



Disgust in Anxiety and Obsessive-Compulsive Disorders: Recent Findings and Future Directions

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Abstract

Purpose of Review In the past 20 years, the role of disgust in anxiety disorders and obsessive-compulsive disorder (OCD) has been investigated with increasing precision. In this review, we examine recent evidence implicating disgust in anxiety and OCD, highlighting recent measurement and methodological improvements. Specific emphasis is placed on understanding the mechanisms that may account for the role of disgust in OCD and related disorders.

Recent Findings Recent developments include clarification of the role of distinct disgust-relevant vulnerabilities in the etiology of anxiety and OCD, an improved understanding of the neurobiology of disgust processing in OCD, and an increased focus on disgust-related mechanisms that contribute to psychopathology, such as disgust-based learning and emotion regulation.

Summary Disgust proneness is increasingly linked with symptoms of anxiety and OCD. However, further examination of the mechanisms that account for the roles of distinct disgust-relevant vulnerabilities is needed, and studies that directly examine disgust during the course of treatment are limited. Increasingly, the field has moved toward experimental investigation of specific disgust-relevant mechanisms that influence the etiology and treatment of OCD and related anxiety disorders.

Keywords Disgust · Disgust proneness · Anxiety disorders · Obsessive-compulsive disorder

Introduction

Twenty years ago, Phillips and colleagues [1] declared that disgust was “the forgotten emotion of psychiatry” but noted that this emotion was central to several psychiatric conditions, including anxiety and obsessive-compulsive disorder (OCD). A few years later, in a special series on disgust in the *Journal of Anxiety Disorders*, McNally [2] declared that “disgust has arrived.” Figure 1 shows a notable increase in peer-reviewed articles published since 1998 that contain the word “disgust” and “anxiety,” “anxious,” “OCD,” or “obsessive-compulsive” in the title. Along with numerous other related articles that have been published, it is clear that there has been a growth in research in the past two decades implicating disgust in the development and maintenance of OCD and anxiety-related disorders. There is now a noticeable shift in the literature with more

recent work aimed at identifying the mechanisms that can explain how normative disgust processing becomes pathological.

In addition to demonstrating that the disgust response co-occurs with symptoms of OCD and anxiety-related disorders, personality research suggests that individual differences in trait-level disgust, often referred to as disgust proneness, may predict susceptibility to certain anxiety-related disorders [3, 4•]. Individual differences in disgust proneness may be explained by the combination of early developmental experiences [5–7], including the learning of cultural norms about what is disgusting [8], and genetic influences [9]. Although it remains unclear which learning experiences and which genes are most salient in producing heightened disgust proneness, a recent meta-analysis revealed a moderate positive association between self-reported disgust proneness and OCD and several anxiety-related disorders, an association that remained significant after controlling for negative affect [4•].

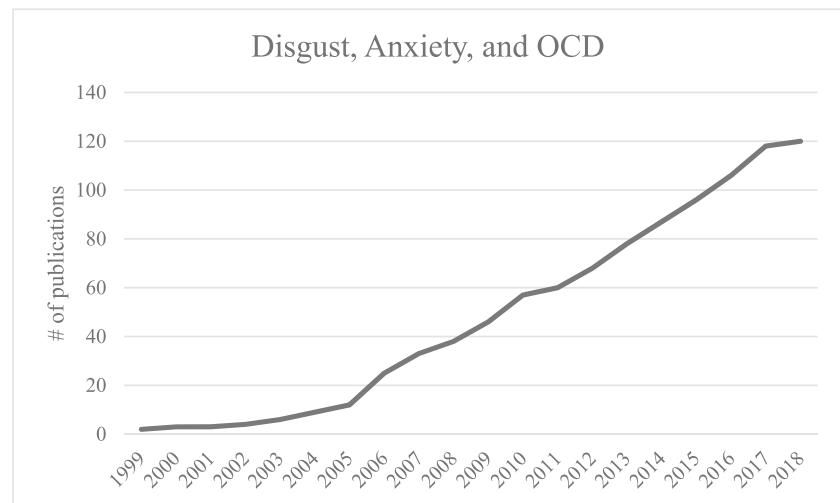
Psychometric research suggests that disgust proneness may consist of two distinct personality components, disgust propensity, or how easily one is disgusted, and disgust sensitivity, or how negative the experience of disgust is perceived to be [10]. Recent research has begun to examine how the two types of disgust proneness influence OCD and anxiety-related

