Mechanisms of Disgust in Psychopathology

By

Graham C L Davey

University of Sussex, Brighton, UK

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Correspondence to:

Graham Davey, Ph.D.,

Emeritus Professor of Psychology,

School of Psychology

The University of Sussex

Brighton,

BN1 9QH

UK.

Email: grahamda@sussex.ac.uk

Tel: +44 1273 678485

Over the previous two to three decades there has been accumulating evidence that the disease-avoidance emotion of disgust is closely associated with and regularly experienced in a number of different psychopathologies and mental health problems (Davey, 2011; Olatunji, Cisler, McKay & Phillips, 2010; Knowles, Jessup & Olatunji, 2018). Some of the symptoms of these mental health problems have obvious links to disgust and the kinds of events and stimuli that will elicit disgust (e.g. contamination fears in obsessive compulsive disorder, OCD) (Knowles, Jessup & Olatunji, 2018; Melli, Poli & Olatunji, 2019; Poli, Melli & Radomsky, 2019), others appear to have an indirect link with disgust through harbingers of disease (such as small animal phobias) (Ware, Jain, Burgess & Davey, 1994; Davey, 1994; Mulkens, de Jong & Merckelbach, 1996), while still other psychopathology conditions have characteristics similar to the avoidance responses typical of disgust such as fear of oral incorporation (e.g. ‘picky eating’ and eating disorders) (Harvey, Troop, Treasure & Murphy, 2002; Davey, Buckland, Tantow & Dallos, 1998; Harris, Romer, Hanna, Keeling, LaBar et al., 2019). But perhaps most perplexing is the fact that there is a growing list of psychopathologies whose severity is directly associated with levels of disgust even though those psychopathologies appear to have little or no theoretical or functional link with the disgust emotion. These disorders include separation anxiety (Muris, Merckelbach, Schmidt & Tierny, 1999), agoraphobia (Muris, Merckelbach, Nederkoorn, Rassin, Candel & Horselenberg, 2000), symptoms of schizophrenia (Schienle, Scafer, Stark, Walter, Franz et al., 2003), and height anxiety and claustrophobia (Davey & Bond, 2006). This list of disgust-related psychopathologies raises a number of theoretical questions about how the disgust emotion has become associated with these conditions, and what role, if any, disgust plays in the development and maintenance of these psychopathologies. Such questions are not just of theoretical interest, they may also provide vital information about the kinds of effective interventions we might develop to alleviate these psychopathologies.

 However, while there have been significant advances in identifying the psychopathologies associated with disgust, and advances to some extent in understanding some of the developmental and cognitive characteristics associated with the disgust emotion (Knowles, Cox, Armstrong & Olatunji, 2019; Rottman, DeJesus & Greenebaum 2019), there has been less progress in clearly identifying the mechanisms by which the disgust emotion influences psychopathology symptoms – if, indeed, it does at all, and is not simply an epiphenomenon of the psychopathology symptoms it is associated with. In this chapter I will describe a number of putative mechanisms through which the emotion of disgust might influence the symptoms of mental health problems and examine how these putative mechanisms might fit the existing evidence on disgust-relevant psychopathologies. But first it is necessary to describe the characteristics and functionality of the disgust emotion, and discuss how these features relate to more commonly experienced psychopathology emotions such as anxiety and fear.

**1. Disgust, Anxiety & Fear**

Disgust is regularly described as a specially evolved natural defensive emotion whose purpose is to protect against harm (Rozin & Fallon, 1987; Davey, 1994), with the proposed primary biological function of disgust being to protect the organism specifically against pathogens, illness, disease and contamination (Tybur, Lieberman, Kurzban & DeScioli, 2013; Stevenson, Case, Oaten, Stafford & Saluja, 2019; Curtis & de Barra, 2018). The main response features of the disgust emotion are consistent with this in that (1) disgust is associated with a distinctive, universal facial expression involving a wrinkling of the nose and down-turning of the corners of the mouth that would facilitate the ejection of bitter substances or poisons from the mouth (Davey, 1994; Ekman, Levenson & Friesen, 1983), (2) feelings of revulsion and nausea (Rozin & Fallon, 1987), (3) fear of contagion (Rozin & Fallon, 1987), (4) physical avoidance of ‘disgusting’ objects (Woody & Teachman, 2000; Rottman, DeJesus & Greenebaum, 2019), and (5) heart rate deceleration which conserves energy and relaxes sphincter muscles in the gastrointestinal tract (Page, 1994; Stark, Walter, Schnienle & Vaitl, 2005). These are all reactions that can potentially serve to prevent contact with pathogens or sources of illness, disease and contamination and – in more specific cases – to prevent the oral incorporation of items that might potentially be causes of illness and disease.

