Due to the fact that intra-individual differences in personality styles did not seem to influence vocal emotion processing in either Study 1 or Study 2, combined with relatively lower sample sizes generally employed in ERP research, intra-individual analysis will not be followed up in Study 3.

C. STUDY 3 –THE RELATIONSHIP BETWEEN VOCAL PROCESSING AND INDIVIDUAL DIFFERENCES – AN ERP ANALYSIS

1C. Introduction

People consciously produce and perceive emotions on a daily basis and these abilities will enable individuals to respond and interact appropriately. However, there are still some aspects of emotion processing that are out of reach for our conscious. Imagine coming home from the hospital with your newborn infant. During the next few days you experience that your baby has a spectrum of emotional expressions already; she cries when in need for food and she smiles to the sound of your voice. But how able are infants to perceive emotions before they even know what they are? Research has shown that only 2-day old infants can distinguish emotional expressions, and that they can even imitate facial emotion expressions that they perceive (Field, Woodson, Greenberg, and Cohen, 1982). The ability to produce and perceive emotions develops with experience (De Haan et al., 2004), suggesting that individual differences can influence emotion processing. The present study aims at exploring whether and how inter-individual differences can influence brain activity in response to vocal emotions.

ERP evidence of vocal emotion processing

There is a growing literature exploring how the brain processes vocal emotions. As discussed previously, ERP investigations are a useful tool to examine the temporal unfolding of vocal emotions (Paulmann et al., 2013) and research has focused on establishing *when* acoustical information is analysed and integrated

(Paulmann et al., 2011). Schirmer and Kotz (2006) suggested a three stage working model, in which vocal emotion processing is explained as a multi-step process consisting of several sub-processes, involving sensory, cognitive, and emotional processing systems. According to this model, sensory processing (Stage 1) of vocal emotions occurs within the first 100 ms after stimuli onset, in which differences in frequency or sound intensity can be identified. After 200 ms emotionally significant acoustic cues become integrated and distinct emotion categories can be successfully distinguished (Stage 2). Higher-order cognitive processes (Stage 3) finally process emotional information and cognitive judgments can be made regarding the emotional significance of the stimuli (Schirmer & Kotz, 2006).

In line with this model, several important ERP components have already been consistently identified as important correlates of vocal emotion processing (Kotz & Paulmann, 2007). For example, there is a general consensus that distinct vocal emotions can be successfully distinguished 200 ms after stimulus onset (i.e. Stage 2). This positive ERP effect is generally named the P200 component, and mean amplitudes tend to be especially pronounced at fronto-central electrode sites (Paulmann et al., 2013). The P200 is often followed by a longer lasting later component (i.e. Stage 3) such as the long lasting component (LLC), P300, N400, or late positive complex (P600). These later components are agued to reflect further integration of acoustical information and more elaborate processing of vocal cues (Paulmann et al., 2011). In contrast to the P200 component, mean amplitudes of these later components tend to be more broadly distributed across the scalp, often with more pronounced modulations at centro-parietal electrode sites (Paulmann et al., 2011). The P200 and later components thus provide valuable information about different processing stages of vocal emotion processing. In fact, it has been shown that processing of neutral and emotional stimuli differs at early and late stages (e.g., Paulmann & Kotz, 2008; Paulmann et al., 2011; 2013), which is consistent with the biological significance hypothesis discussed earlier. Thus, ERP research at a group level has begun to establish how vocal emotions unfold over time.

However, as for the vocal emotion literature in general, there is a lack of research on how inter-individual differences influence the implicit time course processing of vocal emotions (Brück et al., 2011). Some studies have however explored how gender can predict differences in implicit vocal emotion processing. For example, in an ERP investigation examining gender-specific Stroop effects, Schirmer and Kotz (2003) predicted that the integration process of emotional prosody and word valence would be influenced by gender. Interestingly, they did not find gender differences in word-prosody integration; however, results did imply that females are more influenced by prosody at an earlier processing stage than men. Thus, it seems like gender differences can explain some variation in vocal emotion processing. There is however an obvious need for systematic investigations of how inter-individual differences, such as personality and mood, can influence the temporal evolution of vocal emotions (Brück et al., 2011).

The influence of individual differences on vocal emotion processing – neuro-scientific evidence

The emotion literature in general has recently started to explore the relationship between individual differences and emotion processing. In a review by Hamann and Canli (2004), they outline several important individual difference variables that have been identified as potential modulating factors, including, sex differences and differences in genotype, and personality traits and dispositional affect. For example, in a fMRI study by Canli et al. (2002), they reported that extraverted individuals had a greater activation in the amygdala in response to happy facial expressions in contrast to fearful faces. In the vocal domain however, there are relatively few studies that have examined the influence of inter-individual differences. One exception is the fMRI study by Brück et al. (2011). In short, they examined how extraversion and neuroticism influenced processing of vocal emotions and concluded that while extraversion did not seem to have a modulating effect on vocal emotion processing, neuroticism did.

As discussed previously, only focusing on the neuroanatomical components underlying vocal emotion processing is limited, as it cannot reveal the temporal dynamics of vocal emotions (e.g. Paulmann et al., 2011). To my knowledge, the only study that has examined the relationship between inter-individual differences and ERPs in response to vocal emotions is the study by Pell et al. (2015). Results showed that, while all the Big Five personality dimensions were unrelated to both early (P200) and late (LPC) processing stages of vocal emotions, trait anxiety was associated with greater mean amplitudes at P200. However, this effect was not found at the LPC component. They concluded that highly anxious individuals have an enhanced sensitivity to vocal emotions at early processing stages. Finally, to my knowledge, it is yet unexplored whether short-time fluctuations in mood, affect intensity, and general life satisfaction modulate the temporal processing of vocal emotions. A comprehensive and systematic investigation of how inter-individual differences influences online, or implicit, time course processing of vocal emotions is thus badly needed.

Overall aim for Study 3

It is predicted that behavioural results should lead to a similar picture of vocal emotion perception as found in Study 1 since stimuli materials and design was identical. However, as the main focus of the present study is to examine whether inter-individual differences can predict differences in brain modulations in response to vocal emotions, a reasonable lower sample size was employed in the present study. This might influence findings, at least when correlating behavioural findings with individual difference variables. More importantly, and based on the vocal emotion processing model proposed by Schirmer and Kotz (2006) and previous findings in the ERP and vocal emotion literature, two ERP components will be of relevance. Firstly, when examining group data, the P200 component, which is known to reflect early salience detection, should be fronto-centrally distributed and show evidence of differences in brain modulation for distinct emotion categories. Further, if the biological significance hypothesis can be supported, neutral and emotional stimuli should differ in their mean amplitudes. Finally, it is expected that mean amplitudes at the LLC component, implicated in more elaborated processing of emotional meaning, should be more broadly distributed than mean amplitudes observed at P200 and should also differentiate amongst the different emotions.

With regard to the effect of individual differences, clear predictions are difficult to make based on the scarce literature. However, mood- and trait-congruency hypotheses are still of special interest and there has been some evidence supporting a trait-congruency link during emotion processing. For example, in the neuroimaging literature, there is evidence that extraversion can predict greater activation in amygdala in response to happy faces (Canli et al., 2002), while neuroticism has been shown to modulate vocal emotion processing (Brück et al. (2011). However, Pell et al. (2015) failed to find a relationship between the temporal processing of vocal emotions and neuroticism. If personality traits do not influence the online processing of vocal emotions in a systematic manner, then the present study should replicate findings reported by Pell et al. (2015). Similar to the literature on vocal emotions and inter-individual differences, it is far from clear how inter-individual differences influence brain modulations in response to vocal emotions.

2C. Methods

2C.1. Participants

Twenty-seven (15 females, mean age: 23.6, SD: 10.0) native English participants gave their written consent. They received either £10 for participation or credits as part of a module requirement. One participant was excluded, as nerve damage was reported together with difficulties in maintaining hearing and visual capacity for longer time periods. All other participants reported normal or corrected to normal hearing and vision.

2C.2. Stimulus materials

2C.2.1. Sentence stimuli

Sentence stimuli were identical to Study 1, taken from a previous inventory (Paulmann et al., in review).

2C.2.2. Questionnaire measures

The same questionnaires were used as in Study 1 and Study 2.

2C.3. Design

A cross-sectional design was used, in which the individual difference measures (BFI, PANAS-X, AIM, SWLS) used in Study 1 and Study 2 was used as predictor variables, while the criterion variable was emotion recognition accuracy (number of correct sentences identified) and ERPs in response to vocal emotions presented (mean amplitudes).

2C.4. Procedure

Participants were seated in a sound proof booth at a distance of approx. 90 cm from the computer. They were informed of the EEG procedure and prepared for EEG recording. Participants then received instructions regarding the experimental task and completed practice trials to ensure that they fully understood the task and that EEG recording was optimal. The experimental task was identical to Study 1, except that participants did not have to carry out an intensity rating task.

2C.4.1. EEG acquisition procedure

The EEG was recorded from 64 Ag-AgCl electrodes mounted on a custom-made cap. Signals were recorded continuously with a band pass between DC and 70 Hz and digitized at a sampling rate of 500 Hz (Xrefa amplifier). The reference electrode was placed on the left mastoid. Bipolar horizontal and vertical EOGs were recorded for artifact rejection purposes. Electrode resistance was kept below 5KΩ. Data was re-referenced offline to linked mastoids. The data was inspected visually in order to exclude trials containing extreme artifacts and drifts, and all trials containing EOG-artifacts above 30.00μV were rejected automatically. Trials were averaged over a time range of 200 ms before stimulus onset to 1000 ms after stimulus onset.

2C.4.2. Event-related potential recording procedure

For the ERP analysis, electrodes were grouped according to regions of interests. Left frontal electrode-sites (LF): F5, F3, FC5, FC3; left central sites (LC): C5, C3, CP5, CP3; left posterior sites (LP): P5, P3, PO7, PO3; midline (ML): Fz, Cz, CPz, Pz; right frontal sites (RF): F6, F4, FC6, FC4; right central sites (RC): C6, C4, CP6, CP4; and right posterior sites (RP): P6, P4, PO8, PO4. Based on visual inspection, peak amplitude measurements, and previous research (e.g. Paulmann et al., 2013), an early time window from 170 to 230 ms (P200) and a later time window from 450 to 750 ms (LLC) after stimulus onset were selected for analysis of mean amplitudes.

3C. Results

3C.1. Behavioural analyses

Similar to Studies 1 and 2, participants that reported suffering from mental disorders were excluded due to possible impairments in vocal emotion processing (e.g. Leppänen et al., 2004). Thus, three participants were excluded, leaving 24 participants for the final analyses. As only native speakers of English participated in the present study, no additional analyses were conducted to increase power. Furthermore, as the sample size is reasonably smaller in ERP studies and as the present study had a balanced male – female ratio, combined with the fact that Studies 1 and 2 did not find any gender influence on individual difference variables of special interest, no additional correlational analyses were performed for the female sample.

3C.1.1. Accuracy rates

Similarly as in Study 1, an average accuracy score was calculated for each emotion for each participant, and then averaged across participants. These data are presented in *Table 27*.

Table 27: Mean recognition accuracy in percentage and SD for each emotional category and emotion accuracy averaged across emotions (Pls.sur = pleasant surprise).

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Recognition accuracy	67.1	41.9	32.6	40.3	70.9	74.9	67.5	56.4
SD	0.12	0.19	0.16	0.15	0.15	0.10	0.17	0.08

Overall recognition score (56.4%) presented in *Table 27* is comparable to the overall recognition score obtained in Study 1 (55.8%, see *Table 1*), and thus similar to results obtained in the previous literature (e.g. Scherer, 1989). Again, pleasant surprise is the emotion category that obtained the highest recognition rate (74.9%), while fear is the emotion category that obtained the lowest recognition rate (32.6%). Thus, the pattern of recognition rates is similar to Paulmann et al. (in review), which used the same stimuli.

3C.1.1.1. Error patterns

Similar error patterns were obtained for Study 1 and Study 3. For each emotion category, the target emotion is most frequently correctly identified with the intended emotion. *Table 28* shows the confusion patterns obtained in the present study, which reveals that anger is most often confused with disgust while disgust is most frequntly confused with neutral. This pattern of error responding is similar to Study 1 (see *Table 2*). Further, fear is still confused most frequently with sad, and sad and neutral is often confused with each other, which is also consistent with results obtained in Study 1. Pleasant surprise is still confused with happy while happy is confused with neutral.

Table 28: Average recognition accuracy in percentage for each emotional category and confusion patterns of error responding.

	RESPONSE GIVEN						
Expression	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad
Anger	**67.1**	14.9	1.7	2.5	7.3	5.3	1.2
Disgust	4.9	**41.8**	1.8	8.9	19.5	17.0	6.1
Fear	5.7	3.4	**32.6**	6.8	12.6	12.3	26.6
Happy	1.7	1.2	1.4	**40.3**	38.0	16.1	1.2
Neutral	0.7	2.7	1.0	1.6	**70.9**	1.2	22.0
Sad	1.0	1.0	1.0	18.0	3.5	**75.0**	0.5
Pls.sur	1.4	4.7	4.1	0.8	21.2	0.4	**67.4**

3C.1.1.2. Unbiased hit rates

Unbiased hit rates (H_u scores) were again calculated and arcsine transformed from raw hit rates to control for response frequency (Wagner, 1993). The unbiased hit rates are presented in *Table 29*. The outlier labelling method was again employed on unbiased hit rates to detect outliers, but no outliers were identified.

Table 29: H_u scores and SD for each emotion and averaged across all emotion categories.

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Recognition accuracy	0.59	0.27	0.26	0.23	0.31	0.38	0.48	0.36
SD	0.15	0.17	0.15	0.12	0.08	0.11	0.15	0.10

Comparable to Study 1, pleasant surprise is no longer the most accurately recognised emotion when examining unbiased hit rates, as shown in *Table 29*. Rather, as in Study 1, anger is now the most accurately recognised emotion category when controlling for response frequency. Further, again similar to Study 1, happiness is now the least recognised emotion category. The average H_u score obtained (0.36) is comparable to average H_u score obtained in Study 1 (0.35, see *Table 3*) and in the previous literature (e.g. Pell et al., 2009a).

3C.1.1.3. Analysis of Variance (ANOVA)

To examine whether emotion categories could be correctly distinguished from each other, a one-way ANOVA was conducted with a p-level adjusted to .017 (Keppel, 1991). A significant main effect was found for Emotion, $F(6,132)=37.815$, $p<.001$. *Post hoc* comparisons showed that accuracy rates for all emotion categories were significantly different, except the contrasts disgust vs. fear, disgust vs. happy, disgust vs. neutral, fear vs. happy, fear vs. neutral. As evident from *Table 29*, anger is the emotion category that is most accurately recognised while happiness is the poorest recognised emotion.

3C.1.1.4. Individual difference variables

Similarly to Studies 1 and 2, means and SDs for all individual difference variables were compared against findings reported previously in the literature. These comparisons are listed in *Table 30*. Note that, since the mean age of the present sample was 23.6, previous findings on BFI variables were retrieved for the year-group aged 24 (Srivastava et al., 2003). Again it is evident that present results on fluctuations in individual difference variables are comparable to previous findings.

Table 30: Means and SDs from the present study for each variable in each questionnaire (BFI, AIM, SWLS, and PANAS-X) including means and SDs obtained for the same variables in previous research.

		PRESENT STUDY		PREVIOUS LITERATURE	
Measure	Variable	Mean	SD	Mean	SD
BFI	Agreeableness	3.76	0.46	3.67	0.70
	Conscientiousness	3.33	0.69	3.55	0.71
	Extraversion	3.30	0.84	3.28	0.89
	Neuroticism	2.71	0.83	3.29	0.82
	Openness to Experience	3.53	0.57	3.95	0.65
AIM	Affect Intensity Measure	3.68	0.54	3.70	0.50
SWLS	Satisfaction with Life Scale	22.87	6.29	23.50	6.43
PANAS-X	General NA	16.87	5.53	20.20	7.20
	General PA	29.57	5.51	32.60	7.10
	Basic NA	9.79	2.54	-	-
	Basic PA	17.71	3.54	-	-
	Fear	11.43	3.17	12.30	4.90
	Hostility	9.39	4.58	12.90	5.00
	Guilt	9.48	2.27	12.00	5.20
	Sadness	8.87	3.14	11.70	4.80
	Joviality	13.22	2.13	26.80	6.60
	Self Assurance	24.65	6.46	17.70	4.70
	Attentiveness	15.26	3.65	13.50	2.90
	Shyness	11.57	3.36	7.70	3.10
	Fatigue	9.39	3.20	12.70	3.90
	Serenity	6.57	2.37	8.90	2.60
	Surprise	5.04	1.89	6.80	2.80

Note: Previous literature on BFI was adapted from Srivastasa et al. (2003) while findings on AIM was retrieved from Bryant et al. (1996). Further, previous literature on SWLS was reported by Diener et al. (1985) while the PANAS-X manual (Watson & Clark, 1999) was used for previous results on mood variables (i.e. last few weeks). Basic NA and Basic PA were not reported in the manual but was included in the present study due to research interest.

3C.1.1.5. Correlational analysis

Pearson's correlations were conducted to investigate the relationship between vocal emotion recognition (unbiased hit rates) and individual difference variables. The results obtained between recognition ability and scores on BFI, AIM, and SWLS (Satisfaction with Life Scale) are reported in *Table 31.* A positive relationship between extraversion and overall vocal emotion recognition was found, *r*=.494, *p*=.017, indicating that individuals scoring high on extraversion also tended to be better able to recognise vocal emotions, on average. The positive relationship between extraversion and vocal emotion recognition was also evident when recognising negative vocal emotions, *r*=.518, *p*=.011. Also, individuals scoring high on neuroticism tended to be better at recognising positive emotions, on average, *r*=.443, *p*=.034.

Table 32 lists the correlations obtained between vocal emotion recognition and PANAS-X. A negative relationship was found between recognition of positive emotions and attentiveness, *r*=-.421, *p*=.046, indicating that individuals scoring high on attentiveness also tended to be poorer at recognising positive vocal emotions. Poorer recognition of happy sentences was also associated with high scores of attentiveness, *r*=-.532, *p*=.009, and fatigue, *r*=-.537, *p*=.008. In contrast, individuals scoring high on General NA tended to have better recognition of happy sentences, *r*=.431, *p*=.040. Better recognition of sad sentences was positively associated with high scores on guilt, *r*=.444, *p*=.034.