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Fig. 1 Cumulative number of published peer-reviewed articles ($N = 120$) examining disgust in the context of anxiety or OCD since the publication of “Disgust – the forgotten emotion of psychiatry” (Phillips et al., 1998) in the *British Journal of Psychiatry* (adapted from Olatunji & McKay, 2007)



disorders. Theoretical explorations of disgust sensitivity suggest that this factor may confer a specific vulnerability for anxiety-related psychopathology, akin to the role of anxiety sensitivity in anxiety disorders [11]. Empirical studies have tested this hypothesis in both analogue and clinical samples [12–14]. Thus far, while disgust sensitivity has been found to be positively associated with anxiety-related disorders and OCD, there is not yet evidence that reveals a specific cognitive mechanism by which disgust sensitivity influences the development and/or maintenance of symptoms.

Disgust propensity appears to predict avoidance behavior more generally, a process that is central to cognitive-behavioral theories of anxiety and OCD [12]. This finding has been informed by research assessing disgust proneness with behavioral approach tasks [15, 16]. Research using facial electromyogram (EMG) [17, 18] and other physiological responses [19, 20] have also shown significant relationships between disgust proneness and symptoms of anxiety and OCD. Examinations of cognitive processing have also found significant biases for disgust-relevant cues in attention [21–23], memory [24, 25], and interpretation [26] among individuals with anxiety and OCD [27]. Research along these lines highlights that empirical work on disgust proneness has begun to integrate data from multiple levels of analysis in order to better explain variance in the full range of behavior as it relates to symptoms of anxiety and OCD (Table 1).

Disgust and OCD

The majority of recent research on disgust and psychopathology has focused on the role of disgust in OCD. Approximately 50% of individuals diagnosed with OCD have significant contamination fears, including obsessions regarding dirt and disease and compulsions surrounding cleanliness [28]. Researchers have suggested that contamination-based OCD

may be explained as a false contamination alarm caused by dysfunctional responses to disgust information and elevated disgust proneness [29, 30]. Consistent with this view, multiple studies have found a significant positive correlation between obsessive-compulsive (OC) symptoms and disgust proneness even after controlling for other factors such as negative affect and other symptoms of anxiety in both nonclinical [31, 32] and clinical [33, 34] samples. Other studies have found that disgust proneness mediates the relationship between OC symptoms and behavioral avoidance of contamination-related stimuli [16, 35], suggesting that disgust proneness plays a causal role in subsequent behavioral avoidance for individuals with OC symptoms. While a unique physiological response to disgust stimuli has not been found for individuals with OCD compared to healthy individuals [36], individuals with more severe OC symptoms and higher contamination fears report increased feelings of disgust as well as increased heart rate response during exposure treatment sessions [37].

Recent neuroimaging studies have also advanced the understanding of OCD by differentiating brain regions that respond to fear and disgust processing. One specific brain region of interest is the insula, a region of the cerebral cortex associated with interoceptive processing and the representation of internal bodily states [38, 39]. Results from previous functional neuroimaging studies consistently reveal greater insular activation in the recognition and experience of disgust [40–43]. A series of more recent neuroimaging studies for disgust processing have provided further evidence for increased insular activation in patients with OCD, especially those with contamination fears [44–46]. These studies suggest that insular activation is particularly relevant when OCD participants are placed in symptom-provoking conditions, where they are asked to confront unpleasant odors or inhibit disgusting images. In addition to the insular region, increased activation has also been observed in the parieto-sub-cortical circuit [47], caudate nucleus [44], and right frontal gyrus, right

Table 1 Examples of studies on disgust and disgust proneness across different levels of analysis

	OCD	Specific phobias	Health anxiety	PTSD
Self-report	Ching, Williams, Siev, & Olatunji, 2018	Verwoerd, Van Hout, & de Jong, 2016	Brady, Cisler, & Lohr, 2014	Engelhard, Olatunji, & de Jong, 2011
Behavioral	Deacon & Olatunji, 2007	Cogle, Summers, Harvey, Dillon, & Allan, 2016	Brady & Lohr, 2014	
Physiological	Duncko & Veale, 2016	Simon, Meuret, & Ritz, 2017		Olatunji, Babson, Smith, Feldner, & Connolly, 2009
Neural	Shapira et al., 2003	Caseras et al., 2010		Shin et al., 1999

OCD obsessive-compulsive disorder, PTSD posttraumatic stress disorder

precentral gyrus, and left inferior parietal lobe [48]. Further, connectivity strength between the insula and ventral striatum was significantly correlated with contamination and washing OC symptoms, revealing functional connectivity in the limbic network [45].

