# The Role of Danger Expectancies and Disgust in Obsessive-Compulsive Washing

## Ms Leonie MacDonald[1] & Dr Mairwen K. Jones[2]

### Abstract

Cognitive Appraisal Models of OCD washing contend that elevated danger expectancies serve as an important risk factor for the disorder. Evidence also indicates that OCD washers may have heightened disgust experiences in response to certain stimuli. This study examined the contribution of danger expectancies and disgust to OCD washing phenomena in a sample of undergraduate students (n=63). All participants completed a Behavioural Avoidance Test (BAT) consisting of a garbage bin containing a mixture of potting soil, raw meat, animal hair and food scraps. Thirty-three participants were randomly allocated to experience a disgust evoking smell during the BAT (disgust condition) and 30 were randomly allocated to a control condition (no disgust evoking smell). Participants exposed to the smell and those with higher levels of pre-existing trait disgust were more likely to avoid the task. Further, participants who had high danger expectancies for the likelihood and severity of a consequent disease showed increased avoidance behaviour. Finally, danger expectancies mediated the relationship between trait disgust and BAT avoidance and exposure to the disgusting smell increased hand sanitiser use post- BAT. The implications of these findings for future research and clinical practice are discussed.

**Keywords:** Obsessive-compulsive disorder; Contamination; Washing; Disgust; Danger expectancies; Behavioural avoidance tasks

### Introduction

Obsessive Compulsive Disorder (OCD) is a relatively frequent disorder, with adult 12-month prevalence estimates ranging from 0.6% to 1.9% (Crino, Slade & Andrews, 2005). Up to 50% of OCD patients report contamination obsessions (Rasmussen & Eisen, 1992) and 65% experience washing compulsions (Summerfeldt, Antony, Downie, Richter, & Swinson, 1997). These patients typically experience intense and persistent feelings of having been polluted or infected (Olatunji, Lohr, Sawchuk, & Tolin, 2007) as a result of coming into contact with an item, place or person perceived to be soiled, impure, dirty, infectious or harmful (Cisler, Brady, Olatunji, & Lohr, 2010). Cognitive theories of OCD propose that dysfunctional beliefs underlie the development and maintenance of obsessions and compulsions (Rachman, 1998; Salkovskis, 1985). Beliefs focusing on danger and negative outcomes and the overestimation of both the probability and cost of such events occurring (e.g. Carr, 1974; Foa & Kozak, 1986; Freeston, Rhéaume, & Ladouceur, 1996; Salkovskis, 1985) have long been recognised as important factors in OCD. The treatment Danger Ideation Reduction Therapy (DIRT) for OCD washing (St Clare, Menzies & Jones, 2008) that focuses exclusively on decreasing estimates of the likelihood and severity of dangerous outcomes has been found to be effective in reducing OCD symptomatology (eg. Jones & Menzies, 1997a; Jones & Menzies, 1998a; Krochmalik, Jones, Menzies, & Kirkby, 2004).

---

[1] School of Psychology, The University of Sydney, Brennan MacCallum Building (A18), University of Sydney NSW 2006, Australia. Ph (+61) 434825523 (Mob) Email: lmor4625@uni.sydney.edu.au

[2] Discipline of Behavioural and Social Sciences in Health, Faculty of Health Sciences, The University of Sydney, PO Box 170, Lidcombe, 1825. Ph. +61 2 9351 9571 Fax: +61 2 9351 9601, Email: mairwen.jones@sydney.edu.au

Other findings demonstrating the importance of threat in OCD washing were reported by Jones and Menzies (1997b) in their study of a sample of 27 OCD Washers who took part in a Behavioural Avoidance Test (BAT) during which they were asked to place their hands in a bin which contained potting soil, animal hair, raw meat and food scraps. A follow up study by Jones and Menzies (1998b), employing the same BAT with a sub-clinical sample of OCD washers indicated that when danger expectancies were raised, avoidance and hand washing behaviour significantly increased. Another line of research regarding OCD Washing concerns the examination of the role of the emotion disgust. Davey (1994) highlighted the importance of avoidant behaviour associated with disgust by conceptualising it as the desire to distance oneself from contaminated stimuli. As such, a degree of disgust is adaptive as it prevents contact with perceived contaminants and subsequent infection. However, individuals with OCD washing may experience elevated disgust as distressing and be less able to tolerate this experience, leading to maladaptive avoidance of sources of disgust and the performance of washing behaviours (Woody & Teachman, 2000). Disgust Propensity and Sensitivity Scale Positive correlations between scores on the Disgust Scale (Haidt et al., 1994) and OCD washing symptoms have been demonstrated in clinical (Thorpe, Patel, & Simonds, 2003; Woody & Tolin, 2002) and non-clinical (Mancini et al., 2001; Schienle, Stark, Walter, & Vaitl, 2003; Tolin, Woods, & Abramowitz, 2006) samples. Studies using the Disgust Propensity and Sensitivity Scale-Revised (DPSS-R; W. van Overveld et al., 2006), with non-clinical samples have demonstrated positive correlations between both disgust sensitivity (DS) and disgust propensity (DP) and OCD washing symptoms (Olatunji, 2009) and DS and contamination fear (David et al., 2009). Behavioural Avoidance Tasks (BATs) have also been employed to examine the relationship between disgust and OCD washing. In an undergraduate sample (n = 60) asked to smell or touch a series of stimuli including rotting food and stained undergarments, participants high in OCD washing symptoms had  higher scores on the Disgust Scale (Haidt et al., 1994), reported feeling more disgusted and demonstrated greater avoidance than low OCD participants (Olatunji, Lohr, et al., 2007). Nicholson and Barnes-Holmes (2012) measured DP and DS in an undergraduate sample ($N$ = 33) and employed a series of BATs that included a surgery video and a cookie resembling faeces. Results indicated that DS, but not DP, predicted avoidance behaviour.

Results from BATs have also provided evidence that disgust may be more influential than anxiety in OCD washing. Disgust was the primary emotion reported by sub-clinical compulsive washers ($N$ = 27) exposed to a BAT including a toilet bowl and container of dirt, insects and animal hair (Cougle, Wolitzky-Taylor, Lee, & Telch, 2007) and in an undergraduate sample ($N$= 33) exposed to a bed pan of "toilet water" (Adams, Willems, & Bridges, 2011). It has also been demonstrated that relative to anxiety, disgust may be more resistant to extinction, suggesting that OCD washing may not always respond to traditional exposure techniques (Adams et al., 2011; McKay, 2006; Olatunji, Wolitzky-Taylor, Willems, Lohr, & Armstrong, 2009). However, other researchers have failed to find support for the relationship between disgust and OCD symptoms (eg. Muris, Merckelbach, Schmidt, & Tierney, 1999; Woody & Tolin, 2002). Further, in a study by Olatunji and Armstrong (2009), an undergraduate sample ($N$ = 83) were asked to touch a series of five stimuli in a toilet cubicle with increasing risk of contagion. A disgust mood induction was implemented whereby half the participants were exposed to sound effects including flatulence, vomiting and toilet splashes as well as relevant guided imagery. The disgust mood induction failed to result in heightened distress, but the authors suggested that a more potent disgust manipulation, such as by adding smells, may have yielded different results since smells can have subtle but powerful effects on cognitive processes (Holland, Hendriks, & Aarts, 2005; Rotton, 1983; Schnall, Haidt, Clore, & Jordan, 2008). Recent research has linked traditional cognitive appraisal models concerning danger expectancies with newer disgust theory. The possible interplay between danger expectancies and disgust was initially identified by Woody and Teachman (2000), who  proposed that while fear and disgust both concern assessments of danger, disgust appraisals mainly focus on the more specific threat of contamination, rather than on a broad range of perceived threats. Since then, important, but sometimes inconsistent findings regarding how danger expectancies and disgust might work together to influence OCD washing have been demonstrated.

