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The fear of other persons' laughter: Poor neuronal protection against social signals of anger and aggression

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ABSTRACT

The fear of other persons' laughter (gelotophobia) occurs in the context of several psychiatric conditions, particularly in the schizophrenia spectrum and social phobia. It entails severe personal and inter-personal problems including heightened aggression and possibly violence. Individuals with gelotophobia ($n=30$; 24 with social phobia or Cluster A diagnosis) and matched symptom-free controls ($n=30$) were drawn from a large screening sample ($n=1440$). EEG coherences were recorded during the confrontation with other people's affect expressions, to investigate the brain's modulatory control over the emotionally laden perceptual input. Gelotophobia was associated with more loose functional coupling of prefrontal and posterior cortex during the processing of expressions of anger and aggression, thus leaving the individual relatively unprotected from becoming affected by these social signals. The brain's response to social signals of anger/aggression and the accompanied heightened permeability for this kind of information explains the particular sensitivity to actual or supposed malicious aspects of laughter (and possibly of other ambiguous social signals) in individuals with gelotophobia, which represents the core feature of the condition. Heightened perception of stimuli that could be perceived as offensive, which is inherent in several psychiatric conditions, may be particularly evident in the fear of other persons' laughter.

1. Introduction

Laughter is in most cases a signal that persons are friendly, trustworthy, playful, and nonthreatening, inviting others to approach (Keating et al., 1981; Reis et al., 1990; Ruch, 1993; LaFrance and Hecht, 1995; Harker and Keltner, 2001). On the other hand, laughter can also take on the form of "laughing at" and ridicule, thereby signifying aggression, social threat and rejection (Ruch and Ekman, 2001; Szameitat et al., 2009; Papousek et al., 2014a). While healthy individuals normally have no difficulties in distinguishing primarily benevolent laughter from malicious laughter, some people are particularly sensitive to the negative aspects of laughter and perceive laughter as predominantly mean-spirited, even when others may perceive it as overtly positively motivated (Platt, 2008; Ruch et al., 2009). The tendency to perceive other persons' smiling and laughter as offensive acts maliciously directed at oneself represents the core feature of "Gelotophobia", meaning the fear of other persons' laughter (from gelos, Greek for laughter). Gelotophobia was initially recognized and described in clinical psychiatry (Titze, 2009). Its empirical investigation has only begun recently, after a reliable diagnostic instrument had been developed (Ruch and Proyer, 2008a, 2008b). The investigation of its neurological underpinnings is still at its beginnings.

Like many other symptoms, the fear of other persons' laughter seems to occur in the context of several psychiatric conditions. Previous research showed that it is often linked to disorders in the schizophrenia spectrum (Forabosco et al., 2009; Weiss et al., 2012) and social phobia (Carretero-Dios et al., 2010; Weiss et al., 2012; Ritter et al., 2015). It recently attracted much attention, not least because anecdotal evidence suggested that perpetrators of violent acts such as school shootings had a horror of being mocked and may have taken revenge for having been laughed at, which fueled the suspicion that it may be linked to aggression and violence (Holden, 2009; Ruch, 2009; Ruch et al., 2014). In fact, individuals with fear of other persons' laughter reported having a greater tendency towards aggressive behavior than symptom-free controls, and several personality characteristics associated with the symptom seem to resemble those of violent individuals (Ruch and Proyer, 2009; Weiss et al., 2012). Further, individuals with fear of other persons' laughter have a heightened proneness to perceive and experience anger, both in response to overt insult and in emotionally relatively neutral or ambiguous interpersonal situations (Papousek et al., 2009, 2014a; Weiss et al., 2012), and feel weak at managing their negative emotions (Papousek et al., 2009;

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Weiss et al., 2012). The combination of anger proneness and defective emotion regulation does not only play a role in aggressive behavior (Harper et al., 2005; Shorey et al., 2011). Heightened perception and experience of anger and feelings of being overwhelmed by it may also indicate that the brain configuration of individuals with fear of other persons' laughter may leave them less protected from becoming affected by emotional information, possibly by signals of anger and aggression in particular.

Quite similar to individuals with gelotophobia, greater impact of especially negative emotionally laden input on their perceptions, judgements, and own affective states were observed in patients with disorders in the schizophrenia spectrum, in particular in patients with prominent positive symptoms (Höschel and Irle, 2001; Suslow et al., 2003; Falkenberg et al., 2008; Mohanty et al., 2008; Cicero and Kerns, 2010; Hooker et al., 2011; Martin et al., 2011; Karcher and Shean, 2012; Alba-Ferrera et al., 2013). More directly related to the methodological approach in the present investigation, a study revealed evidence of loose prefrontal modulatory control over social-emotional input in individuals with high levels of positive schizotypal symptoms. This applied to negative emotions in particular, and was most pronounced during confrontation with signals of anger and aggression (Papousek et al., 2014b). There is also evidence from neurophysiological studies that stimuli signaling anger may be processed more intensely in social phobics than in healthy individuals (Kolassa and Miltner, 2006).

