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Influences of disgust sensitivity on hemodynamic responses towards a disgust-inducing film clip

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Abstract

The major goal of the present functional magnetic resonance imaging study was to investigate the influence of disgust sensitivity on hemodynamic responses during disgust induction. Fifteen subjects viewed three different film excerpts (duration: 135 s each) with disgust-evoking, threatening and neutral content. The films were presented in a block design with four repetitions of each condition. Afterwards, subjects gave affective ratings for the films and answered the questionnaire for the assessment of disgust sensitivity (QADS, [Schienle, A., Walter, B., Stark, R., Vaitl, D., 2002b. Ein Fragebogen zur Erfassung der Ekelempfindlichkeit (FEE) [A questionnaire for the assessment of disgust sensitivity, QADS]. Klin. Psychol. Psychother. 31, 110–120]).

The subjects' overall disgust sensitivity was positively related to their experienced disgust, as well as to their prefrontal cortex activation during the disgust condition. Further, there was a positive correlation between subjects' scores on the QADS subscale spoilage/decay and their amygdala activation ($r = 0.76$). This was reasonable since the disgust film clip depicted a cockroach-invasion and the subscale spoilage/decay contains, among others, an item asking for disgust towards cockroaches. The study stresses, in accordance to previous studies, the importance of considering personality traits when studying affective responses in fMRI studies.

Keywords: Disgust sensitivity; fMRI; Amygdala; Film

1. Introduction

A considerable number of neuroimaging studies on emotions have been conducted over the last decade (for review, see Phan et al., 2002). Besides many congruent findings with regard to emotion-relevant brain areas, there are also discrepant results. This may be partly traced back to the fact that personality traits, as modulating variables, have until now, in the majority of studies, been ignored. To our knowledge, only four studies examined the influence of affective styles on emotional processing: Canli et al. (2001) focused on extraversion and neuroticism (NEO-FFI, Costa and McCrae, 1991) and their association with the processing of emotionally positive and negative scenes from the International Affective Picture System (IAPS, Lang et al., 1999). They found extraversion to be correlated with brain reactivity to positive stimuli in localized brain regions (e.g. amygdala, basal ganglia, middle frontal gyrus), and neuroticism to be correlated with brain reactivity to negative stimuli in localized brain regions (e.g. middle frontal gyrus, middle temporal gyrus). Berthoz et al. (2002) studied the effects of alexithymia on regional cerebral activations in response to the presentation of positive and negative IAPS pictures. They observed less cerebral activation in the left mediofrontal-paracingulate cortex in response to highly negative stimuli and more activation in the anterior cingulate, mediofrontal cortex, and middle frontal gyrus in response to highly

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positive stimuli when men with alexithymia were compared to men without alexithmia. Paulus et al. (2003) analyzed the relationship between hemodynamic changes during risk-involving decision making and the traits of harm-avoidance and neuroticism. They reported that the degree of insula activation depended on the subjects' extent of harm avoidance and neuroticism. Finally, Reuter et al. (2004) related the scores of the Behavioural Inhibition Scale (Carver and White, 1994) to the hemodynamic responses during affective picture processing. Subjects with high behavior inhibition scores showed more brain activation in numerous brain regions (e.g. amygdala, anterior cingulate cortex, thalamus) when they looked at positive and negative pictures (erotic, fear-inducing, and disgust-inducing pictures) in comparison to subjects with low behavior inhibition scores. Altogether, these studies indicate that personality traits may, under certain circumstances, exert a substantial influence on emotion-related brain activity. Therefore, this relationship should taken into account in neuroimaging studies.

The present study attempted to elucidate the relationship between the trait disgust sensitivity and hemodynamic responses during disgust induction. Disgust is usually described as a basic emotion, which serves to protect the organism from harm by eliciting avoidance behavior (Rozin et al., 2000). The triggers of disgust vary considerably: besides the innate disgust response, which is related to food rejection, there has been a cultural evolution of relevant elicitors, including stimuli such as body products, certain small animals, poor hygiene, injury, and death (Rozin et al., 2000; see also Schienle et al., 2005).

The findings of studies, which investigated the neural substrate of disgust, are inconsistent. While Calder et al. (2001) concluded in their review article that the insula is specifically involved in disgust processing, the results of our working group contradict this interpretation (Schienle et al., 2002a; Stark et al., 2003; Stark et al., 2004; Schienle et al., 2005). We observed activation in the secondary sensory fields, the amygdala, the orbitofrontal, and the medial prefrontal cortex during the presentation of disgust-evoking pictures. The insular cortex activation was not restricted to the disgust condition, but was also observed in the fear condition (Schienle et al., 2002a). The discrepant findings with regard to the identified brain areas may be linked to the negligence of trait factors, such as disgust sensitivity (DS), which is thought to modulate the affective response.

DS reflects the subjects' proneness to react with disgust to repulsive stimuli. Usually, DS is assessed by self-report measures (Haidt et al., 1994; Schienle et al., 2002b). Studies investigating DS and disgust-induced emotional responses have found that subjects with elevated DS reported more feelings of disgust than subjects with low DS (Schienle et al., 2001; Stark et al., 2005). Results concerning physiological responses are however found to be less consistent. Only domain-specific DS was positively correlated with disgust-induced physiological changes (Rohrmann et al., 2004). In this study, subjects were classified into a high and low disgust sensitive group. This was accomplished using a questionnaire measuring general disgust sensitivity and subdomains of disgust sensitivity. Physiological (skin conductance responses, cortisol responses) and subjective responses towards disgust-inducing film clips were compared for the two disgust sensitivity groups. The results of this study showed that only the responses of the low and high disgust sensitive subjects differ when a subscale with death-related items of the disgust sensitivity questionnaire was used for classification.

There are only a few studies on the hemodynamic correlates of DS: Schienle et al. (2005) demonstrated that disgust-related hemodynamic changes in the amygdala–a key structure of emotional processing–were positively correlated with DS. In this study the authors contrasted the responses towards disgust-inducing and neutral pictures, which were presented in a block design. The present study attempts to replicate the effects of DS on hemodynamic disgust-related responses by means of a disgust-inducing film clip. The decision to use film clips instead of static pictures was guided by the expectation that films would be more realistic and would therefore induce stronger emotional responses. Film clips have already been used in several previous fMRI studies (Lane et al., 1997; Paradiso et al., 1997). We were further interested if DS is specifically restricted to disgust-inducing stimulation or if it also modulates other forms of negative emotions. For this reason, we presented a threatening movie as well. We focused on the insula, the amygdala, the orbitofrontal cortex and the medial prefrontal cortex as regions of interest (ROI).

2. Method

2.1. Subjects

Fifteen subjects (11 females) participated in the experiment (age: M=29.1 years; range: 20–41 years). One male and one female subject were left-handed as assessed by the Edinburgh Inventory of Handedness (Oldfield, 1971). A medical checklist ensured that all subjects were healthy and did not take medication. The participants gave their informed consent after the experiment had been explained to them. Each of them received 20 Euros for participating.

2.2. Stimulus materials

Three film clips (DISGUST, FEAR, NEUTRAL, 135 s each) with sound track were presented to the subjects.[1] Each clip was a scene selected from a commercial movie: DISGUST showed an invasion of cockroaches, a scene

[1] A fourth film clip depicted a thoracic operation and came from a medical documentary (Franzini et al., 1993). Since the responses towards this film were difficult to interpret because both, fear and disgust, were elicited we decided to omit this condition for clarity.