In a non-clinical sample ($N$ = 56), Deacon and Olatunji (2007) asked participants to provide danger expectancies for the likelihood and severity of contamination from everyday objects and  then engage with a series of BATs in steps of increasing intensity. Both trait disgust (as measured by the Disgust Scale) and danger expectancies predicted avoidance behaviour. However, trait disgust fully mediated the relationship between danger expectancies and BAT avoidance, controlling for gender, depression, anxiety and pre-existing OCD washing symptoms. The authors suggested that OCD washing develops in the context of danger expectancies which induces disgust which in turn motivates efforts to reduce distress via avoidance or washing behaviour. However, the hierarchical nature of the BAT was noted to have elicited little anxiety.

A more intense BAT for future research was suggested, such as that employed by Jones and Menzies (1997b) who asked participants to engage with the stimuli for five minutes, leaving fewer opportunities for withdrawal. Using an undergraduate sample ($N = 33$), Thorpe, Barnett, Friend, and Nottingham (2011) extended the work of Jones and Menzies (1997b), by employing the same BAT and self-report measures of danger expectancies concerning illness beliefs, anxiety and urge to wash. Disgust ratings, were also added to the study. Results indicated that high levels of disgust were related to increased hand washing time after the BAT but that this relationship was almost entirely mediated by danger expectancies concerning judgements of severity of consequent disease. However, the study did not examine the extent to which potential confounding variables, such as gender and psychopathology, may have explained these associations. Further, as participants who were unable to immerse their hands in the stimuli were eliminated from subsequent analysis, avoidance behaviour was not investigated. The current study aims to further examine the role of danger expectancies and disgust in OCD. As some previous BATs have failed to elicit a desirable level of distress in participants, the current study will use the BAT designed by Jones and Menzies (1997b), that has been shown to be effective in clinical (Jones & Menzies, 1998b) and non-clinical (Thorpe et al., 2011) samples. This study will also address limitations of previous research by controlling for gender, anxiety and depression. . Further, hand sanitiser use will be measured as a second outcome measure for washing behaviour. The present study will also investigate whether danger expectancies also mediate the relationship between trait disgust and avoidance behaviour. To explore this, participants will be asked to imagine undertaking the BAT and estimate the likelihood of contracting an illness and associated severity based on the prospect of touching the stimuli. This will allow danger expectancies to be recorded for all participants, including those who completely avoid undertaking the BAT. This methodology is similar to Deacon and Olatunji (2007), who measured danger expectancies before commencing a BAT.

Lastly, in response to the recommendation of Cisler et al. (2010) and to provide a measure of disgust not based solely on self-report ratings, the current study aims to experimentally heighten disgust and examine the effect on avoidance and washing behaviour relating to the BAT. To heighten disgust, the study will employ a smell stimulus, that has previously been shown to be effective in achieving this end by Schnall et al. (2008). This improves upon the methodology employed previously of manipulating disgust using sight and sound stimuli only (e.g. Olatunji & Armstrong, 2009). It was hypothesized that those participants for whom disgust was heightened would demonstrate significantly longer hand washing duration and be significantly more likely to use hand sanitiser and avoid undertaking the BAT, compared with those in the control condition. It was also hypothesised that trait disgust, as measured by the DPSS-R, would be a significant predictor of hand washing duration, hand sanitiser use and avoidance behaviour in the BAT, after controlling for condition. We also hypothesised that danger expectancies concerning estimates of the likelihood and severity of illness would be significant predictors of hand washing duration, hand sanitiser use and avoidance behavior. Lastly, we hypothesised that, after controlling for experimental condition, danger expectancies would be a significant mediator of the relationship between trait disgust and hand washing duration, hand sanitiser use and avoidance behaviour in the BAT.

## Method

### Ethical Considerations

The study was approved by the University of Sydney Human Research Ethics Committee.

### Participants

Sixty-four undergraduate students enrolled in first year psychology at the University of Sydney volunteered to take part in the study in exchange for course credit. As one participant was excluded from the study due to the presence of eczema, the final sample included 63 participants. The sample consisted of 48 females and 15 males with an age range between 17 years and 36 years ($M = 19.08$, $SD = 2.73$). Participants were randomly allocated to either the disgust (n=33) or control condition (n=30) using Research Randomizer (http://www.randomizer.org/).

### Materials/Apparatus

Consistent with the BAT employed by Jones and Menzies (1997b), a garbage bin 49cm high and 40cm in diameter was used which contained 60% potting soil, 22% common household food scraps, 15% raw meat and 3% animal hair.

The smell for the disgust manipulation was created using a commercially available "fart spray" (hereafter referred to as the "noxious smell" and purchased at www.magicshop.com.au). The spray is harmless at low levels but creates a strong and unpleasant odour.

Measures

**The Depression Anxiety Stress Scale (DASS)** (Lovibond & Lovibond, 1995a). The DASS is a 42-item self-report measure which provides individual scores for symptoms of depression (DASS-D), anxiety (DASS-A) and stress (DASS-S). Subjects respond on a 4-point Likert scale (0 = "did not apply to me at all" to 3 = "applied to me very much, or most of the time"). Possible total scores range from 0 to 126, while scores on each subscale range from 0 to 42. Good internal consistency has been demonstrated for each of the three subscales; depression (.91), anxiety (.81) and stress (.89) (Lovibond & Lovibond, 1995b).

**Disgust Propensity and Sensitivity Scale-Revised (DPSS-R)** (W. van Overveld et al., 2006). The DPSS-R is a 16-item self-report measure designed to assess the frequency of disgust experiences (i.e. disgust propensity) and how unpleasant the experience of disgust is (i.e. disgust sensitivity). Subjects are asked to indicate how often a series of statements is true for them on a 5-point Likert scale (1 = "never" to 5 = "always"). The instrument provides an overall score for disgust as well as scores on each of the two subscales for DP and DS. Possible total scores range from 16 to 80, while scores on each subscale range from 8 to 40. Good internal consistency has been demonstrated by W. van Overveld et al. (2006) in a non-clinical sample for both the DP (.78) and DS (.77) subscales.

**Obsessive Compulsive Inventory – Revised (OCI-R)** (Foa et al., 2002). The OCI-R is an 18-item self-report measure designed to assess symptoms of OCD. Subjects are asked to indicate the degree to which certain everyday experiences have distressed or bothered them on a 5-point Likert scale (0 = "not at all" to 4 = "extremely"). The instrument provides an overall score for OCD symptoms as well as scores on 6 subscales, reflecting the subtypes of OCD; washing, checking, ordering, obsessing, hoarding and neutralising. Possible total scores range from 0 to 72, while scores on each subscale range from 0 to 12. Good internal consistency has been demonstrated for the full scale in clinical and non-clinical samples (.81 - .93) and relevant to this study, the washing subscale (.73 - .89). (Foa et al., 2002)

**Pre-BAT anticipatory ratings for anxiety (AA), disgust (AD), danger expectancy - likelihood of catching a disease or becoming ill (ADEL), danger expectancy - severity of disease or illness (ADES)**. These scales with a range from 0 to 100 were identical to those created by Jones and Menzies (1997b) and modified by Thorpe et al. (2011) except for ratings for anticipatory danger expectancies which were added for the purpose of the current study. *AA:* "Imagine I asked you to place your hands in the bin up to wrist level. How anxious would you feel on a scale from 0 (no anxiety) to 100 (worst anxiety you can imagine)?" *AD:* "How disgusted would you feel if I asked you to place your hands in the bin up to wrist level on a scale from 0 (no disgust) to 100 (most disgust you can imagine)?" *ADEL:* "If I asked you to place your hands in the bin up to wrist level, how likely do you feel you may catch a disease or become ill on a scale from 0 (not at all possible) to 100 (certain to occur)?" *ADES:* "If you did catch a disease or become ill, how severe would you imagine this illness to be on a scale from 0 (no noticeable symptoms-minor illness) to 100 (terminal illness-certain death)?" Consistent with Deacon and Olatunji (2007), as ADEL and ADES were highly correlated ($r = .79$), an overall score for Pre-BAT danger expectancies was calculated by averaging ratings for ADEL and ADES.

