

Review

Disgust: the disease-avoidance emotion and its dysfunctions

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This review analyses the accumulating evidence from psychological, psychophysiological, neurobiological and cognitive studies suggesting that the disease-avoidance emotion of disgust is a predominant emotion experienced in a number of psychopathologies. Current evidence suggests that disgust is significantly related to small animal phobias (particularly spider phobia), blood–injection–injury phobia and obsessive–compulsive disorder contamination fears, and these are all disorders that have primary disgust elicitors as a significant component of their psychopathology. Disgust propensity and sensitivity are also significantly associated with measures of a number of other psychopathologies, including eating disorders, sexual dysfunctions, hypochondriasis, height phobia, claustrophobia, separation anxiety, agoraphobia and symptoms of schizophrenia—even though many of these psychopathologies do not share the disease-avoidance functionality that characterizes disgust. There is accumulating evidence that disgust does represent an important vulnerability factor for many of these psychopathologies, but when disgust-relevant psychopathologies do meet the criteria required for clinical diagnosis, they are characterized by significant levels of both disgust and fear/anxiety. Finally, it has been argued that disgust may also facilitate anxiety and distress across a broad range of psychopathologies through its involvement in more complex human emotions such as shame and guilt, and through its effect as a negative affect emotion generating threat-interpretation biases.

Keywords: disgust; psychopathology; disease-avoidance; anxiety

1. INTRODUCTION

Over the past 20 years, there has been a significant growth in the body of research dedicated to the role of the disease-avoidance emotion of disgust in psychopathology. This review has developed to the point where (i) we are now able to positively identify those psychopathologies that have disgust responses as a significant feature of the symptoms (e.g. many animal phobias, contamination fears in obsessive–compulsive disorder (OCD) and blood–injection–injury phobia (BII)) [1,2]; (ii) we can begin to specify how the functional significance of the disgust response contributes as a vulnerability factor in the emergence of a number of psychopathologies [3,4]; and (iii) research has begun to describe the various mechanisms through which the disgust emotion can exert either a direct or indirect effect on psychopathology symptoms [2,5,6]. While this review has focused primarily on the role of disgust in anxious psychopathology, there is also evidence that disgust is closely associated with many forms of psychopathology, including eating disorders [7,8], symptoms of schizophrenia [9], hypochondriasis [10], height phobia and claustrophobia [10], and sexual dysfunction in women [11]; so the relationship between disgust and psychopathology appears inevitably to be a complex one, with the

possibility of the engagement of more than one mechanism and complex patterns of interactions between different emotions and their consequences.

These findings inevitably beg the question of why the emotion of disgust is so prominent in these various psychopathologies. For example, anxiety disorders have traditionally been considered to reflect a mixture of fear and anxiety [1,12,13], and this is not so surprising, given that anxiety is an emotion dedicated to the anticipation of potential threat whereas fear is the emotion that is a direct response to threat [12,14]; so anxiety disorders are viewed as emerging from an organism's natural defence systems to threat. The emotion of disgust appears to be a more specific adaptation. While there is still some debate about the precise adaptive function of the disgust response, it too has been described as a natural defensive emotion that has evolved to protect against harm [15,16]. The proposed primary biological function of disgust is to protect the organism against illness, disease and contamination [16–18]. The main response features of the disgust emotion are consistent with this in that (i) disgust is associated with a distinctive, universal facial expression involving a wrinkling of the nose and down-turning of the corners of the mouth [16,19], (ii) feelings of revulsion and nausea [15], (iii) fear of contagion [15], (iv) avoidance of 'disgusting' objects [20], and (v) heart-rate deceleration [19,21]. These are all reactions that can potentially serve to prevent contact with sources of illness, disease and contamination and—in more specific cases—to prevent the

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oral incorporation of items that might potentially be causes of illness and disease. However, some theorists have extended this basic ‘disease-avoidance’ view of the disgust response to suggest that the disgust emotion has evolved more sophisticated adaptive functions that protect not just the physical body from contamination and harm, but also protect the ‘psychological’ body from harm by providing reminders of our own mortality and inherent animalistic nature [22]. Proponents of this latter view support this account by arguing that most ‘primary’ disgust items can be characterized by their animal origin and their ability to elicit fear of oral incorporation (e.g. phlegm/mucus, diarrhoea, slugs and maggots) [18]. As a result, disgust is constantly a reminder of our animal origins and—because disgusting objects are usually universally revulsive—disgust has become an emotion frequently used to imbue socially and culturally unacceptable activities and attitudes with negative affect. Viewed in this broader, psychological perspective, disgust is not just a food-rejection response serving to avoid disease; it has also come to regulate behaviour in social and interpersonal contexts, and will affect our social attitudes by conveying culturally and morally unacceptable views.

The purpose of this review is to argue that the disease-avoidance emotion of disgust is experienced in a number of common psychopathologies, and that a number of psychological mechanisms can be identified that mediate the role of disgust in psychopathology. The following sections will (i) describe why disgust might be involved in psychopathology, (ii) describe how we might measure disgust so that its role in psychopathologies can be unambiguously studied, (iii) outline which psychopathologies are most closely related to the disgust emotion, (iv) discuss the theoretical factors that link the disgust emotion to these psychopathologies, (v) describe how disgust might be involved in generating clinically significant symptoms, (vi) discuss emerging evidence of the implication of disgust in a range of further psychopathologies, including those that do not appear to have a *prima facie* ‘disgust relevance’, and (vii) describe some potential mechanisms through which disgust might exert some indirect effects on psychopathology.

