International Journal of Psychophysiology 94 (2014) 84–91

Contents lists available at ScienceDirect

International Journal of Psychophysiology

journal homepage: www.elsevier.com/locate/ijpsycho

Dissociation between morality and disgust: An event-related potential study

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ARTICLE INFO

Article history:
Received 27 October 2013
Received in revised form 27 June 2014
Accepted 20 July 2014
Available online 30 July 2014

Keywords:
Morality
Disgust
Event-related potentials

ABSTRACT

This study explored the neural correlates of morality and disgust, particularly, how the mechanisms that mediate our avoidance of physically disgusting and morally abhorrent behaviors are neurologically dissociated during the time-course of processing. Twelve participants were asked to judge the acceptability of different types of behaviors, which varied in their level of moral wrongness and physical disgust, while event-related potentials (ERPs) were recorded. The main results showed that the two morally wrong conditions elicited greater amplitudes of P300-400 at frontal sites than the neutral condition and the physically disgusting, but not morally wrong, condition. The physically disgusting conditions (with and without moral content) elicited significantly more positive deflections in the 500–600 ms timeframe than the neutral condition at central–posterior sites. These findings indicate that our aversion to harmful substances in the physical environment and offensive behaviors in the social environment may be neurologically dissociable in the temporal dimension. Furthermore, the detection of moral violations may be processed earlier in time than that of physical disgust.

1. Introduction

It has long been recognized that emotions bear a strong relationship to moral judgments (Haidt, 2001; Huebner et al., 2009; Hume, 1978). In particular, the emotion disgust has been found to be frequently associated with moral judgments (Olivera La Rosa and Rosselló-Mir, 2013). For example, Schnall et al. (2008b) found that moral judgments were made more severe when participants experienced extraneous feelings of disgust, such as exposure to a bad smell, staying in a disgusting room, or recalling a physically disgusting experience. The same effect was found with the taste. A bad taste induced by drinking a bitter beverage was found to lead to harsher moral judgments compared to drinking a sweet, or a neutral tasting beverage (Eskine et al., 2011). In addition, research on the reverse effect of cleanliness on morality strengthens the link between disgust and moral judgments. It has been found that when the concept of cleanliness was activated, or after the act of physical cleaning was performed, judgments about moral wrongness were less severe (Schnall et al., 2008a).

The relationship between disgust and morality has been shown to be bidirectional. Cross-cultural studies have shown that people not only express revulsion, or disgust, towards harmful substances in the physical world, they also express disgust towards various moral offenses among adults and children (Rozin et al., 1999; Stevenson et al., 2010; Haidt et al., 1997). Even highly abstract moral scenarios that are devoid of physically disgusting stimuli, such as unfair treatment in an experimental game, tend to induce a strong sense of disgust (Chapman et al., 2009). In addition, it has been demonstrated that a threat to moral purity arouses a greater desire for a person to clean himself/herself, which is widely known as the Lady Macbeth effect (Zhong and Liljenquist, 2006).

Based on the supporting evidence, researchers have suggested that the human feeling of disgust has expanded from physical disgust, which is generally elicited by physically repulsive objects, such as rotten food, feces, and rats, to socio-moral disgust, which is elicited by socio-moral violations, through the process of biological and cultural evolution (Haidt et al., 1997; Rozin et al., 2008). In the development of the disgust sensitivity scale, Tybur et al. (2009) found that along with pathogens and sexuality, standard immorality constituted the three domains of disgust. Research by Chapman et al. (2009) found that the facial motor actions evoked when being treated unfairly were very similar to those evoked by physical forms of disgust related to distaste and contamination, suggesting that moral disgust may have an oral origin.

However, not all psychologists agree that moral disgust is a subset of disgust. Royzman and Sabini (2001) believed people's use of the word "disgust" in reference to moral violations is mainly metaphorical, and that our reactions to moral offenses are only linguistically analogous

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http://dx.doi.org/10.1016/j.ijpsycho.2014.07.008
0167-8760/

to reactions to pathogen-related objects. Likewise, Bloom argued (2004) that moral judgments about abstract issues, such as stealing, are unlikely to induce the same feeling of disgust as physical objects, such as feces. Indeed, in the original version of the Disgust Sensitivity Scale (DS), socio-moral items did not reliably correlate with the total DS score, so they were dropped from the scale (Haidt et al., 1994).

Moreover, evidence against the dominant line of reasoning about the relationship between disgust and moral judgments has been reported. For example, David and Olatunji (2011) found the feeling of disgust increased when neutral words were paired with disgusting pictures in an evaluative conditioning paradigm. But judgments about transgressions containing the conditioned disgust words were not any different from those containing neutral words. Furthermore, Olivera La Rosa et al. (2012) found that affective priming by disgust could make moral judgments less severe, which casts serious doubt on the generality of the role of disgust in morality. In addition, the Lady Macbeth effect demonstrated in research by Zhong and Liljenquist (2006) was not consistently replicated by subsequent studies (Earp et al., 2014; Fayard et al., 2009).

To better understand the complex relationship between disgust and morality, studies have been conducted using neuroscience techniques, such as functional magnetic resonance imaging (fMRI) and event-related potentials (ERPs), to examine the biological mechanisms of disgust and moral judgments. Previous brain imaging studies consistently showed physical disgust and moral emotions recruited common as well as distinct brain regions (Borg et al., 2008; Moll et al., 2002, 2005).