 In addition, 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 (Haidt, McCauley & Rozin, 1994; Rozin, Haidt & McCauley, 2016). 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, maggots) (Marzillier & Davey, 2004). 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. In effect, disgust can be used to convey the strong unacceptability of ideas and behaviours, and can also be elicited by violations of moral or social norms and by feelings of being “wronged” or betrayed (e.g. Giner-Sorolla, Kupfer & Sabo, 2018; Plakias, 2018).

However, rather than being a biologically pre-wired adaptation, disgust is an acquired emotion that is shaped during the first 5-6 years of life (DeJesus, Shutts & Kinzler, 2015). It begins with a born dislike of bitter flavours which is observed in human neonates and this distaste is assumed to function to prevent the ingestion of bitter or toxic substances – many of which are characterised by bitter tastes (Mennella, Pepino & Reed, 2005; Reed & Knaapila, 2010). The infant then appears to embark on a developmental process in which they learn which foods are edible through both associative learning (Brown & Harris, 2012) and the learning of culturally acceptable practices (Feder, 2015; Stevenson et al., 2010). By around the age of 5 or 6 years, children have then acquired a concept of disgust that embraces notions of contamination, a learnt catalogue of objects that evoke disgust (including primary disgust objects such as faeces and mucus), and knowledge of the relationship of disgust with the avoidance of contaminants, pathogens, and illness (Blacker & LoBue, 2016; Rottman, DeJesus & Greenbaum, 2019).

 If we now compare the evolutionary role of disgust with that of fear and anxiety, there appear to be some clear and distinct evolutionary purposes for these different emotions. Fear is largely a biologically pre-wired reaction to imminent threats, with a network of reflexive responses reacting to stimuli such as loud noises, looming shadows, sudden sharp pain, rapid movements towards you, and staring eyes (all generalized characteristics of potential predators!) (Russell, 1979). In contrast, anxiety is a more flexible emotion for managing potential future threats and challenges that may not be so imminent. It is an emotion that develops after birth by recruiting some responses from the fear network (such as startle reactions and physiological arousal processes) but adds on some higher-level cognitive processes that influence attentional focus and defensive interpretations of both on-going events and future events (Davey, 2018, Chapter 1; Ouimet, Gawronski & Dozois, 2009). The fact that anxiety is a hybrid emotion built out of a combination of fear reflexes and higher-level cognitive processes suggests that anxiety, like disgust, is almost certainly a learnt emotion rather than an innate one, and can be characterized as a cognitive schema (Izard, 2007). A cognitive schema is a high-level conceptual structure or network in the brain that enables rapid, effective and efficient responding to important events such as everyday threats and challenges (Davey, 2018; Britton & Davey, 2014; Neuberg, Kenrick & Schaller, 2011). In this sense, both anxiety and disgust are learnt emotions whose eventual form will be determined by the early experiences and development of the individual. In contrast, fear is biologically pre-wired and relatively consistent in its reflexive features across individuals.