*Table 31: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and individual difference variables.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
Agreeableness	*r*-value	0.267	0.105	0.282	0.185	0.170	0.150	0.215	0.276	0.275	0.296	0.191
	p-value	0.218	0.633	0.192	0.397	0.438	0.495	0.325	0.203	0.205	0.171	0.383
Conscientiousness	*r*-value	-0.034	0.217	0.249	0.204	-0.073	0.231	-0.028	0.160	0.181	0.141	0.248
	p-value	0.877	0.320	0.251	0.350	0.742	0.288	0.901	0.466	0.408	0.520	0.254
Extraversion	*r*-value	0.269	.528**	0.402	0.268	0.306	0.380	0.297	.494*	.492*	.518*	0.369
	p-value	0.214	0.010	0.058	0.216	0.155	0.073	0.169	0.017	0.017	0.011	0.084
Neuroticism	*r*-value	0.130	-0.140	0.313	.532**	0.288	0.244	0.389	0.320	0.307	0.229	.443*
	p-value	0.555	0.524	0.146	0.009	0.183	0.262	0.067	0.137	0.154	0.293	0.034
Openness to experience	*r*-value	0.034	0.334	0.131	-0.104	0.241	0.239	-0.024	0.165	0.146	0.169	0.075
	p-value	0.879	0.119	0.551	0.637	0.268	0.271	0.915	0.453	0.506	0.440	0.732
Affect Intensity Measure	*r*-value	-0.045	0.063	0.238	0.351	0.209	0.119	0.398	0.254	0.246	0.222	0.269
	p-value	0.839	0.776	0.275	0.100	0.339	0.590	0.060	0.243	0.258	0.309	0.215
Satisfaction with Life Scale	*r*-value	0.128	0.136	0.046	0.110	-0.008	0.236	-0.279	0.067	0.073	0.014	0.196
	p-value	0.560	0.537	0.834	0.617	0.971	0.278	0.197	0.762	0.741	0.950	0.369

Note: The individual difference variables are BFI, AIM, and SWLS. Abbreviations are identical to Table 4.

*Table 32: (on following page): Correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and PANAS-X Abbreviations are identical to Table 4 and Table 5.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
General NA	*r*-value	-0.240	-0.088	0.193	.431*	0.273	0.061	0.383	0.171	0.148	0.081	0.282
	p-value	0.269	0.690	0.376	0.040	0.208	0.781	0.071	0.436	0.499	0.715	0.192
General PA	*r*-value	-0.262	0.007	-0.110	-0.385	0.109	-0.181	-0.387	-0.254	-0.287	-0.254	-0.323
	p-value	0.228	0.974	0.616	0.070	0.620	0.408	0.068	0.243	0.185	0.242	0.132
Basic NA	*r*-value	-0.279	-0.207	0.003	0.376	0.280	-0.113	0.316	0.037	0.004	-0.062	0.152
	p-value	0.197	0.344	0.989	0.077	0.195	0.606	0.142	0.867	0.986	0.778	0.488
Basic PA	*r*-value	-0.098	0.164	-0.052	-0.398	0.183	-0.103	-0.254	-0.115	-0.147	-0.076	-0.286
	p-value	0.658	0.454	0.815	0.060	0.403	0.640	0.243	0.603	0.505	0.730	0.185
Fear	*r*-value	-0.101	0.014	0.190	0.362	0.373	0.113	0.220	0.198	0.165	0.109	0.272
	p-value	0.647	0.948	0.386	0.089	0.079	0.608	0.313	0.364	0.451	0.621	0.210
Hostility	*r*-value	-0.326	-0.273	-0.101	0.156	0.126	-0.190	0.108	-0.130	-0.156	-0.208	-0.018
	p-value	0.129	0.207	0.646	0.477	0.566	0.384	0.625	0.555	0.479	0.342	0.935
Guilt	*r*-value	-0.154	0.049	-0.035	0.372	0.176	0.037	.444*	0.161	0.150	0.104	0.234
	p-value	0.482	0.826	0.875	0.081	0.421	0.867	0.034	0.464	0.495	0.637	0.282
Sadness	*r*-value	-0.215	-0.321	-0.009	0.357	0.219	-0.231	0.322	-0.008	-0.037	-0.084	0.075
	p-value	0.325	0.136	0.966	0.095	0.315	0.290	0.133	0.971	0.868	0.704	0.735
Joviality	*r*-value	-0.282	-0.183	-0.178	-0.371	-0.034	-0.185	-.435*	-0.346	-0.368	-0.369	-0.317
	p-value	0.193	0.403	0.417	0.082	0.878	0.398	0.038	0.106	0.084	0.083	0.140
Self Assurance	*r*-value	-0.032	0.301	0.032	-0.231	0.246	0.007	-0.062	0.051	0.023	0.089	-0.128
	p-value	0.887	0.162	0.884	0.289	0.258	0.974	0.780	0.817	0.916	0.686	0.559
Attentiveness	*r*-value	-0.063	0.052	-0.103	-.532**	0.117	-0.205	-0.375	-0.221	-0.253	-0.164	-.421*
	p-value	0.774	0.815	0.639	0.009	0.595	0.348	0.078	0.310	0.244	0.454	0.046
Shyness	*r*-value	-0.294	-0.242	0.168	0.215	0.188	-0.080	0.112	-0.018	-0.043	-0.094	0.078
	p-value	0.173	0.266	0.443	0.325	0.390	0.717	0.612	0.937	0.846	0.669	0.723
Fatigue	*r*-value	-0.109	0.189	-0.220	-.537**	-0.194	-0.136	-0.293	-0.232	-0.225	-0.141	-0.385
	p-value	0.620	0.388	0.312	0.008	0.375	0.536	0.175	0.287	0.303	0.522	0.070
Serenity	*r*-value	-0.197	-0.044	0.020	0.192	0.376	-0.016	0.158	0.060	0.016	-0.023	0.101
	p-value	0.368	0.843	0.929	0.380	0.077	0.942	0.472	0.787	0.943	0.918	0.646
Surprise	*r*-value	-0.143	0.121	0.001	0.016	0.214	-0.074	0.139	0.045	0.021	0.043	-0.032
	p-value	0.515	0.582	0.998	0.942	0.326	0.738	0.526	0.839	0.925	0.845	0.883

3C.2. ERP analyses

3C.2.1. Descriptives

Average mean amplitudes were calculated for each electrode site for both P200 and LLC components. Also, mean amplitudes were averaged for each region of interest (LF, LC, LP, ML, RF, RC, and RP). These data are presented in *Table 33*. It is evident that greater mean amplitudes at the P200 component are primarily found at fronto-central electrode sites, while mean amplitudes at the LLC component seem to be more widely distributed. These findings are consistent with previous ERP research on vocal emotions (e.g. Paulmann et al., 2013). P200 amplitudes seem to be slightly stronger at electrodes located in left hemisphere while LLC amplitudes seem to be stronger at right hemisphere electrode-sites.

Table 33: Average mean amplitudes (in microVolts) and SD for each region of interest (Roi), as well as mean amplitudes averaged across all regions of interest (RoI average), at the P200 and LLC components.

	Regions of Interest							
	LF average	LC average	LP average	ML average	RF average	RC average	RP average	RoI average
P200	3.320	2.594	1.486	1.815	2.684	1.419	0.062	0.034
SD	2.872	2.876	2.982	3.160	2.930	2.754	2.967	2.265
LLC	-1.521	-1.557	-1.155	-2.388	-2.380	-2.483	-2.363	-2.189
SD	3.532	3.221	3.590	4.181	4.151	3.668	3.930	2.758

3C.2.2. Analysis of Variance (ANOVA)

As in Study 1 and Study 3, significance level was adjusted to $p<.017$ to correct for multiple comparisons (Keppel, 1991). In addition, the Greenhouse-Geisser correction (Greenhouse & Geisser, 1959) was used to correct for non-sphericity when the numerator had more than one degree of freedom. Statistical analyses were run in SAS 9.4 and for the ease of reading, only significant main effects and interactions involving the factor Emotion are reported. The within-subject variables were Emotion (seven emotions: anger, disgust, fear, happy, neutral, pleasant surprise, and sad) and Region of Interest (seven ROIs: left/right frontal (LF/RF), left/right central (LC/RC), left/right posterior (LP/RP), and midline (ML) electrode sites).

3C.2.2.1. P200 mean amplitudes (170-230 ms)

Repeated-measures ANOVAs were conducted to examine whether mean ERP amplitudes differed for each emotion in the early time window. A significant main effect was found for Emotion, $F(6,132)=5.50$, $p=.007$, indicating that distinct emotion categories showed different modulation in mean amplitudes. *Post hoc* contrasts revealed that mean amplitudes in response to anger were distinguished from all other emotions (F's > 9.31, p's < .006), except for happiness (marginal, $p=.019$) and pleasant surprise. Disgust and fear were only significantly different from anger and pleasant surprise (F's > 7.57 and 7.95, p's < .012 and .010 for disgust and fear, respectively). A similar pattern was also found for neutral, which only differed from anger and pleasant surprise (F's > 8.81, p's < .007). Pleasant surprise was significantly different from disgust, fear and neutral (F's > 7.57, p's < .012). No other contrasts were significant.

A significant Emotion by ROI interaction was also found, $F(36,792)=3.03$, $p=.004$, indicating that ERP amplitudes in response to the different emotions differed in their scalp distribution. *Post hoc* contrasts were performed at each ROI. A simple main effect was found for both left frontal electrode site (LF), $F(6,132)=6.83$, $p<.001$ and right frontal electrode site (RF), $F(6,132)=6.36$, $p<.001$. At both LF and RF, mean amplitudes in response to angry sentences were distinguished from sentences intoned in disgust, fear, neutral and sad (*F*'s > 7.32, *p*'s < .013 and *F*'s > 8.72, *p*'s < .007 for LF and RF, respectively). For LF, disgust sentences were significantly differentiated from anger and pleasant surprise (*F*'s > 13.45, *p*'s < .001). A somewhat similar pattern was found at RF, in which anger and happiness was significantly differentiated from disgust (*F*'s > 6.79, *p*'s < .016), while pleasant surprise only reached marginally significant differentiation (*p*=.019).

For both LF and RF sites, mean amplitudes for happy sentences were distinguished from fear, neutral and sad sentences, including disgust sentences at RF (*F*'s > 6.89, *p*'s < .016 and *F*'s > 6.79, *p*'s < .016 at LF and RF sites, respectively). Fear sentences and neutral sentences share a similar pattern at both sites, in which they were distinguished from anger, happy and pleasant surprise (fear sentences: *F*'s > 6.89, *p*'s < .016 at LF sites; *F*'s > 7.19, *p*'s < .014 at RF sites; neutral sentences: *F*'s > 11.40, *p*'s < .003 at LF sites; *F*'s > 13.51, *p*'s < .001 at RF sites). Pleasant surprise sentences differed significantly in mean amplitude from disgust (marginally for RF, *p*=.019), fear, neutral and sad sentences at both LF (*F*'s > 8.53, *p*'s < .008) and RF (*F*'s > 6.62, *p*'s < .017). Finally, for both electrode sites, sad sentences were significantly differentiated from anger, happiness and pleasant surprise (*F*'s > 11.63, *p*'s < .003 at LF sites; *F*'s > 6.62, *p*'s < .017 at RF sites). All other contrasts at LF and RF sites were not significant.

Patterns of mean amplitudes were also comparable for most emotion categories at left central (LC) and right central (RC) electrode sites. A simple main effect was found for both LC sites, $F(6,132)=5.22$, $p<.001$ and RC sites, $F(6,132)=4.72$, $p=.002$. Mean amplitudes in response to angry sentences were distinguished from disgust, fear and neutral sentences for both LC sites (F's > 8.22, p's < .009) and RC sites (F's > 10.78, p's < .003), including disgust sentences for LC. For disgust sentences, anger and pleasant surprise showed significantly different modulation in mean amplitudes for LC (F's > 9.34, p's < .006), while only anger was significantly different from disgust in RC (F's > 10.78, p's < .003). For both LC and RC sites, fear was only significantly different from anger (F's > 8.22, p's < .009 at LC; F's > 15.25, p's < .001 at RC), while neutral sentences were significantly different from anger and pleasant surprise (F's > 8.46, p's < .008 at LC; F's > 8.36, p's < .009 at RC). While pleasant surprise were significantly different from disgust, neutral and sad at LC (F's > 8.46, p's < .008), pleasant surprise was only differentiated from neutral at RC (F > 8.36, p < .009). Finally, sad was only successfully distinguished from anger and pleasant surprise at LC (F's > 8.96, p's < .007). All other contrasts at LC and RC were not significantly differentiated.

A simple main effect was also found at midline (ML) electrode site, $F(6,132)=7.44$, $p<.001$. Angry sentences were significantly different from all other emotion categories (F's > 12.55, p's < .002) with the exception of pleasant surprise. Mean amplitudes in response to disgust sentences were distinguished from anger and pleasant surprise (F's > 12.55, p's < .002), while happy sentences were differentiated from anger, fear and neutral (F's > 7.55, p's < .012). Sentences intoned in a fearful and neutral tone of voice were successfully distinguished from anger, happiness and pleasant surprise (F's > 7.55, p's < .012

and F's > 7.90, p's < .010, for fearful and neutral sentences, respectively). Pleasant surprise sentences were significantly differentiated from disgust, fear and neutral (*F*'s > 9.77, *p*'s < .005), while sad sentences were only differentiated from anger (*F* > 13.02, *p* < .002). All other contrasts at ML sites were not significant. Left posterior (LP) and right posterior (RP) electrode sites did not reach a significant simple main effect, confirming that the P200 component was mainly fronto-centrally distributed.

3C.2.2.2. LLC mean amplitudes (450-750 ms)

To examine whether mean amplitudes differed for each emotion category in the late time window, repeated-measures ANOVAs were conducted. A significant main effect was found for Emotion, $F(6,132)=3.94$, $p=.003$, revealing that sentences spoken in different tones of voice obtained different mean amplitudes. *Post hoc* contrasts showed that angry sentences differed significantly from all other emotion categories (*F*'s > 9.42, *p*'s < .006) with the exception of fear. All other contrasts were not significant and no Emotion by ROI interaction was found. A visual illustration of the P200 and LLC components is presented in *Figure 2*.

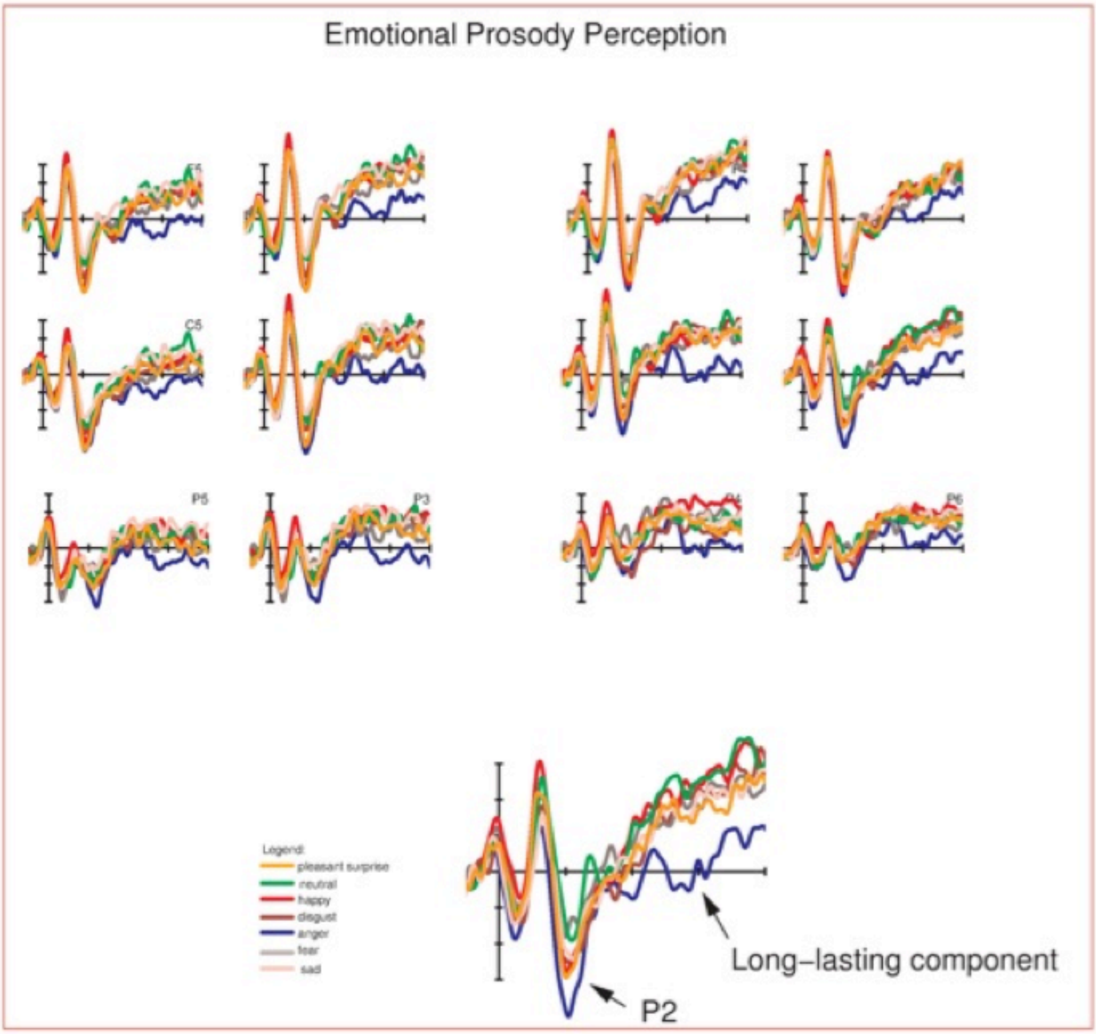


Figure 2: Illustration of P200 (P2) and LLC effects at selected electrodes, in which average waveforms for different emotion categories from 100 ms before stimulus onset up to 800 ms after stimulus onset are presented.

<u>3C.2.3. Correlational analysis</u>

For the ease of reading, and due to the aim of the present study, only overall recognition accuracy (H_u *scores)* and average mean amplitudes for each electrode site are included in the analyses.

3C.2.3.1. P200 (170-230ms) and LLC (450-750 ms) mean amplitudes and accuracy rates

Pearson's correlations were conducted to examine whether average mean amplitudes for P200 component (early time window) correlated with overall recognition accuracy. As evident in *Table 34*, no significant correlations were found, indicating that mean amplitudes at P200 did not predict vocal emotion recognition accuracy.

*Table 34: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between average recognition accuracy (H_u scores) and average mean amplitudes at each region of interest at the P200 component.*

		Regions of Interest							
		LF average	LC average	LP average	ML average	RF average	RC average	RP average	RoI average
Recognition accuracy	*r*-value	-0.015	0.052	0.041	-0.147	-0.241	-0.173	-0.237	-0.193
	p-value	0.947	0.812	0.852	0.502	0.268	0.431	0.276	0.378

Note: The table lists correlations between average emotion recognition across all emotions (anger, disgust, fear, happy, neutral, pleasant surprise, and sad) and average mean amplitudes at each region of interest, including average mean amplitude across all regions of interest (RoI average). Other abbreviations are identical to Table 30.