Although fMRI provides accurate spatial information, it is limited in its capacity to provide temporal information about processes. We used a Go/No-Go paradigm to evoke lateralized readiness potentials (LRPs) in a study to examine the temporal dynamics of processing physical disgust and morality (Yang et al., 2013). The experimental stimuli were physically repulsive acts (e.g., drinking urine), morally unacceptable but not physically repulsive acts (e.g., stealing money), morally unacceptable and physically disgusting acts (e.g., drinking human blood), and neutral acts (e.g., drinking water). A short period of LRPs for No-Go trials was found in an experimental session where participants were required to respond to the physical disgust feature of an act with a Go/No Go decision while responding to the feature of morality with a "left" or "right" hand decision, but not in the session where the Go/No-Go response and the left/right hand assignments were swapped between the physical disgust and morality features of the stimuli. The results suggested that processing of moral information and physical disgust information might occur at different phases in the time-course of processing, with an intuitively faster response for morality (Yang et al., 2013).

The results that the brain could respond to immorality faster than to physical disgust seem quite counterintuitive. It would be interesting to find out whether the temporal priority of morality processing found in the study by Yang et al. (2013) could be replicated. Luo et al. (2013) used the ERP technique to investigate the temporal patterns of core and moral disgust in a lexical judgment task. In their work, core disgust was defined as a basic emotion elicited by physically aversive objects (such as feces or maggots), while moral disgust was defined as a complex emotion which was evoked by behaviors violating moral norms (such as spy, or blackmail). A difference between core disgust and moral disgust stimuli was detected early in processing in the time-window of 200–270 ms at seven posterior electrodes.

However, some potential confounding factors in the research by Luo et al. (2013) are worth mentioning. First, as the morally wrong scenarios always involve behaviors, the moral disgust words used in their experiment, such as blackmail, might be easily taken to be verbs. But the core disgust words used in their study mostly depicted physically disgusting objects, such as maggots, feces, which are nouns. This difference in the two types of stimuli (verbs versus nouns) may account for some of the early time differences in neural activity. Second, Luo et al. (2013) did not differentiate between immoral behaviors involving physical disgust elicitors from immoral behaviors without physical disgust elicitors. The mixture of core disgust and morality in the type of moral disgust stimuli may lead the processing of morality to be linked with that of physical disgust.

In the present study, we sought to find more evidence on the temporal order of processing physical disgust and morality in an explicit evaluation task by examining specific components of ERPs evoked by different types of social behaviors. Participants were asked to judge, from the perspective of common practice, whether they thought it was acceptable for a person to perform each of the four types of behaviors: morally wrong behaviors evocative of physical disgust; morally wrong behaviors that did not involve physical elicitors of disgust; morally neutral, but disgusting behaviors; and morally neutral and non-disgusting behaviors.

Based on previous studies indicating different mechanisms for moral and physical disgust (Borg et al., 2008; Luo et al., 2013; Moll et al., 2002, 2005; Yang et al., 2013), we hypothesized that participants' reactions to moral violations would be neurologically dissociable from their reactions to stimuli that elicit physical disgust during the time-course of the evaluation task. Moreover, if the temporal priority of moral disgust, which we found previously (Yang et al., 2013), was observed in the present experimental paradigm, we expected that the two morally offensive conditions would be dissociated from the two morally acceptable conditions before any dissociation emerged between the disgusting conditions and non-disgusting conditions. In addition, we predicted ERP components, such as P200 and P300, would be sensitive to morality processing while slow waves, such as LPC, would more closely reflect physical disgust processing. Van Berkum et al. (2009) found that the processing of value-inconsistent words elicited positivity around 200–250 ms when people explicitly evaluated morally unacceptable statements. Luo et al. (2013) demonstrated that moral disgust words evoked greater positivity than core disgust and neutral words around 300–360 ms. They also found LPC was particularly sensitive to core disgust processing.

2. Methods

2.1. Subjects

Twelve healthy college students (7 males, age $= 22 \pm 1$ years) were recruited via advertisements. All participants signed written, informed consent forms approved by the ethics committee of Hangzhou Normal University and were paid 20 RMB for their participation. All participants were right-handed, with normal or corrected-to-normal vision, and reported no cognitive or affective disorders.

2.2. Stimuli

Linguistic materials have been effectively used in previous research on disgust and morality (Borg et al., 2008; Luo et al., 2013; Moll et al., 2005). They have the advantage of being better than pictorial materials for matching irrelevant features across different conditions. Moreover, sentences are better than single words for people to imagine moral and disgusting experiences. Therefore, short written statements were used to depict four types of social behaviors: morally wrong and physically disgusting (WD: A person at a party is drinking human blood.); morally wrong, but not physically disgusting (WN: A person at a party is stealing money.); morally neutral, but physically disgusting (ND: A person at a party is drinking urine.); morally neutral and not disgusting (NN: A person at a party is drinking boiling water.). Each of the three negative conditions contained 60 statements while the neutral condition contained 180 statements. To check the effectiveness of the stimulus manipulation, we conducted a pilot study before the ERP experiment, in which 43 people were asked to rate the degree to which each statement was physically disgusting and morally wrong. The statements were rated on a 9-point scale for "how morally wrong it is" and for "how physically disgusting it is" ("1" means least, "9" means most).