**During BAT ratings for state anxiety, state disgust, urge to wash, danger expectancy - likelihood of catching a disease or becoming ill (DEL), danger expectancy - severity of illness or disease (DES).** These scales were identical to those created by Jones and Menzies (1997b) and modified by Thorpe et al. (2011). *State anxiety:* "How anxious do you feel on a scale from 0 (not at all anxious) to 100 (worst anxiety you can imagine)?" *State disgust:* "How disgusted do you feel on a scale from 0 (not at all disgusted) to 100 (worst disgust you can imagine)?" *Urge to wash hands:* "How strongly do you feel like washing your hands on a scale from 0 (no urge) to 100 (extreme urge)?" *DEL:* "How likely is it that you will catch a disease or become ill on a scale from 0 (not at all possible) to 100 (certain to occur)?" *DES:* "If you caught a disease or became ill, how severe would your illness be on a scale from 0 (no noticeable symptoms-minor illness) to 100 (terminal illness-certain death)?" Consistent with the pre-BAT anticipatory ratings, as DEL and DES were highly correlated ($r = .84$), an overall score for BAT danger expectancies was calculated by averaging ratings for DEL and DES.

Procedure

All participants completed the study individually under the supervision of the first author. All testing took place in the same testing room and area outside the room at the University of Sydney. There were five stages to the experiment; questionnaire completion/disgust manipulation, pre-BAT, during the BAT, post-BAT and manipulation check.

**Questionnaire Completion/Disgust Manipulation:** Upon arrival to the testing room, participants were given a questionnaire booklet to complete containing the OCI-R, DASS, and DPSS-R. There were four counterbalanced versions of the questionnaire battery. After an initial introduction, participants were moved to a separate area outside the room to complete the questionnaires. While participants were absent from the testing room, the first author put the BAT stimuli inside a garbage bag, which was placed in the bin to make the BAT appear as realistic as possible. For the disgust condition, eight sprays of the noxious smell were applied to an additional garbage bag attached to the bin. After each participant, the second bag was removed and disposed of outside the testing room. Pre-testing indicated that the noxious smell retained its pungency for only as long as the garbage bag was present in the testing room. However, an additional five minutes minimum was allowed between participants to ensure the smell had completely dissipated. In the control condition, no noxious gas was sprayed

**Pre-BAT:** Once the BAT was in place and participants completed the questionnaires, participants returned to the testing room and were shown the BAT. Initial instructions replicated those of Jones and Menzies (1997b) and Thorpe et al. (2011); "The bin in front of you contains potting soil, animal hair, food scraps and raw meat. In a moment I am going to ask you some questions about this container. There are no right or wrong answers. Each question is designed to be answered quickly and is not meant to be thought about too much." Participants were then told to imagine placing their hands in the bin up to wrist level and were asked the aforementioned ratings for ADEL, ADES, AA and AD.

**During BAT:** Participants were then told, "I would now like you to place your hands in the container and keep them there for five minutes. Again, there are no right or wrong answers. Each question is designed to be answered quickly and is not meant to be thought about too much. If, at some point, you feel unable to keep your hands in the bin any longer you may remove them. If you feel unable to complete the task at all, you are free to not participate and there will be no penalty for this." After participants' hands were checked for open wounds, they were asked, "Please now place your hands in the centre of the bin up to wrist level with fingers placed straight down". With their hands in the bin, participants provided ratings on the following variables at one minute intervals up to a maximum of five minutes; DEL, DES, state anxiety, state disgust and urge to wash hands. The BAT stage ended either when the participant removed their hands from the bin or at the end of five minutes. Hand immersion duration (the length of time participants kept their hands in the bin) was recorded for each participant.

**Post-BAT:** Immediately following the BAT, participants were led to a nearby sink and told they could now wash their hands. The tap was turned on by the Honours candidate to ensure a consistent flow rate for all participants. Hand washing duration was recorded surreptitiously using a digital wristwatch. Upon returning to the testing room, participants were offered hand sanitiser. Sanitiser use was recorded (yes or no responses).

**Manipulation Check:** In addition to the self-reported disgust ratings, based on the manipulation check in Schnall et al. (2008), all participants were asked; a) "Were you consciously aware of any unpleasant odour while you carried out the task? " (yes or no responses were recorded) and, b) How much did the odor bother you? . Participants answered on an 8-point Likert scale from 0 ("didn't notice any smell") to 7 (the smell completely nauseated me").

## Results

Manipulation Checks

Ninety-seven percent (n=32) of participants in the disgust condition and 57% (n=17) in the control condition reported awareness of an odour. A Chi-square test of independence indicated that the difference in proportions was significant, $\chi^2(1, N = 63) = 14.77$, $p < .001$. As the BAT stimuli did have an inherent odour, it was not surprising that some participants in the control condition detected a smell.

However, an ANCOVA demonstrated that participants in the disgust condition were significantly more bothered by the odour ($M$ = 5.31, $SE$ = 0.24) than those in the control condition ($M$ = 0.90, $SE$ = 0.25), $F(1,57)$ = 146.01, $p$ <.001. An ANCOVA indicated that those in the disgust condition, reported feeling significantly more anticipatory disgust ($M$ = 70.56, $SE$ = 5.32) than those in the control condition ($M$ = 52.65, $SE$ = 5.62), $F(1, 57)$ = 4.74, $p$ = .034. Participants in the disgust condition reported higher levels of disgust during the BAT ($M$ = 50.24, $SE$ = 6.47) than those in the control condition ($M$ = 35.16, $SE$ = 6.08). This difference was not statistically significant, $F(1, 49)$ = 2.53, $p$ = .118). However, analyses excluded the eight participants who showed complete avoidance of the BAT, seven of whom were allocated to the disgust condition. Hence, state disgust measured during the BAT may not have been an accurate reflection of whether the disgust manipulation worked. Therefore, it was concluded that the manipulation was successful in heightening disgust for those who were exposed to an unpleasant smell.

Preliminary Analyses

**Age and Gender**. A chi-squared test of independence and independent samples t-test were performed to test for differences on demographic variables between the disgust and control conditions. No significant difference in age was found between the two conditions, $t(61)$ = .218, $p$ =.828. However, there was a significant association between gender and condition, $\chi^2$ (1, $N$ = 63) = 5.22, $p$ = .022. Females were more likely to be assigned to the disgust condition (n=29) compared to the control condition (n= 19). Accordingly, and as planned, gender was included as a covariate in all main analyses.

**Questionnaire Measures**. Independent samples t-tests revealed no significant baseline differences between experimental conditions for any of the questionnaire measures, with the exception of the OCI-R total score, $t(61)$ = 2.25, $p$ =. 028, and OCI-R washing subscale, $t(61)$ = 2.77, $p$ =.007. As further analysis indicated no significant differences between conditions for any of the other OCI-R subscales, it was decided that the OCI-R washing subscale would be included as a covariate in all main analyses, rather than the OCI-R total score. Demographic information, means and standard deviations on the initial questionnaires, and results of independent samples t-tests and the chi-squared test of independence, can be found in Table 1.

