



The Contribution of Disgust in Contamination Fear: The Mediating Role of Harm Avoidance and Incompleteness

Árný Árnadóttir

Sólveig Anna Daníelsdóttir

Lokaverkefni til BS-gráðu

Sálfræðideild

Heilbrigðisvísindasvið



HÁSKÓLI ÍSLANDS

The Contribution of Disgust in Contamination Fear: The Mediating Role of Harm Avoidance and Incompleteness

Árný Árnadóttir

Sólveig Anna Daníelsdóttir

Lokaverkefni til BS-gráðu í sálfræði

Leiðbeinandi: Ragnar Pétur Ólafsson

Sálfræðideild

Heilbrigðisvísindasvið Háskóla Íslands

Júní 2016

Ritgerð þessi er lokaverkefni til BS gráðu í sálfræði og er óheimilt að afrita ritgerðina á nokkurn hátt nema með leyfi rétthafa.

© Árný Árnadóttir, Sólveig Anna Daníelsdóttir

Prentun: Háskólaprent

Reykjavík, Ísland 2016

The objective of the study was to examine the contribution of disgust in contamination fear. In addition, the aim was to determine if the relationship between disgust and contamination fear is partly mediated by incompleteness and harm avoidance. Participants were 84 students enrolled at the University of Iceland. They were asked to answer questionnaires measuring disgust, contamination fear, harm avoidance and incompleteness among other constructs. A behavioral avoidance task (BAT) was then administered, measuring approach and avoidance behaviors. As predicted, results showed that both harm avoidance and incompleteness mediate the relationship between disgust and contamination fear using self-report measures, indicating that contamination-related OCD may be both sensation based as well as driven by cognitive distortions. However contrary to predictions, these results were not replicated in an experimental setting. Additional analyses showed that as expected disgust was a stronger predictor of contamination fear than anxiety. In addition disgust, but not anxiety, predicted the urge to wash as well as avoidant behavior in the BAT. The results indicate that disgust contributes to contamination fear. It is possible that individuals with contamination OCD perform their compulsions in order to reduce a sensation of disgust rather than to get rid of their anxiety or fear.

Preface

This BSc thesis was written under the guidance of Dr. Ragnar P. Ólafsson. We would like to thank him for an excellent guidance and his invaluable help and assistance. We would also like to thank Ragnheiður Ragnarsdóttir and Sóley Siggeirsdóttir for a great collaboration.

Table of Contents

Introduction.....	5
Methods.....	10
Participants.....	10
Test materials	10
The Disgust Propensity and Sensitivity Scale-Revised (DPSS-R)	10
Hospital Anxiety Depression Scale (HADS)	11
Obsessive-Compulsive Core Dimensions Questionnaire (OC-CDQ)	11
Obsessive Compulsive Inventory-Revised (OCI-R).....	11
Padua Inventory-WSUR (PI-WSUR)	11
A behavioral avoidance task (BAT)	12
Procedure	13
Statistical analysis	13
Results.....	14
Descriptive statistics and correlations between measures	14
Mediation analyses.....	16
The role of disgust in contamination fear, urge to wash and avoidant behavior	18
Discussion.....	19
References.....	22

Obsessive-compulsive disorder (OCD) is a disabling psychiatric disorder characterized by obsessive thoughts and compulsive behaviors. The lifetime prevalence of OCD is 1-3% affecting millions of people worldwide (Grant, 2014). Obsessions are uncontrollable and persistent thoughts, ideas or urges that cause significant distress or anxiety. Compulsions are repetitive behaviors or mental acts that the person feels a need to perform as a response to obsessions (American Psychiatric Association, 2013). Common types of obsessions in OCD are distressing images and thoughts related to aggression, sexuality and religion. Obsessions concerning symmetry, ordering and contamination are also prevalent (American Psychiatric Association, 2013). Compulsions can be logically linked to the content of obsessions such as when cleaning compulsions follow contamination obsessions. However, compulsions can also be the result of “magical thinking”, for example when a person believes she has to knock five times before entering a room to prevent danger (American Psychiatric Association, 2013).

Cleaning compulsions are one of the most common symptoms in OCD (Verwoerd, de Jong, Wessel & van Hout, 2013). The purpose of compulsive cleaning is to remove feelings of contamination that is perceived to be a threat to one’s physical or mental health (Rachman, 2004). Cleaning compulsions are driven by contamination fears. About 50% of people with OCD experience fear of contamination (Rachman, 2004). Contamination is defined as a feeling of being polluted or infected following direct or indirect contact with an individual, place or object that is perceived to be impure, soiled or harmful. Alongside these feelings of contamination people experience negative emotions such as fear, disgust, moral impurity and shame (Rachman, 2004). Contamination fears are complex and persistent and do not easily subside. Normally the fear is a result of a physical contact with a contaminated object or person but can also result in reaction to a mental contaminant (Rachman, 2004).

In recent years cognitive theories explaining the development and maintenance of OCD symptoms have been prominent. A notion that has attracted much attention in past decades is that negative, intrusive thoughts become obsessions because of the appraisal that one is responsible for harm or the prevention of harm to self or others (Rachman, 1997; Salkovskis, 1999). Responsibility appraisals seem to apply to contamination obsessions as well as other aspects of obsessive-compulsive symptoms (Smári, Gylfadóttir, Halldórsdóttir, 2003). Rachman (2002) suggested that compulsive cleaning is mainly focused on the prevention of harm to oneself, and the intention to protect others is usually secondary. Overestimation of the likelihood of danger and the severity of

its consequences is also believed, by some theorists, to underlie OCD (Carr, 1974). It has been shown that danger expectancies are a likely mediator of compulsive washing (Jones & Menzies, 1997). Cognitive models have mainly been associated with the emotions anxiety and fear but recent research indicates that the emotion disgust might play a role in maintaining obsessive and compulsive symptoms in OCD (Cisler, Olatunji & Lohr, 2009; Deacon & Olatunji, 2007).