2. WHAT LINKS DISEASE-AVOIDANCE WITH PSYCHOPATHOLOGY?

One of the first questions to ask is why have emotion researchers become so interested in the potential role that disgust- and disease-avoidance may play in generating psychopathology symptoms? The first reason is that there is considerable overlap between the emotions of disgust and anxiety or fear; so is it quite possible that experiencing one may facilitate the other, and—indeed—the individual may confuse one with the other. Both disgust and fear/anxiety have a dominant behavioural tendency of avoidance [23], although fear-motivated avoidance protects the person from perceived danger generally [20], and disgust-motivated avoidance appears to have the more specific function of avoiding contaminants [2,15]. Nevertheless, as Olatunji *et al.* [2] point out, this would probably make both disgust and fear

avoidance indistinguishable in behavioural approach task (BAT) studies.

More generally, both disgust and fear/anxiety are classified as negative emotions [24] and as we shall see later, both have similar effects as negative emotions on information processing in ways that heighten thoughts and feelings associated with anxiety-based psychopathologies [1,6,25]. Finally, the fact that the adaptive significance of disgust may be to protect the body from contamination and harm from disease and illness resonates with the defining characteristics of a number of anxiety-based disorders including contamination fear in OCD, hypochondriasis or health anxiety, somatic disorders involving fear of contamination, BII, and many small animal phobias where contamination and fear of contact are the primary characteristics. In these cases, the functional similarity between the disgust emotion and the fear and anxiety in these psychopathologies leads logically to an investigation of the possible role of disgust in these disorders.

3. MEASURING DISGUST

Before discussing the potential relationships between disgust and psychopathology, it is important to understand how the disgust emotion is measured and how these measures might be used to understand the relationship between disgust and psychopathology. A number of disgust questionnaires (DQs) and inventories have been developed to measure the frequency and intensity with which individuals experience disgust. Because disgust is primarily an emotion experienced in relation to specific disgust elicitors (e.g. faeces, vomit), early inventories represented self-report measures of the intensity of reactions to a range of disgusting stimuli. These inventories include the DQ [26], the disgust scale [22] and the disgust emotion scale [27], and these instruments measured disgust across a relatively consistent range of disgust domains such as foodstuffs, small animals (e.g. invertebrates, rodents), body violations and death, and body products (e.g. faeces, animal/body smells), etc. These types of domain-based measures of disgust have been shown to be highly correlated with measures of anxiety [10,28], and with measures of specific anxiety-based problems such as small animal fears [17,28,29], spider phobia [30,31], BII [32–34], contamination fear in OCD [35–38] and eating disorders [8]. However, these domain-based questionnaires all measure disgust in relation to certain elicitors and so inflated correlations may arise between disgust propensity and psychopathology owing to items that enquire about similar objects in both questionnaires [20,31]. For example, disgust measures contain items enquiring about reactions to small animals and to foodstuffs and body products, items that are also included in measures of small animal fears and contamination fears. Second, domain-based instruments measure disgust propensity, but not disgust sensitivity. Yet, for the development of psychopathology, it is less likely to be how easily people are disgusted (propensity), but also how unpleasant the experience of the emotion is to the individual (sensitivity; cf. [39,40]). In response to these issues, van Overveld *et al.* [41] developed the

disgust propensity and sensitivity scale-R, a disgust measurement instrument that is domain-independent and measures the degree to which both disgust propensity and disgust sensitivity may independently contribute to the development of psychopathology. Not only does this measure reduce confounding between items in disgust and psychopathology inventories, but also appears to have some discriminative value in that different anxiety disorder symptoms are differentially predicted by scores on disgust propensity and disgust sensitivity [41–43]. For example, disgust propensity (how easily people are disgusted and how frequently they experience disgust) is highly associated with fear of spiders, whereas disgust sensitivity (how unpleasant the experience of disgust is to the individual) is a better predictor of fainting in BII [41]. More importantly, both disgust sensitivity and disgust propensity exhibit significant associations with a range of psychopathology measures even when levels of trait anxiety are controlled for, suggesting that these relationships between disgust and psychopathologies are not simply mediated by levels of other relevant emotions such as anxiety [10,44].

While most research on the relationship between disgust and psychopathology has been carried out using self-report questionnaire instruments, other measures of disgust have also provided further insights into how disgust and symptoms of psychopathology may be related. These include behaviour avoidance measures, physiological measures (e.g. heart-rate variability), neural correlates of disgust, measures of facial expressions, and cognitive experimental tasks.

Because one of the important behavioural characteristics of the disgust emotion is avoidance, disgust can also be measured by the degree to which an individual will approach or avoid a potentially disgusting object. Behavioural avoidance test (BAT) measures to disgusting objects have been shown to be significantly correlated with measures of contamination fear [45], the frequency of contamination-related cognitions [46] and measures of BII [47].

