aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Perspectives on Psychological Science
1–36
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DOI: 10.1177/1745691616688879
www.psychologicalscience.org/PPS
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Is Disgust Proneness Associated With Anxiety and Related Disorders? A Qualitative Review and Meta-Analysis of Group Comparison and Correlational Studies

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Abstract
Research suggests that disgust may be linked to the etiology of some anxiety-related disorders. The present investigation reviews this literature and employs separate meta-analyses of clinical group comparison and correlational studies to examine the association between disgust proneness and anxiety-related disorder symptoms. Meta-analysis of 43 group comparison studies revealed those high in anxiety disorder symptoms reported significantly more disgust proneness than those low in anxiety symptoms. Although this effect was not moderated by clinical versus analogue studies or type of disorder, larger group differences were observed for those high in anxiety symptoms associated with contagion concerns compared to those high in anxiety symptoms not associated with contagion concerns. Similarly, meta-analysis of correlational data across 83 samples revealed moderate associations between disgust proneness and anxiety-related disorder symptoms. Moderator analysis revealed that the association between disgust proneness and anxiety-related disorder symptoms was especially robust for anxiety symptoms associated with contagion concerns. After controlling for measures of negative affect, disgust proneness continued to be moderately correlated with anxiety-related disorder symptoms. However, negative affect was no longer significantly associated with symptoms of anxiety-related disorders when controlling for disgust proneness. The implications of these findings are discussed in the context of a novel transdiagnostic model.

Keywords
disgust proneness, anxiety disorders, OCD, transdiagnostic, meta-analysis

Elucidation of the nature and function of disgust in relation to anxiety and related disorders has been a focus of much research in the past two decades (Olatunji, Cisler, McKay, & Phillips, 2010; Woody & Teachman, 2000). Disgust is a negatively valenced emotion that has been viewed as motivating an avoidance response. There is evidence that experiencing disgust may have evolved specifically to protect humans from risk of disease (Curtis, Aunger, & Rabie, 2004; Curtis, de Barra, & Aunger, 2011; Tybur, Lieberman, & Griskevicius, 2009). That is, disgust may function as a "danger signal" that the likelihood of contagion is high. Indeed, a "disease avoidance" framework has been the basis for understanding the function of disgust (Matchett & Davey, 1991; Oaten, Stevenson, & Case, 2009; Olatunji & Sawchuk, 2005). Personality research has also observed that there are marked individual differences in the extent to which disgust is experienced (Haidt, McCauley, & Rozin, 1994; Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999), suggesting that there may be different thresholds for the activation of disease-avoidance concerns. Individual differences in the experience of disgust may reflect a "disgust proneness," a personality trait may consist of three components: *disgust propensity, disgust sensitivity*, and *disgust reactivity.* Disgust propensity reflects one's general tendency to experience disgust

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whereas disgust sensitivity is characterized by one's negative appraisal of the experience of disgust (Olatunji & Cisler, 2009; van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006). Disgust reactivity may be defined as the tendency to react with disgust when exposed to aversive stimuli (Viar-Paxton & Olatunji, in press). There is now increasing evidence that the components of disgust proneness may function as a vulnerability factor for anxiety-related disorders (Olatunji & McKay, 2007).

The purpose of this review is to examine the measurement, nature, and specificity of disgust proneness with special attention to the extent to which it may be considered as a transdiagnostic risk factor for the development of anxiety and related disorders. We compliment this qualitative review with meta-analytic comparisons between those meeting diagnostic criteria for an anxiety disorder *or* those high in anxiety disorder symptoms (i.e., analogue samples) *and* nonclinical/low anxiety symptom controls on disgust proneness. However, such a categorical view is admittedly limited as it assumes that members of the anxiety disorder category are qualitatively distinct from nonmembers. Consistent with a dimensional view that assumes that anxiety is present to a greater or lesser extent in all individuals, we conduct a second meta-analysis on correlations of disgust proneness with symptoms of anxiety and related disorders. To our knowledge, there has not been an attempt to provide a quantitative review of the literature implicating disgust proneness in the anxiety disorders. Conclusions based on the qualitative and quantitative review of the available literature are then integrated to provide the first transdiagnostic heuristic for disgust proneness that may inform future research. The implications of this novel heuristic for the assessment and treatment of disgust proneness in anxiety and related disorders are also considered.

Origins of Disgust Proneness

Although much remains unknown about the origins of disgust proneness, researchers have posited that individual differences in disgust proneness may arise from the combination of genetic (Kang, Kim, Namkoong, & An, 2010; Sherlock, Zietsch, Tybur, & Jern, 2016) and environmental (Rozin & Millman, 1987; Stevenson, Oaten, Case, Repacholi, & Wagland, 2010) factors including childhood socializing experiences where disgust responses are modeled excessively. Environmental factors include social transmission during formative stages of development (Kim, Ebesutani, Young, & Olatunji, 2013; Rozin, Haidt, & McCauley, 2008) as well as socially acquired information shared by a particular culture through social learning and group hygiene behavior (Curtis et al., 2011). The interaction of genes and specific environmental triggers may produce a heightened disgust proneness that may then confer risk for the development of anxiety and related disorders.

Assessment and Structure of Disgust Proneness

Enhancing our understanding of individual differences in disgust proneness requires reliable and valid measures of the construct. The availability of such measures has allowed for meaningful distinctions between disgust proneness and other traits. For example, psychometric research has shown that disgust proneness is distinct from trait anxiety (McDonald, Hartman, & Vrana, 2008), the stable tendency to experience anxiety across many situations (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). Disgust proneness appears to be hierarchically organized as a lower-order trait that is nested within a higher-order dimension of neuroticism. Indeed, neuroticism is associated with an increased likelihood of experiencing a wide range of negative emotions, including disgust (Hennig, Pössel, & Netter, 1996). The availability of self-report measures has also allowed for a better understanding of similarly between disgust proneness and other traits. Like other personality traits related to negative affect (e.g., Shallcross, Ford, Floerke, & Mauss, 2012), disgust proneness has been shown to decline with age (Curtis et al., 2004; Fessler & Navarrete, 2005; Quigley, Sherman, & Sherman, 1997) and is associated with activity in emotion-specific brain regions (Schienle, Schäfer, Stark, et al., 2005b).

Self-report measurement of disgust proneness has undergone substantial refinement over the past two decades. The first measure, the Disgust and Contamination Sensitivity Questionnaire (DQ; Rozin, Fallon, & Mandell, 1984), conceptualized disgust proneness in the context of contaminated foods (Rozin et al., 1984). Given the exclusive focus of the DQ on foods, subsequent measures like the Disgust Scale (DS; Haidt et al., 1994), the Disgust Emotion Scale (DES; Walls & Kleinknecht, 1996), and the Disgust Scale–Revised (DS-R; Olatunji, Williams, Tolin, et al., 2007) were developed to assess a broader array of disgust elicitors such as (a) *food* that has spoiled, is culturally unacceptable, or has been fouled in some way, (b) *animals* that are slimy or live in dirty conditions, (c) *body products* including body odors and feces, mucus, and so on, (d) *body envelope violations*, or mutilation of the body, (e) *death* and dead bodies, and (f) *hygiene*, or violations of culturally expected hygiene practices. More recently, the Disgust Propensity and Sensitivity Scale–Revised (DPSS-R) was developed to remove contextual elicitors from the assessment of disgust proneness and to facilitate the differentiation of disgust sensitivity from disgust propensity (van Overveld, de Jong, Peters, et al., 2006). Disgust propensity may be characterized by avoidant action

tendencies to repugnant materials (van Overveld, de Jong, & Peters, 2010), whereas disgust sensitivity is linked with more general emotional sensitivity (Fergus & Valentiner, 2009; Goetz, Lee, Cougle, & Turkel, 2013).

Assessment of disgust proneness in specific populations

The evolution of disgust measurement also recognizes that there may be important cultural influences on the experience of disgust (Curtis et al., 2011). Accordingly, efforts have been made to adapt many commonly used measures for use in different cultural contexts (e.g., Schienle, Walter, Stark, & Vaitl, 2002). Other measures of disgust proneness have been developed to fill much needed gaps in the literature. For example, assessment of disgust proneness in children has required the use of age-downward versions of adult measures (Muris, Huijding, Mayer, Langkamp, et al., 2012). More recently, Viar-Paxton and colleagues (2015) developed the Child Disgust Scale (CDS), a measure of disgust proneness specifically for children. The CDS is a developmentally appropriate measure with good psychometric properties that can aid research on the role of disgust proneness in anxiety-related disorders in children. Other measures have been developed to examine disgust domains not captured in existing measures. For example, the Three Domains of Disgust Scale (TDDS; Tybur et al., 2009) was recently developed to allow for distinctions between general disgust proneness, proneness toward pathogen disgust, and proneness toward previously overlooked domains of sexual disgust and moral disgust.

Is disgust proneness categorical or dimensional?

The availability of psychometrically sound self-report measures has made it possible to ask questions regarding the latent structure of disgust proneness, a question that has important implications for conceptualizing the etiology of anxiety disorders. If disgust proneness is composed of underlying latent categories, then etiological models that posit discontinuity (e.g., experiencing a dichotomous causal factor means having the pathological form of disgust proneness) would be adequate. However, dimensional variables are generally characterized by a multifactorial etiology (Haslam, 1997) and etiological models of disgust proneness would then focus on identifying the various environmental and/or genetic moderators that contribute to a person's position on a continuum of disgust proneness. Taxometrics, a set of statistical procedures designed to uncover the latent structure (i.e., categorical versus continuous distribution) of phenomena (Meehl & Golden, 1982), has been a useful tool for examining the underlying latent structure of personality traits. Olatunji and Broman-Fulks (2007) examined the latent structure of disgust proneness by applying three taxometric procedures (maximum eigenvalue, mean above minus below a cut, and latent-mode factor analysis) to data collected from two large nonclinical samples on two measures of disgust proneness. Disgust proneness in the first sample was operationalized by disgust reactions to food, animals, body products, sex, body envelope violations, death, hygiene, and sympathetic magic, as assessed by the DS. Disgust proneness in the second independent sample was operationalized by disgust reactions to animals, injections and blood draws, mutilation and death, rotting foods, and odors, as assessed by the DES. These findings have been replicated (Olatunji & Broman-Fulks, 2009) and provide converging evidence that disgust proneness is best conceptualized as a dimensional construct, present to a greater or lesser extent in all individuals.

Disgust Proneness and Anxiety-Related Disorders

The role of disgust proneness in anxiety-related disorders can be traced back to the emergence of the disease-avoidance model of phobias (Matchett & Davey, 1991). This model posits that some animal phobias may be the consequence of certain animals first being associated with the spread of disease, dirt or contamination, or possessing disgust-evoking perceptual features (e.g., looking like mucus or feces; Davey, 1994a). Disease avoidance concerns have also been the basis for understanding the role of disgust proneness in blood-injection-injury (BII) phobia, contamination-based obsessive-compulsive disorder (OCD; Olatunji, Moretz, et al., 2010), and health anxiety (Olatunji, 2009). As observed by Davey (2011), these disorders are characterized by avoidance of disgust-relevant stimuli due to disease concerns. Indeed, studies employing factor analytic and cluster analytic methods have consistently revealed small animals (including invertebrates, insects and small mammals), blood and mutilation, and contaminating agents as being distinct domains of disgust (Marzillier & Davey, 2004). Given that spider phobia, BII phobia, contamination-based OCD, and health anxiety are characterized by disgust elicitors, avoidance in these disorders may function largely to protect against the acquisition of various diseases. To prevent the acquisition of disease, those high in disgust proneness may be especially motivated to engage in avoidance behaviors that are commonly observed in various anxiety and related disorders.

Disgust proneness and spider phobia

The link between disgust proneness and anxiety-related disorders was first observed with regards to spider phobia. As articulated by Davey (1994a), the fear of spiders is closely associated with the disease-avoidance response of disgust. Although spiders are usually not poisonous nor the agents of illnesses, concerns of disease, which are exacerbated by the physical characteristics of spiders (creepy, crawly, hairy, etc.), are often the basis of phobic reactions to spiders. Consistent with a disease-avoidance perspective, self-report measures of disgust proneness have consistently been found to correlate with self-report questionnaires of spider phobia (de Jong & Merckelbach, 1998; Mulkens, de Jong, & Merckelbach, 1996), even when controlling for trait anxiety (Olatunji, Williams, Lohr, et al., 2007). Research has also shown that individuals with spider fears verbally report feelings of disgust when confronted with spiders (Olatunji & Deacon, 2008; Sawchuk, Lohr, Westendorf, Meunier, & Tolin, 2002; Tolin, Lohr, Sawchuk, & Lee, 1997; Vernon & Berenbaum, 2002). Heightened disgust proneness has also been linked to behavioral avoidance in spider phobia (Woody, McLean, & Klassen, 2005). These findings suggest that spiders may be avoided based on expectances of contamination rather than harm (de Jong & Muris, 2002). Indeed, research has shown that higher expectancies for disgust relevant outcomes significantly predicted self-reported spider fear, but fear-expectancies did not (van Overveld, de Jong, Peters, Cavanagh, et al., 2006). Similarly, de Jong and Peters (2007b) found that spider phobic individuals expected a disgust, but not fear, outcome to follow exposure to spiders. An extension of this research also found that higher expectancies for disgust-related outcomes predict behavioral avoidance of spiders (Olatunji, Cisler, Meunier, Connolly, & Lohr, 2008).