The adaptive function of disgust is to defend the organism against disease, illness and contamination (Deacon & Olatunji, 2007). Disgust has a universal facial expression which is characterized by wrinkling of the nose, downturn of the mouth and protrusion of the tongue (Davey, 2011). The behavioral reaction to disgust is distancing oneself physically from the contaminated object and the physiological response is nausea (Tsao & McKay, 2004). The experience of disgust can be divided into three categories (Olatunji et al., 2010). Core disgust is characterized by a threat a person feels of oral incorporation and the repulsive reaction associated with it. An example of core disgust is rotten food, bodily waste products and small animals that are associated with garbage and waste. Animal reminder disgust contains reminders of human mortality and one's animalistic nature. Sex practices and attitudes are subsumed in this category along with injury to the body and death. At last, contamination disgust is evoked by people that are unknown, ill or infected (Olatunji et al., 2010). Research examining the function of disgust have distinguished between disgust propensity and disgust sensitivity. Disgust propensity is the tendency to respond with disgust, thus people high on disgust propensity frequently experience the feeling of disgust. Disgust sensitivity is the tendency to experience disgust as aversive (Goetz, Lee, Cogle & Turkel, 2013).

Mancini, Gragnani and D'Olimpio (2001) tested 278 non-clinical volunteers and found a significant positive correlation between disgust and obsessive symptoms that was partly independent of age, gender, and measures of anxiety and depressive symptoms. Disgust was also the best predictor of washing behavior in a regression analysis (Mancini et al., 2001). Olatunji et al. (2007) found that self-report measures of disgust sensitivity and concerns of contamination correlated positively, even after controlling for negative affect. Results from Cisler, Reardon, Williams and Lohr (2007) further show that anxiety and disgust predict contamination fear independently of each other. Thus, research using self-report measures indicates that disgust may contribute to contamination fear.

Experimental studies have also found a connection between disgust and contamination fear. Tsao and McKay (2004) found a significant difference between a contamination fearful group and a high trait anxiety group on two disgust domains, involving animal and sympathetic magic beliefs, measured with behavioral avoidance tasks (BAT) involving six different domains of disgust. In addition, they found a significant difference between contamination fearful individuals and low trait anxious individuals on four disgust domains, involving food, animal, body envelope violations and death. However, there was not a significant difference between high trait anxious and low trait anxious groups on the six BATs, demonstrating that difference in performance was not governed by generalized anxiety. Deacon and Olatunji (2007) reported a significant association between disgust sensitivity and avoidant responding on contamination-related BATs. The association persisted after controlling for age, gender, anxiety and depression (Deacon & Olatunji, 2007). Findings reported by Olatunji et al. (2007) further support the relationship between disgust and contamination OCD, revealing that participants high on contamination related OCD reported significantly more disgust when watching a disgust-inducing video than participants low on contamination OCD. Additionally high OCD individuals showed more avoidant behavior than low OCD individuals on several disgust-specific BATs as well as experiencing more fear and disgust while performing the BATs. Upon further examination the researchers found that the primary emotional response was disgust.

The discussion above illustrates that multiple studies support the disgust-contamination association. Research using self-report measures as well as experimental studies using disgust-specific BATs support the notion that disgust contributes to the development of contamination fear. Despite these findings it is not known why disgust plays a role in contamination related OCD.

It may be that avoidance of harm contributes to this relationship. Cognitive theories of OCD focus on the role of overestimation of threat and responsibility in maintaining obsessive compulsive symptoms, including contamination compulsions (Cisler, Brady, Olatunji & Lohr, 2010; Olatunji, Unoka, Beran, David & Armstrong, 2009). Cisler et al. (2010) showed that obsessive beliefs, specifically overestimation of threat, interacts with disgust to potentiate contamination fear. This interaction was found with two different samples, across different self-report measures of contamination fear and after researchers controlled for negative affect. Olatunji et al. (2009) found a positive correlation between measures of disgust sensitivity and a broad range of psychopathological symptoms. The correlation diminished substantially or became

nonsignificant when controlling for the level of harm avoidance, measured with the *Temperament and Character Inventory*. Thus the relationship between disgust sensitivity and psychopathological symptoms was partially mediated by harm avoidance. These findings suggest that harm avoidance might be one mechanism by which disgust impacts the maintenance of psychopathological conditions (Olatunji et al., 2009).

In the past decades research focus in OCD has been on overt symptoms. Data reduction statistical methods have given three to five factors comprising symmetry and ordering, checking, contamination and hoarding (Summerfeldt, Kloosterman, Antony & Swinson, 2014). This approach is limiting because it might ignore meaningful underlying components. The same overt symptoms could be caused by different underlying features (Summerfeldt et al., 2014). Thus an individual may clean to get rid of germs and prevent harm while another may perform the same behavior to eliminate an uncomfortable “not just right” feeling (Tallis, 1996). Likewise different overt symptoms could be caused by the same underlying motive (Summerfeldt et al., 2014).

Summerfeldt and colleagues (2014) put forward a model which specifies that the two core motivational dimensions that underlie OCD symptoms are harm avoidance and incompleteness. Contemporary views on underlying motivational dimensions in OCD have mostly emphasized cognitive biases related to anxiety, sensitivity to possible threat and avoidance of harm. This is in line with the cognitive models previously discussed (Summerfeldt, 2004). However, cumulative research has revealed that harm avoidance is not the only underlying motive since a number of individuals with OCD symptoms do not report anxiety or fear of harm. Rather, some people experience an intense feeling of imperfection and that the current condition is just not right (Coles, Frost, Heimberg & Rhéaume, 2003; Summerfeldt, 2004). Incompleteness is often experienced as a sensory-affective disturbance while harm avoidance is characterized by a cognitively biased risk assessment (Summerfeldt et al., 2014). A case study described in Summerfeldt (2004) about a patient with OCD symptoms underlines the importance of distinguishing between underlying motivational dimensions rather than overt symptoms alone. The patient experienced hyper awareness towards his environment and developed highly elaborate rituals. The symptoms could be explained by a feeling of incompleteness. The patient could not identify any feared consequences or anxiety. However, he reported discomfort and tension and a “not just right” feeling (Summerfeldt, 2004).