Pearson's correlations were then conducted to examine whether average mean amplitudes for LLC (late time window) correlated with average recognition accuracy. As evident in *Table 35*, there is a significant negative relationship between overall recognition accuracy and overall mean amplitude at each region of interest, with the exception of left posterior sites. Thus, individuals having smaller mean amplitudes at left frontal sites, r=-.626, p=.001, right frontal sites, r=-.708, p<.001, left central sites, r=-.541, p=.008, right central sites, r=-.665, p=.001, midline sites, r=-.629, p=.001, and right posterior sites, r=-.510, p=.013, tended to be more accurate in judging vocal emotions, on average.

*Table 35: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between average recognition accuracy (H_u scores) and average mean amplitudes at each region of interest at the LLC component. Other abbreviations are identical to Table 30 and Table 31.*

		Regions of Interest							
		LF average	LC average	LP average	ML average	RF average	RC average	RP average	RoI average
Recognition accuracy	*r*-value	-.626**	-.541**	-0.360	-.629**	-.708**	-.665**	-.510*	-0.344
	p-value	0.001	0.008	0.092	0.001	0.000	0.001	0.013	0.108

It is thus evident that smaller mean amplitudes at the LLC component are associated with better overall emotion recognition accuracy. In contrast, mean amplitudes of the P200 did not predict recognition accuracy. Based on previous findings reporting a relationship between mean amplitudes at the early and late time window (Schirmer et al. 2013), Pearson's correlations were conducted to examine whether P200 mean amplitudes can predict mean amplitudes at the LLC component.

*Table 36: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between P200 and LLC mean amplitudes at each region of interest. Other abbreviations are identical to Table 30.*

Correlations between P200 and LLC mean amplitudes			
Region of Interest		ERP components	
LF average	*r*-value	**.556****	
	p-value		**0.006**
LC average	*r*-value	**.610****	
	p-value		**0.002**
LP average	*r*-value	**.612****	
	p-value		**0.002**
ML average	*r*-value	**.591****	
	p-value		**0.003**
RF average	*r*-value	**.608****	
	p-value		**0.002**
RC average	*r*-value	**.618****	
	p-value		**0.002**
RP average	*r*-value	**.623****	
	p-value		**0.001**
RoI average	*r*-value	**.660****	
	p-value		**0.001**

As can be seen in *Table 36*, larger mean amplitudes at the P200 are associated with larger mean amplitudes at LLC. Thus, in line with previous research, mean amplitudes of the early component modulate mean amplitudes of the late component.

3C.2.3.2. P200 (170-230ms) and LLC (450-750 ms) mean amplitudes and individual difference variables

Pearson's correlations were conducted to examine whether mean amplitudes at the P200 component (early time window) correlate with individual difference variables. *Table 37* lists all correlations obtained between average mean amplitudes for the P200 component and scores on BFI, AIM, SWLS, and PANAS-X. Correlations revealed that individuals scoring high on fatigue also tend to have greater mean amplitudes at fronto-central and midline electrode sites in response to vocal emotions at the P200 component. More specifically, significant positive correlations were found between fatigue and average mean amplitudes at LF, r=.575, p=.004; at LC, r=.448, p=.032; at ML, r=.506, p=.014; at RF, r=.625, p=.001; and at RC, r=.542, p=.008.

*Table 37: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) average mean amplitudes at each region of interest at the P200 component and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4, Table 5, and Table and 30.*

		Regions of Interest at the P200 component							
		LF average	LC average	LP average	ML average	RF average	RC average	RP average	RoI average
Agreeableness	*r*-value	-0.068	-0.207	-0.071	-0.199	-0.135	-0.172	0.156	0.065
	p-value	0.756	0.344	0.749	0.364	0.538	0.431	0.477	0.769
Conscientiousness	*r*-value	-0.307	-0.190	-0.030	-0.380	-0.369	-0.342	-0.326	-0.342
	p-value	0.154	0.385	0.890	0.074	0.083	0.111	0.129	0.110
Extraversion	*r*-value	0.286	0.347	0.211	0.210	-0.008	-0.091	-0.174	-0.161
	p-value	0.186	0.105	0.335	0.337	0.972	0.679	0.427	0.464
Neuroticism	*r*-value	-0.101	-0.143	-0.159	-0.292	-0.077	-0.070	-0.291	-0.274
	p-value	0.646	0.514	0.470	0.176	0.726	0.752	0.178	0.205
Openness to experience	*r*-value	0.090	-0.007	-0.261	0.059	-0.008	-0.003	-0.231	-0.033
	p-value	0.683	0.973	0.229	0.789	0.971	0.990	0.290	0.880
Affect Intensity Measure	*r*-value	0.098	0.171	0.256	0.061	0.042	0.091	0.042	-0.032
	p-value	0.658	0.435	0.239	0.782	0.850	0.681	0.849	0.886
Satisfaction with Life Scale	*r*-value	-0.092	0.023	0.243	0.094	-0.053	0.131	0.282	0.004
	p-value	0.677	0.917	0.264	0.670	0.812	0.551	0.192	0.985
GeneralNA	*r*-value	0.197	0.170	0.063	0.133	0.178	0.062	-0.088	-0.005
	p-value	0.367	0.439	0.775	0.546	0.417	0.778	0.689	0.982
GeneralPA	*r*-value	0.100	0.277	0.270	0.253	0.074	0.264	0.238	0.163
	p-value	0.650	0.201	0.213	0.243	0.736	0.223	0.274	0.457
BasicNA	*r*-value	0.199	0.038	-0.169	0.161	0.287	0.152	-0.064	0.061
	p-value	0.362	0.865	0.441	0.463	0.184	0.488	0.772	0.783
BasicPA	*r*-value	0.172	0.345	0.332	0.342	0.108	0.278	0.309	0.272
	p-value	0.432	0.107	0.122	0.111	0.624	0.199	0.152	0.210
Fear	*r*-value	0.209	0.306	0.163	0.240	0.181	0.252	-0.017	0.068
	p-value	0.339	0.155	0.458	0.270	0.408	0.247	0.939	0.757
Guilt	*r*-value	0.354	0.113	-0.152	0.284	.483*	0.263	-0.042	0.096
	p-value	0.098	0.608	0.489	0.190	0.020	0.226	0.849	0.664
Hostility	*r*-value	-0.253	-0.290	-0.234	-0.146	-0.197	-0.212	-0.037	-0.040
	p-value	0.244	0.180	0.282	0.506	0.368	0.332	0.868	0.855
Sadness	*r*-value	0.102	-0.143	-0.320	-0.030	0.185	0.009	-0.102	0.018
	p-value	0.644	0.516	0.136	0.893	0.397	0.968	0.643	0.936
Attentiveness	*r*-value	-0.020	0.208	0.188	0.042	-0.094	-0.019	-0.035	-0.127
	p-value	0.927	0.342	0.391	0.848	0.669	0.932	0.874	0.563
Joviality	*r*-value	0.187	0.367	.431*	0.374	0.119	0.354	0.410	0.365
	p-value	0.392	0.085	0.040	0.079	0.588	0.097	0.052	0.087
SelfAssurance	*r*-value	0.181	0.233	0.093	0.308	0.158	0.192	0.193	0.219
	p-value	0.408	0.285	0.672	0.152	0.471	0.379	0.376	0.316
Fatigue	*r*-value	.575**	.448*	0.242	.506*	.625**	.542**	0.210	0.217
	p-value	0.004	0.032	0.267	0.014	0.001	0.008	0.337	0.320
Serenity	*r*-value	0.197	0.228	0.278	0.326	0.148	0.243	0.358	0.402
	p-value	0.368	0.295	0.199	0.129	0.500	0.263	0.094	0.057
Shyness	*r*-value	-0.110	-0.221	-0.325	-0.038	-0.010	-0.017	-0.025	0.161
	p-value	0.617	0.311	0.130	0.863	0.963	0.940	0.908	0.463
Surprise	*r*-value	-0.035	-0.050	0.169	-0.022	-0.007	0.109	0.277	0.116
	p-value	0.874	0.821	0.442	0.921	0.976	0.620	0.200	0.599

Pearson's correlations were also conducted to examine whether mean amplitudes of the LLC component (late time window) correlate with individual difference variables. All correlations obtained between average mean amplitudes for the LLC component and scores on BFI, AIM, SWLS, and PANAS-X are listed in *Table 38*. It is evident that high scores on conscientiousness are associated with smaller mean amplitudes at all electrode sites except LP. More specifically, conscientious individuals tended to have smaller mean amplitudes at LF, *r*=-.563, *p*=.005; at LC, *r*=-.455, *p*=.029; at ML, *r*=-.533, *p*=.009; at RF, *r*=-.524, *p*=.010; and at RC, *r*=-.479, *p*=.021. Further, fatigue continues to correlate positively with overall mean amplitudes across all regions of interest, *r*=.427, *p*=042. In summary, the effect of fatigue on mean amplitudes tends to be fronto-centrally distributed at the P200 component, while broadly distributed at the LLC component.

*Table 38: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) average mean amplitudes at each region of interest at the LLC component and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4, Table 5, and Table and 30.*

		Regions of Interest at the P200 component							
		LF average	LC average	LP average	ML average	RF average	RC average	RP average	RoI average
Agreeableness	*r*-value	-0.335	-0.330	-0.190	-0.251	-0.304	-0.246	-0.105	-0.113
	p-value	0.118	0.125	0.384	0.249	0.159	0.257	0.634	0.608
Conscientiousness	*r*-value	-.563**	-.455*	-0.160	-.533**	-.524*	-.479*	-0.323	-0.302
	p-value	0.005	0.029	0.466	0.009	0.010	0.021	0.133	0.161
Extraversion	*r*-value	-0.165	-0.021	-0.195	-0.139	-0.276	-0.337	-0.257	-0.271
	p-value	0.451	0.925	0.372	0.527	0.202	0.116	0.236	0.211
Neuroticism	*r*-value	-0.060	-0.158	-0.134	-0.181	-0.058	-0.082	-0.236	-0.265
	p-value	0.787	0.472	0.544	0.409	0.791	0.710	0.279	0.222
Openness to experience	*r*-value	-0.219	-0.371	-.535**	-0.247	-0.192	-0.213	-0.405	-0.265
	p-value	0.316	0.081	0.009	0.256	0.381	0.330	0.055	0.222
Affect Intensity Measure	*r*-value	0.081	0.192	0.130	0.022	-0.028	-0.007	0.075	0.074
	p-value	0.714	0.380	0.553	0.920	0.901	0.975	0.732	0.738
Satisfaction with Life Scale	*r*-value	-0.248	0.051	0.355	-0.011	-0.249	-0.017	0.209	0.293
	p-value	0.254	0.817	0.097	0.961	0.251	0.937	0.338	0.175
GeneralNA	*r*-value	0.278	0.167	0.008	0.150	0.191	0.033	0.029	0.121
	p-value	0.198	0.445	0.972	0.495	0.384	0.881	0.895	0.581
GeneralPA	*r*-value	0.220	0.197	0.049	0.196	0.122	0.086	0.044	0.150
	p-value	0.312	0.368	0.824	0.370	0.579	0.696	0.842	0.494
BasicNA	*r*-value	0.233	0.061	-0.073	0.117	0.191	0.113	0.063	0.182
	p-value	0.285	0.781	0.740	0.596	0.383	0.607	0.776	0.405
BasicPA	*r*-value	0.075	0.166	0.060	0.097	-0.002	0.013	0.060	0.219
	p-value	0.733	0.448	0.785	0.661	0.993	0.954	0.786	0.314
Fear	*r*-value	0.325	0.203	0.017	0.180	0.170	0.062	-0.035	0.078
	p-value	0.130	0.353	0.938	0.412	0.437	0.778	0.874	0.724
Guilt	*r*-value	0.249	0.086	-0.080	0.134	0.271	0.178	0.049	0.281
	p-value	0.253	0.695	0.717	0.542	0.212	0.417	0.825	0.193
Hostility	*r*-value	-0.133	-0.164	-0.067	-0.052	-0.121	-0.135	0.018	0.030
	p-value	0.546	0.455	0.763	0.815	0.581	0.539	0.936	0.891
Sadness	*r*-value	0.159	-0.014	-0.090	0.038	0.139	0.143	0.155	0.080
	p-value	0.469	0.949	0.683	0.864	0.528	0.516	0.480	0.717
Attentiveness	*r*-value	0.251	0.238	0.064	0.203	0.133	0.073	0.083	-0.024
	p-value	0.249	0.275	0.773	0.354	0.546	0.740	0.706	0.914
Joviality	*r*-value	-0.027	0.124	0.104	0.030	-0.073	-0.006	0.062	0.265
	p-value	0.903	0.574	0.637	0.892	0.739	0.977	0.779	0.221
SelfAssurance	*r*-value	0.120	0.127	-0.046	0.110	0.047	0.006	0.016	0.183
	p-value	0.584	0.564	0.834	0.617	0.831	0.979	0.941	0.402
Fatigue	*r*-value	0.387	0.354	0.128	0.319	0.349	0.320	0.187	.427*
	p-value	0.068	0.098	0.559	0.138	0.103	0.136	0.392	0.042
Serenity	*r*-value	0.085	0.163	0.125	0.205	0.156	0.195	0.173	0.298
	p-value	0.700	0.457	0.571	0.349	0.478	0.373	0.430	0.167
Shyness	*r*-value	-0.099	-0.252	-0.156	-0.137	-0.086	-0.099	-0.049	0.135
	p-value	0.653	0.245	0.476	0.534	0.698	0.652	0.825	0.540
Surprise	*r*-value	-0.096	-0.088	0.021	-0.111	-0.064	-0.118	-0.062	0.151
	p-value	0.662	0.691	0.926	0.616	0.773	0.592	0.778	0.492

4C. Discussion

The present study set out to explore whether inter-individual differences could predict differences in the on-line temporal unfolding of vocal emotions. Group level analyses revealed that the data provide are a good representation of the vocal emotion literature as mean ERP amplitudes in response to various emotions can be distinguished from one another (c.f. Paulmann et al., 2011;

2013). The main focus was however on the relationship between vocal emotion processing and inter-individual differences, which provided a somewhat different picture than the first two studies. While conscientious individuals tended to have smaller mean amplitudes at LLC, individuals scoring high on fatigue tended to have larger mean amplitudes at both the P200 and the LLC component. Smaller mean amplitudes at P200 predicted smaller mean amplitudes at LLC, which predicted better vocal emotion recognition.

Behavioural analyses

An overall recognition accuracy of 54.4% was found in the present study. This is comparable to results from Study 1, 55.8%, to a previous study using the same stimuli (Paulmann et al., in review), and to the vocal emotion literature in general (e.g. see Scherer, 1989 for a review). Further, error confusion patterns and unbiased hit rates are also similar to Study 1 and previous research (e.g. Pell et al., 2009a), in which anger is the most accurately recognised emotion while happy is the most poorly recognised emotion. With regard to the influence of individual difference variables on vocal emotion perception, extraversion predicted better recognition overall, while neurotic individuals tended to be better to recognise positive vocal emotions. These findings are inconsistent with results obtained in Study 1. One major difference between the two studies was sample size; while this can influence results (results from Study 1 should be considered as better suited for individual difference analyses given that sample size is reasonable larger (N=53 in Study 1 while N=24 in Study 3)), it should not lead to completely different patterns observed. Rather, similar trends should have been observed in the present study if correlational findings from Study 1 should be considered meaningful and reliable.

ERP analysis

Vocal emotion processing

According to statistical observations from the group data, the present findings fit nicely with the model of vocal emotion processing proposed by Schirmer and Kotz (2006) and with the previous literature in general (e.g., Schirmer et al., 2013; Paulmann et al., 2011; 2013). For example, vocal emotions could be successfully differentiated at the P200 component, indicating that listeners are able to successfully distinguish between distinct emotion categories only 200 ms after sentence onset. Further, ERP amplitudes for the P200 and LLC differed in scalp distribution again in line with previous research (e.g. Paulmann et al., 2011; Paulmann et al., 2013). Although visual inspection (see *Figure 2*) suggests that distinct vocal emotions can be differentiated, at least to some degree, at the LLC component, only contrasts involving angry sentences were found to be significant.

A simple explanation for this inconsistency might be speaker variation. While most ERP studies employ one or two professional actors (e.g. Paulmann et al., 2011; Paulmann et al, 2013), the present study employed several untrained speakers. Although speaker variation is highly valued in behavioural studies (Banse & Scherer, 1996), it is very likely that increased speaker variability and portrayals of less prototypical exemplars cause a higher signal to noise ratio in the ERP domain. While behavioural analyses are unaffected by this variation, this is much more problematic when analysing ERPs. One way to bypass this problem in the future is to present fewer emotional categories in total, but more sentences within each category. This approach will allow testing whether speaker variation indeed leads to higher signal to noise ratio problems which affects individual emotion category contrasts.

Another interesting observation is that mean amplitudes at the P200 component can predict modulation of the LLC component. While smaller mean amplitudes at the P200 component did not predict recognition accuracy, smaller mean amplitudes at the P200 component predicted smaller mean amplitudes at LLC component, which in turn is associated with more accurate judgments of vocal emotions. This is in line with previous findings. For example, in a visual word recognition task, Schirmer et al. (2013) found a negative correlation between mean amplitudes at P200 and LLC, in which greater sensitivity to vocal emotions at the P200 was related to smaller LLC amplitudes. In short, mean amplitudes at the P200 component did not predict recognition accuracy, but rather had a modulating effect on later processing stages. According to Paulmann et al. (2013), this can be explained by stimuli relevance; initial processing attends to potentially relevant stimuli, which then requires a more in-depth processing at later stages. Once potentially relevant stimuli are processed in more depth, they can be better recognised when behavioural responses are initiated. The present findings lend support to this notion.

Further, the biological significance hypothesis is argued to be supported when neutral and emotional stimuli significantly differ in their mean amplitudes. This is somewhat supported by the present findings, as neutral is successfully distinguished from anger and pleasant surprise at the P200 component, while neutral is only successfully distinguished from anger at the LLC component. However, it should be noted that anger is the most successfully distinguished emotion at both P200 and LLC. More specifically, anger can be successfully distinguished from all emotions except happiness and pleasant surprise at the P200 and all emotions except fear at the LLC. These findings, however, also lend support to the biological significance hypothesis, suggesting that anger, which signals possible threat, is easily distinguished from other emotions.