**Table 1: Descriptive Statistics and Results of Independent Samples T-Tests for Age and Questionnaire Measures**

|  | Condition | | | | | Total | |
|  | Disgust | | Control | | | | |
| Variable | $M$ ($SD$) | Range | $M$ ($SD$) | Range | $t$ | $M$ ($SD$) | Range |
| Age | 19.15 (3.37) | 17-36 | 19.00 (1.86) | 17-25 | -0.22 | 19.08 (2.73) | 17-36 |
| OCI-R | 16.39 (12.42) | 0-57 | 23.87 (13.99) | 3-58 | 2.25* | 19.95 (13.61) | 0-58 |
| OCI-R-W | 1.58 (1.92) | 0-8 | 3.37 (3.12) | 0-9 | 2.77* | 2.43 (2.70) | 0-9 |
| DPSS-R | 38.94 (10.46) | 20-72 | 37.80 (10.28) | 22-58 | -0.44 | 38.40 (10.31) | 20-72 |
| DASS-A | 6.82 (8.07) | 0-36 | 6.57 (5.73) | 0-19 | -0.14 | 6.70 (7.00) | 0-36 |
| DASS-D | 9.24 (9.36) | 0-35 | 7.23 (7.39) | 0-31 | -0.94 | 8.29 (8.48) | 0-35 |

*Note.* $M$ = Mean; $SD$ = Standard Deviation; $N$ = 63. OCI-R = Obsessive Compulsive Inventory-Revised; OCI-R-W = Washing Subscale of the Obsessive Compulsive Inventory-Revised; DPSS-R = Disgust Propensity and Sensitivity Scale-Revised; DASS-A = Anxiety Subscale of the Depression Anxiety Stress Scale, DASS-D = Depression Subscale of the Depression Anxiety Stress Scale
*Significant at $p$ < .05.

Relevant descriptive statistics for BAT variables are presented in Table 2.

**Table 2: Descriptive Statistics for BAT Variables**

| BAT Phase | Variable | Disgust M (SD) | Range | Control M (SD) | Range | Total M (SD) | Range |
|---|---|---|---|---|---|---|---|
| | | **Condition** | | | | | |
| Pre-BAT | Danger Expectancies[a] | 31.88 (25.54) | 0-90 | 26.93 (22.04) | 0-75 | 29.52 (23.86) | 0-90 |
| | Anticipatory Anxiety[a] | 56.15 (30.72) | 0-100 | 50.77 (33.19) | 0-100 | 53.59 (31.78) | 0-100 |
| | Anticipatory Disgust[a] | 69.12 (26.50) | 10-100 | 54.23 (31.65) | 0-98 | 62.03 (29.79) | 0-100 |
| During BAT | Danger Expectancies[b] | 22.27 (21.49) | 0-83 | 16.79 (19.41) | 0-67 | 19.38 (20.41) | 0-83 |
| | State Anxiety[b] | 34.45 (28.28) | 0-89 | 25.26 (28.25) | 0-82 | 29.60 (28.38) | 0-89 |
| | State Disgust[b] | 49.03 (28.52) | 2-100 | 36.24 (31.20) | 0-89 | 42.29 (30.38) | 0-100 |
| | Urge to Wash[b] | 66.45 (30.94) | 0-100 | 60.21 (34.03) | 0-100 | 63.16 (32.46) | 0-100 |
| | Hand Immersion (seconds)[a] | 236.36 (124.55) | 0-300 | 284.40 (61.85) | 0-300 | 259.24 (101.88) | 0-300 |
| Post-BAT | Handwashing (seconds)[b] | 51.08 (25.39) | 16-116 | 43.55 (20.83) | 20-88 | 47.11 (23.20) | 16-116 |

*Note. M* = Mean; *SD* = Standard Deviation; BAT = Behavioural Avoidance Test.
[a] *N* = 63; [b] *N* = 5

Overall, mean ratings for disgust were higher than those for anxiety both before and during the BAT. Participants in the disgust condition had higher scores on all self-report BAT measures compared with those in the control condition. Further, participants in the disgust condition spent less time with their hands immersed in the stimuli and more time washing their hands after the BAT than those in the control condition. A higher frequency of hand sanitiser use was recorded for those in the disgust condition (69%) compared with the control condition (35%).

**Hand Immersion Duration**. A high proportion of participants (*n* = 8, 12.5% of the sample) were unable to immerse their hands in the bin for any duration. One participant withdrew from the BAT after 132 seconds and the remaining 54 participants kept their hands immersed in the bin for the entire five minutes. Therefore, the hand immersion duration variable essentially became dichotomous as participants generally engaged with the BAT for the full duration or demonstrated complete avoidance. As a consequence, the outcome variable was not suitable for ordinary hierarchical regression as planned. To overcome this, hand immersion duration was transformed into a new categorical variable named *BAT avoidance* with two levels; avoid (participants who demonstrated avoidance behaviour during the BAT.) and engage (participants who engaged with the BAT for the full five minutes). The eight participants who showed complete avoidance were removed from all analyses of BAT measures, hand washing duration and hand sanitiser use. Twenty-one percent of participants (n=7) in the disgust condition showed avoidance behaviour in the BAT compared with 7% (n=2) in the control condition.

Main Analyses

A bivariate correlation analysis was conducted to examine relationships between variables of interest. To address the hypotheses for hand washing time, hierarchical multiple regressions were conducted with the following order of entry; covariates (gender, anxiety using DASS-A, depression using DASS-D, and OCD washing symptoms using OCI-R-W, step 1), condition (IV1, step 2), trait disgust as measured by the DPSS-R (IV2, step 3) and danger expectancies (IV3, step 4). To address the hypotheses for hand sanitiser use and BAT avoidance, logistic regressions were performed with the same order of entry. To test the significance of any potential mediating relationships between variables, the *PROCESS* custom dialogue box for SPSS (Hayes, 2013) was employed, selected for its ability to test mediation models with a dichotomous outcome variable.. Results are presented for for each DV in turn.

**Bivariate Correlations.** Hand washing duration was significantly positively correlated with anticipatory and state disgust and anxiety, BAT danger expectancies and urge to wash. Hand sanitiser use was significantly positively correlated with condition. BAT avoidance was significantly negatively correlated with trait disgust (both DP and DS), anticipatory disgust and anxiety and danger expectancies. Urge to wash was significantly positively correlated with trait and state disgust, anxiety and danger expectancies. Measures of disgust (both trait, anticipatory and state) were significantly positively correlated with danger expectancies (both pre and during the BAT). Refer to Table 3.

**Table 3: Zero Order Correlations between Dependent Variables, Hypothesized Predictors and Variables of Interest**

|  | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. HW[b] | 1 | | | | | | | | | | | | | |
| 2. HSU[b] | .120 | 1 | | | | | | | | | | | | |
| 3. Avoidance[a] | -.112 | .139 | 1 | | | | | | | | | | | |
| 4. Condition[a] | .163 | .347** | -.208 | 1 | | | | | | | | | | |
| 5. DPSS-R[a] | .221 | .009 | -.419** | .056 | 1 | | | | | | | | | |
| 6. DPSS-R-DP[a] | .209 | -.105 | -.393** | .012 | .919** | 1 | | | | | | | | |
| 7. DPSS-R-DS[a] | .190 | .113 | -.381** | .088 | .928** | .705** | 1 | | | | | | | |
| 8. Pre-BAT D.E. [a] | .230 | -.069 | -.554** | .104 | .490** | .520** | .388** | 1 | | | | | | |
| 9. Anticipatory Disgust[a] | .318* | .121 | -.442** | .252 | .417** | .458** | .316* | .589** | 1 | | | | | |
| 10. Anticipatory Anxiety[a] | .268* | .144 | -.421** | .085 | .429** | .445** | .349** | .584** | .868** | 1 | | | | |
| 11. Danger Expectancies[b] | .269* | -.080 | -.935** | .275* | .428** | .418** | .373** | .539** | .480** | .496** | 1 | | | |
| 12. State Disgust[b] | .364** | -.021 | -.159 | .212 | .323* | .373** | .214 | .586** | .578** | .485** | .667** | 1 | | |
| 13. State Anxiety[b] | .294* | -.030 | -.183 | .163 | .279* | .326* | .181 | .573** | .573** | .495** | .693** | .842** | 1 | |
| 14. Urge to Wash[b] | .330* | .035 | -.156 | .097 | .386** | .367** | .329* | .541** | .552** | .537** | .545** | .797** | .643** | 1 |

