



Pavlovian disgust conditioning as a model for contamination-based OCD: Evidence from an analogue study



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ABSTRACT

Pavlovian fear conditioning provides a model for anxiety-related disorders, including obsessive-compulsive disorder (OCD). However, disgust is the predominant emotional response to contamination, which is a common theme in OCD. The present study sought to identify disgust conditioning abnormalities that may underlie excessive contamination concerns relevant to OCD. Individuals high and low in contamination concern (HCC, $n = 32$; LCC, $n = 30$) completed an associative learning task in which one neutral face (conditioned stimulus; CS+) was followed by a disgusting image (unconditioned stimulus; US) and another neutral face (CS−) was unreinforced. Following this acquisition procedure, there was an extinction procedure in which both CSs were presented unreinforced. The groups did not show significant differences in discriminant responding to the CSs following acquisition. However, following extinction, the HCC group reported less reduction in their expectancy of the US following the CS+, and also reported greater disgust to the CS+, compared to the LCC group. Increased disgust to the CS+ following both acquisition and extinction was correlated with increased symptoms of contamination-based OCD and increased disgust sensitivity. Additionally, disgust sensitivity mediated group differences in disgust responding to the CS+ at acquisition and extinction. Also, failure to adjust US expectancy in response to extinction partially mediated group differences in disgust to the CS+ following extinction. Together, these findings suggest that excessive contamination concerns observed in OCD may be related to difficulty inhibiting acquired disgust, possibly due to elevated disgust sensitivity that characterizes the disorder.

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Obsessive-compulsive disorder (OCD) is a psychiatric condition that affects 1–2% of the population and is characterized by intrusive, unwanted thoughts (obsessions) that motivate rigid, ritualistic behaviors (compulsions) (American Psychiatry Association [APA], 2013). Concern with contamination (i.e., the tendency to think about and notice the possible spread of germs) is a common obsession in OCD and underlies the washing and sanitizing compulsions that typify the disorder (Ruscio, Stein, Chiu, & Kessler, 2010). OCD has a chronic course and is considered one of the ten most disabling conditions by the World Health Organization (Markarian et al., 2010). Although exposure and response prevention is effective in treating OCD, many do not respond to the treatment or remain symptomatic despite improvements,

indicating a need for additional insight into the etiology and maintenance of OCD (McKay et al., 2015).

Until the recent creation of the OCD-spectrum (APA, 2013), OCD was categorized as an anxiety disorder. In line with other anxiety-related disorders, OCD has been conceptualized in terms of Pavlovian fear conditioning (e.g., Milad et al., 2013). Fear conditioning involves the acquisition of anxiety and other preparatory defensive responses to stimuli that signal the threat of immediate bodily harm (Bouton, 2007; Woody & Teachman, 2000). Although Pavlovian conditioning involves directly experiencing stimuli in temporal contiguity, contemporary learning theories of anxiety include additional fear learning pathways, such as vicarious learning (e.g., seeing that a stimulus predicts harm for another person) or verbal transmission (e.g., being told that a stimulus predicts harm; Mineka & Zinbarg, 2006). Anxiety-related disorders appear to be characterized by several fear learning abnormalities, including exaggerated acquisition, impaired extinction, and overgeneralization of conditioned fear responding (Mineka & Zinbarg,

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2006).

Although there is a large body of research on Pavlovian fear conditioning in anxiety-related disorder (Duits et al., 2015), only a handful of these studies have examined OCD. One study found that subclinical OCD was characterized by increased acquisition of eye blink conditioning (Tracy, Ghose, Stecher, McFall, & Steinmetz, 1999); however, subsequent studies failed to observe increased or overgeneralized acquisition of fear conditioning, as revealed by skin conductance, in subclinical (Kaczurkin & Lissek, 2013) as well as clinical OCD (Milad et al., 2013). Milad and colleagues (2013) observed increased skin conductance during extinction training in patients with OCD compared to controls; however, this pattern was unexpectedly found for both danger and safety signals, and OCD symptoms were unexpectedly correlated with increased extinction, making these findings difficult to interpret (Milad et al., 2013). Finally, a study by Nanbu and colleagues (2010) found no difference between patients with OCD and controls in the acquisition or extinction of conditioned fear, as revealed by skin conductance; however, this study did find impaired suppression of the P50 auditory evoked potential during fear extinction, but not acquisition, in the OCD group compared to the control group. In summary, OCD does not appear to be characterized by a consistent fear learning abnormality revealed by skin conductance, an indicator of autonomic arousal that is one of the most common measures of conditioned fear responding (Duits et al., 2015).

These preliminary findings could indicate that fear conditioning offers limited insight into OCD. However, associative learning processes delineated in conditioning models may still be relevant to the etiology and maintenance of OCD. As Mason and Richardson (2010) have suggested, learning theories of OCD may need to look beyond the emotion of fear. Fear and disgust are both basic emotions that organize responding to threat of bodily harm; however, fear targets urgent threats (e.g., being chased by a stray dog, falling off of a ladder) that are threatening because they *damage* the body (Woody & Teachman, 2000).¹ In contrast, disgust targets less urgent threats (e.g., spoiled food, bodily secretions, taboo behaviors) that are threatening because they *defile* the body (Woody & Teachman, 2000), usually because they are associated with pathogens (Tybur, Lieberman, Kurzban, & DeScioli, 2013).