Vocal emotion processing and individual difference variables

No clear predictions were made regarding the relationship between inter-individual differences and ERPs in response to vocal emotions. The literature on the subject is almost absent, with the exception of the recent study by Pell et al. (2015). In short, they found that trait anxiety could predict modulations in mean amplitudes when listening to vocal emotions. However, this was not evident for the Big Five personality dimensions. Similarly, the present study did not find any relationship between mean amplitudes and the personality traits at the P200. Interestingly, conscientiousness predicted mean amplitudes at the LLC component; highly conscientious individuals tended to have smaller mean amplitudes at all electrode sites, except at left posterior electrode sites. In the present study, smaller mean amplitudes at the LLC component were also associated with more accurate vocal emotion recognition. Interestingly, conscientiousness was not directly linked to recognition accuracy.

There are several possible reasons for this. Firstly, it is possible that individuals scoring high on conscientiousness spend more cognitive resources on evaluating the sentence stimuli in more depth than individuals scoring low on conscientiousness. The fact that the effect of conscientiousness is only observed at the LLC component and not at the P200 component supports this assumption, as the LLC is argued to reflect more elaborate processing of the acoustical meaning. However, this does not necessarily imply that conclusions they draw are more accurate, which would also explain why this effect is not observed in behavioural analyses throughout the present investigations. Another possible explanation is that other inter-individual differences moderate the relationship between conscientiousness and mean amplitudes. Perhaps conscious individuals are more accurate when judging vocal emotions, but only when have a high cognitive workload capacity. Future studies should examine this in more detail.

With regard to short-time fluctuations in mood, correlations revealed that individuals scoring high on fatigue tend to have greater mean amplitudes in response to vocal emotions at the P200. Mean amplitudes were fronto-centrally distributed. Furthermore, fatigue also predicted larger mean amplitudes at the LLC, however this effect was more widely distributed. This distribution pattern is consistent with the literature in general (e.g. Paulmann et al., 2013). Thus, similar to the suggestion regarding conscientiousness, fatigue predicts greater mean amplitudes to vocal emotions, while a direct link between fatigue and poorer recognition accuracy is not established. In contrast to conscientiousness, the effect of fatigue is evident already at the P200 component. This seems reasonable, as sleepiness, tiredness, and drowsiness (Watson & Clark, 1999) might slow down influence cognitive processing ability. In summary, results from Study 3 revealed that conscientiousness and fatigue influence the online processing of vocal emotions. The fact that these findings were not directly evident in behavioural analyses highlights the importance of including ERP analyses when examining of the relationship between vocal emotion processing and inter-individual differences.

5. GENERAL DISCUSSION

Based on the assumption that emotion processing is greatly influenced by internal factors, or inter- and intra-individual differences (e.g. Davitz, 1964; Hamann & Canli, 2004; Matsumoto et al., 2000; Schirmer & Kotz, 2006), the present studies set out to explore whether and how these differences influence *vocal* emotion processing. Three independent but related studies were designed to comprehensively and systematically assess whether group data analyses were comparable to the previous vocal emotion literature and whether short-time fluctuations in mood, stable personality characteristics, and individual differences in affect intensity and general life satisfaction influenced vocal emotion processing. Although results of group-level analyses in all three studies were well in line with the literature in general, there was no clear and consistent relationship between vocal emotion processing and any of the inter- and intra-individual differences across all studies.

Vocal emotion processing

As said above, all three studies explored processing of vocal emotions at a group level, in which findings from all three studies are comparable to the vocal emotion literature. Firstly, recognition accuracy is similar across all three studies, 55.8% for Study 1, 61.8% for Study 2, and 56.4% for Study 3. Secondly, recognition accuracy differed across emotions, in which anger and happy were the most accurately and most poorly recognised emotions, respectively. These results are in line with previous findings (e.g. Scherer, 1989; Paulmann et al., in review). Study 2 has somewhat higher average recognition accuracy than Studies 1 and 3, which might be explained by stimuli materials. While Study 2 employed one professional actress, Studies 1 and 3 used several untrained speakers. Thus, less speaker variability and more prototypical portrayals of vocal emotions may explain why Study 2 achieves somewhat higher average recognition accuracy (c.f. Juslin & Laukka, 2001; Scherer, 1995). However, considering the small difference in recognition accuracy between Study 2 and Studies 1 and 3, it is reasonable to argue that portrayals produced by untrained speakers provide as a good alternative to professional actors, as it is possible to overcome problems with ecological validity (Scherer, 1989) and with generalising findings (Greasley et al., 2000).

The analyses of the *explicit, or off-line* time course processing of vocal emotions showed that distinct emotion categories unfolded at different rates. These emotion-specific recognition patterns were consistent with the previous literature (e.g. Pell & Kotz, 2011). Further, ERPs in response to vocal emotions was also consistent with Schirmer and Kotz's (2006) model of vocal emotion processing and the previous literature in general. Firstly, distinct emotion categories showed different modulation in mean amplitudes, both at the P200 and LLC component. In addition, Study 3 found that greater mean amplitudes were observed at fronto-central electrodes at the P200 component, while mean amplitudes at the LLC component were more widely distributed, which is line with findings reported in Paulmann et al. (2013). Also, the fact that mean amplitudes were greater in the right hemisphere for the LLC component is consistent with research showing that the right hemisphere is heavily involved in paralinguistic processing. In summary, analyses of vocal emotion processing at a group level, including recognition accuracy rates, and results on the explicit and implicit temporal dynamics of vocal emotions fits nicely with the previous vocal emotion literature. Thus, group data analysis suggested that data from all three studies provided as a solid and valid base to further analyse vocal emotion processing at an inter- and intra-individual level.

Vocal emotion processing and the influence of individual differences

Mood and vocal emotion processing

The previous mood and emotion literature has mainly focused on the influence of induced mood on emotion processing (e.g. Bouhuys et al., 1995; Lee et al., 2008), arguing that induced mood influence emotion processing in a mood-congruent manner (Rusting, 1998). To expand on this literature, one of the main aims of the present studies was to examine whether short-time fluctuations in mood influence vocal emotion processing in a similar manner. If the mood-congruence hypothesis can predict the influence of short-time mood fluctuations, then individuals scoring high on negative affect and positive affect should be better or quicker to recognise negative and positive vocal emotions, respectively. However, no consistent pattern across all three studies was found in which positive and negative affect could predict differences in vocal emotion processing.

With regard to other mood variables examined, Study 1 found that high scores on serenity tended to predict poorer recognition of vocal emotions. However, this was not replicated in Study 2, in which serenity did not predict poorer recognition of vocal emotions at the final gate. Neither was it supported by recognition rates in Study 3, which makes it very questionable whether serenity actually influences vocal emotion processing in a systematic manner. However, inter-individual analyses from Study 2 found that attentive individuals were quicker and more accurate at recognising vocal emotions. It seems reasonable that individuals that pay attention are better able to focus on minor fluctuations on the acoustic level and then end up putting these (important) details together in an efficient and accurate manner. In other words, as vocal emotion recognition requires the listener to rapidly integrate various quickly changing acoustic features, attentive individuals might be better able to analyse individual acoustic features and put them together quickly and efficiently to derive at the correct emotional category.

This result was somewhat contradicted in Study 3, where a negative relationship between attentiveness and perception of positive vocal emotions was found. However, as noted previously, results from Study 2 should be considered as better suited for individual difference analyses given that sample size is reasonable larger compared to the sample size in Study 3. As there was a clear and consistent trend across gates in Study 2 for attentive individuals to be quicker at recognising vocal emotions accurately, it seems likely that attentiveness do influence the speed of vocal emotion processing and this should be further examined in future studies.

Another interesting finding regarding the relationship between vocal emotion processing and short-time mood fluctuations was observed in Study 3. Individuals scoring high on fatigue tended to have greater mean amplitudes at both P200 and LLC, possibly reflecting higher cognitive efforts used by these individuals. As discussed earlier, smaller mean amplitudes predict more accurate vocal emotion judgments. Interestingly, a *direct* link between fatigue and poorer recognition accuracy was not established. It might be that individuals scoring high on fatigue engage more strongly in early salience detection and more elaborate emotional processing during on-line processing, but that this additional involvement in processing does not lead to worse performance at later behavioural stages. In other words, the increased processing effort is needed to end up at the "same outcome" as individuals scoring low on fatigue. This remains speculative and if fatigue and emotion recognition indeed form a meaningful relationship, then future research should be able to replicate this finding.

In conclusion, it seems unlikely that the mood-congruency hypothesis is particularly helpful in explaining how short-time fluctuations in mood can influence vocal emotion processing. In relation of Bower's (1981) network model, it seems unlikely that short-time fluctuations in mood are strong enough to activate the relevant emotion nodes that cause the activation of mood-congruent processing. Thus, in light of the present findings, everyday mood fluctuations do not seem to influence vocal emotion processing in a similar mood-congruent manner as observed with induced mood (e.g. Bouhuys et al. 1995).

Personality and vocal emotion processing

The second main aim of the present studies was to further examine the contradictive and confusing findings obtained in the personality and emotion literature. Analyses were conducted on both an inter-individual difference level, examining the influence of personality traits on vocal emotion processing, and on an intra-individual level, exploring how trait combinations, or personality styles, might influence vocal emotion processing. When examining behavioural data across Studies 1 and 2, there is no evidence of a relationship between personality traits and the *accuracy* or *speed* of vocal emotion recognition. However, Study 3 found a relationship between overall recognition accuracy and extraversion, and between neuroticism and recognition of positive emotions. Considering that Study 3 is the only study out of three that finds this relationship, it is questionable whether extraversion and neuroticism really influence vocal emotion processing in a systematic manner. Future studies should continue to monitor this relationship before firm conclusions can be drawn.

Interestingly, there was also a relationship between conscientiousness and mean amplitudes of the LLC component. More specifically, high scores on conscientiousness predicted smaller mean LLC amplitudes. However, while smaller mean amplitudes predicted better recognition accuracy at the LLC component, no direct relationship between conscientiousness and better emotion recognition was observed. Reasons for this lack of direct link were discussed in Study 3, emphasising the possibility of other confounding variables. Future studies should further explore this finding to get a better understanding of the relationship observed. Also, it should be noted that this finding is inconsistent with Pell et al. (2015), arguing that none of the Big Five personality dimensions was linked to ERPs in response to vocal emotions. As both studies employed 24 participants, differences in sample size cannot provide an explanation for the differences found. In contrast, the two studies differed in task demands and stimulus materials. Pell et al. (2015) examined processing of both vocal emotions and speech as opposed to just looking at prosody recognition on the sentence level as done in the present study. Still, it seems unlikely that this difference could lead to differences in correlational findings as emotion accuracy and speed was not influenced by these differences. The lack of consistency for correlational results raises the issue of finding results by pure chance. Future studies should thus focus on further explore this inconsistency in a comprehensive and systematic manner.

Taken together, there is thus no evidence from the present studies that inter-individual differences in personality can influence vocal emotion processing in a systematic manner. This is in line with previous studies that also failed to find significant results when examining inter-individual differences (e.g. Elfenbein et al., 2007; Bänziger et al., 2009). As discussed earlier, there are more studies reporting a relationship between vocal emotion perception and various traits (e.g. Cunningham, 1977; Scherer & Scherer, 2011; Burton et al., 2013) than studies reporting no relationship. However, research arguing for a possible relationship between vocal emotion processing and personality traits is continuously contradictive, and studies reporting null results are difficult to publish. Thus, future studies should aim at achieving a better understanding of the contradictive relationship between personality traits and vocal emotion processing. Furthermore, Studies 1 and 2 further examined whether intra-individual differences in trait combinations, or personality styles, could predict vocal emotion processing differences. Again, no relationship was found. However, the influence of intra-individual differences in personality on a neural level is yet largely unexplored. It is of great importance that future studies examine these points in a comprehensive and systematic manner, to ensure that significant findings are replicable across different materials and different individuals when using same personality questionnaire measurements and research designs.

Affect intensity, general life satisfaction and vocal emotion processing

Firstly, and not surprisingly, individuals scoring high on affect intensity also tended to rate vocal emotions as more intense. Consistent with predictions, high intensity ratings were given irrespective of emotion valence (Larsen, 1985; Larsen & Diener, 1987). Interestingly, although affect intensity could not predict differences in overall vocal emotion perception, as evident in Studies 1 and 3, it did seem to influence the temporal processing of vocal emotions. Study 2 revealed that individuals scoring high on affect intensity also tended to be slower at recognising vocal emotions, irrespective of emotion valence. This provides support, at least from the vocal emotion domain, to the assumption made by Eugene et al. (2003) that affect intensity can influence emotion processing. With regard to general life satisfaction, Study 1 found that individuals who judge themselves as being more satisfied with life were better at recognising positive emotions, as predicted. However, Studies 2 and 3 failed to find this positivity-bias. It is thus questionable whether life satisfaction influences vocal emotion processing in a congruent and consistent manner. However, as the present studies served as a first attempt to explore the relationship between vocal emotion processing and affect intensity, and between vocal emotion processing and life satisfaction, future studies should continue to monitor this possible link.

Limitations and future research suggestions

Comprehensive and systematic examination of the relationship between vocal emotion processing and inter- and intra-individual difference variables provide a highly important contribution to the existing literature; an important advantage is that it allows integrating knowledge across research domains that are often studied in isolation. As argued by Rusting (1998), mood- and trait-congruency hypotheses and their influence on emotion processing are studied separately, which makes it difficult to compare and contrast research findings. The present studies were the first attempt, to my knowledge, to examine both hypotheses in relation to vocal emotion processing using different methodologies and materials. This enables detailed and systematic analyses, which yields well-controlled results covering several variables of interest. However, the present investigations are not without limitations.

Facial versus vocal emotion processing

As discussed, findings regarding the relationship between personality traits and emotion processing are confusing and contradictive, in both the vocal and facial domain. In short, all personality variables have been implicated as predicting differences in emotion processing. For example, in the facial domain, Rubin et al. (2005) found a relationship between better facial recognition and transformational leadership, which was moderated by agreeableness and extraversion. In contrast, other studies have identified openness to experience and conscientiousness as traits that enhance facial emotion recognition (Matsumoto et al., 2000). Similarly, evidence from the vocal domain is just as confusing. While Cunningham (1977) found that neurotic individuals are better at vocal emotion perception, Scherer and Scherer (2011) argued that neuroticism predicts poorer recognition. In addition, Scherer and Scherer (2011) found a positive relationship between extraversion and vocal emotion perception, however, Burton et al. (2013) only found this relationship for males. Currently, the obvious lack of consistent findings makes it difficult to conclude how traits influence facial and vocal emotion perception, however how can this be resolved?

Future studies should aim at employing comprehensive study designs, similar to the present investigation. Including group level analyses ensures that the data is representative of consistently established findings in the literature before proceeding to inter-individual analyses. Secondly, detailed analyses allow validating that significant findings are replicable across different materials and different individuals when using same personality questionnaire measurements and research designs. An example from the present investigation is the significant relationship between serenity and vocal emotion perception evident in Study 1. If this finding was a true reflection of the relationship between short-time fluctuations in mood and vocal emotion perception, it should have replicated in Studies 2 and 3. However, this is not the case. Systematic and comprehensive studies can easily examine whether results are meaningful reflections of a predictive relationship or rather significant results due to pure chance.

The present studies do not find a consistent relationship between vocal emotion processing and inter- and intra-individual differences. This is not to suggest that individual difference do not influence emotion processing at all, but rather that the overall emphasis of individual differences in the vocal emotion literature might have been overly exaggerated. The problem of publishing null results, in addition to the continuously contradictive literature in both the facial and vocal domain supports this assumption. Future studies should thus continue to examine whether and how inter- and intra-individual differences influence vocal and facial emotion processing, however, the advantages of comprehensive and systematic investigations should definitely be acknowledged to ensure the validity of any significant findings.

Personality dimensions versus personality styles

As evident throughout the personality and emotion literature, the use of separate personality dimensions is the most common strategy used in emotion processing research, at least in healthy population studies. Often, individuals are assessed on one or two trait dimensions, such as extraversion and neuroticism, and compared and contrasted based on whether they score high or low on a particular trait (Asendorph, 2003). However, a recent development in the personality field is the exploration of personality styles. According to Asendorph (2003), one of the disadvantages when using trait dimensions in isolation is that information about the personality structure is lost.

Although the use of trait dimensions are highly valuable in cross-sectional designs, while the use of trait combinations are highly valuable when making long-term predictions, the emphasise the importance of examining personality on an inter- and intra individual level. The use of personality style analyses has been used in research; however, current focus has been on patient groups (e.g. Saulsmann & Page, 2004; Weiss et al., 2009). However, the present studies are the first attempt to examine differences in emotion processing at an intra-individual level in the healthy population. Results did not indicate any relationship between styles and vocal emotion processing. Still, examining a healthy population in contrast to patient groups can provide different challenges. For example, the present study did not pre-screen for individuals scoring in the extreme end of personality dimensions. Rather, participants classified as having a personality style could still score moderately on one or both dimensions. In contrast, patient groups are often selected based on specific criteria. For example, patients suffering from personality disorders have shown to have extreme scores on one or more trait dimension(s) (e.g. Hyer et al., 1994). Exploring only extreme scorers make it easier to have clear personality profiles.

In contrast, the healthy population has more variety in trait fluctuations; one person can score high on extraversion while moderately on neuroticism. The present study did not screen for healthy individuals scoring on the extreme on trait dimensions, but rather looked at whether natural style fluctuations influenced vocal emotion processing. If personality styles can predict differences in vocal emotion processing, this should be evident when examining healthy extreme scorers. In summary, future studies should thus extend the present study by pre-screening for extreme variants of personality styles in the healthy population. It is at least clear that examining both inter- and intra-individual differences on the same data is highly informative, capturing potential important information on both levels of analyses.

Sample sizes and power

Some focus will be given to discuss sample sizes in the present studies. Relatively low sample size can lead to null results in correlational analyses when examining variables with much variation, such as variation in personality and mood. Here, a reasonable number of participants have been tested. Considering Studies 1 and 2, numbers are well above sample sizes reported in other vocal emotion recognition studies, though it has to be acknowledged that studies focusing on individual differences often exceed numbers tested here. It should be noted though that previous studies have found significant results with a similar or even an even smaller sample size when examining the influence of individual differences on emotion processing. For example, Burton et al. (2013) found that extraverted and conscientious males were better at recognising vocal emotions, although they only tested 42 males. This sample size is considerably smaller than sample sizes obtained in Studies 1 and 2. Further, Pell et al. (2015) found effects of trait anxiety on vocal emotion perception using a similar sample size as the present study. Thus, these findings suggest that it is unlikely that sample size can explain the lack of findings in the present investigations.