Note. HW = Handwashing Duration; HSU = Hand Sanitsier Use; Avoidance = BAT avoidance, DPSS-R = Disgust Propensity and Sensitivity Scale-Revised (trait disgust); DPSS-R-DP = Disgust Propensity Subscale of the DPSS-R ;DPSS-R-DS = Disgust Sensitivity Subscale of the DPSS-R;.D.E. = Danger Expectancies. Coding for dichotomous variables: 0 = Yes, 1 = No (HSU); 0 = Avoidance, 1 = engagement (Avoidance); 0 = control, 1 = disgust (condition).
*$p<.05$, ** $p<.01$
[a] N = 63; [b] N = 5

**Washing Behaviour: Hand washing Duration**. Table 4 presents the results of the hierarchical regression.

**Table 4: Hierarchical Multiple Regression Analyses: Condition, Trait Disgust and BAT Danger Expectancies as Predictors of Hand washing Duration**

|  | Handwashing Duration | | | | | | | |
|---|---|---|---|---|---|---|---|---|
|  | Step 1 | | Step 2 | | Step 3 | | Step 4 | |
| Predictor | B | β | B | β | B | β | B | β |
| Gender | 1.94 | .037 | 5.17 | .098 | 7.73 | .146 | 7.50 | .142 |
| DASS-A | 0.62 | .156 | 0.65 | .165 | 0.24 | .062 | 0.16 | .039 |
| DASS-D | 0.08 | .003 | -0.12 | -.042 | .-0.08 | -.027 | -0.05 | -.017 |
| OCI-R-W | -0.52 | -.058 | 0.23 | .026 | -0.59 | -.066 | -0.69 | -.078 |
| Condition | | | 10.22 | .222 | 9.25 | .201 | 7.54 | .164 |
| DPSS-R | | | | | 0.67 | .260 | 0.55 | .21 |
| BAT Danger Expectancies | | | | | | | 0.22 | .197 |
| $R^2$ | .021 | | .059 | | .101 | | .135 | |
| $\Delta R^2$ | | | .037 | | .042 | | .034 | |

*Note:* Dependent Variable: Hand washing Duration. $N = 55$. DASS-A = Anxiety Subscale of the Depression Anxiety Stress Scale; DASS-D = Depression Subscale of the Depression Anxiety Stress Scale; OCI-R -W = Washing Subscale of the Obsessive Compulsive Inventory-Revised; DPSS-R = Disgust Propensity and Sensitivity Scale-Revised; BAT = Behavioural Avoidance Test. Coding for dichotomous variables: 0 = female, 1 = male (gender); 0 = control, 1 = disgust (condition)

The model predicting hand washing from the covariates was not statistically significant, $F(4,50) =.274$, $p = .893$. When entered in the second step, condition did not explain a significant amount of variance in hand washing, $\Delta R^2 = .04$, $F(1,49) = 1.93$, $p =.171$. This indicated that there was no significant difference between the disgust and control conditions in hand washing duration. When entered in the third step, DPSS-R scores did not explain a significant amount of variance in hand washing, $\Delta R^2 = .04$, $F(1,48) = 2.25$, $p =.140$. Therefore, trait disgust was not a significant predictor of hand washing duration. When entered in the final step, BAT danger expectancies did not explain a significant amount of variance in hand washing, $\Delta R^2 =.03$, $F(1,47) = 1.86$, $p = .179$. Thus, danger expectancies concerning estimates of the likelihood and severity of illness, was not a significant predictor of hand washing duration. There was no evidence that danger expectancies mediated the relationship between trait disgust and hand washing duration.

**Washing Behaviour: Hand Sanitiser Use**. Results of the logistic regression model are presented in Table 5.

**Table 5: Logistic Multiple Regression Analyses: Condition, Trait Disgust and BAT Danger Expectancies as Predictors of Hand Sanitiser Use**

|  | Variable | b | SE | df | Exp(b) |
|---|---|---|---|---|---|
| Step 1 | Gender | -0.04 | 0.62 | 1 | 1.04 |
|  | DASSA | -0.003 | 0.06 | 1 | 0.99 |
|  | DASSD | -0.001 | 0.04 | 1 | 0.99 |
|  | OCIRW | -0.008 | 0.12 | 1 | 0.99 |
| Step 2 | Gender | 0.64 | 0.73 | 1 | 0.53 |
|  | DASSA | 0.005 | 0.07 | 1 | 1.01 |
|  | DASSD | -0.03 | 0.05 | 1 | 0.97 |
|  | OCIRW | 0.14 | 0.13 | 1 | 1.16 |
|  | Condition | 1.99* | 0.72 | 1 | 7.30 |
| Step 3 | Gender | -0.63 | 0.75 | 1 | 0.54 |
|  | DASSA | 0.007 | 0.07 | 1 | 1.01 |
|  | DASSD | -0.03 | 0.05 | 1 | 0.97 |
|  | OCIRW | 0.14 | 0.14 | 1 | 1.16 |
|  | Condition | 1.99* | 0.72 | 1 | 7.32 |
|  | DPSSR | -0.003 | 0.04 | 1 | 0.99 |
| Step 4 | Gender | -0.70 | 0.77 | 1 | 0.50 |
|  | DASSA | 0.02 | 0.07 | 1 | 1.02 |
|  | DASSD | -0.03 | 0.05 | 1 | 0.97 |
|  | OCIRW | -.157 | 0.14 | 1 | 1.17 |
|  | Condition | 2.22* | 0.77 | 1 | 9.18 |
|  | DPSSR | 0.006 | 0.04 | 1 | 1.01 |
|  | BAT Danger Expectancies | -.002 | 0.02 | 1 | 0.98 |

*Note.* Dependent Variable: Hand Sanitiser Use. $N$ = 55. DASS-A = Anxiety Subscale of the Depression Anxiety Stress Scale; DASS-D = Depression Subscale of the Depression Anxiety Stress Scale; OCI-R -W = Washing Subscale of the Obsessive Compulsive Inventory-Revised; DPSS-R = Disgust Propensity and Sensitivity Scale-Revised; BAT = Behavioural Avoidance Test. Coding for dichotomous variables: 0 = yes, 1 = no (hand sanitiser use); 0 = female, 1 = male (gender); 0 = control, 1 = disgust (condition).
* $p < 0.01$.

The model predicting hand sanitiser use from the covariates was not statistically significant, $\chi^2 (4) = 0.03$, $p =.999$. Experimental condition was entered into the model in step 2 and was statistically significant, $\chi^2 (1) = 8.83$, $p = .003$. The log odds of using hand sanitiser over not doing so for those in the disgust condition were 7.30 the odds of those in the control condition ($b = 1.99$, $p = .006$, Exp($b$) = 7.30), such that those participants for whom disgust was heightened were significantly more likely to use sanitiser. Trait disgust was entered into the model in step 3 and was not statistically significant, $\chi^2 (1) = 0.006$, $p = .940$.

BAT danger expectancies was entered into the model in step 4 and was not statistically significant, $\chi^2$ (1) = 1.59, $p$ = .208. Therefore, neither trait disgust nor danger expectancies concerning estimates of the likelihood and severity of illness were significant predictors of hand sanitiser use.. There was no evidence that danger expectancies mediated the relationship between trait disgust and hand sanitiser use. Worth noting, in the final step, the log odds of using hand sanitiser over not doing so for those in the disgust condition were 9.18 the odds of those in the control condition ($b$ = 2.22, $p$ = .004, Exp($b$) = 9.18).