Exposure to disgusting stimuli is specifically associated with heart-rate deceleration [19,21,48] and it has been argued that when psychopathologies are associated with heart-rate deceleration rather than acceleration, this is consistent with the involvement of the disgust rather than fear emotion in that psychopathology [1]. Relatively little research has explored the usefulness of this measure, but studies using heart-rate measures have shown a biphasic heart-rate response (an initial acceleration followed by significant deceleration) to spider-related pictures in spider-fearful individuals [49], and to phobic-related stimuli in BII phobia sufferers [49,50].

There is emerging evidence that experiencing disgust is associated with activation in specific brain areas, and although this review is still in its infancy, it too could be used as a means of measuring experienced disgust and its involvement with psychopathology [1]. Neuroimaging studies have implicated the involvement of the anterior insula during disgust experiences [51–53], although these studies have been limited to the perception and recognition of disgust facial expressions. However, Wright *et al.* [54] report finding more anterior

insula activation for contamination and mutilation stimuli than specific fear-related stimuli in a non-clinical population, suggesting that disgust-relevant stimuli may be more important in anterior insula activation than fear-relevant stimuli *per se*. In more direct comparisons of disgust and psychopathology, Straube *et al.* [55] found both insula and amygdala activation to spider pictures in spider phobia, suggesting that spider phobia may be characterized by both fear and disgust experiences. Similarly, studies suggest that both fear and disgust may underlie contamination fears in OCD, and Schienle *et al.* [56] and Breiter *et al.* [57] both found activation of both insula and amygdala in individuals reporting contamination fears. However, while these reported studies may be consistent with a role for disgust in some psychopathologies, the literature is still inconsistent and further research will be required [1].

Because disgust has a very distinctive facial expression with both distinctive visual and muscular components, this too can be used as an index of an individual's current experience of disgust. Greater levator labii and corrugator muscle activation is typical of the disgust facial expression [58], and greater levator labii muscle activation has been found in spider-fearful than in non-fearful individuals while viewing pictures of spiders or approaching a spider in a BAT procedure [59,60], as well as in BII individuals viewing surgery videos [61].

Finally, the experience of disgust can also be revealed indirectly with the use of experimental tasks that measure attentional or processing factors related to disgust stimuli. Charash & McKay [62] used a Stroop colour-naming task to measure attentional bias to disgust and non-disgust words. They found that self-report measures of disgust sensitivity were directly related to response latencies to disgust words on the Stroop task, suggesting that the Stroop test may represent an attention-based measure of sensitivity to disgust. Subsequent studies have demonstrated a relationship between measures of psychopathology and disgust-related attentional biases. Armstrong *et al.* [63] used an eye-tracking attentional measure of disgust and control faces, and found that individuals high in contamination fear maintained attention on disgusting faces compared with control faces, with one implication of this finding being that disgust is a highly relevant emotion involved in contamination fears.

While all these different measures of disgust provide useful ways of assessing an individual's experience of that emotion in terms of its frequency and intensity, individually these are far from exclusive measures of the disgust experience. For example, both behavioural avoidance and attentional biases *per se* may be measures of fear as much as disgust, and the fact that anterior insula activation has also been implicated in interoceptive processes generally [64] suggests that it may not be an exclusive indicator of disgust. Even specifically developed inventories have their limitations based on the fact that many of the items they contain can often be confounded with items in the measures of the psychopathologies to which disgust is being linked. Nevertheless, the range of measures discussed in this section provides a consistent picture of disgust

as a regularly experienced emotion that can be measured in cognitive, behavioural, psychological and physiological terms, and is consistently associated with a variety of psychopathology measures.

4. WHICH PSYCHOPATHOLOGIES INVOLVE DISGUST?

Both Cisler *et al.* [1] and Olatunji *et al.* [2] have written scholarly and timely reviews of the evidence relating disgust to psychopathology, and conclude that there is convincing converging evidence that disgust is closely related to three specific anxiety disorders: small animal phobias (in particular spider phobia), BII and contamination-related OCD. In clinical terms, all of these disorders are characterized by the degree of distress they cause the sufferer and the disruptive effect that the symptoms have on normal daily functioning. Small animal phobias are clinically defined in the *Diagnostic and statistical manual of mental disorders*, 4th edn, text rev. (DSM-IV-TR) [65], by a marked and persistent fear that is excessive and unreasonable, and are triggered by the animal or cues related to the animal, resulting in avoidance, anxious anticipation or a panic attack ([65], p. 449). BII is a persistent and excessive fear cued by seeing blood or an injury or by receiving an injection or other invasive medical procedure, and is associated with a strong vasovagal response ([65], p. 445). Contamination is defined as an intensive and persistent feeling that the person has been polluted or infected [66], and contamination concerns are the most common of the obsessive-compulsive symptom dimensions [67]. This disorder is associated with intrusive thoughts of contamination that usually lead to excessive sanitizing and disinfecting of the self and the environment. OCD-based contamination fears are regularly associated with ritualistic washing behaviours and avoidance of any situations that might be a potential source of perceived contamination, causing significant disruption to normal daily functioning [68].

The evidence linking the disgust emotion with these three specific psychopathologies is significant, and comes from studies that have investigated this link at psychological, psychophysiological, neurobiological and cognitive levels [1,2].