If short-time fluctuations in mood and personality traits did influence vocal emotion perception in a consistent manner, weak trends should at least have been evident in the data, however this is not the case. Perhaps individual variation in personality and mood is so varied and complex that differences in vocal emotion perception cannot be explained by systematic differences in the individual difference variables examined here. Further support to this assumption comes from the fact that increasing the sample size by including non-native listeners did not lead to major changes of the data (see *Appendix B* for Study 1 and *Appendix D* for Study 2). Firstly, and interestingly, overall recognition accuracy is not only comparable when including non-native listeners in Studies 1 and 2, but accuracy actually increases in Study 1. While the average H_u score is 0.35 when analysing responses from only native listeners, H_u *score* increases to 0.55 when including non-native listeners. It should be noted however, that non-native listeners are students at a UK university and uses the English language on a daily basis.

However, when considering the relationship between vocal emotion processing and intra-individual differences in personality sample size becomes more problematic. The consequence of dividing the sample into five different personality style groups is reduced power. Note that group analyses (e.g. testing native vs. non-native listeners, or female vs. male listeners) are often run on similar sample sizes. It is thus questionable whether reduced power led to the lack of effects. Thus, as the present studies are the first attempt to include personality style data in the vocal emotion literature, these data should be considered as providing preliminary results only and these issues can be explored in more detail in the future.

Concluding thoughts

It is obvious that multi-study investigations are invaluable when examining the relationship between emotion processing and inter- and intra-individual differences. The present project is the first attempt to do exactly this. Overall, results do not support a clear and consistent relationship between vocal emotion processing and short-time fluctuations in mood and stable personality characteristics. Thus, mood- and trait-congruency hypotheses do not explain differences in vocal emotion processing very well, at least in the present studies. It is thus questionable whether previous findings have created an overly exaggerated picture of the relationship between vocal emotion processing and inter-individual differences. Perhaps mood and personality combinations are so complex that it is difficult to find a consistent pattern of vocal emotion processing differences. This provides a possible explanation for why the literature on vocal emotion processing and individual differences are so inconsistent and difficult to comprehend. In contrast, promising results on affect intensity suggests that differences in emotion intensity levels that individuals experience can explain some variation in vocal emotion processing, at least how quickly vocal emotions are identified. Future studies should further explore the relationship between individual differences and vocal emotion processing, integrating group-, inter-, and intra-individual analyses.

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APPENDICES

Study 1

Appendix A

<u>*The 15 sentences uttered by the speakers*</u>

1. The fence was painted brown.
2. The dog had two owners.
3. The book was green.
4. It was a heavy car.
5. The cat has night vision.
6. The water bottle was full.
7. The shop sells many things.
8. The boxes contained many items.
9. The horse was eating an apple.
10. The bird flew over the house.
11. There was food in the fridge.
12. This is a yellow blanket.
13. The top was made of cotton.
14. The woman crossed the street.
15. The man posted a card.

Appendix B

<u>*Additional information for result section*</u>

To increase power non-native participants were included in the analyses (N=80). To ensure that analysing native and non-native listeners in the same sample did not influence recognition accuracy, recognition accuracy (H_u scores) was examined first. These data are listed in *Table 36*.

Table B1: Mean recognition accuracy in percentage and SD for each emotional category and average emotion accuracy across emotions (Pls.sur = pleasant surprise).

	INTENDED EMOTION							
	Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Recognition accuracy	0.66	0.43	0.36	0.34	0.67	0.75	0.67	0.55
SD	0.15	0.17	0.15	0.15	0.18	0.12	0.15	0.07

Secondly, correlations between vocal emotion recognition accuracy (H_u scores) and individual differences when including non-native participants in the sample (N=80) were examined. These data are presented in *Table B2* and *Table B3*. Also, correlations between vocal emotion recognition accuracy (H_u scores) and individual differences when males were also excluded (N=45) are presented in *Table B4* and *Table B5*.

*Table B2: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and individual difference variables.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
Agreeableness	*r*-value	-0.017	.278*	-0.164	0.144	0.005	-0.106	0.016	0.041	0.044	0.01	0.105
	p-value	0.879	0.012	0.146	0.204	0.964	0.348	0.886	0.717	0.697	0.93	0.354
Conscientiousness	*r*-value	-0.081	-0.01	0.029	0.01	.237*	0.075	0.12	0.064	0.026	-0.003	0.082
	p-value	0.477	0.927	0.799	0.929	0.034	0.509	0.288	0.573	0.82	0.978	0.471
Extraversion	*r*-value	-0.039	0.016	-0.062	-0.135	-0.07	-0.004	-0.149	-0.092	-0.088	-0.031	-0.182
	p-value	0.73	0.89	0.587	0.232	0.54	0.972	0.187	0.417	0.439	0.782	0.106
Neuroticism	*r*-value	-0.034	0.001	0.163	-0.078	.231*	0.04	0.195	0.101	0.067	0.055	0.07
	p-value	0.763	0.996	0.148	0.489	0.04	0.723	0.083	0.373	0.552	0.625	0.538
Openness to experience	*r*-value	-0.119	-0.138	0.046	-.280*	-0.096	-0.214	-0.045	-0.183	-0.182	-0.139	-0.213
	p-value	0.292	0.224	0.688	0.012	0.395	0.056	0.694	0.105	0.106	0.22	0.058
Affect Intensity Measure	*r*-value	0.088	0.189	-0.024	0.113	0.116	-0.04	0.096	0.122	0.112	0.083	0.135
	p-value	0.438	0.094	0.835	0.317	0.304	0.721	0.398	0.282	0.324	0.462	0.234
Satisfaction with Life Scale	*r*-value	-0.047	0.009	0.003	0.127	-0.027	0.032	0.019	0.023	0.03	-0.005	0.096
	p-value	0.676	0.936	0.978	0.26	0.814	0.78	0.867	0.842	0.794	0.968	0.397

Note: Individual difference variables are BFI, AIM, and SWLS. Abbreviations are identical to Table 4.

*Table B3:(on following page): Correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and PANAS-X. Abbreviations are identical to Table 4 and Table 5.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
General NA	*r*-value	0.037	0.021	0.091	0.171	-0.026	-0.057	-0.041	0.05	0.06	0.038	0.088
	p-value	0.742	0.851	0.424	0.128	0.821	0.618	0.719	0.657	0.597	0.739	0.439
General PA	*r*-value	0.064	-0.149	0.084	-0.016	-0.072	-0.011	-0.105	-0.04	-0.03	-0.005	-0.076
	p-value	0.575	0.187	0.458	0.886	0.527	0.924	0.356	0.726	0.79	0.965	0.503
Basic NA	*r*-value	0.024	0.021	-0.006	0.139	-0.027	-0.104	-0.096	-0.004	0	-0.014	0.032
	p-value	0.835	0.853	0.96	0.217	0.812	0.36	0.395	0.969	0.999	0.902	0.778
Basic PA	*r*-value	0.095	-0.101	0.038	-0.008	-0.054	-0.028	-0.146	-0.037	-0.03	0.004	-0.096
	p-value	0.402	0.37	0.74	0.947	0.636	0.808	0.197	0.745	0.789	0.975	0.398
Fear	*r*-value	0.046	0.025	0.124	0.142	-0.044	-0.103	0.002	0.052	0.065	0.041	0.095
	p-value	0.687	0.828	0.274	0.209	0.699	0.365	0.986	0.647	0.567	0.717	0.402
Hostility	*r*-value	-0.05	-0.02	-0.051	0.169	0.076	-0.012	-0.149	-0.015	-0.031	-0.047	0.019
	p-value	0.657	0.857	0.654	0.133	0.503	0.917	0.187	0.895	0.788	0.676	0.867
Guilt	*r*-value	0.04	0.033	0.031	0.088	-0.09	-0.109	-0.079	-0.007	0.009	0.008	0.009
	p-value	0.725	0.773	0.788	0.437	0.429	0.335	0.487	0.951	0.937	0.947	0.937
Sadness	*r*-value	0.026	0.022	-0.114	0.073	-0.008	-0.096	-0.096	-0.04	-0.042	-0.048	-0.012
	p-value	0.819	0.843	0.313	0.52	0.941	0.399	0.397	0.728	0.713	0.67	0.918
Joviality	*r*-value	0.046	-0.073	-0.013	0.011	-0.118	-0.07	-0.169	-0.075	-0.06	-0.034	-0.098
	p-value	0.685	0.518	0.912	0.924	0.296	0.535	0.134	0.507	0.595	0.767	0.386
SelfAssuranc	*r*-value	0.069	-0.133	0.01	-0.085	0.045	0.044	-0.15	-0.045	-0.058	-0.007	-0.15
	p-value	0.542	0.24	0.928	0.452	0.694	0.695	0.184	0.691	0.611	0.948	0.184
Attentivenes	*r*-value	0.175	-0.046	0.163	0.071	-0.017	-0.019	0.017	0.087	0.098	0.1	0.058
	p-value	0.121	0.686	0.148	0.53	0.883	0.869	0.882	0.444	0.386	0.377	0.612
Shyness	*r*-value	-0.058	-0.13	-0.065	-0.014	0.117	-0.132	-0.139	-0.102	-0.134	-0.129	-0.096
	p-value	0.612	0.25	0.565	0.9	0.301	0.244	0.22	0.367	0.236	0.255	0.398
Fatigue	*r*-value	-0.012	0.022	-0.159	0.018	0.154	.264*	-0.05	0.035	0.01	0.021	-0.019
	p-value	0.917	0.848	0.16	0.871	0.172	0.018	0.659	0.756	0.93	0.852	0.867
Serenity	*r*-value	-0.138	-.297**	-0.206	-.310**	-0.177	-.235*	-0.05	-.318**	-.315**	-.299**	-.236*
	p-value	0.222	0.007	0.067	0.005	0.116	0.036	0.659	0.004	0.004	0.007	0.035
Surprise	*r*-value	0.033	-.237*	-0.055	-0.068	-0.101	-0.167	-.228*	-0.177	-0.175	-0.141	-0.187
	p-value	0.769	0.034	0.631	0.55	0.374	0.139	0.042	0.117	0.121	0.214	0.096

*Table B4: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and individual difference variables when excluding male participants.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
Agreeableness	*r*-value	-0.110	0.075	-0.070	0.036	-0.057	0.031	-0.203	-0.060	-0.056	-0.087	0.044
	p-value	0.471	0.622	0.646	0.814	0.712	0.840	0.180	0.694	0.716	0.569	0.775
Conscientiousness	*r*-value	-0.167	0.011	-0.103	0.004	0.231	0.116	0.076	0.006	-0.039	-0.076	0.069
	p-value	0.271	0.945	0.503	0.980	0.127	0.448	0.620	0.967	0.802	0.622	0.650
Extraversion	*r*-value	0.024	-0.032	-0.286	-0.284	-0.122	-0.093	-0.161	-0.193	-0.189	-0.139	-0.258
	p-value	0.876	0.832	0.057	0.059	0.424	0.543	0.292	0.205	0.213	0.363	0.087
Neuroticism	*r*-value	-0.011	0.087	0.114	-0.060	0.226	0.246	0.050	0.122	0.091	0.076	0.098
	p-value	0.941	0.568	0.456	0.696	0.136	0.104	0.744	0.424	0.554	0.618	0.521
Openness to experience	*r*-value	-0.125	-0.026	-0.046	-0.286	-0.102	0.149	-.299*	-0.152	-0.149	-0.141	-0.121
	p-value	0.412	0.866	0.764	0.057	0.506	0.330	0.046	0.317	0.329	0.356	0.429
Affect Intensity Measure	*r*-value	0.229	0.156	0.056	0.168	0.158	0.250	0.083	0.227	0.220	0.175	0.265
	p-value	0.131	0.306	0.715	0.270	0.301	0.098	0.586	0.134	0.146	0.249	0.079
Satisfaction with Life Scale	*r*-value	-0.029	0.000	-0.059	.300*	-0.097	0.033	0.082	0.040	0.063	-0.012	0.235
	p-value	0.849	0.999	0.699	0.045	0.528	0.829	0.593	0.796	0.681	0.938	0.120

Note: Individual difference variables are BFI, AIM, and SWLS. Abbreviations are identical to Table 4.

*Table B5: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) and PANAS-X when excluding male participants.*

		INTENDED EMOTION										
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	EmoAve	AveNotNeu	AveNegEm	AvePosEm
General NA	*r*-value	0.002	-0.178	0.139	0.180	0.004	-0.057	-0.041	0.013	0.013	-0.021	0.097
	p-value	0.991	0.243	0.362	0.237	0.979	0.708	0.788	0.934	0.931	0.892	0.528
General PA	*r*-value	0.164	-0.154	-0.038	0.131	-0.010	0.039	-0.022	0.024	0.028	-0.009	0.117
	p-value	0.281	0.313	0.806	0.391	0.946	0.799	0.888	0.876	0.853	0.951	0.444
Basic NA	*r*-value	0.065	-0.104	0.076	0.150	0.054	-0.103	0.010	0.036	0.029	0.018	0.049
	p-value	0.671	0.497	0.621	0.326	0.724	0.500	0.947	0.816	0.851	0.909	0.751
Basic PA	*r*-value	0.144	-0.129	-0.053	0.149	0.010	-0.038	-0.080	0.006	0.004	-0.028	0.085
	p-value	0.345	0.400	0.728	0.330	0.950	0.803	0.600	0.971	0.978	0.857	0.578
Fear	*r*-value	-0.016	-0.213	0.184	0.183	0.019	0.048	-0.060	0.028	0.027	-0.028	0.160
	p-value	0.918	0.160	0.226	0.229	0.901	0.754	0.693	0.857	0.861	0.855	0.295
Hostility	*r*-value	-0.036	-0.180	0.033	0.190	0.084	-0.186	0.044	-0.014	-0.032	-0.052	0.030
	p-value	0.812	0.238	0.828	0.210	0.583	0.220	0.776	0.928	0.835	0.734	0.845
Guilt	*r*-value	0.117	-0.051	0.132	0.048	-0.059	-0.108	-0.025	0.029	0.044	0.066	-0.027
	p-value	0.445	0.741	0.388	0.754	0.701	0.481	0.872	0.851	0.776	0.668	0.858
Sadness	*r*-value	0.120	0.042	-0.075	0.113	0.142	-0.107	0.071	0.066	0.045	0.049	0.020
	p-value	0.432	0.784	0.623	0.458	0.353	0.485	0.642	0.667	0.769	0.749	0.894
Joviality	*r*-value	0.044	-0.193	-0.034	0.062	-0.121	-0.146	-0.134	-0.098	-0.085	-0.092	-0.039
	p-value	0.776	0.204	0.826	0.684	0.429	0.337	0.382	0.521	0.580	0.549	0.798
Self Assurance	*r*-value	0.100	-0.048	-0.171	0.173	0.158	-0.020	-0.031	0.027	-0.001	-0.046	0.113
	p-value	0.512	0.754	0.262	0.257	0.300	0.894	0.840	0.861	0.993	0.766	0.461
Attentiveness	*r*-value	.297*	-0.001	0.098	0.182	0.081	0.192	0.029	0.188	0.193	0.149	0.242
	p-value	0.048	0.997	0.522	0.232	0.595	0.207	0.852	0.215	0.205	0.327	0.110
Shyness	*r*-value	0.133	-0.112	0.026	0.041	0.280	-0.051	0.116	0.084	0.038	0.048	0.000
	p-value	0.382	0.464	0.865	0.789	0.062	0.737	0.450	0.584	0.806	0.756	1.000
Fatigue	*r*-value	0.029	-0.023	-0.150	0.044	0.131	-0.139	0.168	0.003	-0.022	-0.009	-0.048
	p-value	0.852	0.882	0.327	0.774	0.391	0.361	0.269	0.983	0.885	0.952	0.752
Serenity	*r*-value	-0.088	-0.154	-.350*	-0.173	-0.063	-0.136	-0.211	-0.250	-0.264	-0.255	-0.203
	p-value	0.565	0.314	0.018	0.256	0.683	0.374	0.163	0.098	0.080	0.091	0.181
Surprise	*r*-value	0.140	-0.231	0.072	0.080	0.037	-0.237	0.075	-0.003	-0.011	0.017	-0.079
	p-value	0.357	0.127	0.638	0.603	0.809	0.116	0.624	0.982	0.942	0.914	0.605

Study 2

Appendix C

The 14 pseudo-utterances portrayed by the female actress

1. Klaff the frisp dulked lantary
2. Ganted the crasp blart fasket
3. Flob hobbered the foler frall
4. Controft jankus the curlod
5. Vian lorb dolan the wance
6. Janded the rendered hindum
7. Homit the gattast thintle
8. Spinst the ronsent doop dant
9. Humla dwarrd the ivwa crot
10. Posal windered the pample
11. Chinter fintest the romal
12. Mooled chumpet the zilted
13. Entrine the zoomit bandoom
14. Tantalint plad the bunner

Appendix D

Additional information for result section

Vocal emotion recognition accuracy (H_u scores) at each gate interval was calculated when including non-native participants in the sample (N=83).

Table D1: Recognition accuracy in percentage and SD for each emotion (pls.sur = pleasant surprise) at each gate, and average recognition for each emotion and each gate.

	GATE IDENTIFICATION						
Expression	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6	Average
Anger	0.50	0.67	0.30	0.79	0.86	0.94	0.68
SD	0.19	0.22	0.15	0.26	0.29	0.29	0.23
Disgust	0.15	0.24	0.24	0.41	0.46	0.58	0.35
SD	0.11	0.18	0.11	0.28	0.32	0.36	0.23
Fear	0.20	0.27	0.65	0.36	0.37	0.35	0.37
SD	0.13	0.16	0.32	0.22	0.23	0.24	0.22
Happy	0.06	0.09	0.25	0.14	0.16	0.17	0.14
SD	0.06	0.07	0.19	0.11	0.11	0.14	0.11
Neutral	0.28	0.32	0.28	0.48	0.52	0.50	0.40
SD	0.10	0.12	0.17	0.21	0.23	0.22	0.18
Pls.sur	0.23	0.24	0.33	0.28	0.29	0.29	0.28
SD	0.11	0.13	0.13	0.15	0.17	0.17	0.14
Sad	0.29	0.46	0.09	0.52	0.54	0.58	0.41
SD	0.14	0.22	0.08	0.25	0.28	0.27	0.21
Average	0.25	0.33	0.31	0.43	0.46	0.49	

Correlations between vocal emotion recognition accuracy (H_u scores) at each gate interval and individual differences when including non-native participants in the sample (N=83) are listed in *Table D2* to *Table D7*.