Disgust proneness and blood-injection-injury (BII) phobia

Research has found measures of disgust proneness to be positively correlated with measures of BII phobia (de Jong & Merckelbach, 1998; Sawchuk, Lohr, Tolin, Lee, & Kleinknecht, 2000), the persistent, intense, and irrational fear of stimuli and situations involving blood, injuries, and mutilation (Marks, 1988). For example, Olatunji, Williams, Sawchuk, and Lohr (2006) found significant relations between disgust proneness and symptoms of BII phobia independent of trait anxiety. Individuals with elevated BII phobia also respond with more disgust than fear when confronted with BII-relevant stimuli (Sawchuk et al., 2002). In fact, facial expressions of BII phobics upon exposure to threat-relevant stimuli have also been found to be more associated with disgust than fear (Lumley & Melamed, 1992). In a relevant study, Sawchuk, Lohr, Lee, and Tolin (1999) exposed BII phobics and nonphobics to a video depicting maggots and larvae and found that BII phobics rated the video as significantly more disgusting than did nonphobics. Given that maggots and larvae are unrelated to BII phobic concerns, this suggests that disgust proneness in BII phobia is a generalized response rather than threat specific. Consistent with this view, BII phobic individuals also demonstrate a strong implicit memory bias for generally disgusting stimuli (Sawchuk et al., 1999). BII phobia is distinct from other phobias in that it is associated with fainting symptoms (or vasovagal syncope), observed in 75% to 80% of its patients (Kleinknecht & Lenz, 1989). Although a component of this fainting response appears to be heritable (Page & Martin, 1998), it has been suggested that the fainting response in BII phobia may be accounted for by heightened disgust proneness (Page, 1994, 2003). However, subsequent descriptive (Olatunji et al., 2006) and experimental (Vossbeck-Elsebusch, Steinigeweg, Vögele, & Gerlach, 2012) research has failed to support a unique role for disgust proneness in the fainting response in BII phobia.

Disgust proneness and contamination-based OCD

Contamination-based OCD is characterized by intrusive, repetitive thoughts, images, or impulses about contagion. Compulsions associated with contamination-based OCD consist of purposeful, repetitive overt and covert behaviors such as excessive washing and cleaning that are performed in an effort to relieve obsessional distress. Given that disgust is thought to serve a disease-avoidance function (Matchett & Davey, 1991), it has been posited that contamination-based OCD represents a dysfunction in disgust proneness (Husted, Shapira, & Goodman, 2006). Indeed, existing research suggests that OCD may be conceptualized in terms of a false contamination alarm in which disgust proneness plays a crucial organizing role (Stein, Liu, Shapira, & Goodman, 2001). Consistent with this view, research has shown that individual differences in disgust proneness predict estimates regarding the likelihood of catching a disease when confronted with potentially contaminated stimuli, even after controlling for anxiety symptoms (Mitte, 2008). Furthermore, research has shown that self-report questionnaires of disgust proneness correlate with self-report measures of symptoms of contamination-based OCD (Mancini, Gragnani, & D'Olimpio, 2001). Longitudinal research has also shown that changes in disgust proneness over a six-month period are associated with changes in OCD symptoms (Berle et al., 2012).

As a danger signal for contagion, the disgust experienced in contamination-related OCD may facilitate avoidance of stimuli high in contagion potency (e.g., bedpans; Deacon & Olatunji, 2007). Self-reported disgust proneness also predicts behavioral avoidance of such stimuli (Deacon & Olatunji, 2007; Olatunji, Lohr, Sawchuk, & Tolin, 2007). Furthermore, Shapira et al. (2003) found that brain activation in the insula during exposure to disgusting stimuli, but not threatening stimuli, successfully discriminated OCD patients from normal controls. The anterior region of the insula has been implicated in gustatory processes, which is consistent with the evolved function of disgust to protect against the ingestion of harmful substances (Calder, Keane, Manes, Antoun, & Young, 2000; Calder, Lawrence, & Young, 2001; Caruana, Jezzini, Sbriscia-Fioretti, Rizzolatti, & Gallese, 2011; Rozin & Fallon, 1987). Accordingly, the neural substrates involved in disgust proneness may be relevant to the development of OCD and, in particular, to the contamination subtype (Husted et al., 2006).

Disgust proneness and health anxiety

Health anxiety is characterized by preoccupation with having a physical illness. Those who experience health anxiety are convinced that harmless physical symptoms are indicators of serious disease or severe medical conditions. Disgust proneness may also play an important role in health anxiety as a defense against the acquisition of disease. Indeed, disgust proneness has been found to predict anxious and avoidant responding to stimuli associated with the common cold, the flu, and mononucleosis (Fan & Olatunji, 2013). Disgust proneness also uniquely predicted anxiety in response to the H1N1 (swine flu) pandemic (Brand, McKay, Wheaton, & Abramowitz, 2013; Wheaton, Abramowitz, Berman, Fabricant, & Olatunji, 2012). Health anxiety may more precisely reflect aversion toward disgust-related bodily sensations and may arise from the belief that these sensations are signs of impending harmful health consequences (Brady, Cisler, & Lohr, 2014). Consistent with this view, studies have also more directly linked disgust proneness to health anxiety (Olatunji, 2009; Thorpe, Patel, & Simonds, 2003). For example, hypochondriacal characteristics have been found to be significantly associated with self-reported disgust proneness (Weck, Esch, & Rohrmann, 2014). Importantly, the association between disgust proneness and symptoms of hypochondriasis and health anxiety appears to be independent of trait anxiety (Davey & Bond, 2006).

Is Disgust Proneness "Transdiagnostic"?

Disgust proneness may represent a transdiagnostic process that is shared across various anxiety-related disorders. In a recent study, Weck and colleagues (2014) found that although patients with hypochondriasis and those with an anxiety disorder had higher scores than those of the healthy controls on several measures of disgust proneness, no differences were found between patients with hypochondriasis and those with anxiety disorders. Similarly, Woody and Tolin (2002) found that although patients with OCD and generalized social phobia (GSP) reported more disgust proneness than healthy controls, no significant differences were found between patients with OCD and those with GSP. One interpretation of these findings is that disgust proneness is a transdiagnostic process that is relevant for a wide range of disorders. However, Olatunji, Tart, Ciesielski, McGrath, and Smits (2011) found that although individuals with generalized anxiety disorder (GAD) and those with OCD endorsed greater disgust proneness than controls, those with OCD also reported significantly higher disgust proneness than those with GAD. This finding suggests that while disgust proneness may be implicated in a wide range of anxiety disorders, it may be a stronger predictor of some anxiety-related disorders relative to others.

It is widely understood that women report more anxiety disorder symptoms than men (Craske, 2003). A similar pattern of differences between men and women in disgust proneness has also been found, with women reporting higher levels of disgust proneness than men (e.g., Haidt et al., 1994). As further evidence for disgust proneness as a transdiagnostic process, research has now shown that the sex difference in several anxiety-related disorders including spider phobia (Connolly, Olatunji, & Lohr, 2008), BII phobia (Olatunji, Arrindell, & Lohr, 2005), contamination-based OCD (Olatunji, Sawchuk, Arrindell, & Lohr, 2005), and death anxiety (Bassett, 2017) can be accounted for by the sex difference in disgust proneness. Women may be more prone to experiencing disgust than men for a variety of reasons (see Fleischman, 2014). Examination of stressors associated with gender-specific learning histories and sex role socialization practices and their interaction with disgust proneness early in development may be valuable in better understanding gender differences in anxiety-related disorders. However, previous research has shown that women report more negative affect compared to men (Kelly, Tyrka, Anderson, Price, & Carpenter, 2008). This suggests that the gender differences in disgust proneness may be an artifact of the broader gender differences in negative affect.

Disgust proneness and "other" anxiety-related disorders

Disgust reactions are commonly observed during exposure to traumatic events (Feldner, Frala, Badour, Leen-Feldner, & Olatunji, 2010; McNally, 2002; Power & Fyvie, 2013) and such reactions may play in a role in the development of posttraumatic stress disorder (PTSD). Consistent with this view, Foy, Sipprelle, Rueger, and Carroll (1984) found that disgust levels were among several items that correctly categorized 90% of Vietnam veterans as either PTSD positive or negative. Likewise, when female sexual assault victims recall the assault memory, they report elevated feelings of disgust (Fairbrother, Newth, & Rachman, 2005; Fairbrother & Rachman, 2004; Feldner et al., 2010), which may contribute to symptoms of PTSD (Badour et al., 2011; Olatunji, Babson, Smith, Feldner, & Connolly, 2009; Shin et al., 1999). Disgust proneness may contribute to PTSD by increasing the frequency of intrusive memories after exposure to a traumatic event (Bomyea & Amir, 2012) or by enhancing the relation between peritraumatic disgust and PTSD-symptom severity (Engelhard, Olatunji, & de Jong, 2011). Disgust proneness may also increase one's vulnerability to the development of PTSD through a diathesis-stress interaction, in which disgust proneness constitutes a latent pathogenic trait that is activated by sufficient stress and trauma (Olatunji, Armstrong, Fan, & Zhao, 2014).

Disgust proneness has also been implicated in several other anxiety-related disorders (Davey, 2003). Indeed, Davey and Bond (2006) found that disgust proneness predicted scores on measures of "disgust-irrelevant" psychopathologies such as claustrophobia and height phobia even after trait anxiety had been partialled out. Other studies have also found significant relationships between disgust proneness and anxiety disorder symptoms that would not, a priori, be considered to be related to disgust, including situational–environmental phobias and separation anxiety (Muris, Merckelbach, Schmidt, & Tierney, 1999), agoraphobia (Muris et al., 2000), and general anxiety (Olatunji, Unoka, Beran, David, & Armstrong, 2009).

Although the available evidence suggest that disgust proneness may be a transdiagnostic process in the anxiety disorders, it is difficult to conceptualize the association between disgust proneness and some anxiety disorder symptoms (e.g., claustrophobia, height phobia) not associated with disgust within the disease-avoidance framework. The disease-avoidance framework has difficulty simultaneously explaining the mechanisms by which disgust proneness leads to anxiety disorders not associated with contagion concerns (i.e., multifinality). Another issue that existing models fail to address is why one individual with elevated disgust proneness develops one set of anxiety symptoms while another with the same risk factor develops another set of symptoms (i.e., divergent trajectories). Disgust proneness as a transdiagnostic process may also be relative in that it partially depends on the disorder being considered. For example, Fergus and Valentiner (2009) found that although disgust proneness predicted symptoms of disgust-relevant (i.e., spiders, rats, and blood) and fear-relevant (i.e., dogs, lions, and heights) phobias, measures of disgust proneness explained more variance in disgust-relevant phobias. Should disgust proneness be transdiagnostic, it may be necessary to consider theoretical models that may better explain how it contributes to a wide range of anxiety-related disorders independent of other risk factors.

Disgust proneness and the distinction of negative affect

Several personality traits, including trait anxiety, neuroticism, and depression, represent facets of negative affect, the tendency to experience unpleasant affective states (Watson & Clark, 1984). Available studies have generally shown that disgust proneness predicts symptoms of spider phobia when controlling for trait anxiety (Olatunji, Williams, Lohr, et al., 2007) and negative affect more broadly (Olatunji, Cisler, et al., 2007). Disgust proneness also predicts negative emotional responding (Olatunji, 2006) and avoidance tendencies (Olatunji & Deacon, 2008) during exposure to spiders when controlling for trait anxiety. Research has also shown that disgust proneness predicts symptoms of BII phobia when controlling for trait anxiety (Olatunji, Williams, Lohr, et al., 2007) and negative affect (Olatunji, Cisler, et al., 2007). Furthermore, it has been shown that disgust proneness is a unique predictor of verbal and behavioral symptoms of contamination-based OCD, and that this relationship is unmediated by trait anxiety (Moretz & McKay, 2008; Tsao & McKay, 2004). In fact, disgust proneness appears to mediate the relationship between negative affect and symptoms of contamination-based OCD (Olatunji, Moretz, et al., 2010). Prospective research has also shown that change in disgust proneness over a 12-week period predicted change in symptoms of contamination-based OCD, even when controlling for change in negative affect (Olatunji, 2010).

Disgust proneness also predicts other anxiety-related disorders, including health anxiety (Goetz, Lee, & Cougle, 2013; Olatunji, 2009) and symptoms of PTSD (Badour, Ojserkis, McKay, & Feldner, 2014; Bomyea & Amir, 2012) when controlling for negative affect. However, the findings from this literature have not been entirely consistent. For example, Muris and colleagues (1999) found that disgust proneness was unrelated to a range of anxiety disorder symptoms when controlling for trait anxiety. Using a

prospective design, David and colleagues (2009) also found that disgust proneness did not significantly predict change in symptoms of OCD over a 12-week period when controlling for negative affect. Uncontrolled research have also produced negative findings. In a series of studies, Merckelbach, Muris, de Jong, and de Jongh (1999) found no evidence for a connection between disgust proneness and BII fear among undergraduates and in a sample of patients with dental phobia. Experimental research also calls into question the extent to which disgust proneness may be implicated in anxiety and related disorders. For example, Davey and Hurrell (2009) found that although anxiety induction caused increases in self-reported anxiety symptoms, a disgust indication did not result in increases in anxiety. These conflicting findings highlight the need for a quantitative review of the available literature to determine the extent to which disgust proneness may be implicated in anxiety and related disorders.

The Present Investigation

Previous qualitative reviews have concluded that disgust proneness may play an important role in anxiety-related disorders (Olatunji, Cisler, et al., 2010), that this role can be meaningfully differentiated from that of other emotional processes (Cisler et al., 2009a; Woody & Teachman, 2000), and that this role may be partially understood from a disease-avoidance perspective (Davey, 2011). More recent qualitative reviews have described unique pathways that may account for how disgust is learned and unlearned in the context of specific anxiety-related disorders (Ludvik, Boschen, & Neumann, 2015). However, a quantitative review of the literature implicating disgust proneness in the anxiety disorders has not been offered. A quantitative description of this literature could allow for stronger inferences to be made regarding the role of disgust proneness in the anxiety disorders. In Part I of the present investigation, meta-analytic comparisons were made on disgust proneness scores between those meeting diagnostic criteria for an anxiety disorder *or* those high in anxiety disorder symptoms (i.e., analogue samples) *and* nonclinical/low anxiety symptom controls. The purpose of this review was to answer the following five questions:

1. Is there a main effect of anxiety disorder status (considering both clinical and analogue studies) on disgust proneness, such that disgust proneness differs between those high and low in anxiety disorder symptoms?
2. Is the main effect of anxiety disorder status on disgust proneness moderated by the general type of anxiety disorder, such that differences in disgust proneness emerge in anxiety-related disorders typically associated with disgust ("disgust disorders," e.g., OCD) compared to those not associated with disgust ("non-disgust disorders," e.g., GAD)?
3. Within the disgust disorders, is the main effect of disorder status on disgust proneness moderated by the specific disorder type, such that differences in disgust proneness emerge between specific conditions (e.g., between BII phobia and OCD)?
4. Is the main effect of anxiety disorder status on disgust proneness moderated by the disgust proneness scale used in the study, such that some scales are associated with larger group differences in disgust proneness?
5. Is the main effect of anxiety disorder status on disgust proneness moderated by the type of sample used in the study, such that differences in disgust proneness vary between clinical and analogue samples?
6. Is the main effect of anxiety disorder status on disgust proneness moderated by age or gender?