**2. Comparing Disgust, Anxiety & Fear**

 Measures of disgust sensitivity and propensity have been shown to be highly correlated with measures of anxiety (Davey & Bond, 2006; Ware, Jain, Burgess & Davey, 1994), and with measures of specific anxiety-based problems such as small animal fears (Matchett & Davey, 1991; Davey, 1994), spider phobia (Mulkens, de Jong & Merckelbach, 1996; Thorpe & Salkovskis, 1998), blood-injury injection phobia (BII) (de Jong & Merckelbach, 1998; Olatunji, Smits, Connolly, Willems & Lohr, 2007), contamination fear in OCD (Mancini, Grannani & D’Olimpio, 2001; Olatunji, Lohr, Sawchuk & Tolin, 2007), and eating disorders (Davey, Buckland, Tantow & Dallos, 1998). These correlations are instructive, but do not tell us too much about the role of disgust in these conditions, because in many cases these correlations may be inflated by a confounding of disgust-relevant items in the measures of both disgust and the psychopathology (Davey, 2011). However, comparisons of individuals diagnosed with disgust-relevant psychopathologies do show that they experience higher levels of disgust than individuals without a diagnosis (Cisler, Olatunji & Lohr, 2009; Olatunji, Cisler, McKay & Phillips, 2010), which does suggest at the very least that disgust is experienced more intensely in individuals suffering these psychopathologies than in healthy individuals. Psychopathologies where this is the case include OCD contamination fears, small animal phobias, and BII phobia (Olatunji, Cisler, McKay & Phillips, 2010). It is perhaps not so surprising that in these psychopathologies disgust is experienced more because the objects of fear and anxiety in these psychopathologies are also objects that would naturally elicit disgust (such as dirty toilets, pathogens, blood and injury, disease-relevant animals such as rats, slimey animals such as slugs and snails, and animals associated with contamination such as maggots).

 But there is also considerable overlap between the emotions of disgust and the emotions of anxiety and fear, so it is quite possible that experiencing one may facilitate the other. Both disgust and fear/anxiety have a dominant behavioural tendency of avoidance (Izard, 1993), although fear- and anxiety-motivated avoidance protects the person from almost any perceived threat (Woody & Teachman, 2000), whereas disgust-motivated avoidance has the more specific function of avoiding pathogens and contaminants (Olatunji, Cisler, McKay & Phillips, 2010; Rozin & Fallon, 1987).

**3. Disgust as a Causal Agent in Psychopathologies**

There is experimental evidence that disgust may play a causal role in facilitating symptoms in a number of anxiety-related conditions. For example, Webb & Davey (1993) 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 (2009) 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. A further study by Davey, MacDonald & Brierley (2008) investigated the effect of an experimental disgust induction on subsequent anxiety to scenarios of fear-relevant, disgust-relevant and fear-irrelevant stimuli in a non-clinical population. The results indicated that disgust facilitated levels of self-reported anxiety to a range of scenarios regardless of whether they were disgust-relevant, fear-relevant or fear-irrelevant, and suggested that disgust can have a general facilitating effect on self-reported anxiety to a range of stimuli regardless of their disgust-relevant status.

While there is good evidence that disgust can facilitate anxiety in a number of experimental procedures, there are still some significant failures to demonstrate this effect – failures suggesting that disgust may only enhance anxiety in certain contexts and procedures. One significant failure to find an effect of induced disgust on anxiety was reported by Marzillier & Davey (2005). In a series of three studies and using a range of mood induction procedures, Marzillier & Davey demonstrated that induced anxiety produced increases in self-reported disgust, but there was no evidence that induced disgust facilitated self-reported anxiety. These results were independent of the type of mood induction procedure used and the type of dependent measure used, and suggests that if disgust does have a causal influence on anxious psychopathology then this influence is not mediated simply by experienced disgust facilitating experienced anxiety.

 At this point we can begin to speculate about how disgust facilitates anxiety in those procedures where it does, and why it fails in some other situations and procedures. First, because both disgust and anxiety facilitate avoidance responses, disgust may increase self-reported anxiety by priming avoidance goals that facilitate feelings of fear and anxiety (Olatunji & Armstrong, 2009; Olatunji, Sawchuk, Lohr & de Jong, 2004) – but only if there is something that this avoidance tendency can be directed at (such as a target stimulus or event within the procedure). However, if disgust facilitates only disgust-relevant avoidance responses, then we would expect disgust to selectively enhance anxiety to disgust-relevant stimuli and events rather than to disgust-irrelevant stimuli and events.

Secondly, because disgust is a negatively-valenced emotion, some of the negativity experienced through disgust may become associated with any proximal stimuli or events and facilitate levels of fear and anxiety, perhaps through a process of evaluative conditioning (De Houwer, Thomas & Baeyens, 2001). But again, this is only likely to be detected in disgust induction procedures if there is a stimulus or event to be evaluated. It’s unlikely to facilitate anxiety or fear if there is nothing to which the disgust-induced negativity can be attached. And this is not withstanding the view that, at best, evaluative conditioning is a relatively elusive phenomenon (Field & Davey, 1997, 1998).