*Table D2: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 1 and individual difference variables.*

		EMOTION RECOGNITION ACCURACY AT GATE 1							
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.032	-0.049	0.077	-0.103	0.052	0.130	0.115	0.087
	p-value	0.772	0.659	0.487	0.353	0.643	0.243	0.301	0.433
Conscientiousness	*r*-value	-0.045	-0.001	0.041	-0.025	0.097	-0.038	.279*	0.085
	p-value	0.689	0.991	0.714	0.819	0.383	0.733	0.011	0.444
Extraversion	*r*-value	-0.024	0.139	0.023	0.088	0.195	-0.010	0.134	0.119
	p-value	0.827	0.211	0.836	0.428	0.078	0.932	0.227	0.284
Neuroticism	*r*-value	.294**	-0.054	-0.005	0.008	0.178	0.146	0.049	0.198
	p-value	0.007	0.626	0.964	0.942	0.108	0.188	0.657	0.073
Openness to experience	*r*-value	-0.024	0.142	0.032	0.212	0.062	0.035	0.057	0.097
	p-value	0.832	0.199	0.776	0.055	0.580	0.755	0.606	0.385
Affect Intensity Measure	*r*-value	0.088	-0.092	-0.082	0.009	.251*	0.193	0.126	0.131
	p-value	0.428	0.409	0.459	0.939	0.022	0.080	0.257	0.237
Satisfaction with Life Scale	*r*-value	-0.170	0.063	-0.182	-0.084	0.079	0.037	-0.024	-0.099
	p-value	0.125	0.569	0.100	0.451	0.480	0.740	0.831	0.372
General NA	*r*-value	0.016	-0.036	0.075	0.215	-0.030	-0.026	-0.114	-0.001
	p-value	0.885	0.747	0.498	0.051	0.785	0.814	0.304	0.992
General PA	*r*-value	-.230*	-0.150	-0.123	0.120	-0.119	-0.139	0.023	-0.202
	p-value	0.036	0.176	0.270	0.279	0.285	0.210	0.836	0.067
Basic NA	*r*-value	0.029	-0.083	0.052	0.194	-0.048	-0.003	-0.117	-0.015
	p-value	0.794	0.454	0.639	0.079	0.665	0.975	0.291	0.893
Basic PA	*r*-value	-.291**	-0.067	-0.129	0.153	-0.123	-0.152	0.005	-0.216
	p-value	0.008	0.548	0.245	0.168	0.266	0.171	0.961	0.050
Fear	*r*-value	-0.068	-0.112	0.106	0.170	0.084	-0.108	0.013	-0.008
	p-value	0.539	0.312	0.340	0.125	0.452	0.330	0.906	0.943
Hostility	*r*-value	-0.065	0.009	-0.002	0.212	-0.077	-0.008	-0.141	-0.060
	p-value	0.558	0.935	0.989	0.054	0.488	0.943	0.204	0.588
Guilt	*r*-value	0.090	0.021	0.155	0.067	-0.174	0.021	-0.075	0.039
	p-value	0.418	0.852	0.162	0.550	0.115	0.853	0.498	0.727
Sadness	*r*-value	0.121	-0.172	-0.080	0.162	0.018	0.072	-0.153	-0.017
	p-value	0.278	0.119	0.471	0.144	0.868	0.520	0.167	0.880
Joviality	*r*-value	-.274*	-0.027	-0.147	0.112	-0.088	-0.036	-0.007	-0.178
	p-value	0.012	0.805	0.183	0.312	0.426	0.745	0.952	0.107
Self Assurance	*r*-value	-.254*	-0.030	-0.073	0.209	-0.171	-.216*	-0.085	-.221*
	p-value	0.020	0.788	0.515	0.058	0.121	0.050	0.448	0.044
Attentiveness	*r*-value	-0.180	-0.137	-0.085	0.055	-0.045	-0.172	0.133	-0.135
	p-value	0.103	0.218	0.445	0.622	0.687	0.120	0.231	0.225
Shyness	*r*-value	-0.083	-0.130	-0.076	.218*	-0.012	-0.059	-0.134	-0.116
	p-value	0.455	0.241	0.496	0.047	0.913	0.599	0.227	0.297
Fatigue	*r*-value	0.159	-0.110	0.070	-0.029	-0.176	-0.033	-0.124	-0.025
	p-value	0.150	0.323	0.527	0.794	0.111	0.766	0.264	0.820
Serenity	*r*-value	-.302**	-0.130	-.227*	0.127	-0.037	-0.112	-0.030	-.247*
	p-value	0.006	0.242	0.039	0.253	0.742	0.315	0.790	0.024
Surprise	*r*-value	-0.106	-0.022	0.035	0.054	-.274*	-0.041	-0.087	-0.127
	p-value	0.342	0.841	0.752	0.629	0.012	0.714	0.433	0.251

Note: The individual difference variables are BFI, AIM, SWLS, and PANAS-X. Abbreviations are identical to Table 4 and Table 5.

*Table D3: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 2 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 2							
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.196	0.050	-0.047	-0.009	0.151	0.089	-0.038	0.105
	p-value	0.076	0.651	0.673	0.937	0.174	0.425	0.733	0.345
Conscientiousness	*r*-value	0.070	0.062	0.047	0.067	-0.001	0.102	-0.058	0.074
	p-value	0.531	0.580	0.670	0.549	0.989	0.358	0.602	0.505
Extraversion	*r*-value	.244*	0.215	0.121	0.197	0.204	0.046	-0.018	.218*
	p-value	0.026	0.051	0.275	0.075	0.064	0.681	0.871	0.048
Neuroticism	*r*-value	-0.002	-0.057	0.021	-0.072	0.018	0.156	0.060	0.045
	p-value	0.985	0.607	0.848	0.516	0.871	0.159	0.588	0.688
Openness to experience	*r*-value	0.047	0.165	0.057	-0.026	0.068	-0.024	0.136	0.093
	p-value	0.673	0.137	0.609	0.814	0.543	0.829	0.219	0.402
Affect Intensity Measure	*r*-value	0.028	-0.005	0.057	0.075	0.136	.217*	-0.017	0.114
	p-value	0.800	0.961	0.610	0.499	0.220	0.049	0.876	0.307
Satisfaction with Life Scale	*r*-value	0.168	0.193	0.083	.220*	0.175	0.144	-0.084	0.197
	p-value	0.128	0.081	0.456	0.045	0.113	0.194	0.452	0.074
General NA	*r*-value	-0.169	-0.196	-0.033	-0.107	-0.181	0.034	-0.094	-0.154
	p-value	0.127	0.076	0.768	0.335	0.101	0.762	0.396	0.165
General PA	*r*-value	-0.033	-0.055	0.095	0.065	0.007	-0.130	-.230*	-0.076
	p-value	0.769	0.621	0.393	0.559	0.950	0.243	0.037	0.493
Basic NA	*r*-value	-0.147	-0.206	-0.009	-0.129	-0.083	-0.039	-0.100	-0.154
	p-value	0.185	0.061	0.934	0.245	0.457	0.726	0.371	0.165
Basic PA	*r*-value	-0.018	-0.017	0.085	0.121	-0.015	-0.131	-0.210	-0.060
	p-value	0.868	0.878	0.446	0.278	0.893	0.238	0.057	0.592
Fear	*r*-value	-0.034	-0.078	0.102	-0.038	-0.007	0.113	-0.113	0.003
	p-value	0.763	0.483	0.361	0.734	0.947	0.310	0.310	0.982
Hostility	*r*-value	-.240*	-.268*	-0.092	-0.117	-.258*	-0.123	-0.017	-.254*
	p-value	0.029	0.014	0.409	0.290	0.018	0.269	0.881	0.021
Guilt	*r*-value	-0.064	-0.091	-0.071	0.004	-0.009	0.020	-0.150	-0.080
	p-value	0.563	0.416	0.523	0.968	0.937	0.856	0.175	0.474
Sadness	*r*-value	-0.118	-0.203	0.035	-.238*	0.011	-0.116	-0.038	-0.143
	p-value	0.287	0.066	0.753	0.030	0.920	0.295	0.730	0.197
Joviality	*r*-value	0.067	0.024	0.089	0.148	0.067	-0.074	-0.071	0.036
	p-value	0.546	0.827	0.424	0.182	0.547	0.509	0.522	0.743
Self Assurance	*r*-value	-0.087	-0.033	0.058	0.065	-0.146	-0.180	-.369**	-0.162
	p-value	0.432	0.769	0.605	0.559	0.187	0.104	0.001	0.144
Attentiveness	*r*-value	-0.067	-0.057	0.057	0.066	0.017	-0.084	-0.116	-0.059
	p-value	0.547	0.606	0.611	0.554	0.877	0.448	0.295	0.594
Shyness	*r*-value	-0.148	-0.170	-0.018	-0.189	-0.068	-0.112	-0.134	-0.180
	p-value	0.181	0.123	0.875	0.087	0.542	0.314	0.228	0.104
Fatigue	*r*-value	-.306**	-0.199	0.008	-.218*	-0.139	-0.074	-0.037	-0.214
	p-value	0.005	0.071	0.945	0.047	0.211	0.509	0.739	0.052
Serenity	*r*-value	-0.040	-0.001	-0.023	0.072	0.006	-0.123	-0.096	-0.065
	p-value	0.718	0.992	0.833	0.516	0.958	0.267	0.386	0.560
Surprise	*r*-value	-0.054	-0.083	0.010	-0.053	-0.070	-0.090	-0.155	-0.107
	p-value	0.626	0.457	0.926	0.637	0.528	0.417	0.163	0.334

*Table D4: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 3 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 3							
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.113	0.132	-0.010	0.051	-0.048	-0.010	0.154	0.079
	p-value	0.310	0.234	0.929	0.646	0.664	0.930	0.164	0.475
Conscientiousness	*r*-value	.280*	-0.035	-0.120	0.063	0.044	0.064	-0.002	0.038
	p-value	0.010	0.754	0.279	0.570	0.694	0.565	0.989	0.733
Extraversion	*r*-value	0.137	-0.008	-0.063	0.215	0.119	0.197	0.204	0.165
	p-value	0.216	0.941	0.574	0.051	0.284	0.074	0.065	0.136
Neuroticism	*r*-value	0.047	0.143	0.199	-0.058	0.020	-0.070	0.015	0.123
	p-value	0.672	0.196	0.071	0.600	0.860	0.529	0.895	0.269
Openness to experience	*r*-value	0.058	0.032	-0.050	0.160	0.061	-0.027	0.073	0.072
	p-value	0.605	0.776	0.654	0.149	0.585	0.811	0.512	0.516
Affect Intensity Measure	*r*-value	0.123	0.195	0.010	-0.009	0.059	0.076	0.138	0.123
	p-value	0.267	0.077	0.926	0.934	0.594	0.497	0.212	0.268
Satisfaction with Life Scale	*r*-value	-0.030	0.036	0.104	0.191	0.087	.221*	0.182	0.202
	p-value	0.789	0.748	0.348	0.083	0.436	0.044	0.099	0.067
General NA	*r*-value	-0.113	-0.026	0.053	-0.202	-0.033	-0.105	-0.183	-0.127
	p-value	0.310	0.814	0.633	0.066	0.768	0.343	0.098	0.252
General PA	*r*-value	0.026	-0.137	-0.096	-0.059	0.096	0.065	0.012	-0.050
	p-value	0.819	0.217	0.386	0.594	0.390	0.559	0.913	0.652
Basic NA	*r*-value	-0.116	-0.004	0.041	-0.214	-0.009	-0.127	-0.085	-0.109
	p-value	0.298	0.970	0.710	0.052	0.935	0.251	0.444	0.326
Basic PA	*r*-value	0.007	-0.149	-0.153	-0.022	0.087	0.120	-0.011	-0.075
	p-value	0.950	0.179	0.166	0.843	0.435	0.282	0.924	0.498
Fear	*r*-value	0.014	-0.107	0.088	-0.088	0.101	-0.036	-0.009	0.024
	p-value	0.898	0.334	0.427	0.427	0.364	0.747	0.936	0.829
Hostility	*r*-value	-0.138	-0.009	-0.153	-.272*	-0.090	-0.116	-.260*	-.292**
	p-value	0.212	0.937	0.167	0.013	0.418	0.295	0.018	0.007
Guilt	*r*-value	-0.072	0.021	0.105	-0.096	-0.074	0.006	-0.011	-0.011
	p-value	0.515	0.851	0.343	0.388	0.504	0.960	0.923	0.921
Sadness	*r*-value	-0.155	0.069	0.088	-0.207	0.037	-.238*	0.008	-0.060
	p-value	0.163	0.533	0.430	0.060	0.737	0.031	0.941	0.592
Joviality	*r*-value	-0.007	-0.034	-.220*	0.020	0.093	0.146	0.071	-0.057
	p-value	0.947	0.762	0.046	0.854	0.404	0.187	0.526	0.610
Self Assurance	*r*-value	-0.081	-0.214	-0.075	-0.038	0.056	0.064	-0.141	-0.115
	p-value	0.465	0.052	0.501	0.730	0.612	0.563	0.205	0.299
Attentiveness	*r*-value	0.135	-0.169	-0.040	-0.060	0.059	0.065	0.018	-0.010
	p-value	0.223	0.127	0.721	0.590	0.599	0.557	0.870	0.931
Shyness	*r*-value	-0.136	-0.057	0.017	-0.177	-0.017	-0.190	-0.072	-0.132
	p-value	0.222	0.607	0.875	0.109	0.876	0.085	0.520	0.235
Fatigue	*r*-value	-0.122	-0.035	0.101	-0.201	0.009	-.217*	-0.142	-0.099
	p-value	0.273	0.754	0.365	0.068	0.935	0.048	0.201	0.372
Serenity	*r*-value	-0.031	-0.111	-.226*	0.002	-0.018	0.071	0.011	-0.139
	p-value	0.778	0.320	0.040	0.988	0.873	0.525	0.924	0.211
Surprise	*r*-value	-0.081	-0.040	-0.152	-0.086	0.015	-0.053	-0.066	-0.148
	p-value	0.466	0.722	0.171	0.438	0.895	0.636	0.555	0.182

*Table D5: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 4 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 4							
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.046	0.156	0.093	-0.024	0.130	0.181	0.123	0.157
	p-value	0.682	0.158	0.403	0.830	0.243	0.102	0.270	0.155
Conscientiousness	*r*-value	0.043	0.088	0.140	0.107	0.131	0.145	0.136	0.156
	p-value	0.702	0.427	0.206	0.335	0.238	0.190	0.220	0.160
Extraversion	*r*-value	0.142	0.108	0.126	0.047	0.176	0.064	0.113	0.162
	p-value	0.201	0.332	0.257	0.674	0.112	0.568	0.309	0.143
Neuroticism	*r*-value	0.205	-0.008	-0.013	0.025	-0.099	0.106	-0.023	0.050
	p-value	0.063	0.939	0.906	0.824	0.374	0.340	0.837	0.654
Openness to experience	*r*-value	0.068	0.117	0.086	0.053	0.053	0.130	0.149	0.135
	p-value	0.543	0.293	0.439	0.632	0.633	0.242	0.180	0.224
Affect Intensity Measure	*r*-value	0.032	-0.043	0.131	0.084	0.147	.258*	-0.076	0.113
	p-value	0.776	0.703	0.237	0.449	0.185	0.019	0.496	0.308
Satisfaction with Life Scale	*r*-value	0.098	0.158	-0.055	0.055	0.102	0.185	0.068	0.135
	p-value	0.380	0.154	0.624	0.623	0.359	0.093	0.541	0.222
General NA	*r*-value	-0.054	-0.026	0.076	0.006	-.228*	-0.016	-0.066	-0.063
	p-value	0.631	0.813	0.496	0.954	0.038	0.885	0.551	0.569
General PA	*r*-value	-0.148	-0.097	0.091	-0.055	0.052	0.012	-0.030	-0.040
	p-value	0.182	0.385	0.414	0.619	0.637	0.911	0.788	0.723
Basic NA	*r*-value	-0.067	-0.069	0.043	-0.055	-.260*	-0.047	-0.106	-0.111
	p-value	0.547	0.537	0.700	0.624	0.018	0.672	0.341	0.318
Basic PA	*r*-value	-0.158	-0.075	0.053	-0.072	0.042	0.005	-0.017	-0.048
	p-value	0.154	0.501	0.632	0.516	0.707	0.963	0.877	0.667
Fear	*r*-value	0.022	0.032	0.197	0.034	-0.127	0.060	-0.068	0.037
	p-value	0.843	0.776	0.075	0.758	0.251	0.588	0.543	0.738
Hostility	*r*-value	-0.195	-0.197	-0.037	-0.121	-.290**	-0.110	-0.113	-.222*
	p-value	0.077	0.074	0.743	0.275	0.008	0.324	0.311	0.044
Guilt	*r*-value	-0.017	0.056	0.067	-0.081	-0.172	0.055	-0.065	-0.015
	p-value	0.880	0.613	0.545	0.466	0.119	0.623	0.561	0.895
Sadness	*r*-value	-0.019	-0.098	-0.073	-0.003	-.221*	-0.139	-0.086	-0.137
	p-value	0.861	0.379	0.512	0.981	0.044	0.211	0.440	0.216
Joviality	*r*-value	-0.079	-0.009	0.026	-0.050	0.129	0.079	0.057	0.032
	p-value	0.478	0.937	0.813	0.653	0.244	0.477	0.607	0.772
Self Assurance	*r*-value	-.222*	-0.125	0.018	-0.097	-0.132	-0.096	-0.181	-0.170
	p-value	0.043	0.261	0.873	0.385	0.236	0.389	0.101	0.124
Attentiveness	*r*-value	-0.112	-0.078	0.109	-0.034	0.080	0.000	0.069	-0.003
	p-value	0.315	0.484	0.329	0.760	0.472	0.997	0.537	0.982
Shyness	*r*-value	-0.115	0.002	-0.086	0.088	-0.144	-0.067	-0.090	-0.095
	p-value	0.298	0.986	0.438	0.428	0.193	0.546	0.420	0.391
Fatigue	*r*-value	-.256*	-0.119	-0.166	-0.157	-.331**	-0.129	-.271*	-.283**
	p-value	0.020	0.284	0.133	0.157	0.002	0.245	0.013	0.009
Serenity	*r*-value	-.271*	-0.123	-0.055	-0.088	0.037	0.040	-0.066	-0.112
	p-value	0.013	0.270	0.623	0.428	0.742	0.716	0.554	0.312
Surprise	*r*-value	-.265*	-0.163	-0.041	-0.209	-0.196	-0.091	-0.154	-.223*
	p-value	0.016	0.142	0.710	0.058	0.076	0.414	0.164	0.043