Part I: Meta-Analysis of Diagnostic and Analogue Group Comparisons of Disgust Proneness

Literature search

The PsycINFO and PubMed databases were searched for peer-reviewed, scholarly articles printed in English with titles or abstracts containing the term "disgust" paired with any of the following terms: *disorder, psychopathology, anxiety, obsessive compulsive, OCD, contamination, phobia, snake, spider, blood, injection, BII, post-traumatic, PTSD.* Additional studies were identified from the reference sections of studies discovered through this literature search. This search was repeated three times between May 2012 and March 2015 to update the meta-analysis to include all publications through 2014. These searches returned approximately 1,650 articles. The abstracts of these articles were examined and studies were excluded if they were not empirical (i.e., review), if they did not contain a measure of disgust proneness, or if they did not examine individual differences in disgust proneness in the context of anxiety-related disorders or psychopathology. A large number of studies were excluded because they examined processing of facial expressions of disgust and other emotions, with no consideration of individual differences in disgust and/or symptoms of anxiety-related disorders. This process of selection led to the identification of 129 studies that were then considered for inclusion in the meta-analysis.

The initial body of studies was searched for studies that compared high and low symptom groups in terms of their disgust proneness and reported means and standard

deviations for both groups. In this analysis, we included both clinical samples, in which the high symptom group was composed of patients and the low symptom group was composed of a control sample from the community, and analogue samples, in which the high symptom and low symptom group were composed by applying cut-off scores to a convenience sample (i.e., extreme-groups recruitment). This search initially yielded 62 studies. From these studies, 7 were excluded because they contained a patient group, but not a control group, and thus could not provide an effect size for this analysis; 7 were excluded because there was no measure of disgust proneness; 3 were excluded because *M*s, but not *SD*s, were reported; 2 were excluded because the groups were formed on the basis of a median split, rather than diagnostic status or extreme-groups recruitment; and 1 study was excluded because it had the same participants as one of the studies already included in the database. The final database for Part I of the meta-analysis included 43 studies (N = 3,985; high-symptom n = 1,762,[1] low-symptom n = 2,223; see Table 1 for study details). Overall, these participants were 67% female with a mean age of 23.87.

For moderator analysis, we coded the general and specific type of disorder that was studied. In terms of *general* disorder type, we coded if the condition of interest was a "disgust disorder," meaning that it focused on disgust-eliciting stimuli or events (e.g., OCD, spider phobia, BII phobia), or if it was a "non-disgust disorder" (e.g., social anxiety disorder, GAD) meaning that the disorder focused on stimuli or events that are not typically disgust-eliciting. Within the disgust disorders, we also coded the specific disorder type, which included spider phobia, BII phobia, OCD, and PTSD.[2] One study of health anxiety (Weck et al., 2014), one study of snake phobia (Klieger & Siejak, 1997), and one study of emetophobia (van Overveld, de Jong, Peters, van Hout, & Bouman, 2008) were excluded, because in categorical moderator analyses, we only included levels of a moderator with at least two studies ($k > 1$). This procedure limited the effects of outliers and ensured meaningful comparisons between levels of a moderator. We also coded the scale that was used to measure disgust proneness, again requiring $k > 1$ for inclusion in the categorical moderator analysis, which led to the exclusion of 5 studies with unique measures. We coded the type of sample, recording if the high symptom group was composed of patients with diagnoses established through clinical interviews (clinical sample) or individuals from a convenience sample who had elevated symptom levels above a cutoff score (analogue sample). We also coded the gender composition of the full sample (percentage female) and age of the full sample for each study for consideration as moderators.

To maintain independence of samples, we included only one estimate of the difference in disgust proneness between individuals high and low in anxiety per study in all analyses. For the estimate of the overall combined effect, if a study included multiple measures of disgust proneness and/or multiple high symptoms groups, we initially computed the standardized mean difference for each comparison, and then computed an average of these comparisons and entered this value.[3] We then used this estimate for moderator analysis, with the exception of moderator analysis for disgust proneness scale or disorder type (specific or general). For these analyses, we selected one level of the moderator for each study and entered the average of the standardized mean difference for each comparison involving this level of the moderator. This selection was random with replacement, with the exception that we favored levels of a moderator with low *k*s, to allow the inclusion of as many levels as possible.

Statistical analysis

Studies were entered into a database using Comprehensive Meta-Analysis (CMA) Version 2 (Biostat; Borenstein, Hedges, Higgins, & Rothstein, 2005). For each study, an effect size for the group difference in disgust proneness was established based on *M*s and *SD*s. Hedges's g was used as the measure of effect size, which has benchmarks similar to Cohen's d (0.2 = small; 0.5 = medium; 0.8 = large), but is less positively biased (Grissom & Kim, 2005). We used the Q statistic to test for the presence of between-study variability, to validate the selection of a random-effects model and to determine if categorical and continuous moderators could be observed. We used the metafor package for R statistical software to produce a forest plot depicting individual and combined effect sizes (Viechtbauer, 2010).

Results

Differences between symptom groups in disgust proneness. Overall, participants high in symptoms of anxiety-related disorders were higher in disgust proneness compared to participants low in symptoms, as revealed by a large, significant combined effect size (k = 43, g = 1.15, 95% CI [0.95, 1.34], $p < .001$, *FSN* = 8,286). Duval and Tweedie's "trim and fill" procedure did not detect asymmetry in the funnel plot (Fig. 1), and the effect remained large (g = 1.09, 95% CI [0.91, 1.27], $p < .001$) after removing one clear outlier (Olatunji, Williams, Tolin, et al., 2007). There was significant heterogeneity in the contributing effect sizes, $Q(42) = 261.362$, $p < .001$, $I^2 = 83.93$. This main effect was moderated by the type of

Table 1. Study Characteristics and Effect Sizes for Part I, Meta-Analysis of Group Differences in Disgust Proneness (DP)

Study	High Sx *n*	Low Sx *n*	*g*	*SE*	% female	Age (*M* years)	Sample type	Disorder	Measure of DP
Berle et al. (2012)	109	60	0.24	0.16	59	44.80	Clinical	OCD	DES
Bianchi and Carter (2012)	51	29	1.06	0.25	84	20.00	Clinical	BII, spider	DES
Connolly, Lohr, Olatunji, Hahn, and Williams (2009)	32	30	1.11	0.27	63	19.66	Analogue	OCD	DS-R
D'Olimpio et al. (2013)	92	87	2.31	0.19	58		Clinical	OCD, PD[a]	DS
de Jong and Muris (2002)	18	18	1.89	0.39	100	12.50	Clinical	Spider	DQ
de Jong and Peters (2007a)	25	27	2.29	0.35	100	19.60	Analogue	BII	DES
de Jong, Andrea, and Muris (1997)	22	21	0.76	0.31	100	11.60	Clinical	Spider	DQ
de Jong, Peters, and Vanderhallen (2002)	24	24	0.74	0.30	100		Clinical	Spider	DQ, DS
Deacon and Olatunji (2007)	26	30	0.94	0.28	54	20.00	Analogue	OCD	DS
Hermann et al. (2007)	9	10	1.23	0.48	100	25.40	Clinical	BII	QADS
Huijding and de Jong (2007)	60	30	2.78	0.30	83	34.00	Clinical	Spider	Other
Jhung et al. (2010)	41	37	0.59	0.23	23	23.37	Clinical	OCD	DS-R
Klieger and Siejak (1997)	21	30	0.93	0.29	100	19.20	Analogue	Snake	DS
Koch, O'Neil, Sawchuk, and Connolly (2002)	38	35	1.25	0.25	67		Analogue	BII	DES
Lawrence et al. (2007)	17	19	1.24	0.36	42	34.43	Clinical	OCD	DS-R
Leutgeb, Schäfer, Köchel, Scharmüller, and Schienle (2010)	14	14	2.30	0.48	100		Clinical	Spider	QADS
Mulkens, de Jong, and Merckelbach (1996)	24	45	0.73	0.26	100	23.04	Clinical	Spider	DQ
Olatunji (2006)	22	28	0.72	0.29	96	19.86	Analogue	Spider	DES
Olatunji and Deacon (2008)	22	28	0.87	0.29	98	19.86	Analogue	Spider	DS
Olatunji, Lohr, et al. (2005), Study 2	13	11	1.03	0.42	79	20.45	Analogue	BII	Other
Olatunji, Lohr, Sawchuk, and Patten (2007)	40	40	1.76	0.26	73	19.78	Analogue	BII	DES
Olatunji, Williams, Tolin, et al. (2007), Study 4	32	14	4.82	0.59	70	34.62	Analogue	OCD	DS-R
Olatunji, Lohr, Sawchuk, and Tolin (2007)	30	30	1.45	0.29	77		Analogue	OCD	DS
Olatunji, Tart, et al. (2011), Study 1	60	30	0.90	0.23	50	39.12	Clinical	OCD, GAD	DPSS-R
Olatunji, Armstrong, et al. (2014)	21	16	1.09	0.35	0	33.00	Clinical	PTSD	DPSS-R
Olatunji, Cisler, et al. (2008)	38	46	1.97	0.26	79	19.58	Analogue	Spider	DES
Rüsch et al. (2011)	20	37	1.74	0.32	100	30.83	Clinical	PTSD	QADS
Sawchuk, Lohr, Tolin, Lee, and Kleinknecht (2000)	80	58	1.33	0.19	77	21.49	Analogue	BII, spider	DES, DS
Sawchuk, Lohr, Westendorf, Meunier, and Tolin (2002)	76	40	0.82	0.20	78	19.79	Analogue	BII, spider	DES, DS
Schienle, Schäfer, Stark, Walter, Franz, et al. (2003)	61	150	0.74	0.16	74	29.30	Clinical	BII-OCD, AD[a]	QADS
Schienle, Schäfer, Stark, Walter, Kirsch, et al. (2003)	12	12	0.75	0.41	100	24.70	Clinical	BII	QADS
Schienle, Schäfer, Walter, Stark, and Vaitl (2005a)	23	20	1.14	0.32	81	24.80	Clinical	BII	QADS
Schienle, Schäfer, Stark, Walter, and Vaitl (2005b)	10	13	0.07	0.41	100	23.30	Clinical	Spider	QADS

(continued)

Table 1. (Continued)

Study	High Sx *n*	Low Sx *n*	*g*	*SE*	% female	Age (*M* years)	Sample type	Disorder	Measure of DP
Schienle, Schäfer, and Naumann (2008)	18	18	0.43	0.33	100	25.70	Analogue	Spider	QADS
Schienle, Schäfer, Stark, Walter, and Vaitl (2005a)	12	12	1.02	0.46	60	40.70	Clinical	BII	QADS
Teachman and Saporito (2009)	59	30	1.23	0.24	67	18.90	Analogue	BII, spider	DS
van Overveld, de Jong, and Peters (2009)	30	30	1.28	0.28	87	22.90	Clinical	BII	DPSS-R, DQ, DS
van Overveld, de Jong, Peters, van Hout, and Bouman (2008)	138	34	1.31	0.20	90	25.20	Analogue	Emetophobia	DQ, DS
Vossbeck-Elsebusch, Steinigeweg, Vögele, and Gerlach (2012)	24	24	0.06	0.28	64	23.20	Analogue	BII	Other
Viar, Etzel, Ciesielski, and Olatunji (2010)	108	338	0.78	0.11	64	35.67	Analogue	BII	Other
Weck, Esch, and Rohrmann (2014)	63	29	0.32	0.23	63		Clinical	Health, PD[a]	SADS
Whitton, Henry, and Grisham (2014)	44	24	0.75	0.26		32.86	Clinical	OCD, GAD[a]	DPSS-R, DS-R
Woody, McLean, and Klassen (2005)	55	60	0.57	0.19	52	20.30	Analogue	Spider	DS

Note: Effect sizes listed are those entered for the estimate of the overall combined effect size. Sx = symptoms of anxiety-related disorder; AD = adjustment disorder; BII = blood-injection-injury phobia; GAD = generalized anxiety disorder; PD = panic disorder; OCD = obsessive-compulsive disorder; PTSD = posttraumatic stress disorder; DES = Disgust Emotion Scale; DPSS-R = Disgust Propensity Sensitivity Scale–Revised; DQ = Disgust Questionnaire; DS = Disgust Scale; DS-R = Disgust Scale–Revised; QADS = Questionnaire for the Assessment of Disgust Sensitivity; SADS = Scale for the Assessment of Disgust Sensitivity.

[a]Most frequent diagnosis in non-disgust anxiety-related disorder group.

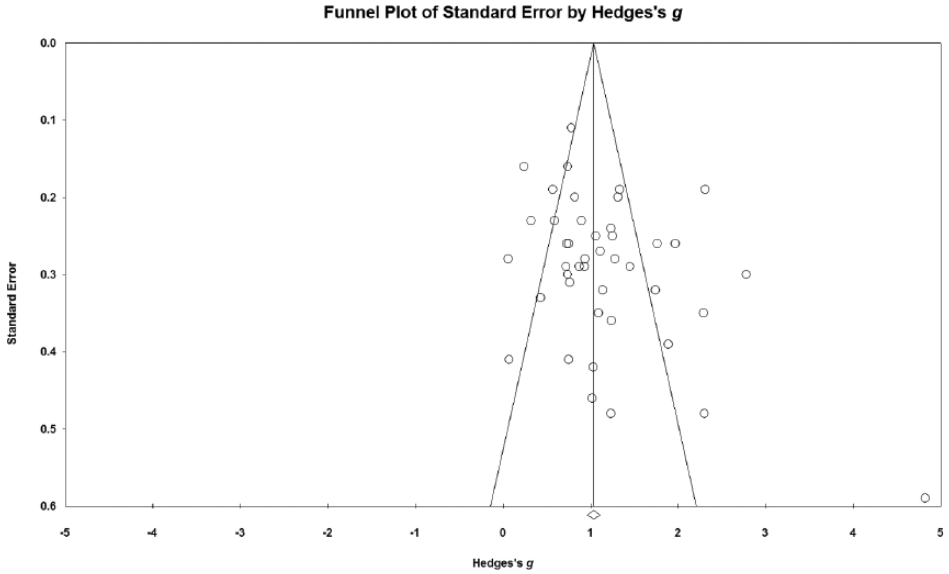

Fig. 1. Funnel plot for group comparison studies.

anxiety-related disorder, as revealed by a significant test of categorical moderation, $Q(1) = 14.99$, $p < .001$. Although studies of non-disgust disorders found higher levels of disgust proneness in high-symptom participants compared to low-symptom participants ($k = 5$, $g = 0.56$, 95% CI [0.32, 0.79], $p < .001$), this effect was significantly smaller than the effect observed in studies of disgust disorders ($k = 38$, $g = 1.24$, 95% CI [0.99, 1.49], $p < .001$). Thus, the purported disgust disorders were indeed characterized by elevated levels of disgust proneness relative to the non-disgust disorders (see Fig. 2 for forest plot of findings).