A third possibility is that disgust as a negative emotion may facilitate information processing biases that affect attentional focus, decision-making, and interpretations of proximal events and stimuli, and there is indeed good evidence that disgust does induce these negative information processing biases (and I’ll talk more about these later in the chapter) (Davey, Bickerstaffe & MacDonald, 2006: Leathers-Smith & Davey, 2010; Knowles, Cox, Armstrong & Olatunji, 2019). Once again, we would expect disgust to enhance anxiety and fear via its biasing effect on information processing only if there are events and stimuli on which these information-processing biases can operate. But because these information-processing biases can potentially influence any event or stimulus, we would expect disgust in this respect to be able to facilitate fear and anxiety to any event or stimulus regardless of its disgust-relevant status. Such a view would be consistent with the findings of Davey, MacDonald & Brierley (2008) described earlier, and also explains why induced disgust does *not* enhance anxiety when there are no stimuli or events in the procedure that can be influenced by biased information processing (e.g. Marzillier & Davey, 2005).

 However, these putative explanations of how disgust might influence fear and anxiety allude primarily to cognitive processes involved in information processing and stimulus evaluation, but disgust also has a social and cultural role through which it might influence levels of fear and anxiety. For example, disgust can be used to imbue any thoughts and behaviours with negative affect (Rozin & Fallon, 1987), can be evoked by feelings of moral violation or feelings of being “wronged” (Giner-Sorolla, Kupfer & Sabo, 2018; Plakias, 2018), or by facilitating feelings of self-disgust (Powell, Simpson & Overton, 2015). Are these evolved “social” contributions of disgust also implicated in facilitating psychopathology in any way? There is, for instance, good reason to suppose that disgust directed at the self may influence feelings of shame, guilt, low self-esteem, and self-harm – all feelings and actions relevant to a number of common psychopathologies (Smith, Steele, Weitzman, Trueba & Meuret, 2015; Ille, Schöggl, Kapfhammer, Arendasy, Sommer & Schnienle, 2014).

**4. Putative Mechanisms of Disgust in Psychopathology**

 There are now a significant number of studies published linking disgust to psychopathology, and this evidence provides a background for discussing the possible mechanisms by which disgust influences mental health problems. In this section I will discuss four possible processes by which disgust may have a direct or indirect causal effect on psychopathology symptoms. These are (1) response driven effects of disgust, (2) disgust directed towards the self, (3) disgust-related effects of violations of moral or social norms, and (4) stimulus-driven and strategic information-processing biases.

**4.1 Response Driven Effects of Disgust**

 There is a clear pathway for disgust to influence psychopathology when the focus of those psychopathologies is disgust-relevant stimuli or events. We have already mentioned relevant candidates such as contamination fear in OCD, fear of small disease-relevant animals (including spider phobia), blood-injury inoculation (BII) fears, and to some extent a range of eating disorders (such as anorexia nervosa and ‘picky eating’). When associated with high levels of disgust these psychopathologies may to some extent develop directly out of the disgust emotion’s ability to enable the sufferer to quickly classify the focus of the psychopathology as dangerous and facilitate the deployment of strong avoidance, withdrawal and rejection responses, as well as inhibiting habituation (Olatunji, Wolitzky-Taylor, Willems, Lohr & Armstrong, 2009; Mason & Richardson, 2010). Once these avoidance responses are established, this may then lead to anxiety and fear becoming predominant responses as the disgust-relevant stimuli and events are anticipated and coping strategies developed to avoid contact and contamination.