*Table D6: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 5 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 5							
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.098	0.087	0.096	0.039	0.048	0.214	0.077	0.145
	p-value	0.377	0.434	0.389	0.727	0.667	0.052	0.487	0.192
Conscientiousness	*r*-value	0.104	0.103	0.104	-0.015	0.109	0.118	0.069	0.135
	p-value	0.351	0.356	0.350	0.896	0.327	0.287	0.537	0.224
Extraversion	*r*-value	-0.013	-0.011	0.068	0.044	0.176	0.119	-0.021	0.072
	p-value	0.907	0.921	0.541	0.690	0.110	0.284	0.848	0.515
Neuroticism	*r*-value	0.134	0.074	-0.002	0.050	0.079	0.103	0.029	0.104
	p-value	0.227	0.506	0.988	0.651	0.480	0.354	0.793	0.350
Openness to experience	*r*-value	0.066	0.103	0.024	-0.092	0.060	-0.006	0.024	0.056
	p-value	0.552	0.356	0.832	0.409	0.589	0.956	0.832	0.617
Affect Intensity Measure	*r*-value	0.006	-0.047	0.003	0.062	0.144	0.120	-0.116	0.035
	p-value	0.959	0.675	0.980	0.580	0.195	0.282	0.295	0.754
Satisfaction with Life Scale	*r*-value	0.037	0.084	-0.101	0.068	0.208	0.045	0.032	0.077
	p-value	0.742	0.450	0.364	0.544	0.059	0.686	0.775	0.490
General NA	*r*-value	-0.149	0.046	-0.011	0.049	-0.174	-0.076	-0.019	-0.079
	p-value	0.180	0.682	0.920	0.657	0.115	0.493	0.861	0.480
General PA	*r*-value	-0.116	-0.039	-0.013	-0.032	-0.036	-0.021	-0.097	-0.073
	p-value	0.296	0.729	0.908	0.773	0.744	0.853	0.382	0.514
Basic NA	*r*-value	-0.129	0.045	-0.064	0.004	-0.147	-0.081	0.000	-0.082
	p-value	0.246	0.689	0.563	0.973	0.185	0.467	0.997	0.464
Basic PA	*r*-value	-0.128	-0.032	-0.096	-0.021	-0.064	-0.077	-0.084	-0.106
	p-value	0.248	0.773	0.390	0.850	0.566	0.489	0.451	0.338
Fear	*r*-value	-0.110	0.056	0.033	0.009	-0.157	0.031	-0.077	-0.040
	p-value	0.323	0.614	0.768	0.936	0.155	0.782	0.492	0.717
Hostility	*r*-value	-.245*	-0.087	-0.129	0.037	-0.160	-0.131	-0.054	-0.180
	p-value	0.026	0.436	0.244	0.740	0.149	0.239	0.628	0.104
Guilt	*r*-value	-0.006	0.162	0.033	-0.016	-0.161	-0.029	0.091	0.023
	p-value	0.956	0.145	0.764	0.887	0.146	0.794	0.414	0.835
Sadness	*r*-value	-0.049	0.012	-0.127	-0.016	0.003	-0.115	0.031	-0.058
	p-value	0.658	0.911	0.252	0.885	0.980	0.300	0.781	0.601
Joviality	*r*-value	-0.060	-0.036	-0.118	0.033	-0.020	-0.042	-0.039	-0.066
	p-value	0.591	0.746	0.288	0.767	0.858	0.703	0.727	0.555
Self Assurance	*r*-value	-.269*	-0.021	-0.103	-0.115	-0.159	-0.110	-0.159	-0.187
	p-value	0.014	0.852	0.355	0.302	0.151	0.323	0.152	0.090
Attentiveness	*r*-value	0.011	-0.019	0.012	0.016	0.019	-0.046	-0.015	-0.008
	p-value	0.922	0.865	0.912	0.888	0.862	0.679	0.895	0.943
Shyness	*r*-value	-0.196	0.035	-0.077	0.052	-0.093	-0.111	-0.085	-0.108
	p-value	0.076	0.751	0.490	0.643	0.400	0.319	0.445	0.331
Fatigue	*r*-value	-0.128	-0.092	-0.045	-0.066	-0.140	-0.205	-0.139	-0.172
	p-value	0.250	0.408	0.685	0.553	0.206	0.063	0.211	0.121
Serenity	*r*-value	-0.206	-0.152	-.244*	-0.077	-0.005	-0.121	-0.161	-0.205
	p-value	0.062	0.170	0.026	0.491	0.961	0.277	0.145	0.063
Surprise	*r*-value	-0.199	-0.033	-0.119	-0.212	-0.214	-0.128	-0.149	-0.200
	p-value	0.071	0.766	0.286	0.054	0.052	0.250	0.180	0.070

*Table D7: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 6 and individual difference variables (BFI, AIM, SWLS, and PANAS-X). Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 6							
Measure		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.075	0.136	.224*	0.016	0.144	.320**	0.094	0.212
	p-value	0.500	0.222	0.042	0.886	0.193	0.003	0.399	0.054
Conscientiousness	*r*-value	0.150	0.159	0.138	0.015	0.211	.265*	0.145	.227*
	p-value	0.177	0.151	0.214	0.891	0.055	0.015	0.192	0.039
Extraversion	*r*-value	0.128	0.037	0.186	.230*	0.192	0.121	0.168	0.188
	p-value	0.249	0.737	0.093	0.037	0.083	0.278	0.128	0.089
Neuroticism	*r*-value	0.134	0.126	0.057	-0.013	0.052	0.031	-0.052	0.088
	p-value	0.227	0.257	0.606	0.905	0.641	0.781	0.641	0.431
Openness to experience	*r*-value	0.092	0.188	0.120	0.073	0.106	-0.035	.237*	0.153
	p-value	0.408	0.089	0.282	0.512	0.341	0.756	0.031	0.167
Affect Intensity Measure	*r*-value	0.096	0.045	0.195	0.097	0.103	0.163	-0.014	0.137
	p-value	0.389	0.687	0.078	0.382	0.355	0.141	0.901	0.215
Satisfaction with Life Scale	*r*-value	0.163	0.092	0.196	0.138	0.214	.279*	0.049	.226*
	p-value	0.141	0.409	0.076	0.212	0.052	0.011	0.661	0.040
General NA	*r*-value	-0.153	0.056	0.018	-0.145	-.247*	-0.172	-0.090	-0.128
	p-value	0.167	0.616	0.872	0.191	0.024	0.121	0.420	0.250
General PA	*r*-value	-0.108	-0.128	0.051	-0.009	0.044	0.012	-0.062	-0.053
	p-value	0.329	0.247	0.649	0.933	0.694	0.916	0.581	0.637
Basic NA	*r*-value	-0.149	0.005	-0.020	-0.203	-.220*	-0.180	-0.149	-0.161
	p-value	0.177	0.962	0.855	0.066	0.046	0.104	0.179	0.146
Basic PA	*r*-value	-0.180	-0.156	-0.046	0.011	-0.014	0.002	-0.075	-0.109
	p-value	0.103	0.159	0.678	0.918	0.902	0.985	0.503	0.328
Fear	*r*-value	-0.041	0.097	0.131	-0.061	-0.184	-0.081	-0.093	-0.027
	p-value	0.711	0.383	0.237	0.582	0.096	0.465	0.402	0.810
Hostility	*r*-value	-.221*	-0.125	-0.157	-.221*	-.248*	-.245*	-0.129	-.262*
	p-value	0.045	0.259	0.155	0.045	0.024	0.025	0.247	0.017
Guilt	*r*-value	-0.120	0.075	0.066	-0.190	-.227*	-0.132	-0.073	-0.095
	p-value	0.281	0.501	0.553	0.085	0.039	0.235	0.512	0.392
Sadness	*r*-value	-0.086	-0.022	-0.089	-0.159	-0.045	-0.106	-0.167	-0.117
	p-value	0.441	0.843	0.425	0.151	0.684	0.341	0.131	0.294
Joviality	*r*-value	-0.124	-0.172	-0.053	0.042	-0.016	0.005	-0.065	-0.096
	p-value	0.265	0.121	0.632	0.703	0.885	0.965	0.558	0.386
Self Assurance	*r*-value	-.291**	-0.135	-0.094	-0.116	-0.106	-0.033	-0.158	-0.188
	p-value	0.008	0.224	0.398	0.295	0.338	0.770	0.155	0.088
Attentiveness	*r*-value	-0.025	-0.055	0.054	0.109	0.113	0.039	0.059	0.038
	p-value	0.825	0.619	0.628	0.328	0.309	0.729	0.595	0.734
Shyness	*r*-value	-.273*	-0.068	-0.113	-0.164	-0.210	-0.154	-.254*	-.232*
	p-value	0.013	0.543	0.310	0.139	0.057	0.165	0.021	0.035
Fatigue	*r*-value	-.221*	-0.084	-0.088	-.245*	-.236*	-0.142	-.270*	-.233*
	p-value	0.045	0.451	0.427	0.026	0.032	0.201	0.014	0.034
Serenity	*r*-value	-0.207	-.238*	-0.115	-0.112	-0.049	-0.059	-0.118	-0.192
	p-value	0.061	0.030	0.300	0.313	0.657	0.594	0.289	0.081
Surprise	*r*-value	-.262*	-0.147	-0.157	-0.154	-.225*	-0.171	-0.180	-.256*
	p-value	0.017	0.186	0.156	0.166	0.041	0.123	0.104	0.019

Also, vocal emotion recognition accuracy (H_u scores) at each gate interval was correlated with individual difference variables when male listeners were also excluded from the sample (N=49). Data are listed in *Table D8* to *Table D13*.

*Table D8: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 1 and individual difference variables (BFI, AIM, SWLS, and PANAS-X) when excluding male participants. Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 1							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	-0.097	-0.130	0.041	-0.216	-0.016	0.108	0.101	-0.038
	p-value	0.508	0.372	0.778	0.137	0.915	0.462	0.490	0.798
Conscientiousness	*r*-value	-0.220	-0.114	-0.122	0.012	0.040	-0.063	.352*	-0.054
	p-value	0.129	0.435	0.403	0.932	0.786	0.667	0.013	0.713
Extraversion	*r*-value	-0.129	0.079	-0.050	0.262	0.082	0.005	0.150	0.044
	p-value	0.378	0.588	0.733	0.069	0.576	0.971	0.304	0.762
Neuroticism	*r*-value	.398**	0.062	0.072	-0.033	0.271	0.138	0.185	.325*
	p-value	0.005	0.672	0.622	0.821	0.059	0.345	0.203	0.023
Openness to Experience	*r*-value	-0.089	0.218	-0.109	.341*	0.063	0.058	-0.048	0.042
	p-value	0.542	0.132	0.458	0.017	0.669	0.695	0.741	0.775
Affect Intensity Measure	*r*-value	.293*	-0.011	0.040	0.057	0.233	.303*	.350*	.344*
	p-value	0.041	0.941	0.783	0.695	0.107	0.034	0.014	0.016
Satisfaction with Life Scale	*r*-value	-0.216	0.119	-0.103	-0.128	-0.028	-0.067	0.237	-0.062
	p-value	0.136	0.414	0.483	0.381	0.850	0.647	0.102	0.674
General NA	*r*-value	0.171	0.036	0.066	0.275	-0.011	0.045	-0.186	0.087
	p-value	0.240	0.806	0.652	0.056	0.941	0.759	0.200	0.554
General PA	*r*-value	-0.241	-0.138	-0.116	.343*	-0.222	-0.197	-0.004	-0.203
	p-value	0.095	0.345	0.426	0.016	0.124	0.176	0.977	0.161
Basic NA	*r*-value	0.161	0.033	0.078	0.271	-0.032	0.013	-0.220	0.064
	p-value	0.268	0.820	0.596	0.060	0.829	0.928	0.128	0.663
Basic PA	*r*-value	-0.269	-0.089	-0.074	.377**	-0.217	-0.168	0.012	-0.178
	p-value	0.061	0.544	0.612	0.008	0.133	0.248	0.935	0.220
Fear	*r*-value	0.141	0.048	0.109	.379**	0.049	-0.052	-0.086	0.118
	p-value	0.334	0.746	0.454	0.007	0.740	0.721	0.558	0.420
Hostility	*r*-value	0.018	0.045	-0.049	0.269	0.039	-0.009	-.283*	-0.028
	p-value	0.902	0.758	0.740	0.061	0.792	0.951	0.049	0.846
Guilt	*r*-value	0.195	0.084	0.153	0.090	-0.162	0.062	-0.156	0.083
	p-value	0.179	0.568	0.295	0.538	0.265	0.671	0.284	0.570
Sadness	*r*-value	0.183	-0.064	0.054	0.176	-0.020	0.033	-0.181	0.052
	p-value	0.207	0.665	0.713	0.226	0.893	0.822	0.214	0.723
Joviality	*r*-value	-0.192	-0.030	-0.070	.314*	-0.175	-0.018	0.113	-0.072
	p-value	0.186	0.836	0.635	0.028	0.229	0.900	0.440	0.623
Self Assurance	*r*-value	-.305*	-0.122	-0.081	.410**	-0.275	-0.212	-0.199	-0.275
	p-value	0.033	0.405	0.579	0.003	0.056	0.143	0.170	0.056
Attentiveness	*r*-value	-0.202	-0.098	-0.030	0.225	-0.091	-0.278	0.106	-0.135
	p-value	0.164	0.503	0.836	0.119	0.536	0.053	0.468	0.355
Shyness	*r*-value	0.071	-0.004	0.132	0.245	-0.039	0.004	-0.088	0.060
	p-value	0.628	0.976	0.367	0.090	0.793	0.979	0.548	0.683
Fatigue	*r*-value	.294*	-0.074	0.249	-0.033	-0.134	-0.027	-0.161	0.081
	p-value	0.040	0.613	0.085	0.820	0.357	0.853	0.270	0.580
Serenity	*r*-value	-.369**	-0.103	-0.019	0.231	-0.062	-0.151	0.128	-0.160
	p-value	0.009	0.482	0.896	0.111	0.670	0.301	0.380	0.271
Surprise	*r*-value	-0.050	-0.048	0.058	0.176	-.283*	-0.074	-0.248	-0.137
	p-value	0.732	0.745	0.693	0.226	0.049	0.613	0.085	0.350

*Table D9: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 2 and individual difference variables (BFI, AIM, SWLS, and PANAS-X) when excluding male participants. Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 2							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.160	-0.025	-0.194	0.003	0.083	-0.031	0.079	0.030
	p-value	0.273	0.866	0.181	0.981	0.569	0.834	0.588	0.837
Conscientiousness	*r*-value	0.053	-0.034	-0.010	0.056	-0.060	-0.044	-0.034	-0.019
	p-value	0.717	0.816	0.947	0.704	0.681	0.763	0.819	0.895
Extraversion	*r*-value	0.131	0.266	-0.004	0.271	0.103	-0.046	-0.020	0.136
	p-value	0.368	0.065	0.979	0.059	0.480	0.753	0.890	0.352
Neuroticism	*r*-value	0.129	-0.045	0.116	0.075	0.067	0.128	0.262	0.179
	p-value	0.379	0.761	0.428	0.610	0.649	0.380	0.069	0.219
Openness to Experience	*r*-value	-0.064	0.151	-0.048	-0.156	-0.024	0.159	-0.144	-0.024
	p-value	0.661	0.300	0.744	0.284	0.871	0.274	0.323	0.872
Affect Intensity Measure	*r*-value	0.136	0.052	0.144	0.120	0.067	0.018	0.213	0.179
	p-value	0.352	0.725	0.323	0.413	0.646	0.904	0.141	0.219
Satisfaction with Life Scale	*r*-value	0.246	0.264	0.049	.354*	0.087	-0.143	0.136	0.215
	p-value	0.088	0.067	0.740	0.013	0.553	0.325	0.350	0.138
General NA	*r*-value	-0.051	-0.119	0.170	-0.057	-0.129	-0.003	0.055	-0.019
	p-value	0.727	0.416	0.244	0.695	0.379	0.983	0.709	0.894
General PA	*r*-value	-0.076	-0.071	0.008	0.002	-0.158	-0.272	-0.259	-0.201
	p-value	0.603	0.628	0.956	0.987	0.277	0.059	0.072	0.166
Basic NA	*r*-value	-0.022	-0.123	0.185	-0.038	-0.038	-0.012	0.017	-0.004
	p-value	0.883	0.400	0.203	0.798	0.796	0.937	0.906	0.980
Basic PA	*r*-value	0.009	-0.024	0.059	0.046	-0.128	-0.228	-.307*	-0.149
	p-value	0.951	0.869	0.689	0.751	0.382	0.114	0.032	0.308
Fear	*r*-value	0.117	0.034	0.268	0.097	-0.005	0.062	0.065	0.145
	p-value	0.423	0.816	0.063	0.509	0.975	0.673	0.656	0.320
Hostility	*r*-value	-0.094	-0.194	0.074	-0.146	-0.184	-0.033	-0.109	-0.148
	p-value	0.519	0.181	0.614	0.316	0.206	0.822	0.456	0.310
Guilt	*r*-value	0.053	0.020	0.085	0.095	0.066	-0.111	0.107	0.071
	p-value	0.717	0.892	0.563	0.518	0.652	0.450	0.466	0.626
Sadness	*r*-value	-0.122	-0.239	0.204	-0.143	0.008	0.056	0.007	-0.050
	p-value	0.405	0.098	0.159	0.326	0.955	0.702	0.960	0.731
Joviality	*r*-value	0.123	0.050	0.067	0.114	-0.002	-0.097	-0.204	-0.007
	p-value	0.399	0.732	0.649	0.437	0.991	0.508	0.161	0.963
Self Assurance	*r*-value	-0.114	-0.112	0.031	-0.058	-.286*	-.361*	-.378**	-.301*
	p-value	0.434	0.442	0.831	0.690	0.046	0.011	0.007	0.035
Attentiveness	*r*-value	-0.036	-0.025	0.046	0.040	-0.067	-0.153	-0.216	-0.112
	p-value	0.808	0.863	0.752	0.787	0.650	0.295	0.136	0.446
Shyness	*r*-value	-0.019	-0.128	0.164	-0.154	-0.059	-0.019	-0.084	-0.057
	p-value	0.897	0.381	0.259	0.291	0.688	0.897	0.568	0.697
Fatigue	*r*-value	-0.220	-0.140	0.105	-0.138	0.009	-0.009	0.020	-0.085
	p-value	0.129	0.338	0.473	0.345	0.951	0.950	0.892	0.560
Serenity	*r*-value	-0.037	0.065	-0.034	0.065	-0.038	-0.127	-0.111	-0.062
	p-value	0.798	0.659	0.816	0.659	0.794	0.386	0.448	0.672
Surprise	*r*-value	-0.054	-0.100	-0.053	-0.162	-0.252	-0.154	-0.226	-0.215
	p-value	0.711	0.496	0.717	0.267	0.081	0.292	0.118	0.138