Other Disgust Phenomena in OCD

Disgust may also manifest in OCD in the form of mental contamination, in which individuals feel contaminated even in the absence of a physical contaminant [49]. In two studies, mental contamination mediated the relationship between disgust proneness and contamination-related OC symptoms and disgust avoidance in OCD patients [50, 51]. Even though imagined stimuli cannot carry disease, they do induce feelings of disgust in individuals with OC symptoms. Similarly, even watching others be contaminated can induce feelings of disgust in individuals with OC symptoms. In a small study of ten participants, individuals with OC symptoms reported feeling disgusted while observing others touch contaminated stimuli but also experienced vicarious relief when they observed that person wash after contamination [52].

Individuals with OCD typically endorse one or more dysfunctional beliefs that contribute to their symptoms, including threat overestimation, an inflated sense of responsibility for harm, perfectionism, intolerance of uncertainty, inflated importance of their own thoughts, and a need to control their thoughts [53, 54]. Several recent studies have found significant relationships between disgust and endorsement of these beliefs. For example, individuals with high contamination-based disgust and strong responsibility/threat overestimation beliefs had more severe OC concerns about their sexual orientation, such as a fear that they may become gay against their will [55]. While disgust proneness was not uniquely implicated, this factor did significantly interact with other OC beliefs to produce non-contamination-based concerns. Disgust proneness, along with thought-action fusion, mediated the relationship between religiosity and OC symptoms in a Turkish Muslim sample [56]. Additionally, Muslim individuals with high scrupulosity also had greater disgust proneness and endorsed more symptoms of contamination fear after exposure

to disgust-inducing images [57]. Scrupulosity may represent a form of “moral dirtiness,” and those high in disgust proneness may be especially at risk for this variant of OCD. On the other hand, in a clinical sample of individuals with OCD, obsessive beliefs did not contribute to increased contamination fear, while disgust proneness did [58]. Although disgust proneness is typically implicated primarily in contamination-based OCD, individuals with high disgust proneness and a strong endorsement of other obsessive beliefs seem to have more severe non-contamination OC symptoms. This suggests that disgust proneness may interact with other risk factors to confer risk of disorders that are not directly characterized by concerns of physical contamination and disease.

Disgust and Specific Phobias

Disgust has also been implicated in the development of select specific phobias, including spider phobia, blood-injection-injury (BII) phobia, and emetophobia (fear of vomiting). These specific phobias are often considered to be biologically prepared, potentially because small animals, insects, and body products are considered disease vectors; their disease-carrying potential may explain why these stimuli commonly elicit disgust reactions [3, 59]. Additionally, animals like spiders and snakes may be associated with disgust due to their physical features, including being creepy, hairy, or slimy [4••]. Research has shown that disgust proneness is associated with a fear of vomiting [60, 61], and it remains significantly associated with spider fear [62, 63] and BII fear [64] even after controlling for trait anxiety. Disgust also appears to affect cognitions surrounding a fear of vomiting. Compared to individuals with low fear of vomiting, highly vomit-fearful individuals used disgust information presented after an ambiguous scenario to predict that a character in a scenario had a higher chance of becoming ill, a form of reasoning known as disgust-based emotional reasoning [61]. Emotional reasoning often leads to overestimation of threat, even in objectively safe situations, and is hypothesized to contribute to the maintenance of dysfunctional beliefs [65].

The relationship between disgust proneness, BII fear, and fainting has also been the subject of recent empirical work. Initially, the relationship between disgust and fainting in the presence of BII stimuli was attributed to their shared underlying increase in parasympathetic activity [66]. However, recent work has found that disgust proneness is not significantly related to a history of fainting in individuals with BII phobia [67] and that disgust is not consistently linked to a parasympathetic response [68]. Another study suggested that parasympathetic excitation and sympathetic withdrawal are key features of BII phobia, but do not appear to differentiate individuals with and without a fainting response [69]. Thus, the fainting response in BII phobia may not be driven by disgust *per se*.