Within the disgust disorders, the main effect was not moderated by the specific type of disorder, $Q(3) = 1.95$, $p > .10$, as similar effect sizes were observed across the following conditions: spider phobia ($k = 14$, $g = 1.10$, 95% CI [0.72, 1.48], $p < .001$), BII phobia ($k = 13$, $g = 1.16$, 95% CI [0.88, 1.44], $p < .001$), OCD ($k = 10$, $g = 1.59$, 95% CI [0.82, 2.34], $p < .001$), and PTSD ($k = 2$, $g = 1.46$, 95% CI [0.83, 2.10], $p < .001$).[4] The main effect for all anxiety-related disorders was not moderated by the scale used to measure disgust proneness (DES, $k = 9$, $g = 1.61$, 95% CI [1.01, 2.21], $p < .001$; QADS, $k = 9$, $g = 1.04$, 95% CI [0.64, 1.44], $p < .001$; DS, $k = 8$, $g = 1.16$, 95% CI [0.72, 1.61], $p < .001$; DQ, $k = 5$, $g = 0.93$, 95% CI [0.60, 1.27], $p < .001$, DS-R, $k = 4$, $g = 0.88$, 95% CI [0.58, 1.17], $p < .001$ DPSS-R, $k = 3$, $g = 1.05$, 95% CI [0.73, 1.36], $p < .001$; $Q(5) = 5.33$, $p > .10$), nor was it moderated by the type of sample, as similar effect sizes were observed in studies using clinical ($k = 23$, $g = 1.10$, 95% CI [0.81, 1.40], $p < .001$) and analogue samples, ($k = 20$, $g = 1.20$, 95% CI [0.94, 1.46], $p < .001$), $Q(1) = .79$, $p > .10$. There was also no moderation by gender or age (ps for slopes > .10).

Discussion

Does disgust proneness differ between nonclinical controls and those high in anxiety disorder symptoms? This meta-analysis revealed that those high in anxiety disorder symptoms evidence higher levels of disgust proneness than nonclinical controls. This finding is consistent with research suggesting that disgust proneness may contribute to the development and maintenance of anxiety and related psychopathology (Olatunji, Ebesutani, et al., 2011). Do differences in disgust proneness vary according to the scale used to measure the construct? In this analysis, the magnitude of group differences did not depend on the disgust proneness scale. Do differences in disgust proneness vary between clinical and analogue samples? Importantly, the observed effects were not moderated by whether the high symptom group consisted of clinical or analogue samples. Do differences in disgust proneness emerge in anxiety-related disorders typically associated with disgust ("disgust disorders," e.g., OCD) compared to those not associated with disgust ("non-disgust disorders," e.g., GAD)? Although those characterized as having a disgust disorder and those characterized as having non-disgust disorders both reported higher levels of disgust proneness than nonclinical controls, larger effects were observed for those with a disgust disorder compared to those with a non-disgust disorder. The question was also asked as to

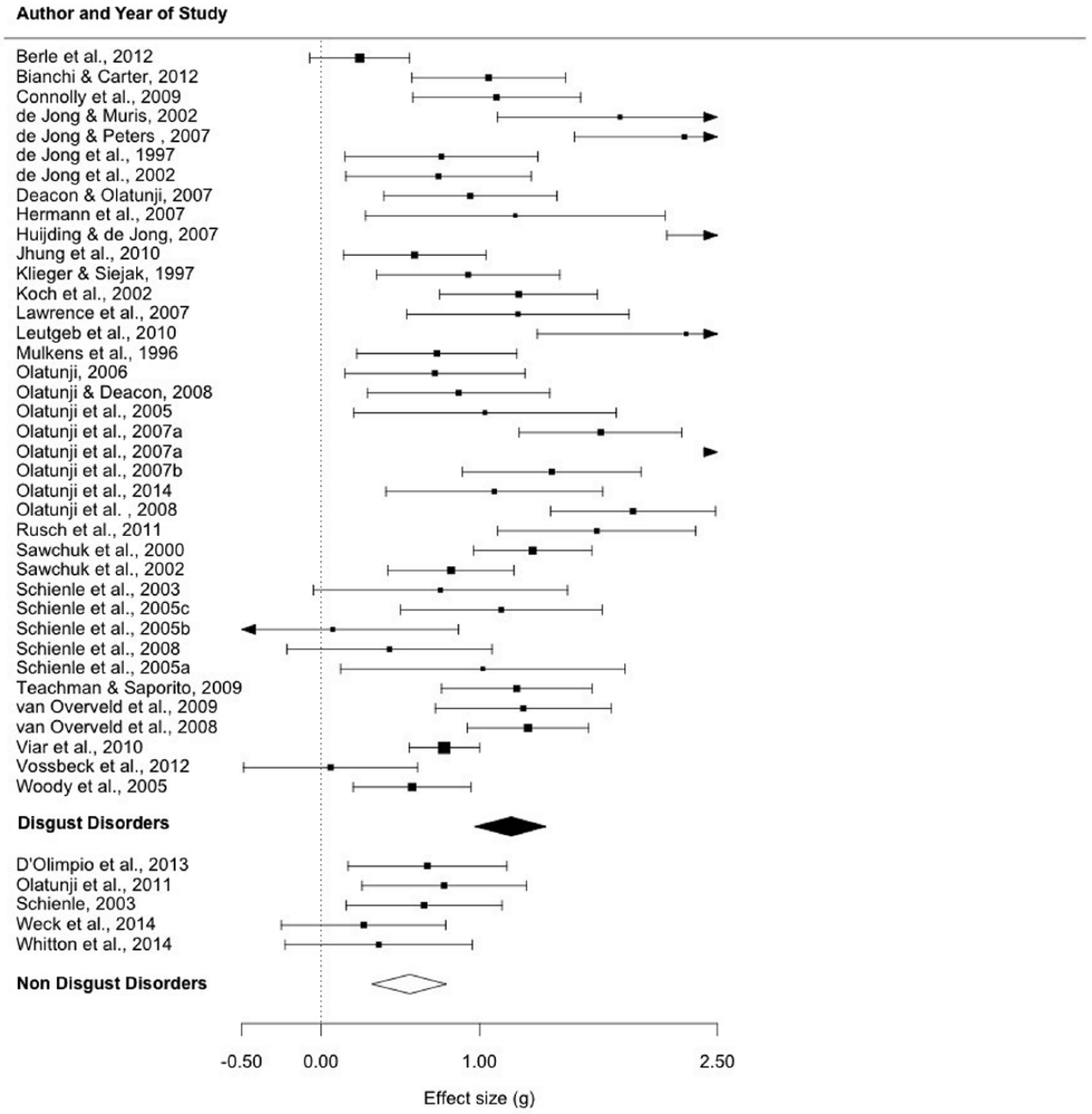

Fig. 2. Forest plot of differences in disgust proneness between individuals high and low in symptoms of anxiety-related disorders. For individual studies, lines represent 95% confidence interval and size of square reflects precision of estimate. For combined effect sizes of disgust-disorders and non-disgust disorders, width of diamond reflects 95% confidence interval.

whether differences between nonclinical controls and those with an anxiety disorder varied as a function of the diagnosis. The findings revealed that for the studies of disgust disorders, the effect was not moderated by the type of diagnosis. Observed effects were also not moderated by gender or age.

Although the present findings suggests that those with elevated symptoms of anxiety are characterized by heightened disgust proneness, this meta-analysis is limited by the use of categorical data which may influence the nature of the association between disgust proneness and anxiety disorder symptoms. A categorical view assumes that members of the anxiety disorder category are qualitatively distinct from nonmembers, whereas a dimensional view assumes that anxiety is present to a greater or lesser extent in all individuals. Employing a categorical approach may have resulted in artificially inflated levels of disgust proneness among those with an anxiety disorder as such disorders are saturated with negative emotionality (e.g., Beuke, Fischer, & McDowall,

2003). A problem with the categorical approach is defining clear-cut thresholds between the presence and absence of anxiety. Employing the categorical approach may also contribute to a potential Type II error that disgust proneness is related to anxiety disorders only artificially, through negative affect. There is a growing consensus that anxiety disorder symptoms are dimensional in nature (Bjelland et al., 2009) suggesting that any threshold may be arbitrary, and the adoption of a categorical view would cause information loss and reduce statistical power (Markon, Chmielewski, & Miller, 2011). A more valid dimensional approach to anxiety is likely to maximize the strength of observed relationships with measures of disgust proneness (DeCoster, Iselin, & Gallucci, 2009). Consistent with a dimensional view, a second meta-analysis was performed on correlations of disgust proneness with symptoms of anxiety and related disorders. The purpose of Part II of this review was to answer the following five questions:

1. Is disgust proneness related to concurrent levels of anxiety disorder symptoms?
2. Does the association between disgust proneness and anxiety disorder symptoms vary as a function of symptoms typically associated with disgust ("disgust disorders," e.g., OCD) compared to those not associated with disgust ("non-disgust disorders," e.g., GAD).
3. Do the association between disgust proneness and anxiety disorder symptoms vary as a function of the diagnosis?
4. Is the association between disgust proneness and anxiety disorder symptoms independent of negative affect?
5. Does the association between disgust proneness and anxiety disorder symptoms vary by the scale used to measure disgust proneness?
6. Does the association between disgust proneness and anxiety disorder symptoms vary by age or gender?

Part II: Meta-Analysis of Correlations Between Disgust Proneness and Symptoms of Anxiety-Related Disorders

Literature search

For Part II of the meta-analysis, the abstracts of the articles identified in Part I were further analyzed, and studies were included if they reported a correlation between a measure of individual differences in disgust proneness (i.e., disgust sensitivity or propensity) and a symptom of anxiety-related disorders (i.e., anxiety disorders, OCD spectrum disorders, and trauma and stressor-related disorders). These criteria resulted in a total of 83 samples with 17,092 participants (Table 2 presents study details for Part II). Based on the 99% of studies reporting gender composition, the participants were 67% female. Based on the 99% of studies reporting age, the mean age for the participants was 21.67 years.

Statistical analysis

Part II of the meta-analysis was also conducted in CMA Version 2 software. Meta-analytic estimates of correlation are achieved in CMA by transforming individual study correlation coefficients into Fisher's z units, computing a summary Fisher's z unit for all studies, and then transforming the summary Fisher's z unit back into a meta-analytic correlation coefficient (Borenstein et al., 2005). The studies included in the meta-analysis exhibited considerable heterogeneity in terms of participants and study materials. Accordingly, a random effects model, rather than a fixed effect model, was used to estimate the meta-analytic correlation coefficient, as a random effects model accounts for variability between studies (Hedges & Vevea, 1998). Although random effects models can exhibit bias when relatively few studies are included in the meta-analysis (e.g., $k < 20$), our selection of studies was sufficiently large to avoid this limitation (Schmidt, Oh, & Hayes, 2009). We used the Q statistic to test for the presence of between-study variability, to validate the selection of a random-effects model and to determine if tests of moderation were warranted. In addition, we used the Q statistic for tests of categorical moderators. We used unrestricted maximum likelihood meta-regression to test continuous moderators.