In the case of small animal phobias, questionnaire studies have indicated that high levels of disgust sensitivity are associated with small animal phobias in general [28,29] and spider phobia specifically [30]. These studies suggest that there is a significant number of animals with high fear status that do not pose a serious *physically aggressive* threat to humans, and a study by Arrindell *et al.* [69] found that disgust sensitivity was significantly associated with fear of small fear-relevant animals, non-slimy invertebrates and slimy invertebrates. Factor analysis studies have been relatively consistent in identifying these fear-relevant animals as small rodents (e.g. mice, rats), reptiles and amphibians (snakes, lizards, frogs, etc.), insects (e.g. spiders, cockroaches) and invertebrates (e.g. slug, snail, leech), and these disgust-related categories of small animal fears are found almost universally in different cultures across the world [70]. Studies involving individuals with a clinical diagnosis

of spider phobia have shown that females with spider phobia were significantly less likely to eat a cookie after a spider had walked over it than were individuals without spider phobia, suggesting that fear of contamination by spiders in spider phobia is significantly heightened [30,71,72]. Similarly, individuals with spider phobia exhibit greater activity of the facial muscles characteristic of disgust (the levator labii muscle) during exposure to spiders than non-phobic individuals [59]. Neurological studies have also implicated insula cortex activation during exposure to spiders in spider phobics, suggesting the involvement of disgust in this reaction, although it must be pointed out that these studies also implicated amygdala activation as well (see later text) [55,73]. Finally, using an expectancy bias paradigm, studies have indicated that spider-phobic individuals expected pictures of spiders to be followed by contamination-relevant outcomes (e.g. drinking a distasteful fluid) significantly more than did non-phobics, who expected spiders to be followed by harm-relevant outcomes [74,75].

While there is some evidence that disgust sensitivity interacts with trait anxiety to generate feelings of faintness typical of BII [76], evidence associating BII with disgust has come mainly from studies of facial expression and from psychophysiological data. For example, in studies examining distinctive facial expressions to phobogenic stimuli, Lumley & Melamed [61] found that BII phobics displayed significantly more facial expressions of disgust than non-phobics. Further evidence comes from psychophysiological studies. For instance, BII phobics exhibit a unique vasovagal response that is very similar to the diphasic response found to disgusting stimuli [50], and the latter part of this diphasic response plays a significant role in the fainting response that frequently accompanies BII. Studies by both Ost *et al.* [77] and Sarlo *et al.* [49] have demonstrated the diphasic heart-rate response in BII phobics to relevant phobogenic stimuli. Finally, self-report studies have indicated that BII phobics report higher disgust levels to phobogenic stimuli than do non-phobics [78,79], suggesting elevated levels of disgust experience when viewing such stimuli.

There is significant evidence from self-report questionnaire studies that the disgust experience and disgust sensitivity are significantly correlated with measures of contamination fear [5,35–38,80], and in behavioural avoidance studies, disgust measures are significantly associated with avoidance of contamination-related stimuli [45,46]. Second, at least some neurological studies have suggested that disgust may be the predominant response in contamination fears. Both Cisler *et al.* [80] and Shapira *et al.* [81] found heightened insula activation to contamination stimuli in a contamination fear sample indicating the possible involvement of experienced disgust. Further evidence for disgust being the predominant emotion in OCD-based contamination fear comes from studies showing that (i) disgust is a better predictor of OCD washing than fear, anxiety or depression [36,37,82] and (ii) only disgust-specific hygienic concerns retained a significant association with OCD washing when depression, anxiety and other non-contamination symptoms of OCD were controlled for [83].

5. WHY IS THERE A LINK BETWEEN SMALL ANIMAL PHOBIAS, BLOOD-INJECTION-INJURY PHOBIA AND OBSESSIVE-COMPULSIVE DISORDER CONTAMINATION FEARS AND THE DISGUST EMOTION?

Why is there now so much accumulated evidence linking disgust to the three psychopathologies described in the previous section? One common factor is that all three disorders have disgust elicitors as a significant component of their psychopathologies. In both factor analysis and cluster analysis studies of disgusting objects, common clusters of elicitors that emerge include small animals (including invertebrates, insects and small mammals), blood and mutilation (e.g. fish hooks in eyes, amputated hands) and contaminating agents (e.g. diarrhoea, vomit and phlegm) [18,22,33]. Thus, the three disorders identified as strongly associated with disgust all have prominent disgust elicitors as environmental triggers for their various symptoms, and so the symptoms of these disorders may share a functionality in common with disgust of protecting the individual from contact with and infection by contaminated stimuli [20].

While it is intuitively apparent that blood, injury and mutilation and contaminating agents might be related to disease-avoidance, it is not so obvious why this might be the case with those small animals that become the focus of fears and phobias—and especially so with spider phobia, which is arguably the most common animal phobia in Western cultures. First, we know that disgusting objects are nearly always associated with animals, animal products, parts of animals, animal body products, etc.; so it is perhaps not surprising that animals themselves will also elicit disgust [15,84]. However, not all animals have a close association with disgust. Fear of predatory animals and many farm animals, for example, is not related to levels of disgust sensitivity—which might be expected if such animals are primary disgust objects [17,69]. There is therefore something more substantial than just being an animal that relates small fear-relevant animals to disgust.