Neuroimaging research has also advanced current understanding regarding the similarities and differences between specific phobias at the neural level of analysis. While viewing spider images, individuals with spider phobia have been shown to respond with increased activation in the dorsal anterior cingulate and anterior insula, brain regions implicated in the experience of disgust [40]. In contrast, individuals with BII phobia demonstrated increased activation in the thalamus and visual/attention areas (including the occipito-temporo-parietal cortex) when viewing injections and injuries [70]. Although disgust has been implicated in both phobias, the distinct neurobiological substrates suggest that disgust may be more strongly experienced in spider phobia compared to BII phobia. However, future research is needed to determine if differences in the experience of disgust does indeed explain the distinct neural correlates for spider phobia and BII phobia.

Disgust and Health Anxiety

Illness anxiety disorder is characterized by severe health anxiety, in which individuals overestimate their likelihood of becoming ill and believe that the consequences of illness are especially severe [71]. Because of the imagined consequences of contracting an illness, these individuals may then engage in increased health-protective behaviors. Given that disgust serves a functional role in the avoidance of disease, it is not surprising that individuals high in disgust proneness may be especially vulnerable to health anxiety. Indeed, individuals with severe health anxiety had higher disgust reactions to images of individuals who displayed illness cues, such as coughing or having a rash, compared to individuals in a healthy comparison group [72]. Recent research has also shown that disgust proneness has a specific and robust association with anxiety toward and avoidance of potential health hazards [14]. Another recent study has demonstrated that individuals with significant health anxiety exhibit similar behavioral avoidance in response to disgust stimuli as individuals with high contamination fear, suggesting similar disgust-related mechanisms in contamination-based OCD and health

anxiety [73]. Indeed, comorbidity between OCD and health anxiety is estimated to be around 15% [74], and symptom overlap between the two conditions is high [75].

While the majority of research on health anxiety and disgust has examined the broad construct of disgust proneness, two recent studies have compared the effects of disgust propensity and disgust sensitivity in these individuals. In a sample of undergraduates, disgust sensitivity, but not disgust propensity, predicted increased health anxiety [76]. However, in a clinical sample, patients with hypochondriasis and patients with another anxiety disorder endorsed similar levels of both disgust propensity and disgust sensitivity [77]. Thus, while individual trait responses to disgust do appear to influence health anxiety symptoms, high disgust proneness may not specifically contribute to health anxiety symptoms in clinically anxious populations.

The intensive media coverage of recent pandemic illnesses, including swine flu (H1N1) and Ebola, has provided a unique paradigm within which to study individual responses to these illnesses and their relationship with disgust. Three studies found that individuals high in disgust proneness were more likely to be concerned about the spread of these illnesses, their severity, and their likelihood of infection [78–80]. Individuals high in disgust proneness also performed more safety behaviors, such as seeking reassurance from doctors and friends and researching possible symptoms on the internet, in response to their health-related concerns [80]. Related research with healthy individuals found that after they spent a week performing as many health behaviors as possible, including frequent hand-washing and carrying hand sanitizer, they endorsed higher disgust propensity [81]. Excessive media coverage of significant health events appears to increase symptoms of health anxiety in both anxious and nonanxious populations who are high in disgust proneness. The mechanisms include an increase in health-related safety behaviors, which in turn decreases individual tolerance for disgust and the potential for contamination.

Disgust and PTSD

Disgust reactions are frequently observed during exposure to traumatic events [82, 83]. Previous research suggests disgust responses may also contribute to the development of posttraumatic stress disorder (PTSD). Indeed, pervasive disgust served as a discriminatory factor in correctly categorizing 90% of Vietnam veterans with or without a PTSD diagnosis [84]. Likewise, a later study found that veterans of the war in Afghanistan who reported greater peritraumatic disgust exhibited more severe posttraumatic stress symptoms 6 months later, independent of their reported fear reactions to the event [85]. Consistent with the findings in veterans, sexual assault victims have endorsed similar feelings of disgust, in addition

to feelings of mental pollution and OC-like urges. When asked to recall a sexual assault experience, female participants often report elevated feelings of disgust and urges to wash [86, 87]. Similarly, adolescents with prior sexual assault experiences endorsed more present and intense feelings of disgust compared to those who had experienced a physical assault [82]. Moreover, these reports of elevated disgust may contribute to posttraumatic stress symptoms later on [88, 89].