Zero-order correlations. We test the combined effect size for the overall relationship between disgust proneness and symptoms of anxiety-related disorders, and then examined possible moderators of this relationship. We tested for moderation by general type of disorder (disgust disorders, $k = 79$; non-disgust disorders, $k = 5$). The non-disgust disorders represented in Part II of the meta-analysis included social anxiety disorder, GAD, panic disorder, agoraphobia, claustrophobia, and height phobia. We then tested for moderation by the specific type of disorder, within the disgust disorders (OCD: $k = 35$; spider phobia: $k = 13$; BII phobia: $k = 19$; PTSD: $k = 6$; snake phobia: $k = 2$; health anxiety: $k = 8$). We also tested for moderation by the scale used to measure disgust proneness. In addition, we examined gender (% female) and age as continuous moderators of the relationship between disgust proneness and all anxiety-related disorder symptoms using unrestricted maximum likelihood meta-regression. In Part II of the meta-analysis, the same general approach from Part I

Table 2. Study Characteristics and Effect Sizes for Part 2, Meta-Analysis of Correlations Between Disgust Proneness (DP) and Anxiety Disorder Symptoms

Study	*N*	% female	Age (*M* years)	*r* DP, Sx	*r* NA, Sx	*r* DP, NA	Disorder	DP measure	NA measure
Badour, Feldner, Blumenthal, and Bujarski (2013)	38	100	32.34	.52			PTSD	DPSS-R	
Badour et al. (2013)	40	100	28.18	.46			PTSD	Other	
Badour, Brown, et al. (2012)	49	100	28.37	.27	.61	.34	PTSD	DPSS-R	PANAS-NA
Badour, Ojserkis, McKay, and Feldner (2014)	72	100	31.15	.50	.25	.33	PTSD	DPSS-R	STAI-T
Berger and Anaki (2014)	314	54	33.70	.27	.36	.38	OCD	DS-R	Other
Berle et al. (2012)	109	59	44.80	.38			OCD	DES	
Berle et al. (2012)	109	59	44.80	.38			OCD	DES	
Bianchi and Carter (2012)	107	84	20.00	.60			BII, spider	DES	
Bomyea and Amir (2012)	38	63	19.40	.53	.35	.21	PTSD	DS-R	BDI, STAI-T
Brady, Cisler, and Lohr (2014)	620	62	19.50	.41	.33	.40	Health	DPSS-R	ASI, PANAS-NA
Cisler et al. (2009b)	594	58	19.30	.50	.25	.43	BII, OCD, spider	DPSS-R, DS-R	PANAS-NA
Cisler, Brady, Olatunji, and Lohr (2010), Study 1	252	71	19.00	.41	.32	.34	OCD	DPSS-R	PANAS-NA
Cisler et al. (2010), Study 2	308	71	19.48	.46	.35	.44	OCD	DPSS-R	PANAS-NA
Cisler, Olatunji, Sawchuk, and Lohr (2008)	259	68	21.58	.52	.23	.21	BII, OCD	DS	STAI-T
Connolly, Olatunji, and Lohr (2008)	179	70	20.55	.50	.10	.18	BII	DES	PANAS-NA
D'Olimpio et al. (2013)	73	58	31.61	.52			OCD	DS	
Davey and Bond (2006)	111	64	36.50	.38			Health, claustrophobia, height	DPSS-R, DSQ	
David et al. (2009)	300	52	19.00	.57	.45	.42	OCD	DS	PANAS-NA
de Jong and Merckelbach (1998)	96	100	18.50	.36	.26		BII, spider	DQ, DS	STAI-T
Deacon and Olatunji (2007)	56	54	20.00	.59	.35	.45	OCD	DS	BAI, BDI
Dorfan and Woody (2011)	103	60	21.97	.55	.42	.65	OCD	DS	BAT
Engelhard, Olatunji, and de Jong (2011)	107	0	24.00	.04	.19	.37	PTSD	DPSS-R, DS-R	ASI
Fan and Olatunji (2013)	60	77	19.33	.34	.51	.27	Health	DS-R	BAI
Goetz, Lee, Cougle, et al. (2013)	755	72	19.60	.37	.44	.35	OCD	DPSS-R	ASI
Goetz, Lee, and Cougle (2013)	156	75	19.04	.29	.61	.22	Health	BAT	
Hirai and Vernon (2011)	533	57	20.00	.47			BII	DS	
Klieger and Siejak (1997)	51	100	19.20	.37			Snake	DS	
Mancini, Gragnani, and D'Olimpio (2001)	278	64	25.50	.40	.45	.35	OCD	DS	BDI, STAI-T
Melli, Bulli, Carraresi, and Stopani (2014)	63	49	33.40	.40	−.06	.10	OCD	DPSS-R	BAI, BDI
McDonald, Hartman, and Vrana (2008), Study 1	420	62	19.70	.39	.17		BII, animal, SAD	DS	STAI-T
McDonald et al. (2008), Study 2	213	67		.42	.18		BII, animal, SAD	DS	STAI-T
Mulkens, de Jong, and Merckelbach (1996)	69	100	23.04	.39			Spider	DQ	
Merckelbach, Muris, de Jong, and de Jongh (1999), Study 1	166	84	21.20	.02			BII	DSQ	
Merckelbach et al. (1999), Study 2a	44	75	19.10	.37			Spider	DSQ	
Merckelbach et al. (1999), Study 2b	52	67	35.30	.23			BII	DSQ	

(continued)

Table 2. (Continued)

Study	*N*	% female	Age (*M* years)	*r* DP, Sx	*r* NA, Sx	*r* DP, NA	Disorder	DP measure	NA measure
Merckelbach et al. (1999), Study 3	36	64	36.30	.06			BII	DSQ	
Muris, Merckelbach, Schmidt, and Tierney (1999)	189	51	9.67	.31	.59	.35	BII, PD, Spider	Other	Other
Muris, Mayer, Huijding, and Konings (2008)	348	50	10.64	.44		.14	BII, SD, PD	DS, DSQ	Other
Nicholson and Barnes-Holmes (2012)	33	64	19.73	.29	.41	.17	OCD	DS-R	Other
Nicholson and Barnes-Holmes (2012)	33	64	19.73	.35	.47	.28	OCD	DS-R	Other
Olatunji (2006)	50	96	19.86	.42	.41		Spider	DES	STAI-T
Olatunji (2009)	498	56	18.86	.40	.48	.34	Health	DPSS-R	PANAS-NA
Olatunji (2010)	177	68	20.27	.41	.06	.24	OCD	DPSS-R, DS	BDI, PANAS-NA
Olatunji and Armstrong (2009)	83	83	19.30	.53	.18		OCD	DPSS-R	STAI-T
Olatunji and Deacon (2008)	50	98	19.86	.47	.30	.12	Spider	DS	PANAS-NA, STAI-T
Olatunji, Sawchuk, et al. (2005)	259	68	21.50	.54	.22	.21	OCD	DS	ASI, STAI-T
Olatunji, Williams, Sawchuk, and Lohr (2006)	259	68	21.50	.30	.25	.23	BII	DS	ASI, STAI-T
Olatunji, Cisler, et al. (2007)	340	50	19.17	.31	.37	.37	OCD, spider	DPSS-R	PANAS-NA
Olatunji, Lohr, Sawchuk, and Patten (2007)	80	73	19.78	.68	.25	.31	BII	DES	STAI-T
Olatunji, Smits, et al. (2007)	22	91	19.72	.46	.42		BII	DES, DS	
Olatunji, Williams, Lohr, et al. (2007)	352	59	21.34	.27	.38		OCD	DES	PANAS-NA, STAI-T
Olatunji, Williams, Tolin, et al. (2007), Study 3	215	73	19.17	.47	.23	.52	OCD	DES, DS, DS-R	Other
Olatunji, Williams, Tolin, et al. (2007), Study 4	56	70	34.62	.46			OCD	DS	
Olatunji, Unoka, et al. (2009)	121	68	29.57	.34	.47		OCD, spider	DS-R	HA-TCI
Olatunji, Wolitzky-Taylor, et al. (2009)	46	62	18.86	.36	.32	.71	Spider	BAT, DPSS-R	BAT, STAI-T
Olatunji, Moretz, et al. (2010), Study 1	417	55	18.84	.43	.25	.29	OCD	DPSS-R	BDI, PANAS-NA
Olatunji, Moretz, et al. (2010), Study 2	101	66	20.44	.39	.13	.36	OCD	DPSS-R	PANAS-NA
Olatunji, Moretz, et al. (2010), Study 3	46	41	26.30	.27	.20		OCD	DPSS-R	BDI
Olatunji, Ebesutani, et al. (2011)	153		29.21	.29	.17	.35	OCD	DES, DPSS-R	BAI, BDI
Olatunji, Tart, et al. (2011), Study 1	90	50	39.12	.61	.51	.35	OCD	DPSS-R	BAI, BDI
Olatunji, Ebesutani, et al. (2014), Study 2	581	59	19.32	.57	.30	.41	OCD	DPSS-R	PANAS-NA
Radomsky, Rachman, Shafran, Coughtrey, and Barber (2014)	57	51	39.95	.45	.38		OCD	DS	ASI, BDI
Radomsky et al. (2014)	410	87	22.45	.46	.43		OCD	DS	ASI, BDI
Rozin, Taylor, Ross, Bennett, and Hejmadi (2005)	166	63	18.20	.25			OCD	DS	
Sawchuk, Lohr, Tolin, Lee, and Kleinknecht (2000)	138	75	21.49	.42			Spider	DES, DS	
Skolnick and Dzokoto (2013)	103	55	25.30	.47			OCD	DS-R	
Skolnick and Dzokoto (2013)	96	60	19.60	.59			OCD	DS-R	
Smits, Telch, and Randall (2002)	27	100	18.30	.10	.26	.88	Spider	DSQ	BAT
Thorpe, Patel, and Simonds (2003)	175	78	23.40	.31	.52		Health, OCD	DS	BAI

(continued)

Table 2. (Continued)

Study	*N*	% female	Age (*M* years)	*r* DP, Sx	*r* NA, Sx	*r* DP, NA	Disorder	DP measure	NA measure
Thorpe, Barnett, Friend, and Nottingham (2011)	30	57	21.70	.54	.47	.64	Health, OCD	DS	BAI
Tolin, Woods, and Abramowitz (2006)	1005	75	18.99	.25			OCD	DS	
van Overveld, de Jong, Peters, et al. (2006)	967	79	20.40	.27			BII	DPSS-R, DQ, DS	
van Overveld, de Jong, Peters, van Hout, and Bouman (2008)	172	90	25.20	.45			EP	DPSS-R, DQ, DS	
van Overveld, de Jong, Peters, and Schouten (2011)	616	66	29.00	.27			BII	DPSS-R, DS-R	
Vernon and Berenbaum (2008), Study 1	139	62	19.70	.42			Spider	DS	
Vernon and Berenbaum (2008), Study 2	167	72	19.40	.47			Spider	DS	
Vernon and Berenbaum (2008), Study 3	61	57	19.90	.49			Spider	DS	
Viar, Etzel, Ciesielski, and Olatunji (2010)	446	64	35.67	.32	.40	.41	BII	Other	Other
Vossbeck-Elsebusch and Gerlach (2012)	58	64	23.60	.27			BII	Other	
Wiens, Peira, Golkar, and Öhman (2008)	53	100	24.98	.32			Snake	DS	STAI-T
Wheaton, Abramowitz, Berman, Fabricant, and Olatunji (2012)	315	74	20.02	.25	.42	.12	Health	DS-R	ASI
Williams, Abramowitz, and Olatunji (2012)	245	55	19.10	.34	.26	.49	OCD	DPSS-R	ASI
Woody and Tolin (2002), Study 3	56	69	34.60	.17			OCD	DS	

Note: Effect sizes are those entered for the estimate of the overall combined effect size. DP = disgust propensity; NA = negative affect; Sx = symptoms of anxiety-related disorders; AG = agoraphobia; BII = blood-injection-injury phobia; EP = emetophobia; GAD = generalized anxiety disorder; OCD = obsessive-compulsive disorder; PD = panic disorder; PTSD = posttraumatic stress disorder; SAD = social anxiety disorder; ASI = Anxiety Sensitivity Index; BAI = Beck Anxiety Inventory; BAT = Behavioral Approach Task; BDI = Beck Depression Inventory; DES = Disgust Emotion Scale; DPSS-R = Disgust Propensity Sensitivity Scale–Revised; DQ = Disgust Questionnaire; DS = Disgust Scale; DSQ = Disgust Sensitivity Questionnaire; DS-R = Disgust Scale–Revised; HA-TCI = Harm Avoidance–Temperament and Character Inventory; PANAS-NA = Positive and Negative Affect Schedule–Negative Affect; STAI-T = State-Trait Anxiety Inventory–Trait Version.

for establishing the overall combined effect and analyzing moderators was applied. In all analyses, we included only one estimate of the correlation between disgust proneness and symptoms of anxiety-related disorder per study. For the estimate of the overall combined effect, if a study reported multiple correlations between measures of disgust proneness and symptoms of anxiety-related disorders, we computed an average of these correlations and entered this value.[5] We then used this estimate for moderator analysis, with the exception of moderator analysis for disgust proneness scale or disorder type (specific or general). For these analyses, we selected one level of the moderator for each study (averaging all correlations within the study that involved this level of the moderator), using random selection with the exception that we favored levels of a moderator with low *k*s to allow the inclusion of as many levels as possible. In line with Part I of the meta-analysis, only levels of a moderator with $k > 1$ were considered in the analysis. For analysis of specific disorder type, this resulted in excluding one study of emetophobia (van Overveld et al., 2008). For the analysis of scale, this resulted in excluding five studies. We also tested the continuous moderators of age and gender composition (% female) for the sample

Partial correlations. To determine if disgust proneness has a relationship with symptoms of anxiety-related disorders that is not accounted for by its relationship with trait negative affect, we derived a meta-analytic partial correlation between disgust proneness and symptoms of anxiety-related disorders controlling for negative affect. This analysis relied on the estimate of the overall relationship between disgust proneness and symptoms of anxiety-related disorders obtained in the analysis of zero-order correlation described above. In addition, we obtained a meta-analytic estimate of the zero-order correlation between disgust proneness and negative affect, and between negative affect and symptoms of anxiety-related disorders, using the same general approach used to estimate the relation between disgust proneness and symptoms of anxiety-related disorders. Although some studies reported direct measures of negative affect (i.e., the Negative Affect scale from the Positive Affect Negative Affect Schedule; PANAS; Watson, Clark, & Tellegen, 1988) or related traits (neuroticism; Eysenck & Eysenck, 1975), measures of trait anxiety (e.g., State-Trait Anxiety Inventory, Form Y Trait Version; Spielberger et al., 1983), anxiety-related traits (e.g., Anxiety Sensitivity Index–3; Taylor et al., 2007) and depression (e.g., Beck Depression Inventory–II; Beck, Steer, & Brown, 1996) were also considered as measures of trait negative affect, and when correlations involving more than one of these measures were reported, we averaged across them to capture the breadth of this construct and to maintain independence of samples. Following the approach of Olatunji, Naragon-Gainey, et al. (2013), we conducted the partial correlation analysis by inserting meta-analytic zero-order correlations into the following equation: $r_{xy \cdot z} = r_{xy} - r_{xz}r_{yz} / \sqrt{(1 - r_{xz}^2)(1 - r_{yz}^2)}$, where x = disgust proneness, y = symptoms of anxiety-related disorders, and z = negative affect as the covariate (Strauss, 1981). Because the number of studies (k) contributing to each meta-analytic zero-order correlation differed, we used the harmonic mean of the three *k*s (see Olatunji, Naragon-Gainey, et al., 2013) when determining the degrees of freedom for the partial correlation test statistic: $t = (\sqrt{df} * r_{xy \cdot z}) / \sqrt{(1 - r_{xy \cdot z}^2)}$, where $df = k_{\text{harmonic mean}} - 3$ (Strauss, 1981).