Davey [85] outlined a number of possible reasons why those small animals related to fear have a close association with the disgust emotion. First, the main features of the disgust emotion include a physiological manifestation (nausea), a distancing of the self from the disgusting object (avoidance), and sensitivity to contamination from or oral incorporation of, the offensive object [15]. Thus, as outlined earlier, the adaptive benefit of the disgust emotion appears to be the prevention of oral incorporation of disgusting objects, and as a consequence the prevention of the transmission of disease [16]. This link between disgust and the prevention of the spread of disease, infection and illness may be an important factor in defining why small, fear-relevant animals have such a strong association with disgust rather than fear *per se*. Davey [85] outlined three possible ways in which fear-relevant animals might have acquired their disgust relevance: (i) by historically being directly associated with the spread of disease (e.g. rats, cockroaches) or the contamination of food (e.g. maggots, mice), (ii) by possessing physical characteristics that resemble

primary disgust-evoking stimuli such as mucus and faeces (e.g. animals that are perceived as slimy such as snakes, lizards, slugs, worms, frogs, etc.), and (iii) by being opportunistically or superstitiously associated with disease, or acting as signals for infection. While the rationale for the first two groups is reasonably self-evident, the latter is included because, historically, many animals have become associated with illness and the spread of disease, but in fact are entirely innocent of any involvement. One such example is the spider. For instance, in most of Europe, during the Middle Ages, spiders were considered a source of contamination that absorbed poisons in their environment, and any food that had come into contact with a spider was considered to be infected [86]. The spider's bite was also one way of explaining the causes of many of the terrible epidemics of plague and disease that swept across Europe from the Middle Ages onwards [87]. While not fatally venomous, many European spiders do possess bites that cause painful systemic reactions, and these bites became opportunistically associated with causally unrelated diseases and illness [86–88]. During the Middle Ages, spiders were also perceived as harbingers of the Great Plagues that swept across Europe from the tenth century onwards [89], and it is interesting that cross-cultural studies of animal fears tend to suggest that spider fear features more prominently in lists of animal fears from cultures that consist mainly of Europeans and their descendants [70]. So, while explicit knowledge of the spider's association with disease and illness may have been lost over time, it may still be manifest today in its ability to elicit disgust.

6. IS DISGUST INVOLVED IN GENERATING CLINICALLY SIGNIFICANT SYMPTOMS?

While disgust and small animal phobias, BII, and contamination fears may share a common functionality, this does not explain why the responses and symptoms in the case of these psychopathologies become so excessive and dysfunctional in some individuals and reach levels meeting criteria for clinical diagnosis. Just because disgust and these specific psychopathologies share similar environmental triggers does not in any way imply that the former is a cause of the latter or that the former is a vulnerability factor for the latter—the two may simply coexist in parallel because of their common environmental elicitors.

Nevertheless, the fact that disgust and disgust-relevant psychopathologies share similar functional goals—i.e. the avoidance of disease and contamination—implies that inducing disgust should also facilitate distress and avoidance in the associated psychopathologies. There is some evidence for this. For example, Webb & Davey [90] asked a non-clinical population to rate fear to four categories of animals (predatory, fear-relevant small mammals and reptiles, fear-relevant invertebrates, and fear-irrelevant animals) before and after watching a violent, disgusting or neutral video. They found that participants who watched the violent video showed increased fear ratings to larger predatory animals, whereas participants

who watched the disgusting video showed increased fear to fear-relevant small mammals and invertebrates. The effects of disgust induction on symptoms of contamination fear also suggest a causal role for disgust. In a study by Olatunji & Armstrong [91] a disgust induction caused a significantly greater increase in distress to low-contagion stimuli in high-contamination fear individuals than low contamination fear individuals. Interestingly, inducing disgust-evoked distress levels to potentially contagious stimuli in low contamination fear participants that paralleled levels found in high-contamination fear participants, suggesting that high levels of disgust may be involved in the development of clinical levels of contamination fear.

Prospective studies will also provide some information about how disgust sensitivity and propensity interact with symptoms of psychopathology, although to date there are very few such studies. In one study, Olatunji [92] has shown that over a 12 week period changes in disgust levels in a non-clinical population predicted changes in symptoms of contamination-based OCD, and that this relationship was still significant even when levels of negative mood and depression were controlled for.

However, there are interpretation difficulties even for prospective and experimental studies. Because elicitors of the symptoms of small animal phobia, BII and contamination fears are also disgust elicitors, it is perhaps not surprising that changes in disgust will relate directly to changes in psychopathology symptoms—especially if these symptoms are measured in terms that are also highly relevant to disgust (e.g. avoidance and distress). One possible promising approach that might be able to avoid this confound is in exploring the effects of disgust and its induction on the biological correlates of psychopathology. Fruitman *et al.* [93] compared the effect of a disgust provocation manipulation on patients with a diagnosis of OCD contamination fear and a group of healthy control participants. The disgust induction had the effect of lowering plasma levels of tumour necrosis factor- α and interleukin-6 in OCD patients but not in healthy controls, suggesting that experiencing disgust does have a causal effect on factors known to be immunological abnormalities correlated with OCD contamination fear [94,95].