More recent research has expanded upon these findings, providing further evidence for the role of disgust in mental contamination following a traumatic event. In a study of female sexual assault victims, self-focused disgust was significantly related to mental contamination following unwanted physical advances and/or a sexual trauma [90]. These results suggest that peritraumatic disgust focused on the self rather than the perpetrator may be more relevant in assessing internal feelings of contamination. Further, posttraumatic disgust and guilt mediated the relationship between peritraumatic disgust and PTSD symptoms in a sample of veterans who had experienced an interpersonal trauma, after controlling for gender [91]. Together, these findings suggest that the experience of disgust, especially if focused on oneself, may be an important mechanism in the development of posttraumatic stress symptoms.

New evidence has also emerged that highlights gender as a contributing factor in the relationship between disgust and PTSD. An earlier study [89] found that gender moderated the relationship between disgust responding and PTSD, such that females with PTSD reported more disgust in response to individualized traumatic event cues compared to females without PTSD, as well as males with and without PTSD. Contradictory results emerged in a more recent study, which suggested that men and women did not differ in trauma-related symptoms, but that the relationship between peritraumatic and posttraumatic disgust was stronger for men than for women [91]. Indeed, this supports the possibility of a gender-specific mechanism in PTSD, but future research is required for a clear and more detailed understanding of gender differences.

Recent research has also shed light on the role of disgust proneness in PTSD. Through a diathesis-stress model, disgust proneness may increase an individual's vulnerability to develop PTSD. In this case, high trait disgust proneness may interact with a traumatic stressor to produce increased symptoms following a traumatic event [4••]. Other potential mechanisms of disgust proneness have also been recently explored. For instance, disgust proneness may be an important factor in predicting the frequency of intrusive memories after exposure to a trauma-related film paradigm [92]. Additional research has also examined disgust sensitivity as it pertains to the development of PTSD. When comparing trauma-exposed veterans with and without PTSD to healthy controls, researchers found veterans without PTSD reported significantly lower disgust sensitivity than veterans with PTSD and healthy

controls. This finding suggests that lower levels of disgust sensitivity may serve as a resiliency factor in the face of trauma, thus protecting an individual from the development of PTSD [93]. However, the mechanism for this resilience function is still unclear.

Disgust in the Treatment of OCD and Anxiety-Related Disorders

The implications of disgust proneness for the treatment of OCD and anxiety-related disorders has become a major focus of recent research [94–96]. In an adult clinical sample, changes in disgust proneness predicted changes in OC washing symptoms [95]. In a youth clinical sample, the relationship between changes in disgust proneness and anxiety symptoms was strongest in children with an OCD diagnosis, compared to those with other anxiety disorder diagnoses [94, 97]. These studies suggest that while individuals with other anxiety disorders may see declines in disgust proneness during treatment, individuals with OCD are especially likely to see symptom reduction if treatment successfully decreases disgust proneness. When researchers further compared the roles of disgust propensity and disgust sensitivity, changes in disgust propensity but not disgust sensitivity mediated changes in OC symptoms from pre- to post-treatment after controlling for negative affect [96]. Although disgust sensitivity may play a role in the development of OCD, changes in disgust propensity appear to drive symptom reduction in OCD.

Recent research has also provided insight into mechanisms that may influence disgust during the treatment of OCD. For example, following extinction in a disgust-learning paradigm, high contamination-fearful individuals reported greater disgust for a neutral face previously paired with a disgusting image (CS+) compared to a neutral face not paired with a disgusting image (CS–), as well as a lower reduction in the expectancy of a disgusting image appearing after the CS+, compared to individuals with low contamination fear. Additionally, increased disgust after extinction was significantly correlated with increased disgust proneness [98•]. These findings suggest that individuals with contamination-based OCD may have greater difficulty inhibiting learned disgust reactions, due (in part) to heightened disgust proneness. This view is consistent with research showing that individuals with primary disgust emotions and increased OC symptoms had worse treatment outcomes [99]. Although few OCD treatment studies have directly targeted disgust, one study found that individuals with contamination-based OCD symptoms habituated to disgust more slowly and to a lesser degree than those without such symptoms [100]. Directly targeting disgust during exposure-based treatment is likely to be a key component of successful treatment for those with contamination-based OCD.