Summerfeldt et al. (2014) examined the structural validity of the two dimensional model of harm avoidance and incompleteness, using factor analysis. They performed four different studies examining both clinical and non-clinical samples and using interviewer and self-report measures. The four studies supported that harm avoidance and incompleteness are correlated yet separate constructs that both underlie OCD symptoms (Summerfeldt, 2014). Another study that examined the structural validity of the two dimensional model was carried out by Pietrefesa and Coles (2008). They hypothesized that the two constructs would be independent and separate. In addition they hypothesized that incompleteness would be more strongly related to ordering than harm avoidance and that harm avoidance would be more strongly related to washing compulsions than incompleteness. The results showed that harm avoidance and incompleteness are separate, though highly correlated constructs. Results also revealed that, as predicted, incompleteness was more strongly related to ordering compulsions than harm avoidance. However, in contrast to their expectations, incompleteness was as strongly correlated to washing compulsions as harm avoidance (Pietrefesa and Coles, 2008). These results therefore support the notion that both incompleteness and harm avoidance contribute to washing compulsions. A research by Cogle, Goetz, Fitch, and Hawkins (2011) showed that incompleteness also contributes to washing duration. Results showed that individuals that often experience feelings of incompleteness took longer to wash their hands, after immersing them in a dirt mixture, than individuals low on incompleteness feelings. This indicates that non-cognitive sensory experiences might be important in determining washing termination (Cogle et al., 2011). The above-mentioned research results support the notion that incompleteness is a motivational dimension underlying OCD symptoms along with harm avoidance.

Based on the research results reviewed the purpose of the current study is to determine if disgust contributes to contamination fear. In line with studies discussed above using self-report measures it was expected that a measure of disgust would be positively correlated with a measure of contamination fear and that this relationship would hold when controlling for anxiety and depression. In addition the aim was to test this hypothesis in an experimental setting. It was expected that the feeling of disgust, after completion of the BAT, would predict fear of contamination and the urge to wash. Anxiety experienced after completion of the BAT was expected to be a weaker predictor. It was also expected that disgust, but not anxiety, experienced when exposed to a disgust evoking stimuli would predict avoidant behavior in the BAT. At last

the aim was to examine if the relationship between disgust and contamination fear is partly mediated by incompleteness and harm avoidance. The notion that the OCD motivational dimensions harm avoidance and incompleteness mediate a part of the association between disgust and contamination fear was put forward by Ólafsson (Ólafsson, Emmelkamp, Ólason & Kristjánsson, 2016). Their findings displayed that there was a direct effect of disgust on contamination fear but contrary to their expectations incompleteness, but not harm avoidance, partly mediated this relationship. However, in light of research results discussed above it is expected that harm avoidance and incompleteness mediate the relationship. This will be examined both by using self-report measures as well as in an experimental setting.

Methods

Participants

Participants were 84 students enrolled at the University of Iceland. They were all volunteers recruited via an introductory email and classroom presentations. There were 27 men and 57 women, ranging in age from 21 - 34 (mean = 24.83 +/- 2.80). Participants received approximately \$8 for participation. Studies support the notion that OCD symptoms are on a continuum which range from non-pathological to pathological levels (Gibbs, 1996). Most people have at least some tendencies to obsessions and compulsions but levels of severity vary between individuals. Therefore it is of relevance to use a nonclinical sample to gain understanding of people diagnosed with OCD (Olatunji, Jeffrey, Sawchuk & Tolin, 2007; Whiteside & Abramowitz, 2004).

Test materials

The *Disgust Propensity and Sensitivity Scale-Revised* (DPSS-R; van Overveld, de Jong, Peters, Cavanagh & Davey, 2006) is a 16-item measure designed to assess the tendency to experience disgust (i.e., disgust propensity) and the negative appraisal of those experiences (i.e., disgust sensitivity). The measure contains two subscales: Disgust Propensity and Disgust Sensitivity, each containing eight items. The questions are answered on a 5-point Likert-type scale ranging from “never” to “always”. The total scale has good internal consistency with an alpha coefficient of 0.90. The subscales Disgust Propensity and Disgust Sensitivity each have good internal consistency with alpha coefficients of 0.84 and 0.83 respectively. Additionally the scale has

demonstrated good convergent validity (Olatunji, Cisler, Deacon, Conolly & Lohr, 2007). The Icelandic translation also shows good psychometric properties (Steinarsson, 2014).

Hospital Anxiety Depression Scale (HADS; Zigmond & Snaith, 1983) was used to measure symptoms of anxiety and depression. The measure is a 14 item questionnaire that consists of two seven-item subscales. The questions are answered on a 4-point Likert-type scale and scores on each subscale can range from 0 - 21. Studies indicate that HADS is a reliable and valid measure of depression and anxiety (Herrmann, 1997). The Icelandic version has also shown good psychometric properties with alpha coefficients for the depression subscale ranging from 0.65 - 0.85 and alpha coefficients for the anxiety subscale ranging from 0.78 - 0.86 (Smári, Ólason, Arnarsson & Sigurðsson, 2008).

The *Obsessive-Compulsive Core Dimensions Questionnaire* (OC-CDQ; Summerfeldt et al., 2014) was used to assess harm avoidance and incompleteness. The harm-avoidance subscale and the incompleteness subscales both consist of 10 items rated on a 5-point Likert-type scale ranging from “never applies to me” to “always applies to me”. The harm avoidance and incompleteness subscales possess good convergent validity as well as good internal consistency with alpha coefficients of 0.91 and 0.93 respectively (Pietrefesa & Coles, 2008). Factor analysis of the questionnaire shows that the two constructs are separate but highly correlated (Summerfeldt, 2014). Preliminary support for the psychometric properties of the Icelandic version was established by Ólafsson et al. (2016). The alpha coefficients of both subscales was 0.91 and factor analysis supported a model with two correlated factors (Ólafsson et al., 2016).

Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) was used to measure OCD symptoms. The instrument is a 18 item self-report questionnaire with six subscales. Questions are rated on a 5-point Likert scale ranging from “not at all” to “extremely”. The possible range of scores is 0-72 with scores above 20 indicating a likely presence of OCD (Foa et al., 2002). The OCI-R has excellent psychometric properties that are similar to the original OCI scale. Internal consistency was high for the total score with alpha coefficient of 0.90 (Foa et al., 2002). Additionally the scale has demonstrated good convergent and divergent validity (Hajcak, Huppert, Simons & Foa, 2004). The psychometric properties of the Icelandic version of OCD-R are comparable to the original version (Smári, Ólason, Eyþórsdóttir & Frölunde, 2007).