In contrast to the (actual or supposed) malicious aspects of laughter and other social-emotional cues, evidence suggests that the positive aspects of laughter (related to joy) might be down-modulated in individuals with fear of other persons' laughter. They tend to mimic joyful smiles less frequently than individuals with no fear, and other persons' joyful laughter does not entail positive contagious qualities (Papousek et al., 2009; Hofmann et al., 2015; Ruch et al., 2015). Thus, social signals of joy may have a diminished impact on individuals with fear of other persons' laughter. Behavioral findings also suggested dampened perception of joyful laughter stimuli in social phobia (Ritter et al., 2015).

At the neurobiological level, modulation of incoming affectively laden information is reflected in altered state-dependent coupling of prefrontal and posterior association cortex. The prefrontal cortex exerts feedback control on posterior association cortices, in order to modulate perceptual representations of affectively relevant information (Miskovic and Schmidt, 2010; Rudrauf et al., 2008). Connectivity and functional communication between neural populations are adapted in support of dynamically changing processing demands (Sepulcre et al., 2010). These changes are indicated by changes of EEG coherence between two scalp areas (Fries, 2005; Srinivasan et al., 2007). EEG coherence between prefrontal and posterior association cortex normally increases during exposure to highly threatening information, which was interpreted as activation of a regulatory mechanism protecting the individual from being unduly affected by the aversive input (Miskovic and Schmidt, 2010). Further research demonstrated that individuals considerably differ in their brain responses. Several studies focusing on these inter-individual differences showed that diminished prefrontal–posterior coupling, indicated by smaller EEG beta coherences, was related to greater impact of the perceptual input on the individual (Reiser et al., 2012; Papousek et al., 2013a, 2013b, 2014b). Thus, more loose prefrontal–posterior coupling during social-emotional processing seems to indicate loosening of control of the prefrontal cortex over incoming affectively laden information, leaving the individual less protected from becoming affected by the emotional input.

In the present study, preselected groups of individuals with fear of other persons' laughter and matched symptom-free controls were exposed to realistic, unambiguous non-verbal auditory displays of anger and aggression, good-natured cheerful laughter, and (for control) sadness. State-dependent changes of EEG coherences were recorded, in order to explore patterns of prefrontal–posterior coupling or de-coupling during confrontation with other people's affect expressions. On the basis of its characteristic behavioral features and relevant evidence from psychiatric conditions overlapping with gelotophobia, it was expected that individuals with fear of other persons' laughter would show reduced prefrontal–posterior coupling during the processing of social signals of anger and aggression, indicating a lack of modulatory control over the emotionally laden perceptual input. As opposed to that, it was hypothesized that prefrontal–posterior coupling may be relatively enhanced in individuals with gelotophobia during exposure to other persons' cheerful laughter.

2. Methods

2.1. Participants

Participants were drawn from a large screening sample ($n=1440$) comprising university students from three local universities and from a variety of disciplines. They were screened using the standard diagnostic instrument for gelotophobia (Geloph $<15>$, Ruch and Proyer, 2008b). Individuals who had screening scores indicating gelotophobia and had indicated contact information were personally invited to participate in the study, which was announced as a study on the perception of sound recordings of groups of people. Thirty individuals reaching the cut-off score for gelotophobia (≥ 2.5) agreed to participate (21 women, mean age 22.9 ± 4.4 yrs.). In addition, 30 sex- and age-matched controls were invited and agreed to participate (scores <2.0; 21 women, mean age 23.2 ± 3.2 yrs; $t(58)=0.34$, ns). The mean Geloph $<15>$ scores in the gelotophobia group and the group without fear were 2.8 ± 0.2 and 1.2 ± 0.2, $t(58)=30.1$, $p<0.001$ (range of scores in the Geloph $<15>$: 1.0–4.0). The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; First et al., 2002) and the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1997) were administered for obtaining diagnoses of social phobia and Cluster A personality disorders (schizoid, paranoid, schizotypal). In the gelotophobia group, 11 participants had a diagnosis of Cluster A personality disorder, 7 had a diagnosis of social phobia, and 6 had a combined social phobia and Cluster A diagnosis. In the control group, none were diagnosed with social phobia or Cluster A personality disorders. Presence of social phobia and positive schizotypal symptoms in the gelotophobia group were additionally substantiated by the Social Phobia Inventory (SPIN, German version; Sosic et al., 2008) and the Schizotypal Personality Questionnaire (SPQ, German version with 5-point Likert scale system; Klein et al., 1997; Wuthrich and Bates, 2005). See Table 1 for mean scores (SPIN: $F(4,55)=21.7$, $p<0.001$; SPQ: $F(4,55)=17.8$, $p<0.001$). None of the participants were taking psychoactive medication. The study was approved by the local ethics committee. Written informed consent was obtained from all participants. Participants received €10, – for participating in the study.

2.2. Social-emotional stimulation

Four clips from the "ECOS" set of sound clips (Weber et al., 2011; see also Papousek et al. (2012, 2013a, 2014b) and Reiser et al. (2012)) were used: ECOS-A (anger and aggression; angry shouting without understandable language), ECOS-C (cheerfulness; good-natured, hearty laughter), ECOS-S (sadness; bitter weeping and sobbing), and ECOS-N, serving as the reference condition (neutral; soft murmurs and trivial everyday sounds without understandable