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Exposure to social-evaluative video clips: Neural, facial-muscular, and experiential responses and the role of social anxiety

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ABSTRACT

Engaging in social interaction often implies being evaluated. Receiving positive evaluations from others may elicit affiliative emotions whereas negative evaluations are likely to trigger withdrawal and defensive social behavior. Evolution has equipped humans with efficient systems to detect, appraise, and regulate responses to such evaluative communications and to express complementary responses. The current study investigates neural, facial-muscular, and experiential responses to short videos delivering neutral, positive, and negative audiovisual messages as well as their relation to individual differences in social anxiety. Fifty-eight participants (32 female) watched 90 videos with male and female actors displaying positive, negative, and neutral statements. Experientially, ratings of valence and arousal showed the expected category differences. Neurally, larger centro-parietal late positive event related potentials were found for emotional (positive and negative) videos compared to neutral videos. Facial electromyography revealed reduced corrugator muscle and increased zygomaticus major muscle activity for positive videos compared to neutral and negative videos. Cognitive components of social anxiety were related to a more unpleasant experience of negative videos and a less pleasant experience of positive videos. Thus, a set of neural, facial-muscular, and experiential responses contribute to social interaction in the context of relatively naturalistic social-evaluative stimuli.

1. Introduction

Day-to-day dyadic interaction is replete with more or less openly expressed social evaluations. These evaluations play important roles for emotional well-being, self-esteem, and mental health (American Psychiatric Association, 2013). In fact, humans invest much of their social lives managing positive impressions, building social bonds, and avoiding negative evaluation (Bierhoff & Jonas, 2011; Kelley et al., 2003). Positive social evaluations conveying acceptance and appreciation may elicit emotions such as happiness and pride to elevate self-esteem (Fleming & Courtney, 1984). In contrast, negative social evaluations involving rejection or aggression may evoke anger, sadness or fear and decrease self-esteem (Leary, Twenge, & Quinlivan, 2006). According to the social self-preservation theory social-evaluative threats predict a decrease in self-esteem and social rejection predominates. (Dickerson, Gruenewald, & Kemeny, 2004). Evolutionary accounts hold that positive social evaluations secured survival of hominid ancestors due to hierarchical groups whereas negative social evaluations by dominant group members could have resulted in rejection from the community (reviewed by Weeks, Rodebaugh, Heimberg, Norton, & Jakatdar, 2009). This might be why humans have evolved a sophisticated system to monitor, detect, and respond to both positive and negative social-evaluative cues, such as emotional facial expressions and verbalizations by relevant others (Wieser & Brosch, 2012).

Given such firm evolutionary roots, it is unsurprising that central and peripheral nervous systems respond in a coordinated fashion to signs of positive and negative social evaluation such as images of angry, fearful, or happy faces. It is a relatively robust finding in functional magnetic resonance imaging (fMRI) research, for instance, that the amygdala along with the fusiform gyrus, and temporal structures respond more to faces than objects (i.e., face selectivity, reviewed by Troiani, Price, & Schultz, 2014). The speed of this face selective system has been unraveled in electroencephalography (EEG) research where the N170, as the earliest component, has received much attention demonstrating increased negative amplitudes for faces compared to non-face objects (e.g., Blau, Maurer, Tottenham, & McCandliss, 2007; Wang, Miao, & Zhao, 2014).

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Discriminating between emotional (i.e., positive and negative) and neutral faces (termed *emotion specificity* here); however, has been more challenging in hemodynamic and electrical neuroimaging. In fMRI, despite some inconsistencies, the overall pattern suggests that the amygdala and other neural systems are differentially activated by angry and fearful faces than by neutral ones (e.g., Fusar-Poli et al., 2009). However, the same pattern often appears for happy vs. neutral faces, making positive vs. negative discrimination difficult (i.e., valence specificity; Hooker, Germine, Knight, & D'Esposito, 2006). The same holds for EEG: the N170 is larger (i.e., more negative) for emotional facial expressions relative to neutral faces (e.g., Marinkovic & Halgren, 1998). However, other research did not find any emotion specificity at all (e.g., Eimer & Holmes, 2002; Wieser, Gerdes, Greiner, Reicherts, & Pauli, 2012). The early posterior negativity (EPN) and the late positive potential (LPP) have also been shown to be augmented by emotional facial expressions (Marinkovic & Halgren, 1998; Schupp, Junghofer, Weike, Hamm, 2004). Specifically, emotional faces perceived as positive or negative produced larger (i.e., more positive) LPP amplitudes compared to those perceived as neutral (Reicherts et al., 2012). However, results are inconsistent with regard to positive and negative valence leading to the understanding that they mainly index arousal. Thus, since *valence specificity* is of interest in the study of social behaviors and affective computing, neural indices need to be complemented by data from other response systems.