 But the responses that have evolved to characterize disgust may have some broader implications for psychopathology development than just facilitating anxious reactions to disgust-relevant stimuli. Most emotions that have evolved to protect against harm will have benefits (in terms of protection against harm), but will probably do so at the cost of foregoing other opportunities and benefits. For example, the pathogen-avoidance function of disgust must be traded off against other important functional goals such as acquiring food or engaging in mating activities (e.g. Fleischman, Hamilton, Fessler & Meston, 2015). In this sense, disgust acts to *regulate* exposure to potentially harmful pathogens rather than avoid them unconditionally, and so may contribute to decision-making under risk (e.g. weighing up the costs and benefits of interacting with something that may be potentially harmful) (Sparks, Fessler, Chan, Ashokkumar & Holbrook, 2018; Tyber, Lieberman, Kurzban & DeScioli, 2013). Sparks et al. (2018) argue that considering the role of disgust at this ultimate functional level rather than at a proximal mechanism level can help to explain some of the characteristics of disgust such as the higher levels of disgust propensity and sensitivity found in females as opposed to males (Al-Shawaf, Lewis & Buss, 2017). This higher-level functionality of disgust may influence risk-taking and protective decision-making, with higher levels of disgust being associated with greater risk avoidance that may trigger anxiety and fear when risk avoidance strategies are activated. In fact, all harm-avoidance emotions, including disgust, are likely to have their own effects on risky decision-making and contribute these inputs to risk taking and risk avoidance across diverse domains of behaviour (Sparks, Fessler, Chan, Ashokkumar & Holbrook, 2018). One implication of this is that individual differences in risk-taking across all harm-related domains may in part be driven by disgust levels and its input into avoidant decision-making, with higher disgust levels leading to greater avoidance – and avoidance is a key feature of very many psychopathologies, and one which contributes directly to the symptoms of psychopathology. For example, avoidance detrimentally affects emotional regulation, which means you become less emotionally reactive the more you avoid. This then has a number of negative knock-on consequences. You’ll be less privy to a range of useful information conveyed by an emotional response (an emotion will tell you whether you should be frightened of something, angered by it, or merely surprised by it), you’ll become less adaptive in your interactions with your environment (because your emotional reaction would normally signal which adaptive responses are most appropriate to deploy in those circumstances), you’ll be more likely to make less effective actions in the future (and thereby likely to experience more emotional distress), and the interpersonal value of the emotion is lost (your friends, family and colleagues will be less likely to understand your behaviour - or they may even entirely misinterpret it) (Salter-Pedneault, Tull & Roemer, 2004).

**4.2 Disgust Directed Towards the Self**

 Many researchers are beginning to identify self-disgust as a form of the disgust emotion that is directed inwards at core and stable features of the self (e.g. Powell, Simpson & Overton, 2015). Self-disgust may be generated by negative evaluation of the individual’s own features or actions by using disgust to imbue attributes of the self with negative affect – either as a form of self-punishment or self-evaluation. Alternatively, disgust elicited by an external stimulus or disgust directed at the individual by others may become associated with attributes of the self, and through processes of iterative self appraisal may become incorporated as a core attribute of the self which influences how the individual perceives the world and the self over the longer term.

 But if self-disgust is to be a useful construct that can influence mental health symptoms, then it needs to be clearly differentiated from other similar negative emotions such as shame, guilt, self-criticism and self-hatred. In effect, a definition of self-disgust should include disgust or contamination-based appraisals of the self, a strong physical sense of revulsion at the self along with other visceral aspects of disgust, and even attempts to cleanse the disgusting self (Gilbert, Clarke, Hempel, Miles & Irons, 2004; Simpson, Hillman, Crawford & Overton, 2010). After conducting a review of the similarities and differences between self-disgust and other self-oriented negative constructs, Clarke, Simpson & Varese (2018) define self-disgust as “a psychologically destructive emotion, sometimes latent but easily triggered, with visceral content and resulting in a desire/need to avoid the disgusting aspect of the self psychologically and behaviourally and to attempt to expunge the self” (Clarke, Simpson & Varese, 2018, p124).

 If we are to successfully investigate whether self-disgust contributes to psychopathologies, we need to have valid and reliable psychometric measures of self-disgust that can identify the core features of the emotion and differentiate it from other similar negative emotional constructs, and examples are The Self-Disgust Scale (Overton, Markland, Taggart, Bagshaw & Simpson, 2008) and The Questionnaire for the Assessment of Self-Disgust (Schienle, Ille, Sommer & Arendasy, 2014). However, there is still some doubt about whether these measures capture all of the relevant features of self-disgust across different populations (see Clarke, Simpson & Varese, 2018). But even in the absence of truly valid measures of self-disgust, we can still speculate about the mechanisms by which self-disgust might have a direct or indirect causal influence on mental health symptoms.