**Avoidance Behaviour: BAT Avoidance.** Results of the logistic regression model are presented in Table 6.

### Table 6: Logistic Multiple Regression Analyses: Condition, Trait Disgust and Pre-BAT Danger Expectancies as Predictors of BAT Avoidance

|        | Variable | $b$ | S.E. | df | Exp(b) |
|--------|----------|-----|------|-----|--------|
| Step 1 | Gender | -0.16 | 0.92 | 1 | 0.85 |
|        | DASSA | -0.03 | 0.05 | 1 | 0.97 |
|        | DASSD | -0.04 | 0.04 | 1 | 0.96 |
|        | OCIRW | -0.23 | 0.13 | 1 | 0.80 |
| Step 2 | Gender | 0.60 | 1.08 | 1 | 1.81 |
|        | DASSA | -0.03 | 0.06 | 1 | 0.98 |
|        | DASSD | -0.02 | 0.05 | 1 | 0.98 |
|        | OCIRW | -0.51* | 0.20 | 1 | 0.60 |
|        | Condition | -3.21* | 1.44 | 1 | 0.04 |
| Step 3 | Gender | 1.34 | 1.28 | 1 | 3.82 |
|        | DASSA | 0.05 | 0.08 | 1 | 1.06 |
|        | DASSD | -0.03 | 0.06 | 1 | 0.97 |
|        | OCIRW | -0.39 | 0.22 | 1 | 0.68 |
|        | Condition | -3.20* | 1.57 | 1 | 0.04 |
|        | DPSSR | -0.15* | 0.07 | 1 | 0.86 |
| Step 4 | Gender | 2.46 | 1.61 | 1 | 11.68 |
|        | DASSA | 0.06 | 0.11 | 1 | 1.06 |
|        | DASSD | -0.11 | 0.08 | 1 | 0.99 |
|        | OCIRW | -0.32 | 0.31 | 1 | 0.97 |
|        | Condition | -3.08 | 1.70 | 1 | 0.05 |
|        | DPSSR | -0.17 | 0.10 | 1 | 0.84 |
|        | Pre-BAT D.E. | -0.08* | 0.04 | 1 | 0.93 |

*Note.* Dependent Variable: BAT Avoidance. $N$ = 63. BAT = Behavioural Avoidance Test. DASS-A = Anxiety Subscale of the Depression Anxiety Stress Scale; DASS-D = Depression Subscale of the Depression Anxiety Stress Scale; OCI-R -W = Washing Subscale of the Obsessive Compulsive Inventory-Revised. DPSS-R = Disgust Propensity and Sensitivity Scale-Revised. D.E. = Danger Expectancies. Coding for dichotomous variables: 0 = avoid, 1 = engage (BAT Avoidance) 0 = female, 1 = male (gender); 0 = control, 1 = disgust (condition).
*Significant at $p < .01$

The model predicting BAT avoidance from the covariates was not statistically significant, $\chi^2$ (4) = 6.40, $p$ =.171. Condition was entered into the model in block 2 and was statistically significant, $\chi^2$ (1) = 7.82, $p$ = .005. The log odds of engaging with the BAT over avoiding the BAT for those in the disgust condition was 0.04 the odds of those in the control condition ($b$ = -3.21, $p$ = .025, Exp($b$) = 0.04), such that those participants for whom disgust was heightened were significantly less likely to engage with the BAT for the full duration (that is, showed increased avoidance behaviour). Trait disgust was entered into the model in block 3 and was statistically significant, $\chi^2$ (1) = 6.09, $p$ = .014. Increased trait disgust was significantly associated with a decreased likelihood to engage with the BAT for the full duration, ($b$ = -0.15, $p$ = .028, Exp($b$) = 0.86). That is, those participants with high trait disgust demonstrated increased avoidance behaviour. Pre-BAT danger expectancies was entered into the model in block 4 and was statistically significant, $\chi^2$ (1) = 7.29, $p$ = .007. Increasing danger expectancies concerning estimates of the likelihood and severity of illness was significantly associated with a decreased likelihood to engage with the BAT for the full duration ($b$ = -0.78, $p$ = .043, Exp($b$) = 0.93). That is, participants with high danger expectancies demonstrated increased avoidance behaviour. To test for a significant mediation, results from the logistic regression together with output gained from the *PROCESS* command for SPSS (Hayes, 2013) was examined.

The four conditions of mediation, according to the recommendations of Baron and Kenny (1986) were met. Trait disgust was significantly associated with BAT avoidance when Pre-BAT danger expectancies was not included in the model Trait disgust was not significantly associated with Pre-BAT danger expectancies ($b = 0.865$, $p = .198$). Further, Pre-BAT danger expectancies was significantly associated with BAT avoidance, controlling for trait disgust while trait disgust was no longer significantly associated with BAT avoidance after controlling for Pre-BAT danger expectancies In order to test if this mediation was significant, 95% percentile based confidence intervals were examined based on 2000 bootstrapped samples. As these intervals did not contain zero, it was concluded that the mediation was significant, 95% [-0.6108, -.0049] (Hayes, 2009). Pre-BAT danger expectancies mediated the relationship between trait disgust and BAT avoidance.

**Discussion**

It was predicted that participants for whom disgust was heightened would exhibit significantly greater avoidance behaviour than those in the control condition. When the disgusting smell was added to the BAT, participants were more likely to avoid the task than those who were not exposed to the smell. Additionally, consistent with prediction, trait disgust was a significant predictor of avoidance behaviour while controlling for condition. Taken together, these results endorse the notion that disgust may serve to protect individuals from illness acquisition by motivating avoidance of contact with perceived sources of contamination (Woody & Teachman, 2000). It was further hypothesised that danger expectancies concerning estimates of the likelihood and severity of illness would be significant predictors of avoidance behaviour. Consistent with expectation and the findings of Jones and Menzies (1997b) and Deacon and Olatunji (2007), when participants were asked to imagine undertaking the BAT, those who more strongly believed that they would contract an illness from contact with the stimuli, and that the illness would be severe in nature, were more likely to avoid the task. These results suggest that when individuals are confronted with the prospect of contact with stimuli perceived to have contaminating properties, avoidance is effective in reducing their perception of the likelihood and severity of illness and associated distress. Our hypothesis that danger expectancies concerning estimates of the likelihood and severity of illness would mediate the relationship between trait disgust and BAT avoidance was supported. This finding is related to that of Thorpe et al. (2011), who demonstrated that the relationship between trait disgust and hand washing duration was mediated by danger expectancies concerning illness beliefs. The current study is the first to provide evidence that this mediation model also applies when avoidance behaviour is used as the outcome measure and suggests that when an individual is faced with the prospect of contact with stimuli perceived to be contaminated, a predisposition to be both more easily disgusted (DP) and find the disgust experience more aversive (DS) may activate cognitive appraisals whereby the likelihood and severity of illness is overestimated.

High danger expectancies in turn increase the likelihood that the stimuli will be avoided. Accordingly, it may be the interpretation of feeling disgusted (that is, DS) that triggers this chain of events. This proposition is consistent with the cognitive appraisal models of both Salkovskis (1985) and Rachman (1998) in that disgust experiences are only problematic if they are appraised as threatening and significant. While Nicholson and Barnes-Holmes (2012) demonstrated that DS, not DP, predicted BAT avoidance behaviour, Goetz, Lee, Cougle, and Turkel (2013) demonstrated that DP, not DS predicted avoidance in a BAT. More recently, Athey, Elias et al (2015) investigated disgust propensity and OCD symptoms in a large clinical sample of patients receiving treatment for OCD. They found change in disgust propensity was significantly associated with improvement in contamination/washing symptoms. Future research should analyse DP and DS separately in regression analyses to clarify these inconsistencies. The present study found no evidence of significant associations between disgust, danger expectancies and hand washing duration after the BAT. The lack of support for the hypotheses relating to hand washing duration is inconsistent with previous research in a clinical sample (Jones and Menzies, 1997b) and undergraduate sample (Thorpe et al., 2011) and may be largely attributed to the observation that the average time participants spent washing their hands (47.11 seconds) was much lower than demonstrated in these studies (90.7 seconds and 131.9 seconds respectively). It is unclear why there was such a discrepancy between the two undergraduate samples but a number of suggestions can be made. Firstly, analyses of the hand washing duration variable excluded the high proportion of participants who withdrew from the BAT and therefore had no need to wash their hands.