Disgust proneness may also influence other negative emotional experiences in OCD. For example, guilt is commonly observed in patients with OCD, especially among those with obsessions concerning being responsible for harm [101, 102]. Disgust and guilt have a significant moral component, especially when an individual perceives themselves as being responsible for harm [103]. Indeed, disgust proneness appears to partially mediate the relationship between trait guilt and contamination fear in a nonclinical sample [103], suggesting that a tendency to feel guilty contributes to contamination concerns in part because guilt evokes a tendency to feel disgusted. Thus, while disgust plays a significant role in OCD symptomatology, the experience and regulation of other emotions require further examination as this may have important treatment implications. Indeed, emotion regulation may be a key component in successful treatment of excessive disgust reactions in OCD. For example, recent studies have observed significantly decreased distress and decreased learned disgust among participants who received cognitive reappraisal training, compared to no training or emotional suppression [104, 105]. Additionally, training individuals with contamination-based OCD to use either imagery rescripting or cognitive reappraisal significantly reduced disgust compared to a control task [106]. Cognitive-behavioral treatment emphasizes the importance of reappraisal, which may be an especially useful tool for individuals with OCD in order to regulate the distress associated with experiencing disgust.

Other recent research has emphasized the importance of addressing disgust reactions directly in treatment for specific phobias and PTSD. For example, during a one-session exposure treatment for individuals with spider phobia, changes in both fear and disgust contributed to successful treatment [107]. In another study, women with significant spider fear were randomized to complete three sessions of contamination-focused exposure therapy or a waitlist control. Although there was no direct effect of this treatment on spider fear or spider-related disgust, individuals with high disgust propensity had decreased levels of spider fear and perceived danger after treatment compared to individuals in the waitlist control condition [108]. Disgust proneness also predicted treatment outcomes for youth with BII phobia after a single session of cognitive-behavioral therapy. Youth who reported higher levels of disgust proneness before treatment were significantly more likely to be classified as non-responders [109]. Finally, for women with a history of sexual victimization, change in disgust significantly predicted improvement in PTSD symptoms across the course of exposure for those who exhibited a significant decline in their anxiety symptoms [110]. Thus, disgust-based exposure may serve as a transdiagnostic treatment for individuals with high disgust proneness.

Conclusions

Although the role of disgust proneness in OCD and anxiety-related disorders has been increasingly well studied, most of the currently available studies have examined disgust proneness and disorder symptoms concurrently making it difficult to make definitive causal inferences [4]. Some research has revealed prospective associations between disgust proneness and OC symptoms [111]. However, more research employing longitudinal designs is needed in order to better demonstrate causality between disgust proneness and anxiety-related disorder symptoms. Although there has been a notable increase in the measurement of disgust proneness across multiple levels of analysis in OCD and anxiety-related disorders (Table 1), more research along these lines is needed to uncover mechanisms that may inform existing theoretical models. While a disease-avoidance model has traditionally been employed to account for the functional role of disgust proneness in contamination-based OCD, it is unclear if such a model can account for the role of disgust proneness in anxiety disorders where disease concerns are not salient. For example, individuals with social anxiety disorder (SAD) also appear to process disgust stimuli differently from healthy individuals, but only under certain conditions. Socially anxious individuals demonstrate an automatic attentional orienting bias toward disgust faces [112, 113] and avoid disgust faces during longer viewing tasks [114]. However, these disgust faces are most likely interpreted as socially threatening, indicating maladaptive beliefs about judgment or rejection among those with SAD rather than concerns about disease avoidance.

Future longitudinal and experimental research on disgust proneness may also reveal important treatment mechanisms. Although exposure-based treatments have long been used to treat anxiety disorders and OCD, new research suggests the slower extinction of disgust reactions may require either more intensive treatment or a different treatment approach for patients characterized by heightened disgust proneness. However, the mechanisms that may inform treatment development along these lines remain unclear. For example, incorporating evidence from advanced neuroimaging techniques may help elucidate neurobiological mechanisms that underlie the experience and extinction of disgust, revealing potential targets for a more precise treatment approach for OCD and anxiety-related disorders characterized by disgust proneness. Although recent research has greatly advanced current understanding of the role of disgust in anxiety and OCD, progress in the field will require more innovative approaches to exploring underlying mechanisms that may then inform treatment development.

Compliance with Ethical Standards

Conflict of Interest Kelly A. Knowles, Sarah C. Jessup, and Bunmi O. Olatunji declare no conflict of interest.

Human and Animal Rights and Informed Consent All reported studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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- Of major importance

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