The washing and contamination subscale of the *Padua Inventory-WSUR* (PI-WSUR; Burns, Keortge, Formea, Sternberger, 1996) was used to assess fear of contamination. The

subscale has 10 items rated on a 5-point Likert scale ranging from “not at all” to “very much”. The contamination subscale has demonstrated good internal reliability with alpha coefficient of 0.90 (Olatunji et al., 2007). The subscale has also demonstrated acceptable validity (Burns et al., 1996). The psychometric properties of the Icelandic translation of the PI-WSUR are acceptable (Jónsdóttir & Smári, 2000).

A *behavioral avoidance task* (BAT), constructed by the researchers, was used to measure approach and avoidance behaviors associated with potentially contaminating stimuli that can evoke both feeling of disgust and anxiety. The assignment consisted of eight steps and each step completed was recorded. Researchers emphasized that it was not obligatory to complete all steps. Subjects were asked to stand two meters from a cat litter box, filled with sand and artificial cat waste made out of chocolate, biscuits and syrup. Participants were then asked how much disgust they felt in that moment on a scale from 0 (no disgust at all) to 100 (the most disgust you can imagine). In addition they were asked how much anxiety or fear they experienced in that moment on a scale from 0 (no anxiety at all) to 100 (the most anxiety you can imagine). Participants were then given a plastic glove and asked to put it on. As a first step the subjects were asked to approach the litter box. If they completed the first step they were asked to take the lid of the box. When exposed to the cat waste, subjects were asked again how much disgust and anxiety or fear they felt on the scale from 0-100. In the third step, participants were asked to touch the outside of the box, while the researcher counted to five, wearing the plastic glove. The fourth step was identical to the one before, except subjects were asked to touch the inside of the box. In the fifth step, participants were asked to run their fingers through the sand in a corner containing no waste, wearing the plastic glove, while the researcher counted to five. In the sixth step subjects were asked to run their fingers through the sand where it contained waste, wearing the plastic glove, while the researcher counted to five. The seventh and eighth steps were identical to steps five and six except that participants were asked not to wear a glove. When participants had gone through all the steps they were willing to complete they were asked again to rate how much disgust and anxiety or fear they felt on the scale from 0-100. Next participants were offered to clean their hands using a wet wipe and told to take as many wipes as they thought was necessary. After they had finished cleaning their hands they were asked for the last time to rate how much disgust and anxiety or fear they felt in that moment on a scale from 0-100.

After completion of the behavioral avoidance task, participants were asked to answer a short 12 item BAT questionnaire constructed by the researchers, with questions focused on affective, cognitive and physical experiences during the task. Questions were answered on a 10 point Likert-type scale ranging from “not at all” to “very much”. The first 10 questions will not be used in the current study. Question 11 concerned the feeling of being contaminated, dirty or polluted and question 12 regarded the urge to wash when performing the task.

Procedure

The study was approved by the National Bioethics Committee and was reported to the Data Protection Authority. Before participating in the study participants were asked to read an information sheet before giving an informed consent for participation. Next participants filled in seven questionnaires; DPSS-R, HADS, OC-CDQ, OCI-R, PI-WSUR, NJRE-R and OBQ-R. The second part of the study was a computer task designed to measure habit learning. NJRE-R, OBQ-R and the data collected in the computer assignment will not be used in the present report. The third part of the study was the BAT and afterwards participants answered the BAT questionnaire. At last, participants were debriefed and received compensation for participation.

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS, 23). First correlations and reliability estimates were computed for the aforementioned measures. Next mediation analyses were performed with a SPSS macro for conditional process analysis (PROCESS v2.13). This program makes it possible to test two mediation variables simultaneously. In all analyses harm avoidance and incompleteness were mediator variables measured with self-report questionnaires. In the first analysis disgust was the independent variable and contamination fear the dependent variable, both measured with self-report questionnaires. In this analysis measures of anxiety and depression were used as covariates in the prediction of the outcome variable. In the last two analysis, two items from the BAT questionnaire (feelings of contamination, urge to wash) were used. At last a linear regression analysis was used to determine if disgust and anxiety predict feelings of contamination, urge to wash and behavioral avoidance on the BAT.

Results

1. Descriptive statistics and correlations between measures

Means, standard deviations and reliability estimates for all questionnaire measures were calculated as well as their inter correlations (see table 1). Internal reliability was satisfactory for all measures (>0.70) and the majority of the correlations were significant at the 0.01 level. Disgust (DPSS total score) was moderately correlated with contamination fear and the relationship persisted after controlling for anxiety and depression ($r=0.59$). Disgust was also moderately correlated with symptoms of OCD as well as with a measure of harm avoidance but a low correlation was found between disgust and incompleteness.

Table 1. Descriptive statistics, reliability estimates and correlations between self-report measures used in the study.

	1. DPSS _{tot}	2. DPSS _{prop}	3. DPSS _{sens}	4. PI _{cont}	5. HADS _{anx}	6. HADS _{dep}	7. OC-CDQ _{harm}	8. OC-CDQ _{inc}	9. OCI _{tot}
1.		.90**	.89**	.63**	.39**	.21 ^{ns}	.55**	.39**	.54**
2.			.60**	.54**	.28**	.10 ^{ns}	.46**	.36**	.46**
3.				.59**	.42**	.28*	.50**	.35**	.51**
4.					.32**	.28**	.56**	.46**	.69**
5.						.57**	.70**	.52**	.55**
6.							.55**	.30**	.34**
7.								.65**	.74**
8.									.71**
9.									
Mean	34.04	19.15	14.88	5.68	6.83	2.90	11.40	16.30	13.85
S.D.	9.53	5.38	5.28	6.19	4.24	2.87	7.90	7.74	11.92
Cronbach's α	0.89	0.86	0.80	0.91	0.87	0.77	0.91	0.89	0.92

Note. ^{ns} non significant; ** = $p < 0.01$; * = $p < 0.05$. DPSS_{tot} = Disgust Propensity Sensitivity Scale-Revised total score; DPSS_{prop} = Disgust Propensity Sensitivity Scale-Revised propensity scale score; DPSS_{sens} = Disgust Propensity Sensitivity Scale-Revised sensitivity scale score; PI_{cont} = Padua Inventory-WSUR washing and contamination subscale score; HADS_{anx} = Hospital Anxiety and Depression Scale anxiety scale score; HADS_{dep} = Hospital Anxiety and Depression Scale depression scale score; OC-CDQ_{harm} = Obsessive-Compulsive Core Dimensions Questionnaire harm avoidance scale score; OC-CDQ_{inc} = Obsessive-Compulsive Core Dimensions Questionnaire incompleteness scale score; OCI_{tot} = Obsessive Compulsive Inventory-Revised total score.