An alternative view that links disgust with clinically diagnosable levels of small animal phobia, BII and OCD contamination fear is that while disgust sensitivity may represent a vulnerability factor for these disorders, it is the development of fear and anxiety around each relevant disgust elicitor that projects what commences as a normal disgust reaction into a clinically diagnosable disorder. There is evidence for this in the fact that all three psychopathologies are characterized not just by disgust but also by high fear levels. Sawchuk *et al.* [78] found that individuals suffering BII reported significantly greater disgust and fear responses to surgery relevant pictures than healthy controls. Similarly, both Schienle *et al.* [56] and Mataix-Cols *et al.* [96] report neurological studies showing that individuals with OCD and OCD with contamination fears showed greater activation of both insula and amygdala to disorder-relevant pictures than healthy controls, suggesting greater levels of both

disgust and fear to these stimuli. Similar neurological studies have suggested that both disgust and fear may characterize spider phobics when compared with non-fearful control groups [55,73]. One interpretation of these facts is that experiencing disgust in relation to a specific elicitor (e.g. contamination agents) activates disease-avoidance goals and increases distress by priming avoidance goals that facilitate feelings of fear and anxiety [91,97]. The more these reciprocal relationships between disgust and avoidance goals become reinforced, the greater become the feelings of distress and anxiety when confronted by the disgust elicitor. Interestingly, numerous experimental studies have now shown that experienced disgust *per se* does not facilitate experienced anxiety when there is no specific disgust elicitor present [98]. However, when disgust is experienced in the presence of potential disgust elicitors, anxiety and fear to those elicitors is increased [90,91,99]. This suggests that induced disgust is not simply being mistaken for anxiety by the individual, and nor can induced disgust trigger higher levels of anxiety without the presence of a suitable object to which disgust can be attributed. Such findings are consistent with the view that disgust facilitates anxiety and fear only by priming avoidance goals to specific stimuli, and that clinically relevant anxiety symptoms may emerge out of this process. This is an approach that is consistent with much of the existing data and worthy of further research.

7. DISGUST INVOLVEMENT IN OTHER PSYCHOPATHOLOGIES

While there is considerable accumulating evidence for a strong relationship between disgust and small animal phobias, BII and OCD contamination fears, there is also evidence for a relationship between disgust and some other psychopathologies—many of which have a less obvious connection to the disgust emotion.

Much of this additional evidence is correlational in nature and links measures of disgust with measures of separation anxiety [100], agoraphobia [35], eating disorders [7,8], symptoms of schizophrenia [9], hypochondriasis and health anxiety [10,82], height phobia and claustrophobia [10] and sexual dysfunction in women [11,101]. It is worth discussing some of these psychopathologies individually to examine how consistent and persuasive the research on their links with disgust actually is.

First, there appears to be a *prima facie* case for expecting disgust to be a significant factor underlying *eating disorders* generally and pathological eating patterns specifically. One factor that has been clearly identified in many accounts of eating disorders is the feeling of disgust that those with eating disorders exhibit towards food, the intake of food and the perception of their own bodies. For example, imbuing food with disgusting properties enables the anorectic or bulimic to turn food into a forbidden substance that should not be incorporated into the body [102]. Similarly, individuals who exhibit bingeing and purging behaviour regularly report increases in shame, guilt and disgust when recalling episodes of bingeing, and the development of a sense of disgust with body shape and body

functions is extensively documented in eating disorders [103–105]. Intuitively, the disgust emotion and its disease-avoidance functionality would seem to be an ideal vehicle for developing the physical avoidance of food and foodstuffs, and for imbuing body shape with negative affectivity. In the case of pathological eating patterns, feelings of disgust may have become linked to foodstuffs generally (e.g. in anorexia nervosa) or to specific eating behaviours (e.g. bingeing) and may mediate pathological responses typical of eating disorders (such as self-starvation or purging).

Despite there being an intuitive link between disgust and eating disorders, research on this topic has so far produced rather mixed results. In two early studies, Davey *et al.* [8] found (i) a significant correlation between measures of eating disorder and measures of disgust sensitivity in a non-clinical student population, but only in female participants and (ii) participants in a second study who had clinically diagnosed eating disorders exhibited significantly higher levels of disgust than matched non-clinical control participants. However, both studies indicated that elevated disgust in relation to eating disorders appeared to be confined primarily to disgust of food, the body and body products, and did not extend to disgusting stimuli that are not associated with food or the body (i.e. those scoring high on eating disorder symptomatology did not have a higher disgust sensitivity generally). Troop *et al.* [106] and Harvey *et al.* [7] reported relatively similar findings. Patients with a DSM-IV diagnosed eating disorder were more disgusted by body products, food and death than non-clinical controls [106], by high calorie foods and overweight body shapes [7], and food, body products and sexual practices [107]. In addition, Harvey *et al.* [7] also found higher scores on measures of general disgust sensitivity in patients diagnosed with eating disorders than non-clinical controls. In contrast, some other studies have failed to find any relationships between disgust and disordered eating either in questionnaire-based studies [35] or in studies investigating the activation of disgust-relevant brain areas using functional magnetic resonance imaging [108]. Other studies have thrown further doubt on the critical importance of disgust in eating disorders by showing that the relationship between measures of disgust and measures of eating disorders is entirely mediated by levels of trait anxiety and anxiety sensitivity [44]. In conclusion, the evidence seems to suggest that any involvement of the disgust emotion in eating disorders is modest, and may be indirectly mediated by other factors such as anxiety and anxiety sensitivity.