Results

Overall relationship between disgust proneness and symptoms of anxiety-related disorders. Disgust proneness and symptoms of anxiety-related disorders were moderately correlated ($k = 83$, $r = .40$, 95% CI [0.37, 0.42], $p < .001$; *FSN* = 29,335) according to our meta-analytic estimate. Although there was some asymmetry in the funnel plot (Fig. 3), the findings appeared robust to publication bias, as a Duval and Tweedie's "trim and fill" procedure did not substantially reduce the estimated correlation (14 studies trimmed: $r = .36$, 95% CI [0.33, 0.39]).

Moderator analysis. There was significant heterogeneity in the correlations contributing to the meta-analytic estimate of the relationship between disgust proneness and symptoms of anxiety-related disorders, $Q(82) = 300.40$, $p < .001$, $I^2 = 72.71$. This variability did not appear to be accounted for by differences between studies in participants' gender composition or age (*p*s for slopes > .10). There was not a significant difference between disgust-disorders in the magnitude of the association between symptom severity and disgust proneness, $Q(5) = 6.24$, $p > .10$.[6] Symptoms of all of these disorders were moderately correlated with disgust proneness (*r*s = .35–.46, *p*s < .001). However, there was a significant difference between disgust-disorders and non-disgust disorders in the magnitude of the association between symptom severity and disgust proneness, $Q(1) = 18.52$ $p < .001$, as symptoms of disgust disorders had a medium correlation with disgust proneness ($k = 78$, $r = .40$, $p < .001$), whereas symptoms of non-disgust disorders had a small correlation ($k = 5$, $r = .27$, $p < .001$). The relationship between disgust proneness and symptoms of all anxiety-related disorders was moderated by the type of scale used to assess disgust proneness (DS: $k = 25$, $r = .43$, $p < .001$; DPSS-R: $k = 19$, $r = .42$, $p < .001$; DS-R: $k = 13$, $r = .38$, $p < .001$; DES: $k = 10$, $r = .44$, $p < .001$; DSQ: $k = 7$, $r = .23$, $p = .001$; DQ: $k = 4$, $r = .33$, $p < .001$; $Q(5) = 11.81$, $p = .037$). Studies using the DSQ to measure disgust proneness

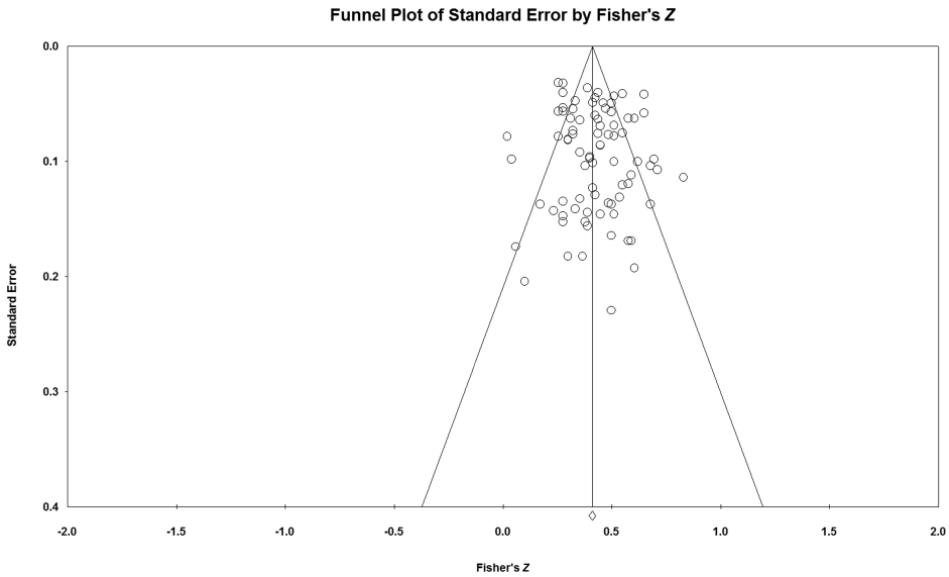

Fig. 3. Funnel plot for correlational studies.

observed relatively weaker correlations between disgust proneness and symptoms of anxiety-related disorders.

Partial correlations. To calculate the partial correlation between disgust proneness and symptoms of anxiety-related disorders while covarying for negative affect, we calculated the meta-analytic zero-order correlations between disgust proneness and negative affect (k = 43; r = .36, p < .001) and between negative affect and symptoms of anxiety-related disorders (k = 54; r = .34, p < .001) from the subsets of studies reporting these respective correlations. After controlling for negative affect, disgust proneness continued to be moderately correlated with symptoms of anxiety-related disorders (r = .32, p < .02). Thus, the relationship between disgust proneness and symptoms of anxiety-related disorders across studies is not accounted for by negative affect. After controlling for disgust proneness, negative affect had a small correlation with symptoms of anxiety-related disorders that was only marginally statistically significant (r = .23, p < .10).

Discussion

Is disgust proneness related to concurrent levels of anxiety disorder symptoms? This meta-analysis of dimensional data revealed that disgust proneness is moderately associated with anxiety-related disorder symptoms. Importantly, these findings were robust against publication bias and support previous articulated notions that disgust proneness may play an important role in anxiety-related disorder symptoms (Olatunji, Ebesutani, et al., 2011). Prior research has shown that a categorical approach to psychopathology is generally less reliable than a dimensional approach (Markon et al., 2011). Accordingly, a more precise account of the nature of anxiety with a more dimensional approach may result in a more accurate assessment of associations with disgust proneness (Bjelland et al., 2009). Do the association between disgust proneness and anxiety disorder symptoms vary as a function of the diagnosis? Consistent with the analysis based on categorical data, the observed association was not moderated by specific type of anxiety disorder symptom. Does the disgust proneness measure matter? Studies using the DSQ did yield weaker associations between disgust proneness and symptoms of anxiety-related disorders. Observed associations were also not moderated by age or gender.

Does the association between disgust proneness and anxiety disorder symptoms vary as a function of symptoms typically associated with disgust compared to those not associated with disgust? The findings did show that disgust proneness was more strongly associated with disgust-based disorders than non-disgust disorders. Is the association between disgust proneness and anxiety disorder symptoms independent of negative affect? Examination of partial correlations revealed that disgust proneness continued to be significantly correlated with symptoms of anxiety-related disorders when covarying for negative affect. In fact, negative affect was no longer significantly associated with symptoms of anxiety-related disorders when covarying for disgust proneness. This finding is consistent with previous research that has shown that the association between negative affect and some anxiety disorder symptoms is mediated by disgust proneness (Olatunji, Ebesutani, et al., 2011).

General Discussion

The present meta-analysis is the first to quantitatively review the evidence on the association between disgust proneness and anxiety-related symptoms. The findings revealed that disgust proneness and symptoms of anxiety-related disorders were moderately correlated, a pattern that was consistent across categorical and dimensional data. Although previous research has revealed rather robust gender (Haidt et al., 1994) and age (Curtis et al., 2004; Fessler & Navarrete, 2005) differences in disgust proneness, the magnitude of the association between disgust proneness and symptoms of anxiety-related disorders were not moderated by gender or age. However, studies using the DSQ to measure disgust proneness observed relatively weaker correlations between disgust proneness and symptoms of anxiety-related disorders. This is perhaps not surprising given that the DSQ assesses only attitudes about contamination of otherwise highly desirable food. By focusing exclusively on food rejection tendencies, the DSQ may be an inadequate measure of the full range of disgust proneness that may confer risk of anxiety-related disorders.

Specificity of disgust proneness in anxiety-related disorders

Disgust proneness has been described as a genetically based personality trait that is a vulnerability factor for certain anxiety disorders (Muris, 2006). An important question in the existing literature is the extent to which disgust proneness is a risk factor for anxiety-related disorders marked by contagion concerns ("disgust disorders") or for anxiety-related disorders more broadly. The role of disgust proneness in many anxiety disorders has been understood in the context of a disease-avoidance model (Matchett & Davey, 1991; Oaten et al., 2009). However, there is increasing evidence that disgust proneness may play a role in anxiety-related disorders that are not motivated by disease-avoidance concerns (Davey, 2011). Disorders that are motivated by disease-avoidance concerns were categorized as "disgust disorders" and those not directly motivated by disease-avoidance concerns were categorized as "non-disgust disorders" in the present investigation. The findings showed that those with higher anxiety symptoms (including both disgust and non-disgust disorders) endorsed significantly higher disgust proneness compared to low anxiety symptom participants. However, the difference in disgust proneness from those low in anxiety symptoms was greater for disgust disorders compared to non-disgust disorders. Disgust proneness may function as a strong vulnerability factor in the pathogenesis of anxiety disorders marked by contagion concerns and the development of such disorders may also be explained by the tendency to misinterpret the experience of disgust as dangerous (Cisler, Olatunji, Sawchuk, & Lohr, 2008; Olatunji, Cisler, et al., 2007; Travis & Fergus, 2015).

Examination of group comparison studies also revealed that non-disgust disorder participants reported higher levels of disgust proneness compared to controls, although the effect was smaller than the effect observed in studies of disgust disorders. Examination of correlational studies also showed disgust proneness was significantly associated with symptoms of non-disgust disorders, although the effect was smaller than the effect observed with disgust disorders. It has been suggested that disgust proneness may play a role in some anxiety disorders because threat-relevant stimuli are often associated with disgust (Thorpe & Salkovskis, 1998). However, this view seems incomplete given that disgust proneness is also significantly associated (although to a lesser degree) with anxiety-related disorder symptoms that involve stimuli not associated with disgust. That being said, criteria contamination must be considered when reconciling the stronger association between disgust proneness and anxiety-related disorders characterized by contagion concerns compared to those that are not characterized by such concerns. Measures of anxiety-related disorders characterized by contagion concerns often include mention of repulsion, repugnance, and contamination. Accordingly, it may be expected that those with anxiety-related disorders characterized by contagion concerns will more strongly endorse these disgust-relevant items. However, disorders not characterized by contagion concerns also appear to be associated with disgust proneness.

Differentiating disgust proneness from negative affect

In the correlational meta-analysis, disgust proneness continued to be moderately correlated with symptoms of anxiety-related disorders when controlling for negative affect. In line with previous research (e.g., Olatunji, Ebesutani, et al., 2011), this finding suggests that the relationship between disgust proneness and anxiety disorder symptoms is not likely to be explained by general negative affect. In fact, the correlational meta-analysis revealed that negative affect had a small nonsignificant correlation with symptoms of anxiety-related disorders when controlling for disgust proneness. One interpretation of this finding is that disgust proneness is a more precise correlate of some anxiety disorders, especially those characterized by contagion concerns, whereas negative affect may be a more robust predictor of other forms of psychopathology (i.e., major depression). This finding is consistent with previous research (Olatunji, Ebesutani, et al., 2011) observing a reduction in the direct effect of

negative affect on symptoms of anxiety-related disorders when accounting for disgust proneness, as well as the related finding that disgust proneness mediates the effect of negative affect on symptoms of certain anxiety-related disorders (Olatunji, Moretz, et al., 2010). Conceptually, negative affect may represent a higher order generalized risk factor that increases the likelihood of developing disgust proneness as a more specific risk factor for some anxiety-related disorders.

Toward a transdiagnostic model of disgust proneness

A heuristic for transdiagnostic models of psychopathology advanced by Nolen-Hoeksema and Watkins (2011) may be useful in better understanding the link between disgust proneness and different anxiety-related disorders. This model contends that transdiagnostic factors can be organized into those that are more distal to psychopathology (setting conditions with causal mechanisms intervening between the conditions and the psychopathology) and those that are more proximal (processes with few causal mechanisms intervening between these process and the psychopathology). This model further highlights the importance of identifying the mechanisms linking distal risk factors to proximal risk factors and proximal risk factors to psychopathology. Last, the model illustrates how moderators can lead individuals with transdiagnostic risk factors to develop specific types of disorders. As depicted in Figure 4, disgust proneness is conceptualized as a proximal risk factor that may be linked back to possible environmental and biological distal risk factors though various mechanisms. Distal risk factors that lead to disgust proneness may include environmental context factors such as overcontrolling parenting. Maladaptive coping strategies for disgust experiences may be reinforced by overcontrolling parenting (e.g., Chorpita & Barlow, 1998). Research has shown that compared to older children, parents of young children emote more disgust to their offspring and show greater behavioral avoidance when exposure to aversive stimuli (Stevenson et al., 2012). Parents also selectively direct facial and vocal expression of disgust toward young children and this has detectable consequences on their disgust behavior (Oaten, Stevenson, Wagland, Case, & Repacholi, 2014). Overcontrolling parenting may undermine children's sense of mastery by imparting avoidance coping strategies for managing exposure to disgust-relevant stimuli. These strategies may then prevent the extinction of disgust and the reappraisal of associated danger (i.e., disease). Parenting style appears to be a very important environmental context for the development of disgust proneness. This view is consistent with research showing that parental disgust proneness is a primary predictor of offspring animal phobia (Davey, Forster, & Mayhew, 1993) and the acquisition of spider fear is influenced by specific parental disgust reactions when children are confronted with spiders (de Jong, Andrea, & Muris, 1997).

Sexual and emotional abuse is another salient environmental context factor that may contribute to disgust proneness. Children with a history of sexual or emotional abuse may develop dysregulated stress responses that contribute to the development of disgust proneness, especially when such responses are characteristic of an immune response toward contamination (Stevenson et al., 2012). Such stress responses may include bradygastric activity of the stomach, a response that has been linked to disgust especially among those high in disgust proneness (Meissner, Muth, & Herbert, 2011). The hypothesis that distal risk factors for disgust proneness may include sexual/emotional abuse history is consistent with the existing literature. Traumatic events involving sexual victimization have been linked to elevated feelings of disgust (Badour et al., 2011) and adolescents are six times more likely to endorse the presence of disgust during a sexual assault relative to a physical assault (Feldner et al., 2010). Borderline personality disorder (BPD) is also thought to emerge, in part, from a history of sexual and emotion abuse (McLean & Gallop, 2003). Interestingly, Schienle, Schäfer, Stark, Walter, Franz, et al. (2003) found heightened disgust proneness among individuals with BPD compared to a healthy control group and a group of alcohol-dependent individuals. The finding of heightened disgust proneness in BPD has been replicated (Rüsch et al., 2011; Standish, Benfield, Bernstein, & Tragesser, 2014), and there is also evidence of heightened disgust-relevant sensory processing in BPD (Arrondo et al., 2015).