Table 2 displays descriptive statistics and inter correlations between the BAT, disgust and anxiety experienced during the BAT and the reported fear of contamination as well as the urge to wash during the BAT. The means displayed show that the feeling of disgust is low in the beginning of the BAT but increases considerably when participants are exposed to the cat waste. The feeling of disgust increases even further after completion of the BAT and declines substantially after washing. Repeated measures ANOVA was conducted with the four steps of the BAT as the independent variable and level of disgust as the dependent variable. The main effect of steps in the task was significant in this analysis ($F(3,255) = 39.808$, $p < .001$). Simple contrasts showed that

there was a significant difference in level of disgust between the first and second step as well as between the third and fourth step in the task ($p < .001$). There was not a significant difference between the second and third step ($p = .166$). The mean anxiety felt is higher than disgust at the beginning of the task and gradually declines throughout the assignment. Repeated measures ANOVA was conducted with the four steps of the BAT as the independent variable and level of anxiety as the dependent variable. The main effect of steps in the task was significant in this analysis ($F(3,255) = 7.950$, $p < .001$). Simple contrasts showed that there was not a significant difference in anxiety between the first and second step ($p = .838$) nor between the second and third ($p = .099$) but there was a significant difference in anxiety between the third and fourth step ($p < .001$). As displayed in table 2, disgust experienced after completion of the BAT had a moderate correlation with the reported fear of contamination and a low correlation with the reported urge to wash. Anxiety experienced after completion of the BAT had a low correlation with fear of contamination and a very low correlation with the reported urge to wash.

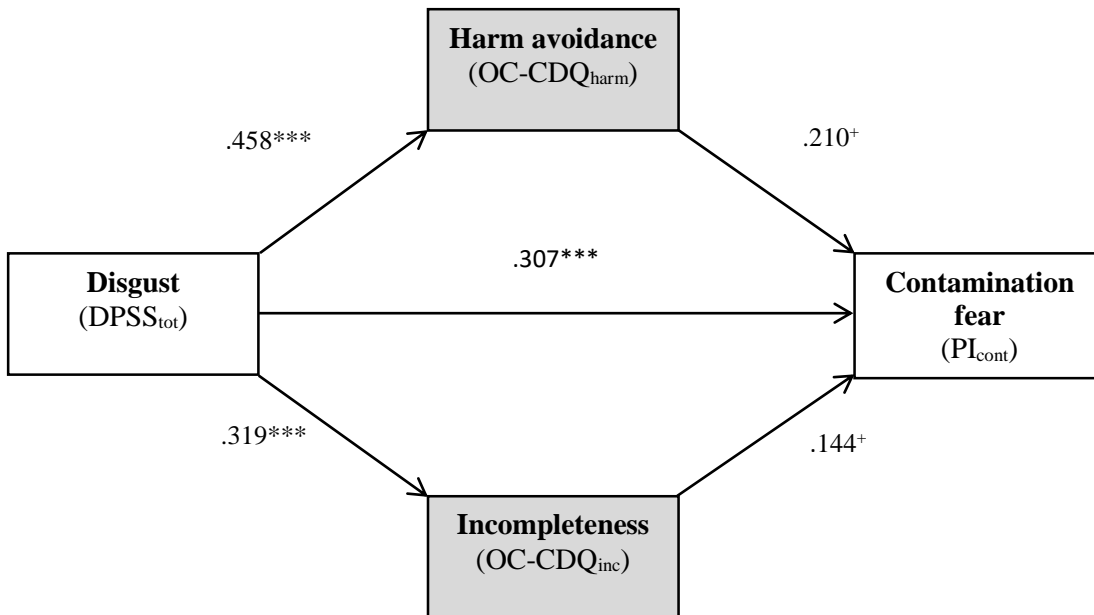
Table 2. Descriptive statistics and inter correlations for BAT measures.

	1. BAT	2. Disg1	3. Anx1	4. Disg2	5. Anx2	6. Disg3	7. Anx3	8. Disg4	9. Anx4	10. Cont _{fear}	11. Urge _{wash}
1.		-.11 ^{ns}	-.06 ^{ns}	-.48**	-.35**	-.43**	-.43**	-.42**	-.22*	-.21 ^{ns}	-.12 ^{ns}
2.			.39**	.29**	.28*	.07 ^{ns}	.10 ^{ns}	.23*	.10 ^{ns}	-.04 ^{ns}	-.02 ^{ns}
3.				.31**	.47**	.14 ^{ns}	.26*	.00 ^{ns}	.26*	.29**	.08 ^{ns}
4.					.54**	.75**	.45**	.49**	.33	.48**	.32**
5.						.50**	.81**	.18 ^{ns}	.18 ^{ns}	.38**	.20 ^{ns}
6.							.59**	.58**	.42**	.58**	.42**
7.								.25*	.70**	.48**	.22*
8.									.40**	.23*	.08 ^{ns}
9.										.40**	.20 ^{ns}
10.											.64**
11.											
Mean	6.80	2.27	9.14	18.27	8.92	20.52	7.21	6.88	2.74	1.21	3.14
S.D.	1.32	8.64	14.55	19.95	15.39	22.34	14.77	12.43	5.54	2.22	3.06

Note. ^{ns} non significant; ** = $p < 0.01$; * = $p < 0.05$. BAT = Behavioral avoidance task score; Disg1 = Disgust felt in beginning of BAT; Anx1 = Anxiety felt in beginning of BAT; Disg2 = Disgust felt when exposed to cat waste; Anx2 = Anxiety felt when exposed to cat waste; Disg3 = Disgust felt after completing the BAT; Anx3 = Anxiety felt after completing the BAT; Disg4 = Disgust felt after washing; Anx4 = Anxiety felt after washing. Cont_{fear} = fear of contamination during the BAT; Urge_{wash} = The urge to wash during the BAT.