*Table D10: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 3 and individual difference variables (BFI, AIM, SWLS, and PANAS-X) when excluding male participants. Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 3							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.100	0.108	0.004	-0.017	-0.198	0.090	0.002	0.004
	p-value	0.495	0.461	0.979	0.908	0.172	0.539	0.987	0.978
Conscientiousness	*r*-value	.348*	-0.061	-0.201	-0.029	-0.013	-0.056	0.053	-0.048
	p-value	0.014	0.679	0.166	0.845	0.928	0.700	0.717	0.741
Extraversion	*r*-value	0.152	0.007	-0.022	0.268	-0.008	0.107	0.271	0.160
	p-value	0.298	0.961	0.879	0.062	0.957	0.465	0.060	0.271
Neuroticism	*r*-value	0.183	0.134	0.080	-0.051	0.118	0.065	0.077	0.142
	p-value	0.208	0.360	0.586	0.727	0.418	0.657	0.598	0.329
Openness to Experience	*r*-value	-0.050	0.055	-0.035	0.146	-0.044	-0.021	-0.157	-0.008
	p-value	0.733	0.707	0.811	0.317	0.765	0.885	0.280	0.959
Affect Intensity Measure	*r*-value	.347*	.304*	0.100	0.051	0.142	0.072	0.120	0.264
	p-value	0.015	0.034	0.494	0.730	0.330	0.621	0.413	0.067
Satisfaction with Life Scale	*r*-value	0.232	-0.067	0.209	0.266	0.045	0.096	.354*	.295*
	p-value	0.109	0.649	0.149	0.065	0.761	0.512	0.012	0.039
General NA	*r*-value	-0.187	0.043	-0.013	-0.128	0.170	-0.132	-0.054	-0.067
	p-value	0.198	0.770	0.931	0.380	0.243	0.368	0.713	0.647
General PA	*r*-value	-0.005	-0.195	-0.132	-0.072	0.007	-0.153	0.001	-0.153
	p-value	0.974	0.180	0.364	0.625	0.960	0.294	0.994	0.295
Basic NA	*r*-value	-0.221	0.011	-0.067	-0.135	0.186	-0.042	-0.035	-0.083
	p-value	0.127	0.941	0.647	0.356	0.200	0.777	0.811	0.572
Basic PA	*r*-value	0.011	-0.165	-0.207	-0.026	0.058	-0.125	0.044	-0.140
	p-value	0.939	0.258	0.153	0.857	0.691	0.394	0.764	0.337
Fear	*r*-value	-0.088	-0.054	0.066	0.021	0.269	-0.007	0.099	0.092
	p-value	0.548	0.713	0.654	0.885	0.062	0.960	0.497	0.532
Hostility	*r*-value	-.282*	-0.011	-0.197	-0.202	0.075	-0.188	-0.143	-0.257
	p-value	0.050	0.939	0.176	0.164	0.607	0.195	0.326	0.075
Guilt	*r*-value	-0.158	0.061	0.138	0.010	0.080	0.065	0.097	0.092
	p-value	0.280	0.677	0.346	0.946	0.583	0.656	0.509	0.528
Sadness	*r*-value	-0.181	0.031	-0.202	-0.247	0.211	0.004	-0.142	-0.166
	p-value	0.214	0.835	0.164	0.087	0.146	0.979	0.329	0.255
Joviality	*r*-value	0.111	-0.016	-0.228	0.049	0.066	0.002	0.110	-0.040
	p-value	0.446	0.911	0.115	0.740	0.655	0.990	0.451	0.783
Self Assurance	*r*-value	-0.198	-0.209	-0.195	-0.114	0.031	-.286*	-0.060	-0.270
	p-value	0.174	0.150	0.179	0.436	0.831	0.046	0.681	0.061
Attentiveness	*r*-value	0.104	-0.274	-0.065	-0.028	0.047	-0.062	0.039	-0.064
	p-value	0.478	0.056	0.656	0.849	0.749	0.673	0.792	0.664
Shyness	*r*-value	-0.089	0.004	-0.083	-0.138	0.165	-0.065	-0.155	-0.089
	p-value	0.544	0.978	0.570	0.345	0.257	0.658	0.287	0.544
Fatigue	*r*-value	-0.158	-0.030	0.055	-0.143	0.109	0.003	-0.136	-0.045
	p-value	0.277	0.836	0.707	0.326	0.457	0.982	0.350	0.760
Serenity	*r*-value	0.126	-0.150	-0.214	0.070	-0.037	-0.031	0.061	-0.090
	p-value	0.390	0.305	0.139	0.632	0.802	0.831	0.676	0.540
Surprise	*r*-value	-0.239	-0.073	-0.073	-0.102	-0.050	-0.253	-0.163	-0.219
	p-value	0.098	0.619	0.619	0.484	0.731	0.079	0.264	0.130

*Table D11: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 4 and individual difference variables (BFI, AIM, SWLS, and PANAS-X) when excluding male participants. Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 4							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.098	0.124	-0.043	-0.017	0.172	.315*	0.071	0.148
	p-value	0.504	0.395	0.768	0.907	0.238	0.028	0.626	0.312
Conscientiousness	*r*-value	-0.065	-0.139	-0.043	0.003	0.137	0.042	0.073	-0.006
	p-value	0.660	0.341	0.772	0.983	0.348	0.774	0.618	0.967
Extraversion	*r*-value	0.115	-0.023	-0.046	0.142	0.214	0.230	0.028	0.112
	p-value	0.430	0.874	0.756	0.332	0.139	0.112	0.850	0.442
Neuroticism	*r*-value	.310*	0.111	0.105	0.174	-0.071	-0.152	0.265	0.173
	p-value	0.030	0.449	0.473	0.233	0.628	0.297	0.066	0.234
Openness to Experience	*r*-value	0.001	0.080	0.061	-0.103	-0.039	0.120	0.054	0.047
	p-value	0.995	0.586	0.677	0.480	0.788	0.412	0.713	0.747
Affect Intensity Measure	*r*-value	.330*	0.004	0.216	0.206	0.271	-0.002	.343*	.294*
	p-value	0.020	0.978	0.135	0.156	0.059	0.990	0.016	0.040
Satisfaction with Life Scale	*r*-value	0.267	0.238	-0.019	0.166	0.107	.322*	0.172	0.254
	p-value	0.064	0.099	0.898	0.253	0.465	0.024	0.237	0.079
General NA	*r*-value	-0.009	-0.010	0.217	-0.132	-.298*	-0.079	0.049	-0.036
	p-value	0.951	0.945	0.133	0.366	0.038	0.591	0.740	0.807
General PA	*r*-value	-0.237	-0.161	0.020	-0.097	0.027	0.014	-0.033	-0.105
	p-value	0.101	0.270	0.893	0.508	0.851	0.924	0.821	0.474
Basic NA	*r*-value	-0.045	-0.026	0.203	-0.193	-.320*	-0.127	0.059	-0.067
	p-value	0.758	0.861	0.162	0.185	0.025	0.383	0.689	0.648
Basic PA	*r*-value	-0.171	-0.143	-0.018	-0.121	0.018	0.023	-0.084	-0.109
	p-value	0.239	0.326	0.901	0.408	0.903	0.877	0.565	0.455
Fear	*r*-value	0.088	0.070	.285*	-0.086	-0.218	-0.019	0.134	0.076
	p-value	0.549	0.630	0.047	0.555	0.132	0.898	0.359	0.603
Hostility	*r*-value	-0.100	-0.137	0.113	-0.157	-.304*	-0.109	-0.065	-0.152
	p-value	0.494	0.347	0.438	0.281	0.034	0.457	0.656	0.299
Guilt	*r*-value	-0.005	0.119	0.157	-0.203	-0.208	-0.077	0.168	0.032
	p-value	0.971	0.415	0.281	0.161	0.152	0.597	0.249	0.829
Sadness	*r*-value	-0.108	-0.117	0.134	-0.176	-.316*	-0.200	-0.024	-0.151
	p-value	0.460	0.423	0.359	0.226	0.027	0.167	0.868	0.301
Joviality	*r*-value	0.025	0.002	-0.053	-0.060	0.121	0.142	-0.017	0.032
	p-value	0.864	0.991	0.717	0.683	0.406	0.332	0.910	0.826
Self Assurance	*r*-value	-.370**	-.316*	-0.014	-0.233	-0.194	-0.192	-0.177	-.314*
	p-value	0.009	0.027	0.924	0.108	0.181	0.186	0.223	0.028
Attentiveness	*r*-value	-0.157	-0.088	0.049	-0.011	0.105	0.083	-0.032	-0.024
	p-value	0.282	0.548	0.737	0.941	0.474	0.571	0.826	0.869
Shyness	*r*-value	-0.065	0.073	0.057	-0.075	-0.194	-0.107	0.054	-0.035
	p-value	0.656	0.620	0.696	0.609	0.182	0.464	0.713	0.811
Fatigue	*r*-value	-0.226	0.050	0.033	-0.094	-0.272	-0.175	-0.036	-0.136
	p-value	0.119	0.733	0.824	0.522	0.058	0.229	0.809	0.351
Serenity	*r*-value	-0.197	-0.043	-0.018	-0.077	0.160	0.006	0.098	-0.007
	p-value	0.175	0.770	0.903	0.598	0.274	0.967	0.504	0.961
Surprise	*r*-value	-.299*	-0.176	-0.143	-0.270	-.293*	-0.175	-0.246	-.329*
	p-value	0.037	0.226	0.328	0.060	0.041	0.230	0.088	0.021

*Table D12: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 5 and individual difference variables (BFI, AIM, SWLS, and PANAS-X) when excluding male participants. Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 5							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.099	0.014	0.051	0.024	0.078	0.092	0.228	0.117
	p-value	0.498	0.922	0.727	0.870	0.593	0.530	0.116	0.421
Conscientiousness	*r*-value	-0.058	-0.077	-0.009	-0.160	-0.025	-0.021	-0.110	-0.085
	p-value	0.691	0.600	0.953	0.272	0.867	0.889	0.450	0.560
Extraversion	*r*-value	-0.234	-0.027	-0.066	0.082	0.097	-0.018	-0.034	-0.061
	p-value	0.106	0.853	0.652	0.578	0.507	0.901	0.815	0.675
Neuroticism	*r*-value	.299*	0.211	0.152	0.156	0.107	.293*	-0.008	.282*
	p-value	0.037	0.145	0.298	0.285	0.465	0.041	0.959	0.050
Openness to Experience	*r*-value	0.031	-0.007	-0.132	-0.079	0.063	-0.174	0.030	-0.050
	p-value	0.831	0.959	0.364	0.591	0.668	0.231	0.837	0.735
Affect Intensity Measure	*r*-value	0.194	-0.004	0.177	0.143	0.270	0.254	0.009	0.222
	p-value	0.182	0.978	0.223	0.327	0.061	0.078	0.952	0.125
Satisfaction with Life Scale	*r*-value	0.037	0.056	-0.040	0.099	0.151	-0.005	0.052	0.071
	p-value	0.802	0.701	0.785	0.499	0.299	0.970	0.720	0.626
General NA	*r*-value	-0.029	0.113	0.227	0.077	-0.138	0.056	-0.002	0.059
	p-value	0.844	0.438	0.117	0.600	0.343	0.701	0.992	0.689
General PA	*r*-value	-0.258	-0.098	-0.081	-0.044	-0.086	-0.196	-0.191	-0.214
	p-value	0.073	0.505	0.578	0.765	0.558	0.177	0.189	0.140
Basic NA	*r*-value	-0.045	0.129	0.143	0.049	-0.138	0.057	-0.023	0.037
	p-value	0.760	0.377	0.326	0.739	0.344	0.700	0.874	0.799
Basic PA	*r*-value	-0.214	-0.075	-0.135	-0.053	-0.125	-0.210	-0.143	-0.211
	p-value	0.139	0.610	0.357	0.716	0.394	0.148	0.328	0.146
Fear	*r*-value	0.020	0.187	0.237	0.100	-0.106	0.082	-0.072	0.101
	p-value	0.893	0.197	0.100	0.495	0.469	0.573	0.625	0.488
Hostility	*r*-value	-0.184	-0.021	0.018	0.059	-0.077	0.043	-0.082	-0.065
	p-value	0.207	0.884	0.901	0.685	0.600	0.770	0.576	0.655
Guilt	*r*-value	0.067	0.239	0.177	0.010	-0.165	0.071	0.131	0.124
	p-value	0.650	0.098	0.224	0.946	0.258	0.626	0.369	0.398
Sadness	*r*-value	-0.035	0.038	0.063	0.000	-0.108	-0.004	-0.060	-0.021
	p-value	0.813	0.794	0.668	0.998	0.462	0.976	0.683	0.887
Joviality	*r*-value	-0.051	-0.046	-0.160	0.003	-0.047	-0.137	-0.022	-0.104
	p-value	0.727	0.752	0.273	0.982	0.748	0.347	0.881	0.479
Self Assurance	*r*-value	-.456**	-0.105	-0.125	-0.119	-0.226	-0.193	-0.271	-.329*
	p-value	0.001	0.472	0.393	0.417	0.118	0.184	0.060	0.021
Attentiveness	*r*-value	-0.058	-0.041	-0.025	-0.036	-0.055	-0.239	-0.104	-0.122
	p-value	0.692	0.777	0.866	0.804	0.710	0.098	0.477	0.405
Shyness	*r*-value	-0.072	0.158	0.124	0.059	-0.020	0.072	-0.003	0.070
	p-value	0.623	0.277	0.397	0.685	0.893	0.625	0.984	0.632
Fatigue	*r*-value	-0.072	0.050	0.139	0.012	-0.086	-0.068	-0.086	-0.026
	p-value	0.625	0.731	0.342	0.933	0.559	0.643	0.557	0.861
Serenity	*r*-value	-0.254	-0.165	-0.220	-0.051	0.054	-0.020	-0.126	-0.176
	p-value	0.079	0.256	0.128	0.726	0.714	0.893	0.387	0.226
Surprise	*r*-value	-0.269	-0.030	-0.152	-0.217	-0.220	-.283*	-0.156	-0.274
	p-value	0.061	0.836	0.297	0.135	0.129	0.049	0.284	0.057

*Table D13: Pearson's correlations (r-value) and their significance level (p-value: **p<0.01, *p<0.05) between unbiased hit rates (H_u scores) at Gate 6 and individual difference variables (BFI, AIM, SWLS, and PANAS-X) when excluding male participants. Abbreviations are identical to Table 4 and Table 5.*

		EMOTION RECOGNITION ACCURACY AT GATE 6							
		Anger	Disgust	Fear	Happy	Neutral	Pls.sur	Sad	Average
Agreeableness	*r*-value	0.072	0.085	0.254	-0.053	0.225	.317*	0.070	0.215
	p-value	0.624	0.560	0.078	0.715	0.119	0.026	0.634	0.137
Conscientiousness	*r*-value	0.205	-0.023	0.036	-0.029	0.193	0.238	-0.010	0.139
	p-value	0.157	0.877	0.804	0.841	0.184	0.100	0.946	0.342
Extraversion	*r*-value	0.074	-0.033	0.142	0.233	0.177	-0.052	0.083	0.100
	p-value	0.615	0.819	0.329	0.108	0.223	0.723	0.569	0.495
Neuroticism	*r*-value	0.220	0.241	0.184	0.127	0.090	0.210	0.028	0.255
	p-value	0.128	0.095	0.206	0.385	0.537	0.147	0.846	0.077
Openness to Experience	*r*-value	-0.046	0.112	-0.013	0.101	0.058	-0.226	.311*	0.038
	p-value	0.755	0.443	0.928	0.489	0.694	0.118	0.030	0.796
Affect Intensity Measure	*r*-value	0.220	0.117	.304*	0.207	.317*	0.229	0.092	.306*
	p-value	0.130	0.423	0.033	0.153	0.026	0.114	0.530	0.032
Satisfaction with Life Scale	*r*-value	0.178	0.103	.286*	0.151	0.223	0.263	0.064	0.266
	p-value	0.220	0.483	0.046	0.300	0.124	0.068	0.664	0.065
General NA	*r*-value	-0.164	0.031	0.157	-0.058	-0.265	-0.106	-0.102	-0.099
	p-value	0.261	0.831	0.282	0.691	0.066	0.467	0.484	0.500
General PA	*r*-value	-0.266	-0.196	-0.112	-0.079	-0.022	-0.144	-0.160	-0.222
	p-value	0.064	0.178	0.443	0.590	0.878	0.324	0.271	0.126
Basic NA	*r*-value	-0.196	-0.023	0.098	-0.171	-0.281	-0.101	-0.195	-0.165
	p-value	0.177	0.874	0.504	0.241	0.050	0.490	0.178	0.256
Basic PA	*r*-value	-0.273	-0.207	-0.164	-0.051	-0.060	-0.179	-0.146	-0.247
	p-value	0.057	0.154	0.260	0.728	0.682	0.219	0.317	0.087
Fear	*r*-value	-0.083	0.091	0.197	0.069	-0.202	-0.074	-0.111	-0.017
	p-value	0.572	0.536	0.174	0.636	0.164	0.613	0.446	0.910
Hostility	*r*-value	-0.228	-0.122	-0.025	-0.181	-0.238	-0.143	-0.184	-0.230
	p-value	0.114	0.402	0.866	0.214	0.100	0.328	0.205	0.112
Guilt	*r*-value	-0.193	0.076	0.202	-0.231	-.289*	-0.039	-0.169	-0.104
	p-value	0.183	0.602	0.164	0.110	0.044	0.789	0.245	0.477
Sadness	*r*-value	-0.126	-0.099	-0.029	-0.184	-0.193	-0.073	-0.170	-0.171
	p-value	0.390	0.499	0.843	0.207	0.184	0.619	0.244	0.240
Joviality	*r*-value	-0.130	-0.158	-0.091	-0.002	0.023	-0.109	-0.063	-0.131
	p-value	0.375	0.279	0.535	0.988	0.874	0.456	0.667	0.371
Self Assurance	*r*-value	-.442**	-0.280	-0.250	-0.213	-0.226	-0.274	-0.280	-.424**
	p-value	0.001	0.052	0.083	0.142	0.118	0.057	0.051	0.002
Attentiveness	*r*-value	-0.146	-0.077	-0.085	0.107	0.048	-0.073	-0.030	-0.076
	p-value	0.315	0.601	0.562	0.463	0.743	0.620	0.836	0.605
Shyness	*r*-value	-0.161	-0.016	-0.055	-0.132	-0.142	-0.052	-0.174	-0.138
	p-value	0.270	0.911	0.707	0.365	0.329	0.724	0.232	0.345
Fatigue	*r*-value	-0.262	-0.004	-0.034	-0.117	-0.252	-0.105	-0.224	-0.194
	p-value	0.069	0.981	0.815	0.425	0.080	0.474	0.122	0.182
Serenity	*r*-value	-0.224	-0.128	-0.129	-0.145	0.075	-0.077	-0.001	-0.144
	p-value	0.121	0.380	0.379	0.321	0.607	0.601	0.997	0.323
Surprise	*r*-value	-.424**	-0.189	-0.266	-0.207	-.286*	-0.258	-0.220	-.392**
	p-value	0.002	0.192	0.065	0.153	0.046	0.074	0.128	0.005