 Clarke, Simpson & Varese (2018) describe a number of possible pathways by which self-disgust might directly or indirectly influence mental health symptoms. For example, self-disgust may develop during childhood as a result of adverse childhood experiences (such as childhood neglect or physical or sexual abuse), and self-disgust then becomes a predictor or mediator of mental health problems in adulthood such as depression or borderline personality disorder (e.g. Powell, Simpson & Overton, 2015). However, in examples such as this, it is important to be able to identify self-disgust as a genuine contributor to the psychopathology rather than just an unrelated correlate of the psychopathology, or a consequence rather than cause of the psychopathology, or a correlate of other constructs (such as shame or guilt) that may be the genuine causes of the psychopathology. A combination of mediation analyses and prospective studies may be needed to identify causal effects of self-disgust, as will the development of ecologically-valid lab-based procedures in which self-disgust can be directly manipulated and its causal effect on potential mental health symptoms measured.

 In a systematic review of the possible role of self-disgust in a range of psychopathologies, Clarke, Simpson & Varese (2018) found varying levels of evidence of a potential causal role for self-disgust in depression, trauma-related problems such as posttraumatic stress disorder (PTSD), body image and eating disorders, obsessive-compulsive disorder (OCD), and also found evidence for a bidirectional relationship between self-disgust and self-harm. However, in many of these cases it was difficult to effectively rule out the possibility that self-disgust was either a consequence of the psychopathology disorder or merely a correlate of another construct that may have been a genuine causal factor.

 If self-disgust does play a direct or indirect causal role in psychopathology symptoms, what is the nature of the mechanisms that may mediate these effects? These processes are likely to be complex – not least because there may be a bidirectional relationship between self-disgust and symptoms, but also because self-disgust may affect symptoms directly and also indirectly by affecting other internal states that in turn affect symptoms (e.g. self-disgust may directly affect self-harm, but also increase levels of depression which in turn affects self-harm) (Smith, Steele, Weitzman, Trueba & Meuret, 2015; Abdul-Hamid, Denman & Dudas, 2014). In other cases, the role of self-disgust may be to either create or mediate biases in the way that information is processed that can help to develop or maintain common mental health problems such as depression (Powell, Simpson & Overton, 2013), but more direct laboratory-based experimental studies may be needed to determine whether self-disgust itself has a direct effect on information processing biases, including attentional biases and interpretation biases.

**4.3 Disgust-Related Effects of Violations of Moral or Social Norms**

There is considerable research suggesting that the disease-avoidance emotion of disgust has also evolved to convey the strong unacceptability of ideas and behaviours, and can also be elicited by violations of moral or social norms and by feelings of being “wronged” or betrayed (e.g. Giner-Sorolla, Kupfer & Sabo, 2018; Plakias, 2018). This view has been particularly prominent in what has come to be known as the “body-to-soul preadaptation theory” of disgust in which it is hypothesized that there has been an expansion in the function of disgust from guarding the ‘body’ to guarding the ‘soul’ (Haidt, 2012; Rozin, Haidt & McCauley, 2009). As such, people will react to violations of the sacred (e.g. violations of moral norms) with the same disgust emotion that is involved in reactions to pathogens, contamination, and putrid objects such as faeces (e.g. Ritter & Preston, 2011; Plakias, 2018; Lieberman, Tooby & Cosmides, 2003). If violations of moral norms and the sacred do elicit disgust, then might this influence the acquisition and maintenance of psychopathology, and if so, by what processes would this happen?