2. Mediation analyses.

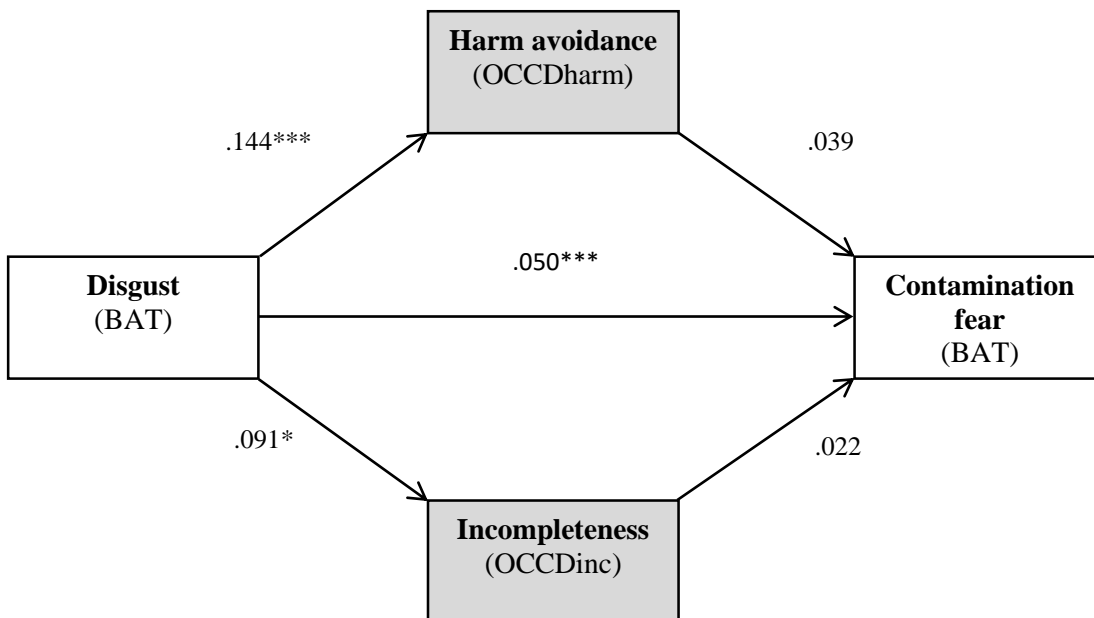
A mediation analysis was conducted with harm avoidance and incompleteness as mediators. These results are presented in Figure 1. In this first mediation analysis all constructs were measured using self-report questionnaires. The results show both a direct and indirect effect of disgust on contamination fear. Both harm avoidance and incompleteness are independent mediators of the indirect effect of disgust on contamination fear.



Total effect of Disgust on Contamination fear = .390***
Total indirect effect of Disgust on Contamination fear = .142 (.038; .310)
Indirect effect through Harm avoidance = .096 (.001; .228)
Indirect effect through Incompleteness = .046 (.004; .126)
HADS anxiety and depression scores were used as covariates in the analysis (data not shown)
***p<.001; *p<.10

Figure 1. Harm avoidance and incompleteness as mediators of the relationship between disgust and contamination fear measured with questionnaires.

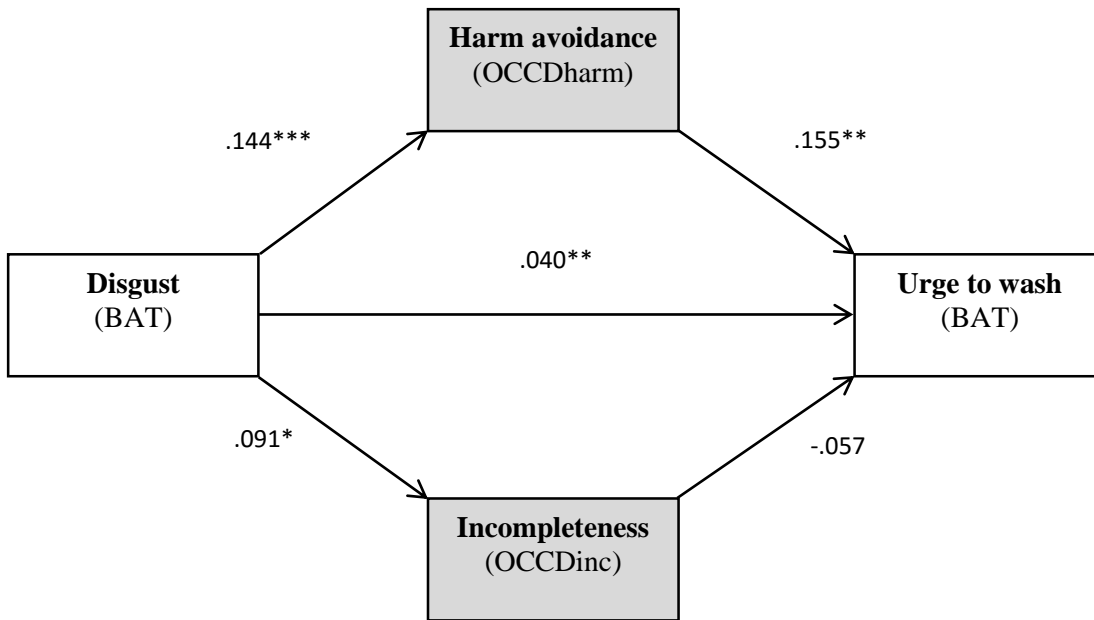
A second mediation analysis was conducted with disgust experienced after completion of the BAT and contamination fear measured during the BAT. However, questionnaire measures of harm avoidance and incompleteness were mediators as in the previous analysis. Figure 2 shows that disgust during the BAT had a direct effect on fear of contamination during the BAT but no indirect effect on contamination fear was observed. Neither harm avoidance nor incompleteness emerged as significant mediators.



Total effect of Disgust on Contamination fear = .057***
 Total indirect effect of Disgust on Contamination fear = .008 (-.0004; .0223)
 Indirect effect through Harm avoidance = .006 (-.0029; .0197)
 Indirect effect through Incompleteness = .002 (-.0028; .0121)
 ***p<.001; *p<.05

Figure 2. Harm avoidance and incompleteness as mediators of the relationship between disgust and contamination fear measured with a BAT.