Experiencing abuse during childhood may contribute to disgust proneness by making children vigilant for signs of danger in the environment. As a result of excessive vigilance, individuals high in symptoms of contamination-based OCD have been shown to infer risk of becoming ill on the basis of experiencing disgust (Verwoerd, de Jong, Wessel, & van Hout, 2013). This process is well characterized by ex-consequential reasoning in inferring "If I feel disgust, there must be danger." Research has shown that high disgust proneness is characterized by vigilance for aversive states (Schienle, Arendasy, & Schwab, 2015). Such vigilance is often coupled with maladaptive coping strategies that paradoxically increase levels of disgust proneness. Indeed, research has shown that excessive engagement in safety behaviors like hand washing significantly increases disgust proneness (Olatunji, 2015) and the link between disgust proneness and hand washing is mediated by danger expectancies about disease (Thorpe, Barnett, Friend, & Nottingham, 2011).

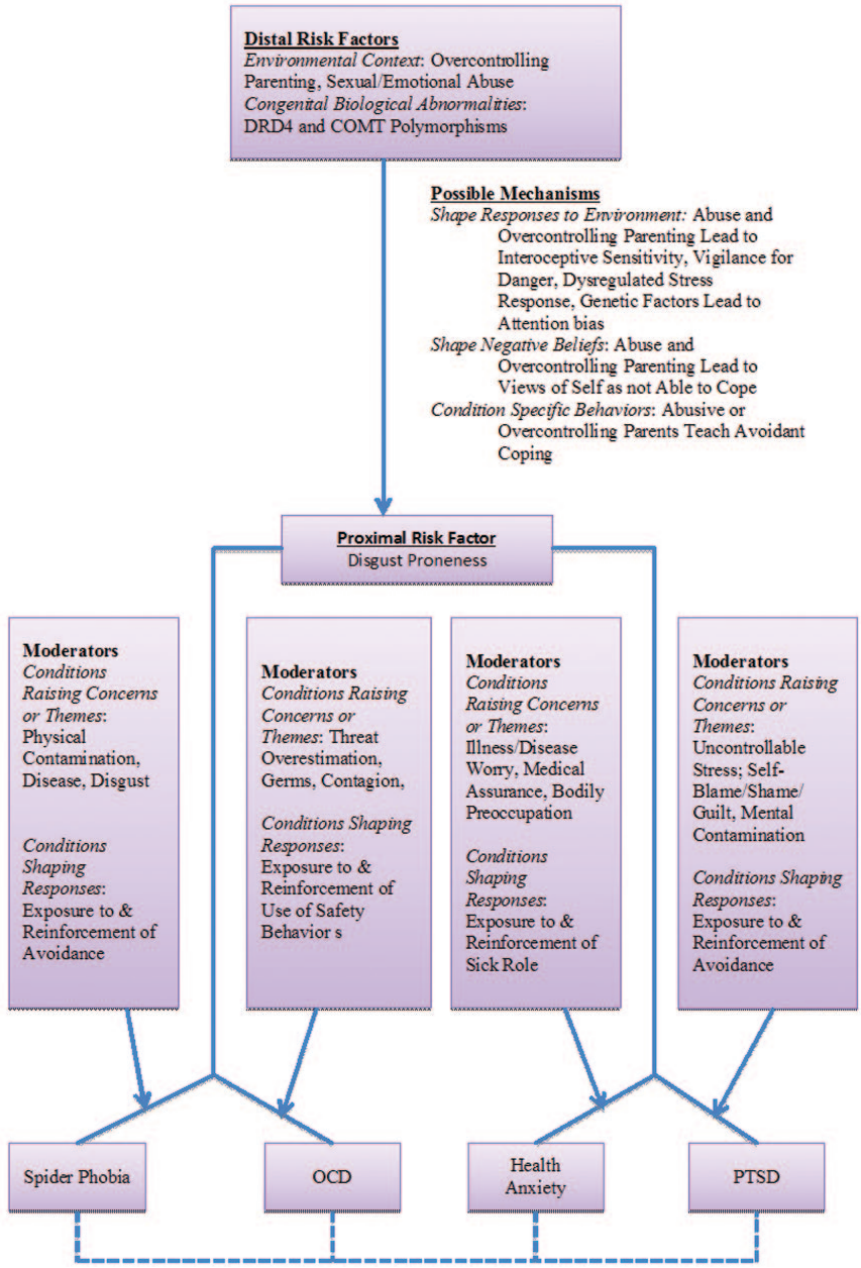

Fig. 4. A transdiagnostic model of disgust proneness. Distal risk factors for disgust proneness may include the environmental context variables of sexual and emotional abuse and over controlling parenting and the congenital biological abnormality of certain polymorphisms. These may lead to disgust proneness by various negatively focused responses to the environment, shaping negative beliefs about one's ability to cope and failing to teach effective coping responses. Moderators may then determine the divergent trajectories individuals high on disgust proneness take with regard to the development of specific anxiety and related disorders.

Although very little research has examined congenital biological abnormalities that predict disgust proneness, such abnormalities may also contribute to disgust proneness. Recent research has shown that disgust proneness is partially heritable (Sherlock et al., 2016) and is affected by genetic components such as dopamine-related gene polymorphisms (Kang et al., 2010). More specifically, Kang and colleagues (2010) found that disgust proneness was associated with the catechol-O-methyltransferase (COMT) Val158Met and dopamine receptor D4 (DRD4) VNTR polymorphism. Individuals with the Val of COMT or the non-2R of DRD4 may present with dopaminergic

hypersensitivity that causes greater vigilance for and responsiveness to disgusting stimuli in the environment. Congenital biological abnormalities may also shape responses to the environment in such a way that leads to disgust proneness. Such abnormalities may potentiate attentional bias to disgust stimuli or chronic neural hyperactivity to disgust stimuli in the insula (e.g., Wang et al., 2014).

Figure 4 shows that distal risk factors may also lead to disgust proneness by shaping responses to the environment. For example, this may occur via interoceptive sensitivity, an apprehension focused on physical sensations that have been conditioned to unpleasant emotional states. Research has shown that interoceptive sensitivity plays a pivotal role in the pathogenesis of anxiety disorders (Domschke, Stevens, Pfleiderer, & Gerlach, 2010). Interoception is characterized by a sense of the physiological condition of the body (i.e., conscious awareness of physiological processes such as those associated with emotion). Disgust is considered the most visceral of all emotions (Harrison, Gray, Gianaros, & Critchley, 2010). Mechanisms that contribute to this visceral property include interoceptive stimuli, like gastrointestinal activity, which may be uniquely associated with disgust proneness. Sensitivity to interoceptive experiences may contribute to a predisposition to be focalized on internal bodily signals and a tendency to experience disgust in a "physical" way, even in the absence of direct contact with a disgusting stimulus (Jalal, Krishnakumar, & Ramachandran, 2015; Scarpazza, Làdavas, & di Pellegrino, 2015). This predisposition may result in a disgust proneness that is consistent, stable, and likely represented in the enhancement of insular activity in the brain (Critchley, Wiens, Rotshtein, Öhman, & Dolan, 2004; Wicker et al., 2003).

Distal risk factors may also shape responses to the environment that lead to disgust proneness by facilitating an attentional bias to negative stimuli. Such a bias may reflect difficulty disengaging attention from both internal (interoceptive sensitivity) and external threat. Indeed, prior research has shown that difficulty in disengagement of attention is greater for disgust compared to fear stimuli and high disgust prone individuals display exaggerated difficulty in disengaging attention from disgust stimuli compared to low disgust prone individuals (Cisler, Olatunji, Lohr, & Williams, 2009). Attentional avoidance may also be a relevant mechanism for disgust proneness. In a recent study utilizing eye tracking technology, participants completed either disgust conditioning, in which a face (conditioned stimulus; CS+) was paired with videos of individuals vomiting (unconditioned stimulus; US), or negative conditioning, in which a face was paired with videos of individuals being harmed in motor-vehicle accidents (Armstrong, McClenahan, Kittle, & Olatunji, 2014). The findings showed that individual differences in disgust proneness was associated with attentional avoidance of the disgust CS+, and this effect was mediated by attentional avoidance of the disgust US. Mason and Richardson (2010) also found that attentional avoidance, as revealed by eye movements, was a reliable conditioned and unconditioned response to disgust stimuli. Attentional avoidance of disgust may be functionally equivalent to behavioral avoidance, preventing extinction and reappraisal processes that could potentially reduce disgust proneness. Classical conditioning, negative information transfer, and observational learning may also play a role in linking distal risk factors to disgust proneness. Indeed, Merckelbach, de Jong, Arntz, and Schouten (1993) found that spider phobics high in disgust proneness reported more conditioning events than spider phobics low in disgust proneness.

The final major component of the transdiagnostic model is the moderators that determine what particular symptoms disgust proneness will lead to in a given individual. The moderators create symptoms by raising concerns or themes that disgust proneness then acts on by shaping responses through various learning pathways. This framework can begin to account for the role of disgust proneness in anxiety disorders marked by contagion concerns (disgust disorders) as well as those not marked by contagion concerns (non-disgust disorders). For example, Figure 4 shows that those high in disgust proneness may be more likely to develop spider phobia if their environment consists of social conditions raising concerns or themes about small animals, contamination, and disease. This may consist of conditions in which the threat is present, such as living in a place where contamination concerns are high or there is a high frequency of venomous spiders. This is consistent with research showing that contamination ideation is more influential in phobic avoidance for persons with spider phobia than persons with other phobias (Bianchi & Carter, 2012). Furthermore, research has shown that spider phobic individuals display a contamination-relevant UCS expectancy bias associated with spiders, whereas controls display a harm-relevant expectancy bias (de Jong & Peters, 2007b).

The second category of moderators represents conditions that shape disgust proneness into disorder-specific responses through learning pathways. For example, an individual that is high in disgust proneness will be more likely to develop spider phobia if they are exposed to environments that model and reinforce avoidance of spiders. The environment condition may consist of simply exposure to verbal information about the threat. This view is in line with research showing that the learning of disgust-relevant information may contribute to the

development of phobic responses. For example Muris, Mayer, Huijding, and Konings (2008) examined whether disgust-valenced information has an impact on children's fear beliefs about animals. Children were presented with disgust-related and cleanliness-related information about unknown animals. Results showed that disgust-related information induced higher levels of disgust and also increased children's fear beliefs in relation to these animals. In contrast, cleanliness-related information decreased levels of disgust and resulted in lower levels of fear. In a more recent study, Askew, Cakir, Poldsam, and Reynolds (2014), presented children with images of novel animals together with adult faces expressing disgust or no emotion. The findings showed that children's fear beliefs and avoidance preferences increased for disgust-paired animals compared with unpaired control animals. Furthermore, the relationship between increased fear beliefs and avoidance preferences for animals was mediated by acquired disgust for the animals. These findings suggest that disgust-related vicarious learning can result in increased fear and avoidance. Importantly, related research has shown that disgust proneness (but not trait anxiety) potentiates disgust-related learning (Olatunji, Tomarken, & David, 2013), which may then confer risk for an anxiety-related psychopathology.

The transdiagnostic framework can be applied to other anxiety disorders. For example, individuals high in disgust proneness may be more likely to develop contamination-based OCD if their environment consists of social conditions where the likelihood and severity of threat, especially with regards to germs and contagion, is overestimated. This is consistent with research showing that negative beliefs, particularly overestimations of threat, significantly interact with disgust proneness in predicting symptoms of contamination-based OCD (Cisler, Brady, Olatunji, & Lohr, 2010). Specific strategies (i.e., hand washing) used to prevent feared outcomes (i.e., contagion) may then lead to the development of contamination-based OCD by preventing the disconfirmation of inaccurate threat beliefs (Deacon & Maack, 2008). Importantly, this transdiagnostic framework may also account for the role of disgust proneness in other subtypes of OCD. For example, disgust proneness has been implicated in religious obsessions and compulsions (Olatunji, Tolin, Huppert, & Lohr, 2005). In this context, the moderators may create symptoms by raising concerns or themes such as cleanliness, moral purity, and thought-action fusion (assumption that inappropriate thoughts are equivalent to the actions they symbolize). These concerns can result in the catastrophic appraisal of sexual, aggressive, or other morally suspect fantasies that disgust proneness can act on by shaping maladaptive responses (e.g., washing, excessive prayer). Disgust proneness has also been implicated in OCD symptoms marked primarily by symmetry concerns (Melli, Chiorri, Carraresi, Stopani, & Bulli, 2015). Moderators may create symmetry concerns in OCD by raising concerns or themes around incompleteness and "not-just-right" experiences. Disgust proneness may then act on such concerns or themes by shaping maladaptive responses that are intended to eliminate feelings of incompleteness when performed just right.

Figure 4 highlights how the transdiagnostic framework may account for the role of disgust proneness in PTSD. Trauma may be conceptualized as a distal risk factor because it sets the conditions for the development of symptoms, but not everyone who experiences the trauma will develop PTSD. This suggests that a number of proximal risk factors, including disgust proneness, may intervene to determine who will develop symptoms. In the current model for PTSD, distal risk factors are more likely to consist of sexual trauma. Examination of emotions experienced over a one-week period among those that experienced childhood sexual abuse revealed significantly higher levels of disgust than other emotions (Coyle, Karatzias, Summer, & Power, 2014). Disgust proneness may lead to PTSD when concerns or themes derived from the trauma related to self-blame, shame/guilt, or mental contamination are salient. For example, mental contamination refers to feelings of dirtiness and urges to wash in the absence of a physical contaminant. Consistent with the hypothesized model, Badour, Feldner, Blumenthal, and Bujarski (2013) found that mental contamination mediated the relationship between disgust proneness and symptoms of PTSD related to sexual assault. Mental contamination among those high in disgust proneness is coupled with maladaptive coping strategies (e.g., avoidance of traumatic event reminders, compulsive washing behavior) that then contribute to PTSD. Indeed, as many as 70% of sexual assault victims experience urges to wash following their assault, and a substantial minority will continue to experience such urges for several months postassault (Fairbrother & Rachman, 2004).