It is worth making clear that once visceral disgust has been elicited (whether it be by violation of moral norms or any other means) it could facilitate psychopathology symptoms through any of the putative mechanisms discussed in this chapter. But might there be some psychopathologies that are particularly vulnerable to the elicitation of moral disgust? One extension of the view that disgust is elicited by violations of moral norms and the sacred is that disgust is also highly associated with religiosity. For example, Terrizzi, Shook & Ventis (2012) found that the disease-avoidance component of disgust was highly correlated with religious conservatism, and this in turn mediated religious prejudices. Religious societies are frequently concerned with the cleanliness of their followers’ minds and bodies (Graham & Haidt, 2010), and religious rituals throughout the world often involve purification practices (Sica, Novara & Sanavio, 2002). Thus, any violation of the moral order required by particular religious beliefs is likely to threaten purity and elicit disgust (Ritter & Preston, 2011), and a bidirectional relationship may exist between religiosity and the emotion of disgust (Olatunji, Tolin, Huppert & Lohr, 2005). What is significant about the relationship between disgust and religiosity is that disgust, morality and religiosity are regularly implicated in the development of many forms of obsessive-compulsive disorder (OCD) (Inozu, Ulukut, Ergun & Alcolado, 2014). In particular, disgust plays a causal role in the contamination fears that often underlie compulsive washing and purifying rituals in OCD (Olatunji, 2010), and religiosity has been estimated to account for almost a quarter of all obsessive concerns in clinical samples (Summerfeldt, Antony, Downie, Richter & Swinson, 1998). Indeed, many religions may espouse everyday customs and rituals that are risk factors for compulsive behaviour or obsessive thoughts (e.g. orthodox Judaism emphasizes cleanliness related to dietary restrictions, family purity, praying correctly etc., Huppert, Siev & Kushner, 2007). In addition, a more radical possibility is that adopting high moral or religious standards is itself caused by disgust, and this is supported by a range of studies demonstrating that a disgust induction leads to more severe moral judgments (Horberg, Oveis, Keltner & Cohen, 2009; Wheatley & Haidt, 2005), so although religiosity and high moral standards are a significant feature of OCD conditions, disgust may be one of the causal drivers for these standards rather than simply being an outcome of religious or moral standards (particularly when applied to cleanliness and purity).

However, while this evidence suggests that moral and sacred violation disgust may be a vulnerability factor for OCD in religious individuals, is moral disgust the same emotion as that elicited by pathogens, illness and disease? There is recent evidence to suggest it may not always be. First, there is emerging evidence that visceral disgust may only be elicited by bodily-related moral violations such as incest or religious food taboos, while negative emotions such as anger are more likely to be elicited by sociomoral violations such as theft (Giner-Sorolla, Kupfer & Sabo, 2018), and indeed, studies have demonstrated that the word disgust is often used to express anger or a negative reaction of intense disapproval rather than featuring the full range of visceral and pathogen-avoidance components of core disease-avoidance disgust (Herz & Hinds, 2013; Royzman & Kurzban, 2011). Furthermore, a recent study by Kollareth & Russell (2019) found that the emotional reaction to a sacred religious violation was not the same as that to simple threats to health. Pathogen exposure led to a predominantly “grossed out” reaction similar to that caused by core disgust, but this “grossed out” reaction was not differentially found with exposure to sacred religious violations. These findings are very similar to those of Royzman, Atanasov, Landy, Parks & Gepty (2014) who reported that participants’ reaction to pathogen-free sacred violations was predominantly anger and did not show core disgust-related features such as nausea, gagging, loss of appetite, or a desire to avoid.

So any mechanisms that mediate the association between disgust elicited by the violation of moral/social norms and psychopathology symptoms are likely to be complex and be contaminated by other negative emotions (such as anger) elicited by these violations. However, the relevance to the core disgust emotion of purity rituals common to many religions may be a significant risk factor for the development of OCD compulsions and obsessions in highly religious individuals – mainly as a result of the disgust emotion fuelling contamination fears if purity rituals are not fully and properly adhered to (see Davey, Dash & Meeten, 2014, Chapter 2).

**4.4 Stimulus-Driven and Strategic Information-Processing Biases**

 Disgust is a negatively experienced emotion and as such has been shown to have effects on information processing similar to many other negative emotions (e.g. Knowles, Cox, Armstrong & Olatunji, 2019). In particular, experiencing disgust creates biases in both attention processes and interpretation processes – effects that are likely to influence the detection and threatening interpretation of stimuli and events regardless of their disgust-relevance. This potentially provides the basis for a mechanism that could explain why disgust is associated with psychopathologies that, *prima facie*, appear to have little or no disgust-relevance, such as separation anxiety (Muris, Merckelbach, Schmidt & Tierny, 1999), agoraphobia (Muris, Merckelbach, Nederkoorn, Rassin, Candel & Horselenberg, 2000), symptoms of schizophrenia (Schienle, Scafer, Stark, Walter, Franz et al., 2003), and height anxiety and claustrophobia (Davey & Bond, 2006) (cf. Davey, 2011, although it should be made clear that there is as yet no clear experimental evidence that disgust plays a *causal* role in these disgust-irrelevant psychopathologies).