It is only recently that disgust has been investigated in the female sexual dysfunctions of *vaginismus* and *dyspareunia*. Vaginismus is the persistent and involuntary contraction of the muscles of the vagina when vaginal penetration occurs, and dyspareunia is female genital pain experienced during or after coitus. Studies by de Jong *et al.* [11] have found that women suffering vaginismus displayed a general enhanced dispositional disgust propensity, and women diagnosed with both vaginismus and dyspareunia exhibited enhanced automatic sex-disgust associations in an implicit association task [101]. On the basis of this growing body of research, de Jong *et al.* [109] have argued that enhanced

disgust sensitivity in relation to sexual activity may be an important part of the mechanism in disruption of sexual arousal, and this conclusion makes intuitive sense given that sexual activities emerge as a primary disgust elicitor in factor analysis and cluster analysis studies of disgust [18,110]. Thus, if sexual activities are a natural disgust elicitor for many people, then heightened disgust propensity and sensitivity will enhance anxiety by priming avoidance goals to sexually related stimuli and activities.

Hypochondriasis or *health anxieties* are another area of psychopathology that would seem to have a natural link with disgust and its disease-avoidance functionality. Hypochondriasis is defined in DSM-IV-TR [65] as ‘the preoccupation with fears of having, or the idea that one has, a serious disease based on the person’s misinterpretation of bodily symptoms’. The preoccupation with health in hypochondriasis may be concerned with bodily functions (e.g. heartbeat or sweating), with minor physical abnormalities (e.g. coughing), or with vaguely defined and ambiguous physical sensations (e.g. ‘aching veins’). Hypochondriasis is also associated with an increase in worry about disease, together with fears of specific diseases, an inability to distract from feeling somatic symptoms and an increased awareness of somatic symptoms after receiving disease-relevant information [111], and so there appear to be some rather obvious *prima facie* theoretical grounds for assuming that the disgust emotion might be involved in hypochondriasis and health anxiety. For example, inflated levels of disgust sensitivity are likely to alert the individual to possible sources of contamination, disease and infection, and to facilitate the processing of information about contamination, disease and illness. Correlational studies have clearly shown a strong association between measures of disgust propensity and sensitivity and measures of health anxiety and hypochondriasis [10,82,112], and regression analyses indicate that the relationship between disgust and hypochondriasis is still highly significant even when measures of negative affect, trait anxiety and fear of contamination are controlled for. Furthermore, in a comparison of clinical patients with a diagnosis of hypochondriasis and non-clinical controls, Ille *et al.* [113] found that disgust sensitivity and specific domains of disgust propensity (e.g. aversion to poor hygiene) significantly differentiated between the two groups. Once again, given that blood, mutilation, vehicles of disease and illness (mucus, faeces, etc.) and hygiene (body odours, bad breath) regularly emerge as categories of primary disgust elicitors, we would expect enhanced disgust sensitivity and propensity to prime avoidance goals to health-related stimuli and as a result generation of anxiety to these stimuli.

Many of the remaining psychopathologies that have exhibited an association with disgust are more perplexing because they do not have a *prima facie* association with the functional significance of the disgust emotion. That is, these psychopathologies themselves have not obviously emerged out of the need or desire to avoid disease, illness or disgust-relevant stimuli that are inherent in the emerging symptoms of the psychopathology (e.g. height phobia, claustrophobia, separation

anxiety and agoraphobia, and symptoms of schizophrenia cannot easily be viewed as disease-avoidance psychopathologies). What is even more perplexing is that some of these significant relationships cannot simply be explained in terms of the disgust–psychopathology relationship being mediated by more obvious emotions such as anxiety because the significant relationship remains even when measures of anxiety have been partialled out (e.g. height phobia, claustrophobia [10]). Thus, if disgust represents a genuine vulnerability factor for these psychopathologies, then we need to identify a different mechanism for mediating the disgust–psychopathology relationship, and this needs to be one that does not allude to the enhancement of anxiety-generating avoidance of disgust-relevant stimuli.

8. MECHANISMS MEDIATING THE INDIRECT EFFECTS OF DISGUST ON PSYCHOPATHOLOGY

Studies of height phobia, claustrophobia, separation anxiety, agoraphobia and symptoms of schizophrenia suggest that the disgust emotion is significantly related to measures of these psychopathologies, and this relationship is not simply mediated by other relevant emotions (e.g. anxiety). If disgust is generating a genuine vulnerability to these disorders, then we need to be able to identify the mechanisms by which disgust might have these effects. Two possibilities are (i) the role of disgust in more complex human emotions such as shame and guilt and (ii) the effect of disgust as a negative emotion on the processing of information and the generation of information processing biases.