Conclusions and Future Directions

Although a transdiagnostic model may begin to clarify the putative mechanism(s) that account for the role of disgust proneness in anxiety and related disorders, it should be noted that the model proposed here is speculative and requires future research to test its predictions. Such a model can be useful in generating predictions about moderators of disgust proneness that lead to divergent trajectories of psychopathology. It is also important to note that disgust proneness may also develop concurrently with some anxiety-related disorders. For example, disgust proneness may develop with OCD or PTSD as a

direct result of systematic avoidance. Disgust proneness may then maintain these disorders by reinforcing avoidant coping, thereby preventing fear extinction. The experience of highly unpleasant events involving disgust may also increase the perceived consequences of disgust related stimuli. For example, the perception of the experience of disgust as dangerous may change following trauma, severe illness, and so on, and this change in belief could result in increased disgust proneness and subsequent avoidance. Disgust proneness may also contribute to the development of anxiety and related disorders through other mechanisms, such as behavioral inhibition (Olatunji, Unoka, et al., 2009). However, a better understanding of the mechanism(s) that explain how disgust proneness confers risk for anxiety-related disorders will require a more precise operationalization of the construct in the existing literature.

A more precise operationalization of disgust proneness may require more attention to the distinct components of the construct that may differentially relate to anxiety disorder symptoms. As previously noted, disgust proneness may consist of three components (Viar-Paxton & Olatunji, in press): *disgust sensitivity, disgust propensity*, and *disgust reactivity.* More recent measurement developments have allowed researchers to begin to make more precise distinctions between the proposed facets of disgust proneness. Indeed, psychometric research has shown that components of disgust proneness are structurally distinguishable (Fergus & Valentiner, 2009) and there is evidence that the components of disgust proneness may yield different pattern of associations with anxiety disorder symptoms (Olatunji, Williams, Tolin, et al., 2007; van Overveld et al., 2008). Given these initial findings, researchers have now begun to better understand the behavioral (van Overveld et al., 2010), physiological (de Jong, van Overveld, & Peters, 2011), and neural (Borg, de Jong, Renken, & Georgiadis, 2013) correlates of different facets of disgust proneness. More research along these lines will be valuable in further delineating how the facets of disgust proneness differentially confer risk for the development of anxiety and related disorders.

Disgust proneness at multiple levels of analysis

The Research Domain Criteria (RDoC; Insel et al., 2010), a strategic plan that has recently been launched by the National Institute of Mental Health (NIMH) aims to study psychopathology through the assessment of salient dimensions across multiple units of analysis (e.g., genes, neurocircuitry) rather than via the traditional approach of assessing forms of psychopathology according to categorically defined syndromes. Disgust proneness can be conceptualized as a key affective experience in different neuropsychiatric disorders. Consistent with the RDoC initiative, recent work has described a diagnostic taxonomy that includes disgust proneness and its neural underpinnings as a salient dimensional on which several current disorders may fall (Fontenelle, de Oliveira-Souza, & Moll, 2015). Although disgust proneness appears to fit well within the RDoC framework, more systematic research is needed to delineate how disgust proneness may be reliably observed across multiple levels of analysis.

Synchrony in disgust proneness has been observed at the verbal and behavioral level of analysis in many anxiety disorders (Koch, O'Neil, Sawchuk, & Connolly, 2002; Mulkens et al., 1996; Olatunji, Lohr, Sawchuk, & Tolin, 2007). Disgust proneness may also manifest at the cognitive level of analysis in domains of attention and memory (Charash & McKay, 2002; Cisler & Olatunji, 2010). The results of physiological studies of disgust suggest a robust heart rate deceleration (Page, 1994), decreased gastric activity (Meissner et al., 2011; Shenhav & Mendes, 2014), and increased salivary flow (van Overveld et al., 2008). A physiological marker for disgust proneness also includes activity of the levator labii muscle region (Susskind et al., 2008; Vrana, 1993). Activity of the levator labii during spider exposure has been found to differentiate spider phobics from controls (de Jong, Peters, & Vanderhallen, 2002; Leutgeb, Schäfer, Köchel, Scharmüller, & Schienle, 2010). A decrease in levator labii during exposure-based treatment may also be a useful index of reductions in disgust responding to threat (Leutgeb & Schienle, 2012). Disgust proneness has been linked to activity in the insular cortex at the neural level of analysis, which may explain unique variance in spider phobia (Straube, Mentzel, & Miltner, 2006) and OCD (Phillips et al., 2000; Schienle, Schäfer, Stark, et al., 2005b; Schienle, Schäfer, Walter, et al., 2005a; Shapira et al., 2003; Stein, Arya, Pietrini, Rapoport, & Swedo, 2006).

The availability of multiple levels of analysis that reflect disgust proneness represents a unique opportunity to examine psychopathology through a novel dimension that has not been previously considered. If disgust proneness is central to the etiology of anxiety and related disorders, then differences that emerge on verbal report measures should be linked to behavioral, cognitive, physiological, and neural levels of analysis. This approach is fully consistent with the RDoC initiative and may lead to a more precise understanding of a broader spectrum of anxiety-related disorders (Cisler et al., 2009a). However, various contextual factors may also moderate disgust proneness across different levels of analysis (Klucken, Schweckendiek, Merz, Vaitl, & Stark, 2013). Future research will also be needed to delineate processes that predict the level of synchrony that may be observed in disgust proneness across different levels of analysis. Similarly, the extent to which disgust proneness

in different anxiety disorders varies across different levels of analysis also requires more research attention. Indeed, preliminary research suggests that the extent to which disgust proneness characterizes anxiety and related disorders may depend on the level of analysis (Cisler et al., 2009a).

Treatment of disgust proneness in anxiety and related disorders

Exposure-based interventions have been shown to be efficacious for reducing fear and avoidance in anxiety and related disorders (Olatunji, Cisler, & Deacon, 2010). However, there is a growing body of research suggesting that disgust may not habituate at the same rate as fear. Conditioning-based research has shown that learned disgust is more resistant to extinction than fear (Olatunji, Forsyth, & Cherian, 2007). This may not be inherently problematic and likely reflects evolutionarily relevant differences between disgust and fear. However, research has shown that the resistance to extinction of disgust is more pronounced among those high in disgust proneness (Mason & Richardson, 2010). Given that disgust proneness may be acquired through a referential model of learning, alternative strategies like counterconditioning (contingent presentation of the CS with a US of opposite valence) and US revaluation (e.g., contingent presentation of the US with US of opposite valence) may facilitate disgust extinction (Ludvik et al., 2015). Clinical research has also shown that disgust habituates at a slower rate than fear during exposure therapy in spider phobia (Smits, Telch, & Randall, 2002), BII phobia (Olatunji, Smits, Connolly, Willems, & Lohr, 2007), and contamination-based OCD (Adams, Willems, & Bridges, 2011; McKay, 2006). Recent research suggests that rather than adrenergic activation associated with appraisals of harm, disgust experiences may be associated with increased vagal tonus during exposure-based treatment and consequently poorer treatment outcome (e.g., Duncko & Veale, 2016).

Research indicating that disgust is more resistant to extinction than fear in anxiety disorders highlights the importance of developing interventions that directly target disgust. Indeed, research has shown that change in disgust during exposure-based treatment explains unique variance in improvements in spider phobic symptoms (Olatunji, Huijding, de Jong, & Smits, 2011). Reductions in disgust proneness were also found to be associated with improvement in contamination/washing symptoms after exposure-based treatment for OCD (Athey et al., 2015). In fact, Olatunji, Tart, et al. (2011) found that decreases in disgust proneness over time mediated improvement in OCD symptoms, even after controlling for improvements in negative affect. Given research showing that changes in disgust proneness is associated with symptom improvement, future research aimed at developing effective strategies for reducing disgust responses may prove to be valuable in improving treatment outcomes for anxiety and related disorders (Mason & Richardson, 2012). Interventions that stem from the inhibitory learning model may prove to be beneficial in treating disgust proneness (i.e., Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). This model emphasizes the importance of new learning during exposure therapy as opposed to merely extinction. Based on this model, exposure optimization strategies include (a) expectancy violation, (b) deepened extinction, (c) occasional reinforced extinction, (d) removal of safety signals, (e) variability, (f) retrieval cues, (g) multiple contexts, and (h) affect labeling. Future research is needed to examine the extent to which these strategies facilitated the effective treatment of anxiety and related disorders characterized by excessive disgust reactions. Research along these lines that adopts an inhibitory learning model approach to disgust tolerance, rather than disgust reduction, may be promising (Bosman, Borg, & de Jong, 2016; Viar-Paxton & Olatunji, 2012).

In a recent study, Knowles, Viar-Paxton, Riemann, Jacobi, and Olatunji (2016) found that although disgust proneness decreases during treatment for youth with OCD, anxiety, and mood disorders, youth with primary OCD experienced the greatest decrease in disgust proneness over the course of treatment. Furthermore, reductions in disgust proneness during treatment were significantly correlated with reductions in multiple symptom measures, with the strongest correlations between reductions in disgust proneness and OCD symptoms. Although disgust proneness may be viewed as transdiagnostic, this finding suggests that detailed assessment of disgust proneness is especially important when treatment planning for OCD. Disgust proneness may also have important treatment prognostic value. In another recent study, women with significant spider fear were randomized to three 30-min sessions of exposure therapy involving repeated contact with disgusting stimuli or a waitlist control condition (Cougle, Summers, Harvey, Dillon, & Allan, 2016). The results showed that at high (but not low) levels of pretreatment disgust propensity, exposure led to lower in vivo spider fear and perceived danger than waitlist. Similar effects of exposure on spider fear were found at high levels of pretreatment spider-related disgust. One interpretation of these findings is that disgust-focused exposure therapy may be an effective transdiagnostic treatment strategy for individuals with elevated baseline disgust proneness. Those with elevated disgust proneness may also be well positioned to benefit most from an inhibitory learning model approach that emphasizes disgust tolerance.

Summary and limitations

Although the present findings suggest that disgust proneness should be incorporated into contemporary theoretical models of the etiology of some anxiety-related disorders, the present review is not without limitations. One important limitation is that levels of disgust proneness were obtained contemporaneously with diagnoses and symptoms. Accordingly, these results cannot be used to imply or show that disgust proneness causes the development of various anxiety-related disorders. In fact, it could be argued that disgust proneness is a consequence, rather than a cause, of having specific anxiety disorders diagnoses. Although some studies have failed to show that induced disgust affects anxiety (e.g., Davey & Hurrell, 2009; Marzillier & Davey, 2005), experimental research has linked the experience of disgust to the development of an interpretation bias for threat (Davey, Bickerstaffe, & MacDonald, 2006) as well as the development of anxiety symptoms (Davey, MacDonald, & Brierley, 2008). Furthermore, research has shown that providing children with disgust-related information about an unknown novel animal increases fear beliefs about and avoidance of the animal (Muris, Huijding, Mayer, & de Vries, 2012; Muris et al., 2008; Muris et al., 2009).

The present study is also limited by reliance on self-report questionnaires, which may capture content better than they capture underlying processes. Future research aimed at delineating underlying processes unique to disgust proneness in anxiety-related disorders may benefit from assessment across multiple level of analysis. Although the current review is limited to examining the role of disgust proneness in anxiety-related disorders, there is a growing body of research suggesting that disgust proneness may play a role in other forms of psychopathology (Olatunji & McKay, 2009). Although it is not yet clear if disgust proneness is a cause or consequence of these other disorders, a major challenge faced by researchers will be providing a comprehensive model that predicts when disgust proneness operates as a risk factor for anxiety-related disorders versus other disorders and the processes that facilitates such a distinction. The transdiagnostic framework proposed in this review may provide a model for conceptualizing disgust proneness as a proximal risk factor that may be relevant for a broad range of disorders. Finally, it is also important that researchers begin to consider the full dimension of disgust proneness. Although much of the available research has focused on linking *high* disgust proneness to the development of various disorders, much remains unknown about the psychological consequences of *low* disgust proneness. A better understanding of the full spectrum of disgust proneness may inform transdiagnostic models of risk and resiliency for psychopathology.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Notes

1. This includes participants high in symptoms of "non-disgust disorders" (n = 115).
2. One study (Schienle, Stark, et al., 2003) was excluded from the moderator analysis of specific disorder type because it used a mixed BII phobia/OCD patient group. Although the specific disorder type moderator analysis focused *within* the disgust disorders, this analysis was not limited to the subset of studies used to establish the combined effect size for the disgust disorders *in the general disorder type moderator analysis*. To maintain independence of effect size estimates and to ensure that we had sufficient studies of non-disgust disorders for a meaningful comparison, if a study included both a disgust disorder and non-disgust disorder sample, we used the study to estimate the combined effect size for non-disgust disorders (and not the disgust disorders) *in the general disorder type moderator analysis*. However, these studies with both a disgust disorder and non-disgust disorder sample could be included *in the specific disorder moderator analysis* without compromising independence, because this analysis focused within the disgust disorders, and thus included only the disgust disorder sample (and not the non-disgust disorder sample) for the study.
3. Due to skew in the sampling distribution of the correlation coefficient, averaging rs can potentially lead to an underestimate of the overall effect. However, this bias becomes negligible in larger samples ($N \geq 30$), and is only noteworthy in very small samples (e.g., $N = 10$; Silver & Dunlap, 1987). The median sample size of the studies included in Part I of the meta-analysis was N = 116, and only two studies had Ns under 30 (N = 27 and N = 22).
4. We repeated this analysis with all phobias collapsed into one category, *specific phobia*, and the results remained the same, $Q(2) = 1.64$, $p > .10$.
5. Due to skew in the sampling distribution of the correlation coefficient, averaging rs can potentially lead to an underestimate of the overall effect. However, this bias becomes negligible in larger samples ($N \geq 30$), and is noteworthy only in very small samples (e.g., $N = 10$; Silver & Dunlap, 1987). The median sample size of the studies included in Part I of the meta-analysis was N = 116, and only two studies had Ns under 30 (N = 27 and N = 22).
6. We repeated this analysis with all phobias collapsed into one category, *specific phobia*, and the results remained the same, $Q(3) = 5.00$, $p > .10$.

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*References marked with an asterisk indicate studies included in the meta-analyses.

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