 Knowles, Cox, Armstrong & Olatunji (2019) have provided a comprehensive review of information processing biases in disgust, with the most robust information-processing bias seeming to be at the attentional level, with disgust-prone individuals exhibiting an initial enhanced orienting response and attentional bias towards disgusting cues compared to neutral cues (Vogt, Lozo, Koster & de Houwer, 2011; Cisler, Olatunji, Lohr & Williams, 2009), and with some studies showing a more general attentional and orienting bias to threat generally in disgust-prone individuals (Stevenson, Oaten, Case & Repacholi, 2014). However, while disgust may be associated with an initial stimulus-driven attentional bias towards disgust-relevant or threat-relevant stimuli, this appears to be subsequently followed by significant avoidance of these stimuli (Bradley, Costa & Lang, 2015; Armstrong, McClenahan, Kittle & Olatunji, 2014). Knowles et al. (2019) argue that this subsequent avoidance of disgust and threat-related material after initial orientation to the material may represent a strategic activity in disgust-prone individuals where the individual chooses to attend away from disgusting or threatening stimuli as a form of emotional regulation to reduce distress.

 What appears to be a downstream consequence of these attentional biases is that subsequent ambiguous information is then interpreted in a threatening rather than benign manner. This has been called the cognitive bias hypothesis (Hirsch, Clark & Mathews, 2006), in which pre-conscious attentional biases to threat determine congruent biases in interpretation. Studies that have examined this interpretation bias following disgust mood inductions suggest that experienced disgust results in a threat-interpretation bias (in which ambiguous stimuli and events are interpreted as threatening rather than benign) that is not dissimilar to the threat-interpretation bias caused by anxious mood, and is not moderated by measures of trait anxiety or anxiety sensitivity (Davey, Bickerstaffe & MacDonald, 2006; Leathers-Smith & Davey, 2011; Mayer, Muris, Busser & Bergamin, 2009). This combined attention-interpretation bias caused by disgust can act to impart stimuli and events with threatening meaning and cause congruent biases in recall and recognition (Everaert, Tierens, Uzieblo & Koster, 2013). It is now well known that experimentally inducing interpretation biases in individuals leads to congruent effects on anxiety state (Mathews & Mackintosh, 2000; Salemink, van den Hout & Kindt, 2007), and this suggests that the effect that disgust has on interpretation biases would have a direct causal effect on experienced anxiety through these interpretations biases, and this is likely to impact on any anxiety-related psychopathology regardless of whether it shares a disease-avoidance functionality with the disgust emotion or not – an assumption borne out by the fact that recent studies have indicated that information-processing biases can be identified as mediators between disgust and subsequent measures of psychopathology (Zanjani, Yaghubi, Shaeiri & Fata, 2018; Ólafsson, Friðriksdóttir, Sveinsdóttir & Kristjánsson, 2019).

 If such a mechanism is operating regularly and allows disgust to causally facilitate psychopathology symptoms, then we need further experimental studies that will clearly demonstrate that disgust’s role is causal in its effect on psychopathology measures, that information processing biases such as attentional and interpretation biases play a mediating role in this process, and that these factors can affect any psychopathology symptom regardless of its disgust relevance.

**5. Conclusions**

Disgust is no longer “the forgotten emotion of psychiatry” (Phillips, Senior, Fahy & David, 1998). Its broad involvement in psychopathology is now well known and well documented. It is experienced more intensely in those suffering a range of psychopathologies than in healthy individuals, and experimental lab-based studies have indicated that its effect on psychopathology symptoms can be causal. But the involvement of disgust in psychopathology is likely to be complex and often difficult to unravel, and we are still some distance away from developing predictive models of the role of disgust in psychopathology. More prospective studies are needed that identify disgust as a genuine risk factor for psychopathologies, and we cannot develop models of disgust in psychopathology until we have clearly established the causal effects of disgust through controlled experimental manipulation of its features and objective measurement of the outcomes of those manipulations on potential psychopathology symptoms.

This chapter has discussed a number of putative mechanisms by which the disgust emotion may exert its effect on psychopathology symptoms, and this range of putative mechanisms testifies to the complexity of the disgust emotion and the many different levels at which it may influence cognition and behaviour. Evidence that validates some or all of these mechanisms will play an important role in helping to develop either preventative or ameliorative interventions for disgust-relevant psychopathologies.

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