A third mediation analysis was conducted with harm avoidance and incompleteness as mediators. Experienced disgust after completion of the BAT and urge to wash during the BAT were the independent and dependent variables respectively. Figure 3 shows that disgust has both a direct and indirect effect on urge to wash during the task. In addition the results show that harm avoidance but not incompleteness mediates this indirect effect.



Total effect of Disgust on the Urge to wash = .057***
 Total indirect effect of Disgust on the Urge to wash = .017 (.005; .035)
 Indirect effect through Harm avoidance = .022 (.008; .044)
 Indirect effect through Incompleteness = -.005 (-.019; .002)
 ***p<.001; **p<.01; *p<.05

Figure 3. Harm avoidance and incompleteness as mediators of the relationship between disgust and the urge to wash measured with a BAT.

3. The role of disgust in contamination fear, urge to wash and avoidant behavior.

The specific contribution of the feeling of disgust and anxiety in predicting contamination fear following a disgust specific BAT was assessed in regression analysis. In the analysis (1) age and biological sex were entered first, followed by (2) anxiety and disgust after completion of the BAT. Age was not a significant predictor of sensation of contamination in the first step ($\beta = -.14$, $t = -1.25$, $p = .213$) and the same applies to biological sex ($\beta = .16$, $t = 1.44$, $p = .154$). When controlling

for variance explained by biological sex, age and disgust, anxiety was a significant predictor of contamination fear ($\beta = .23, t = 2.03, p = .046$). Likewise when controlling for variance explained by biological sex, age and anxiety, disgust was a significant predictor of contamination fear ($\beta = .41, t = 3.45, p = .001$). Thus, both anxiety and disgust predict fear of contamination during the BAT, but disgust is a stronger predictor.

A second regression analysis was performed to examine the specific contribution of the feeling of disgust and anxiety in predicting urge to wash following the BAT. In the analysis (1) age and biological sex were entered first, followed by (2) anxiety and disgust felt after completion of the BAT. Age was not a significant predictor of the urge to wash in the first step ($\beta = .22, t = 1.98, p = .051$) nor was biological sex ($\beta = -.12, t = -1.06, p = .291$). Controlling for biological sex, age and disgust, anxiety was not a significant predictor of the urge to wash ($\beta = -.03, t = -.24, p = .813$). However when controlling for biological sex, age and anxiety, disgust was a significant predictor of the urge to wash ($\beta = .39, t = 2.91, p = .005$).

The specific contribution of disgust and anxiety in predicting avoidant behavior in a disgust specific BAT (steps completed) was assessed with a regression analysis. In the analysis (1) age and biological sex were entered first, followed by (2) disgust and anxiety felt when exposed to disgust evoking stimuli. Results showed that age was not a significant predictor of avoidant behavior ($\beta = -.21, t = -1.89, p = .062$) and neither was biological sex ($\beta = .15, t = 1.34, p = .183$). Controlling for biological sex, age and anxiety, disgust was a significant predictor of avoidant behavior ($\beta = -.33, t = -2.61, p = .011$). Anxiety was not a significant predictor of avoidant behavior when controlling for biological sex, age and disgust ($\beta = -.18, t = -1.46, p < .148$).

Discussion

The present study shows that disgust contributes to contamination fear. To begin with, the positive relationship found between disgust and contamination fear held when controlling for anxiety and depression. This is in line with growing literature demonstrating a correlation between these constructs (Olatunji et al., 2007). It further supports research results showing that the association between disgust and contamination fear is independent of anxiety and depression (Mancini et al., 2001).

One aim of the current project was to examine if the OCD motivational dimensions harm avoidance and incompleteness mediate the association between disgust and contamination fear.

Mediation analysis using self-report measures showed that part of the total effect of disgust on contamination fear could be explained with incompleteness and harm avoidance. Thus, it may be that individuals with contamination OCD carry out their compulsions with the purpose to avoid both possible harm and to reduce feelings of incompleteness. This indicates that contamination-related OCD is driven by a cognitively biased risk assessment as well as being sensory affective in nature. The mediating role of incompleteness found in the present study is in line with results from Ólafsson et al. (2016) as well as earlier research showing an association between incompleteness and washing behavior (Pietrefesa & Coles, 2008; Cougle et al., 2011). In addition, the mediating role of harm avoidance is in agreement with findings by Olatunji et al. (2009) revealing a mediating role of harm avoidance in a broad range of psychopathological symptoms.

However, when using measures from the BAT, mediation analysis showed that neither incompleteness nor harm avoidance explained the total effect of disgust on contamination fear. In addition, harm avoidance but not incompleteness explained the total effect of disgust on the urge to wash. The inconsistent findings between self-report and BAT measures may be because the mediating effect is attributable to the self-report measurement method rather than the constructs the measures are supposed to represent. Thus, avoiding possible harm and a feeling of incompleteness might not actually mediate the relationship between disgust and contamination fear in experimental settings. Another possible explanation for the inconsistent results may be that the BAT measures of disgust and contamination fear were not sensitive and comprehensive enough to capture that incompleteness together with harm avoidance mediate the relationship between disgust and contamination fear.

Another aim was to test in an experimental setting if disgust contributes to contamination fear. Our results demonstrate that disgust is a stronger predictor of contamination fear than anxiety. In addition it was demonstrated that disgust, but not anxiety, is a predictor of the urge to wash. Therefore it is possible that individuals with contamination OCD perform their compulsions in order to reduce a sensation of disgust rather than to get rid of their anxiety or fear. It may be that washing compulsions are not the result of fear of one's health but rather are fixated on eliminating a feeling that one is dirty and disgusting. These results are in agreement with research by Cisler et al (2007) showing that anxiety and disgust predict contamination fear independently of each other as well as research by Mancini et al (2001) showing that disgust was the best predictor of washing behavior. At last consistent with previous research (Deacon & Olatunji, 2007; Olatunji et al., 2007)

the present findings showed that disgust but not anxiety was a predictor of avoidant behavior in the BAT. Thus it might be that avoidant behavior prominent among contamination-OCD patients is the result of a feeling of disgust.