Graduated steps could be added to the BAT in future research, so that hand washing data, at least for initial steps could be collected for all participants. Secondly, the study by Thorpe et al. (2011) took place during public health campaigns relating to bird and swine flu which focused on the importance of hygienic behaviours, especially hand washing. Subjects may have been "primed" to wash their hands to some extent. Thirdly, as hand washing in the present study took place at a sink in a nearby public toilet with the aim to create a natural setting, there may have been a degree of self consciousness and consequently, participants may have completed hand washing more quickly than otherwise. Consistent with expectation, those participants who were exposed to the smell were more likely to use hand sanitiser than those in the control condition. As sanitiser use was not correlated with hand washing duration, it is unclear whether the behaviour was performed to compensate for brief hand washing or served as an additional protective measure for those who washed their hands thoroughly. Although the underlying mechanisms are uncertain, elevated disgust did appear to increase this manifestation of washing behaviour. However, no association was found between heightened levels of trait disgust and sanitiser use. In contrast to findings of Reuter and Renner (2011), danger expectancies, concerning estimates of the likelihood and severity of illness were not significant predictors of hand sanitiser use. As the current study is the first known to include hand sanitiser use as an outcome measure of OCD washing symptoms, more research is needed to determine if this behaviour is an important expression of the disorder and if so, the specific links with disgust and danger expectancies.

The present study had a number of limitations. While the sample size employed was larger than in previous studies with which direct links are made (Deacon & Olatunji, 2007; Thorpe et al., 2011; Jones & Menzies, 1997b), it is important that the current study is replicated with a larger sample. Also, it is important for the current results to be replicated in clinical samples. The present study also had a number of strengths. The possible influence of gender and pre-existing anxiety, depression and OCD washing symptoms was accounted for in manipulation checks and all main analyses. Secondly, trait disgust was measured by the DPSS-R (W. van Overveld et al., 2006) rather than the more traditional Disgust Scale (Haidt et al., 1994). This was beneficial in that the DPSS-R is argued to be more capable of capturing both DP and DS and of measuring general trait disgust that applies to different contexts (Olatunji, Cisler, et al., 2007). The study design allowed for disgust to be manipulated and behavioural responses observed so that associations between danger expectancies, disgust and OCD washing symptoms could be explored without the bias inherent in self-report measures. Thus, the current study was able to address limitations of previous studies that used self-report measures only, or relatively weak manipulations and BATs. The present findings have important implications for future research and clinical practice. By demonstrating that elevated disgust experiences are an important risk factor in the development and maintenance of OCD washing symptoms, this study underscores the need for continuing research into how to diminish disgust reactions in those with an overdeveloped sensitivity (McKay & Tsao, 2005). Future research should also explore the relationships between danger expectancies, disgust and OCD washing symptoms in clinical samples and establish the relative efficacy of targeting danger expectancies, disgust or both.

## References

Adams, T. G., Jr., Willems, J. L., & Bridges, A. J. (2011). Contamination aversion and repeated exposure to disgusting stimuli. Anxiety, Stress & Coping: An International Journal, 24(2), 157-165. doi: 10.1080/10615806.2010.506953

Athey, A. J., Elias, J. A., Crosby, J. M.. Jenike, M. A., Pope, H. G., Hudson, J. I., Brennan, B. P. (2015). Reduced disgust propensity is associated with improvement in contamination/washing symptoms in obsessive–compulsive disorder. Journal of Obsessive-compulsive and related disorders, 4, 20–24.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51(6), 1173-1182. doi: 10.10370022-3514.51.6.1173

Carr, A. T. (1974). Compulsive neurosis: A review of the literature. Psychological Bulletin, 81(5), 311-318. doi: 10.1037h0036473

Cavanagh, K., & Davey, G. C. L. (2000). The development of a measure of individual differences in disgust. Paper presented at the British Psychological Society, Winchester, UK (2000).

Cisler, J. M., Brady, R. E., Olatunji, B. O., & Lohr, J. M. (2010). Disgust and obsessive beliefs in contamination-related OCD. Cognitive Therapy and Research, 34(5), 439-448. doi: 10.1007/s10608-009-9253-y

Cougle, J. R., Wolitzky-Taylor, K. B., Lee, H.-J., & Telch, M. J. (2007). Mechanisms of change in ERP treatment of compulsive hand washing: Does primary threat make a difference? Behaviour Research and Therapy, 45(7), 1449-1459. doi: 10.1016j.brat.2006.12.001

Crino, R. D., Slade, T., & Andrews, G. (2005). The changing prevalence and severity of obsessive compulsive disorder criteria from DSM-III to DSM-IV. American Journal of Psychiatry, 162, 876–882.

Davey, G. C. L. (1994). Disgust. In V. S. Ramachandran (Ed.), Encyclopaedia of human behavior. San Diego, CA: San Diego Press.

David, B., Olatunji, B. O., Armstrong, T., Ciesielski, B. G., Bondy, C. L., & Broman-Fulks, J. (2009). Incremental specificity of disgust sensitivity in the prediction of obsessive-compulsive disorder symptoms: Cross-sectional and prospective approaches. Journal of Behavior Therapy and Experimental Psychiatry, 40(4), 533-543. doi: 10.1016j.jbtep.2009.07.004

Deacon, B., & Olatunji, B. O. (2007). Specificity of disgust sensitivity in the prediction of behavioral avoidance in contamination fear. Behaviour Research and Therapy, 45(9), 2110-2120. doi: 10.1016j.brat.2007.03.008

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. Psychological Bulletin, 99, 20-35.

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The Obsessive-Compulsive Inventory: Development and validation of a short version. Psychological Assessment, 14(4), 485-496. doi: 10.10371040-3590.14.4.485

Freeston, M. H., Rhéaume, J., & Ladouceur, R. (1996). Correcting faulty appraisals of obsessional thoughts. Behaviour Research and Therapy, 34, 433−446.

Goetz, A. R., Lee, H-J., Cougle, J. R., & Turkel, J. E.. (2013). Disgust propensity and sensitivity: Differential relationships with obsessive-compulsive symptoms and      behavioral approach task performance. Journal of Obsessive-Compulsive and Related Disorders. 2(4):412–419.

Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. Personality and Individual Differences, 16(5), 701-713. doi: 10.10160191-8869252894252990212-7

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. Communication Monographs, 76(4), 408-420. doi: 10.108003637750903310360

Hayes, A. F. (2013). Introduction to Mediation, Moderation and Conditional Process Analysis: A Regression Based Approach. New York: Guilford Publications.

Holland, R. W., Hendriks, M., & Aarts, H. (2005). Smells Like Clean Spirit: Nonconscious Effects of Scent on Cognition and Behavior. Psychological Science, 16(9), 689-693. doi: 10.1111j.1467-9280.2005.01597.x

Jones, M. K., & Menzies, R. G. (1997a). Danger ideation reduction therapy (DIRT): Preliminary findings with three obsessive-compulsive washers. Behaviour Research and Therapy, 35(10), 955-960. doi: 10.1016S0005-7967252897252900042-9

Jones, M. K., & Menzies, R. G. (1997b). The cognitive mediation of obsessive-compulsive handwashing. Behaviour Research and Therapy, 35(9), 843-850. doi: 10.1016/S0005-796728972900035-1

Jones, M. K., & Menzies, R. G. (1998a). Danger ideation reduction therapy (DIRT) for obsessive-compulsive washers: A controlled trial. Behaviour Research and Therapy, 36(10), 959-970. doi: 10.1016S0005-7967252898252900057-6

Jones, M. K., & Menzies, R. G. (1998b). The Role of Perceived Danger in the Mediation of Obsessive-Compulsive Washing. Depression and Anxiety, 8, 121-125.