Autonomic measures and facial electromyography (EMG) have been successfully employed to enhance emotional discrimination in research with the International Affective Picture System (i.e., IAPS; Lang, Bradley, & Cuthbert, 1997) and with emotional facial expressions (e.g., Dimberg, 1997; Larsen, Norris, & Cacioppo, 2003). Humans respond spontaneously and rapidly to positive and negative facial expressions (e.g., Dimberg, 1997). These response patterns may operate as indices of emotional contagion as an 'affective state that matches the other's emotional state' but it may also represent mirror effects known as mimicry behavior (e.g., Hess & Blairy, 2001; Lundqvist & Dimberg, 1995). Mimicry is conceptualized as an automatic and reflex-like process where the observer imitates non-verbal emotional facial displays of another person (Hatfield, Cacioppo, & Rapson, 1993). Consistent with facial EMG activity during happy facial expressions, observers show an increased zygomaticus major muscle activity (lifting the lips to smile). Similarly, a negative facial expression elicits increased corrugator supercilii muscle activity (responsible for frowning) both in the actor and observer (Dimberg, 1997). Thus, both facial muscles support the discrimination of behavioral responses to positive from negative (and neutral) social-evaluative stimuli and might therefore usefully complement neural indices. Furthermore, autonomic measures such as heart rate (HR) and skin conductance (SC) are sometimes reported to differentially respond to facial expressions.

Facial expressions as social cues also play an important role in social anxiety which is characterized by the fear of being negatively evaluated by relevant others in social interactions (American Psychiatric Association, 2013). Recent research also suggests that positive evaluation is feared by socially anxious individuals (Reichenberger, Wiggert, Wilhelm, Weeks, & Blechert, 2015; Weeks et al., 2009). However, as shown by Mauss, Wilhelm, & Gross (2003) results of group differences in psychophysiological reactivity remain rather small and inconsistent emphasizing cognitive mechanisms in models of social anxiety (i.e., attentional biases, dysfunctional appraisal and negative self-beliefs). Neurally larger fronto-central P3 (positive event-related potential at approximately 300 milliseconds) amplitudes towards positive social evaluative feedback have been reported (van der Veen, van der Molen, Sahibdin, & Franken, 2014) as well as generally larger LPPs to neutral social stimuli in high socially anxious individuals (Schmitz, Scheel, Rigon, Gross, & Blechert, 2012).

Prior research utilized standardized databases of static images of facial expressions to characterize detection and recognition of basic emotions (Wieser & Brosch, 2012). This approach has high internal validity. However, social reality is more dynamically complex and human emotions in social situations are not limited to basic emotions. Several basic emotions might mix dynamically during the display of an evaluation such as 'I'm disappointed in you'. Moreover, the observer's response to such expressions is likely to be moderated by appraisal mechanisms and individual differences. As a result, both reciprocal responses (responding with anger to angry sentences) as well as complementary responses (responding with anxiety and submissiveness) might ensue (Scherer, 1997). To capture some of this complexity, research has recently moved toward dynamic social stimuli. Several methods have been introduced since, for modifying static characteristics and obtaining dynamic features (e.g., Muehlberger, Wieser, & Pauli, 2008; van der Schalk, Hawk, Fischer, & Doosje, 2011). Studies have paired static images with written sentences to simulate social situations or employed conditioning procedures (e.g., Lee et al., 2013; Pejic, Hermann, Vaitl, & Stark, 2013). In other research, actors have been trained to dynamically pose facial expressions or to deliver emotional messages in video clips, thereby adding auditory information to the stimulus which has been shown to aid semantic interpretation (e.g., van der Schalk et al., 2011; Ziv, Goldin, Jazaieri, Hahn, & Gross, 2013).

The present study aims to extend recent developments toward understanding responses to more naturalistic and dynamic social stimuli. We invited actors to express a range of negative (e.g., "You're embarrassing!"), neutral (e.g., "It's 4 o'clock."), and positive (e.g., "You're class!") sentences with corresponding facial expressions to create a set of brief video clips called 'E.Vids'. Sentence content was chosen to sample a wide range of realistic (high probability to occur in spoken language) but still intense emotional exclamations directed at the observer. The first validation study (Blechert, Schwitalla, & Wilhelm, 2013) confirmed that E.Vids trigger basic emotions and a wide range of other emotional states that may occur in daily life situations. The present study investigated neural, facial-muscular, and experiential responses to neutral, positive, and negative E.Vids. We expected enhanced LPPs for emotional (negative and positive) vs. neutral videos (emotion specificity) based on similar research with static and dynamic emotional stimuli (Reicherts et al., 2012; Schupp et al., 2004). Emotion specificity (e.g., differentiation between positive and negative videos) might be obtained from facial EMG muscle activity: we expected increased zygomaticus major activity responses to positive videos and enlarged activity of the corrugator supercilii toward negative videos in comparison to neutral videos. Furthermore, we explored differential heart rate deceleration and skin conductance responses expecting larger responses toward emotional than neutral videos (Bradley, Codispoti, Cuthbert, & Lang, 2001).

Lastly, given that previous work with this stimulus set revealed interindividual differences in response to such material (Reichenberger et al., 2015), we included a measure of social anxiety. Fear of negative evaluation in social anxiety might enhance valence ratings to negative videos and fear of positive evaluation might attenuate responses to positive videos and potentially also on non-self-report measures.

2. Material and methods

2.1. Participants

A sample of 58 participants (32 female) with an average age of 22.88 years (SD = 2.45) was recruited through online advertisement and in psychology classes. Participants reported no current