(a) *Disgust and complex human emotions*

Disgust is not solely represented by fear of contamination and oral incorporation of bodily products and stimuli of animal origin: it has also been argued that it is an emotion that is associated with more abstract triggers such as inferiority and debasement [84], physical or psychological deterioration [24], offensiveness [114] and negative perceptions of a socio-moral nature that can be projected onto external stimuli or events [18,114] or that can be turned inwards as a form of ‘self-disgust’ [115,116]. In particular, the emotion of shame is often associated with self-disgust—especially when the individual views themselves as possessing negative characteristics or being responsible for negative events [116,117]. This latter factor may be an important one, because empirical studies have frequently found shame and disgust—especially self-disgust—to be closely related [118], especially in the context of anxious psychopathologies such as eating disorders [106] and pain catastrophizing [119]. Thus, possessing many forms of anxious psychopathology may be a sufficient condition for experiencing elevated disgust in the form of self-disgust or shame, and this experienced consequence of the psychopathology may be what the disgust measure is tapping when theoretically unexpected relationships between disgust and psychopathology measures are found. This is undoubtedly a complex and under-researched approach to considering how the disgust emotion may be involved

in psychopathology, but it is nevertheless worthy of further investigation, given what we already know about how disgust has evolved from a basic disease-avoidance emotion to one that has come to regulate behaviour in social and interpersonal contexts, and will affect our social attitudes by conveying culturally and morally unacceptable views [22]. Nevertheless, while this approach might prove valuable in helping to explain the relationship between disgust and some apparently disgust-irrelevant psychopathologies (e.g. separation anxiety, agoraphobia), it is less obviously helpful in other cases (e.g. height phobia and claustrophobia).

(b) *Disgust and information processing*

A second and perhaps more promising line of research is the effect that the disgust emotion has on information processing and in particular on information processing biases. Davey *et al.* [6] used the homophone-spelling task [120] to investigate the effect of induced disgust on the interpretation of ambiguous words. Participants either experienced an anxiety, disgust, happy or neutral mood induction before completing the spelling task. In the homophone-spelling task, participants write down each word as it is recited to them from a tape. Participants who experienced anxiety or disgust inductions interpreted significantly more neutral/threatening homophones (e.g. grown/groan) as threatening than those who had experienced happy or neutral inductions—even though the threat interpretations of the threat/neutral homophones were rated as significantly more anxiety-evoking than disgust-evoking. Furthermore, participants who experienced a disgust induction interpreted significantly less neutral/positive homophones (e.g. one/won) as positive than those who had experienced a happy induction. This disgust-generated threat-interpretation bias appears to be a direct effect of experienced disgust and is not moderated by measures of trait anxiety or anxiety sensitivity [121]. This led Davey *et al.* [6] to suggest that experienced disgust generates a threat-interpretation bias whereby ambiguous material is interpreted in a threatening manner, and the consequence of this is that the threat-interpretation bias will maintain anxious and worrisome thought and even cause anxiety through the induction of negative interpretation biases. The fact that experimentally inducing interpretation biases in individuals leads to congruent effects on anxiety state [122,123] suggests that the effect that disgust has on interpretation biases would have a direct causal effect on experienced anxiety through these interpretation biases, and this is likely to have an impact on any anxiety-related psychopathology regardless of whether it shares a disease-avoidance functionality with the disgust emotion or not. The fact that disgust generates a threat-interpretation bias is also consistent with a growing body of evidence demonstrating that disgust generates attentional biases towards threat stimuli, and this has been found in both emotional Stroop tasks and eye-tracking tasks [62,63,124].

While this is a promising approach to understanding how disgust may have an impact on ‘disgust-irrelevant’ psychopathologies, there needs to be significantly more

research linking disgust and its threat-interpretation bias more directly to the elevated anxiety levels found in individual disgust-irrelevant psychopathologies (e.g. height phobia, claustrophobia). Evidence currently suggests that disgust is not special in generating threat-interpretation biases, but might do so simply because it is one of a number of negative emotions. For example, threat-interpretation biases have been demonstrated with a number of other specific negative emotions such as anxiety [125,126] and anger [127], suggesting that the important variable may be the affective valence of the experienced emotion rather than its specific functionality.

9. CONCLUSIONS

This review has attempted to unravel the rather complex research literature that has developed around the relationship between the disease-avoidance emotion of disgust and psychopathology. There is now accumulating evidence from psychological, psychophysiological, neurobiological and cognitive studies to suggest that disgust is a predominant emotion experienced in small animal phobias (particularly spider phobia), BII and OCD contamination fears [1,2]. These disorders have primary disgust elicitors as a significant component of their psychopathology, and so their symptoms share a functionality in common with disgust of protecting the individual from contact with and infection by potentially contaminating stimuli. Disgust propensity and sensitivity are also significantly associated with measures of a number of other psychopathologies, including eating disorders, sexual dysfunctions, hypochondriasis, height phobia, claustrophobia, separation anxiety, agoraphobia and symptoms of schizophrenia—even though many of these psychopathologies do not share the disease-avoidance functionality that characterizes disgust.

It is still relatively unclear whether disgust plays a direct role in generating clinically significant symptoms in these psychopathologies, although there is accumulating evidence that it does represent an important vulnerability factor through the disease-avoidance functionality that the disgust emotion shares with many of these psychopathologies. What is clear is that when disgust-relevant psychopathologies do meet the criteria required for clinical diagnosis, they are characterized by significant levels of both disgust and fear/anxiety, and disgust may be involved in this elevation to clinical status by activating disease-avoidance goals that increase distress by priming avoidance goals and facilitating feelings of fear and anxiety [91,97]. Finally, it has been argued that disgust may also facilitate anxiety and distress across a broad range of psychopathologies through its involvement in more complex human emotions such as shame and guilt, and as one of a number of negative emotions implicated in the generation of threat-interpretation biases.

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