Krochmalik, A., Jones, M. K., Menzies, R. G., & Kirkby, K. (2004). The Superiority of Danger Ideation Reduction Therapy (DIRT) Over Exposure and Response Prevention (ERP) in Treating Compulsive Washing. Behaviour Change, 21(4), 251-268. doi: 10.1375bech.21.4.251.66103

Lovibond, S. H., & Lovibond, P. F. (1995a). Manual for the Depression Anxiety Stress Scales. Sydney: Psychology Foundation.

Lovibond, S. H., & Lovibond, P. F. (1995b). The structure of negative emotional states:      Comparison    of    the    Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour Research and Therapy, 33(3), 335-343. doi: 10.10160005-7967252894252900075-U

Mancini, F., Gragnani, A., & D'Olimpio, F. (2001). The connection between disgust and obsessions and compulsions in a non-clinical sample. Personality and Individual Differences, 31(7), 1173-1180. doi: 10.1016S0191-8869252800252900215-4

McKay, D. (2006). Treating disgust reactions in contamination-based obsessive-compulsive disorder. Journal of Behavior Therapy and Experimental Psychiatry, 37(1), 53-59. doi: 10.1016j.jbtep.2005.09.005

McKay, D., & Tsao, S. D. (2005). A treatment most foul: Handling disgust in cognitive-behavior therapy. Journal of Cognitive Psychotherapy, 19(4), 355-367. doi:10.1891jcop.2005.19.4.355

Muris, P., Merckelbach, H., Schmidt, H., & Tierney, S. (1999). Disgust sensitivity, trait anxiety and anxiety disorders symptoms in normal children. Behaviour Research and Therapy, 37(10), 953-961. doi: 10.1016S0005-7967252899252900045-5

Nicholson, E., & Barnes-Holmes, D. (2012). Developing an implicit measure of disgust propensity and disgust sensitivity: Examining the role of implicit disgust propensity and sensitivity in obsessive-compulsive tendencies. Journal of Behavior Therapy and       Experimental Psychiatry, 43(3), 922-930.
doi: 10.1016j.jbtep.2012.02.001

Olatunji, B. O. (2009). Incremental specificity of disgust propensity and sensitivity in the prediction of health anxiety dimensions. Journal of Behavior Therapy and Experimental Psychiatry, 40(2), 230-239.
doi: 10.1016j.jbtep.2008.10.003

Olatunji, B. O., & Armstrong, T. (2009). Contamination fear and effects of disgust on distress in a public restroom. Emotion, 9(4), 592-597. doi: 10.1037a0016109

Olatunji, B. O., Cisler, J. M., Deacon, B. J., Connolly, K., & Lohr, J. M. (2007). The Disgust Propensity and Sensitivity Scale-Revised: Psychometric properties and specificity in relation to anxiety disorder symptoms. Journal of Anxiety Disorders, 21(7), 918-930. doi: 10.1016j.janxdis.2006.12.005

Olatunji, B. O., Lohr, J. M., Sawchuk, C. N., & Tolin, D. F. (2007). Multimodal assessment of disgust in contamination-related obsessive-compulsive disorder. Behaviour Research and Therapy, 45(2), 263-276.
doi: 10.1016j.brat.2006.03.004

Olatunji, B. O., Wolitzky-Taylor, K. B., Willems, J., Lohr, J. M., & Armstrong, T. (2009). Differential habituation of fear and disgust during repeated exposure to threat-relevant stimuli in contamination-based OCD: An analogue study. Journal of Anxiety Disorders, 23(1), 118-123. doi: 10.1016j.janxdis.2008.04.006

Rachman, S. (1998). A cognitive theory of obsessions Behavior and cognitive therapy today: Essays in honor of Hans J Eysenck (pp. 209-222). Oxford, England: Elsevier Science Ltd; England.

Rasmussen, S. A., & Eisen, J. L. (1992). The epidemiology and clinical features of obsessive compulsive disorder. Psychiatric Clinics of North America, 15(4), 743-758. doi: 0193-953X

Reuter, T., & Renner, B. (2011). Who takes precautionary action in the face of the new H1N1 influenza? Prediction of who collects a free hand sanitizer using a health behavior model. PLoS One, 6(7), e22130.
doi: 10.1371/journal.pone.0022130

Rotton, J. (1983). Affective and cognitive consequences of malodorous pollution. Basic and Applied Social Psychology, 4(2), 171-191. doi: 10.1207s15324834basp0402_5

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. Behaviour Research and Therapy, 23(5), 571-583. doi: 10.10160005-7967252885252990105-6

Schienle, A., Stark, R., Walter, B., & Vaitl, D. (2003). The connection between disgust sensitivity and blood-related fears, faintness symptoms, and obsessive-compulsiveness  in a non-clinical sample. Anxiety, Stress & Coping: An International Journal, 16(2), 185-193. doi: 10.108010615800021000030544

Schnall, S., Haidt, J., Clore, G. L., & Jordan, A. H. (2008). Disgust as embodied moral judgment. Personality and Social Psychology Bulletin, 34(8), 1096-1109. doi: 10.11770146167208317771

St Clare, T., Jones, M. K., & Menzies, R. G. (2008). Danger Ideation Reduction (DIRT) for obsessive-compulsive washers: A comprehensive guide to treatment. Bowen Hills, QLD: Australian Academic Press.

Summerfeldt, L. J., Antony, M., Downie, F., Richter, M. A., & Swinson, R. (1997). Prevalence of particular obsessions and compulsions in a clinical sample. In R. Swinson, M. Antony, S. Rachman & M. Richter (Eds.), Obsessive Compulsive Disorder: Theory, Research and Treatment (pp. 79-119.). New York: Guilford.

Thorpe, S. J., Barnett, J., Friend, K., & Nottingham, K. (2011). The mediating roles of disgust sensitivity and danger expectancy in relation to hand washing behaviour. Behavioural and Cognitive Psychotherapy, 39(2), 175-190.
doi: 10.1017S1352465810000676

Thorpe, S. J., Patel, S., & Simonds, L. (2003). The relationship between disgust sensitivity, anxiety and obsessions. Behaviour Research and Therapy, 41(12), 1397-1409. doi: 10.1016S0005-7967252803252900058-5

Tolin, D. F., Woods, C. M., & Abramowitz, J. S. (2006). Disgust sensitivity and obsessive-compulsive symptoms in a non-clinical sample. Journal of Behavior Therapy and Experimental Psychiatry, 37(1), 30-40. doi: 10.1016j.jbtep.2005.09.003

van Overveld, M., de Jong, P. J., & Peters, M. L. (2010). The Disgust Propensity and Sensitivity Scale - Revised: Its predictive value for avoidance behavior. Personality and Individual Differences, 49(7), 706-711. doi: 10.1016j.paid.2010.06.008van Overveld, W., de Jong, P., Peters, M., Cavanagh, K., & Davey, G. (2006). Disgust propensity and disgust sensitivity: Separate constructs that are differentially related to specific fears. Personality and Individual Differences, 41(7), 1241-1252. doi: 10.1016j.paid.2006.04.021

Woody, S. R., & Teachman, B. A. (2000). Intersection of disgust and fear: Normative and pathological views. Clinical Psychology: Science and Practice, 7(3), 291-311. doi: 10.1093clipsy7.3.291

Woody, S. R., & Tolin, D. F. (2002). The relationship between disgust sensitivity and avoidant behavior: Studies of clinical and nonclinical samples. Journal of Anxiety Disorders, 16(5), 543-559. doi: 10.1016S0887-6185252802252900173-1