Disgust and contamination are distinct yet inseparable constructs. Disgust is the emotional response to stimuli that have the capacity to defile, stimuli that are considered offensive, polluting, or debasing (Woody & Teachman, 2000). Contamination is the cognitive appraisal that the defiling essence of one stimulus has transferred to another stimulus through contact (Rozin, Millman, & Nemeroff, 1986). Accordingly, disgust is the emotional response to contamination. This intimate relationship between disgust and contamination implies that disgust, rather than fear, may be the primary dysregulated emotion in contamination-based OCD, and indeed, patients with contamination concerns tend to describe symptom-provoking stimuli as “disgusting” rather than “frightening” (Sieg & Scholz, 2001; Tolin, Worhunsky, & Maltby, 2004). In addition, how easily and intensely one experiences disgust, a trait known as disgust sensitivity (Olatunji et al., 2007), has been found to uniquely predict symptom severity in contamination-based OCD, and appears to have a stronger relation to symptoms of contamination-based OCD than state or trait anxiety (e.g., Mancini, Gragnani, & D’Olimpio, 2001).

Disgust, as a human emotion, has only recently been studied in a conditioning framework (e.g., Mason & Richardson, 2010; Armstrong, McLenahan, Kittle & Olatunji, 2014; Olatunji, Forsyth,

& Cherian, 2007). However, there is a wealth of conditioning research on *distaste*, the food-rejection reflex that is considered to be a precursor to disgust (Rozin & Fallon, 1987). Research on the associative learning of distaste (i.e., taste aversion learning; e.g., Garcia, Kimeldorf, & Koelling, 1955) has identified qualitative differences from other forms of Pavlovian conditioning, most notably, what has been referred to as a “hedonic shift” (Garcia, Hankins, & Rusiniak, 1974) in the CS. This phenomenon, also referred to as evaluative conditioning (De Houwer, Thomas, & Baeyens, 2001), involves the apparent transfer of negative valence from the unconditioned stimulus (US) to the conditioned stimulus (CS), such that the CS develops an aversive quality independent of its relation to the US. As a result, taste aversion learning is resistant to extinction, as unreinforced presentations of the CS undermine its status as a signal for the US, but do not modify its intrinsic valence (Bouton, 2007).

Although only a handful of studies have examined disgust conditioning in humans, they have consistently found that conditioned disgust responses are resistant to extinction, inline with conditioned taste aversions and other conditioned evaluative responses (Armstrong et al., 2014; Borg, Bosman, Engelhard, Olatunji, & de Jong, 2016; Bosman, Borg, & de Jong, 2016; Engelhard, Leer, Lange, & Olatunji, 2014; Mason & Richardson, 2010; Olatunji et al., 2007). Disgust learning may be highly relevant to contamination-based OCD, because the process of contamination appears to involve disgust learning. Specifically, contamination involves the acquisition of disgust responding to a novel stimulus after learning that it was associated with an offensive stimulus (Rachman, 2004). Further, the disgust learning that underlies contamination may partially explain why contaminated objects seem to inherit the offensive, disgust-eliciting properties of the original contaminant, rather than merely serving as a signal for the original contaminant (Rozin et al., 1986). As Rozin and colleagues (1986) demonstrated in their classic study, perceptions of contamination are remarkably difficult to reverse and are unaffected by re-evaluating the original contaminant (Rozin et al., 1986). Accordingly, the exaggerated perceptions of contamination in many patients with OCD may be rooted in aberrant disgust learning.

Although no studies have examined disgust conditioning in individuals with OCD or with elevated contamination concerns, a number of studies have observed links between disgust conditioning and disgust sensitivity, a trait that encompasses how easily and intensely one experiences disgust (Olatunji et al., 2007). Disgust sensitivity has been found to predict levels of conditioned disgust responding following acquisition (Mason & Richardson, 2010; Olatunji, Tomarken & Puncochar, 2013) and extinction (Armstrong et al., 2014; Mason & Richardson, 2010) of Pavlovian disgust conditioning in unselected samples. Disgust sensitivity is elevated in individuals with OCD and may serve as a risk factor for the disorder (Olatunji, Cisler, McKay, & Phillips, 2010). However, researchers have had difficulty specifying the precise mechanisms by which disgust sensitivity confers risk for the contamination variant of OCD. One possibility is that elevated disgust sensitivity in OCD leads to aberrant disgust learning, which in turn leads to increased perceptions of contamination.

The goal of the present study was to identify possible abnormalities in disgust conditioning that may underlie excessive contamination concerns characteristic of OCD. We tested two hypotheses regarding aberrant disgust learning related to excessive contamination concern. One hypothesis is that excessive contamination concern is characterized by facilitated acquisition of conditioned disgust responding, which could lead to more frequent perceptions of contamination, as more stimuli acquire disgust beyond a threshold that motivates contamination concerns. A

¹ Anxiety involves the same types of threat, but with less certainty or immediacy (Barlow, 1991).

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