The current study has several methodological limitations that should be acknowledged. First, the sample was fairly homogeneous consisting entirely of university students. The lack of diversity might limit the external validity of the current project. Another limitation concerns the questions regarding disgust and anxiety experienced during the BAT. Participants may have interpreted the scale from 0-100 in different ways, where one person might interpret a score of 30 to represent high feelings of disgust or anxiety while another might interpret that same score to represent fairly little disgust or anxiety. It may be advisable that prospective studies use additional questions to the ones used in the present study to measure contamination fear following the BAT as well as a clinical sample to further clarify the role of disgust in contamination fear. In addition it is preferable that experimental measures of harm avoidance and incompleteness are used to examine the mediating role of these constructs more closely.

To sum up, previous research have mainly examined the relationship between disgust and contamination fear using self-report measures and how they predict outcome on BATs. The current study replicates and extends previous research findings by including measures of disgust and anxiety experienced while participants perform the BAT. Furthermore, with these additional measures the current study underlines prior findings that disgust contributes to contamination fear. These results have implications for the treatment of contamination related OCD as they indicate that disgust plays a significant role in the disorder which is inherently different from anxiety. For example decreased disgust propensity has been shown to mediate improvement in OCD symptoms (Olatunji, Tart, Ciesielski, McGrath & Smits, 2011). Thus, compulsions associated with contamination fear can be motivated by disgust reactions.

References

- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washinton DC: American Psychiatric Association.
- Burns, G. L., Keortge, S. G., Formea, G. M., & Sternberger, L. G. (1996). Revision of the padua inventory of obsessive compulsive disorder symptoms: Distinctions between worry, obsessions, and compulsions. *Behaviour Research and Therapy*, 34, 163-173.
- Carr, A. T. (1974). Compulsive neurosis: A review of the literature. *Psychological Bulletin*, 81, 311-318.
- 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, 439-448.
- Cisler, J. M., Olatunji, B. O., & Lohr, J. M. (2009). Disgust, fear, and the anxiety disorders: A critical review. *Clinical Psychology Review*, 29, 34-46.
- Cisler, J. M., Reardon, J. M., Williams, N. L., & Lohr, J. M. (2007). Anxiety sensitivity and disgust sensitivity interact to predict contamination fears. *Personality and Individual Differences*, 42, 935-946.
- Coles, M. E., Frost, R. O., Heimberg, R. G., & Rhéaume, J. (2003). “Not just right experiences”: Perfectionism, obsessive– compulsive features and general psychopathology. *Behaviour Research and Therapy*, 41, 681-700.
- Cougle, J. R., Goetz, A. R., Fitch, K. E., & Hawkins, K. A. (2011). Termination of washing compulsions: A problem of internal reference criteria or ‘not just right’ experience? *Journal of Anxiety Disorders*, 25, 801-805.
- Davey, G. C. L. (2011). Disgust: The disease-avoidance emotion and its dysfunctions. *Philosophical Transactions of the Royal Society B-Biological Sciences*, 366, 3453-3465.
- Deacon, B., & Olatunji, B. O. (2007). Specificity of disgust sensitivity in the prediction of behavioral avoidance in contamination fear. *Behaviour Research and Therapy*, 45, 2110-2120.

- 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*, 485-496.
- Gibbs, N. A. (1996). Nonclinical populations in research on obsessive-compulsive disorder: A critical review. *Clinical Psychology Review, 16*, 729-773.
- Goetz, A. R., Lee, H. J., Coughle, 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*, 412-419.
- Grant, J. E. (2014). Obsessive-compulsive disorder. *The New England Journal of Medicine, 371*, 646-653.
- Hajcak, G., Huppert, J. D., Simons, R. F., & Foa, E. B. (2004). Psychometric properties of the OCI-R in a college sample. *Behaviour Research and Therapy, 42*, 115-123.
- Hermann, C. (1997). International experiences with the hospital anxiety and depression scale - a review of validation data and clinical results. *Journal of Psychometric Research, 41*, 17-41.
- Jónsdóttir, S. D., & Smári, J. (2000). Measuring obsessions without worry: Convergent and discriminant validity of the revised padua inventory in an Icelandic student population. *Scandinavian Journal of Behaviour Therapy, 29*, 49-56.
- 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*, 1173-180.
- Olatunji, B. O., Cisler, J., McKay, D., & Phillips, M. L. (2010). Is disgust associated with psychopathology? Emerging research in the anxiety disorders. *Psychiatry Research, 175*, 1-10.
- Olatunji, B. O., Cisler, J. M., Deacon, B. J., Conolly, 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*, 918-930.

- 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, 263-276.
- Olatunji, B. O., Tart, C. D., Ciesielski, B. G., McGrath, P. B., & Smits, J. A. J. (2011). Specificity of disgust vulnerability in the distinction and treatment of OCD. *Journal of Psychiatric Research*, 45, 1236-1242.
- Olatunji, B. O., Unoka, Z. S., Beran, B. D., & Armstrong, T. (2009). Disgust sensitivity and psychopathological symptoms: Distinctions from harm avoidance. *Journal of Psychopathology and Behavioural Assessment*, 31, 137-142.
- Ólafsson, R. P., Emmelkamp, P. M. G., Ólason, D. Þ., & Kristjánsson, Á. (2016). *Disgust and fear of contamination: The mediating role of harm avoidance and incompleteness*. Unpublished manuscript, Department of Psychology, University of Iceland, Reykjavík, Iceland.
- Pietrefesa, A. S., & Coles, M. E. (2008). Moving beyond an exclusive focus on harm avoidance in obsessive compulsive disorder: Considering the role of incompleteness. *Behavior therapy*, 39, 224-231.
- Rachman, S. (1997). A cognitive theory of obsessions. *Behaviour Research and Therapy*, 35, 793-802.
- Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, 40, 625-639.
- Rachman, S. (2004). Fear of contamination. *Behaviour Research and Therapy*, 42, 1227-1255.
- Salkovskis, P. M. (1999). Understanding and treating obsessive-compulsive disorder. *Behaviour Research and Therapy*, 37, 29-52.
- Smári, J., Gylfadóttir, T., & Halldórsdóttir, G. L. (2003). Responsibility attitudes and different types of obsessive-compulsive symptoms in a student population. *Behavioural and Cognitive Psychotherapy*, 31, 45-55.

- Smári, J., Ólason, D. T., Eyþórsdóttir, Á., & Frölunde, M. (2007). Psychometric properties of the obsessive compulsive inventory-revised among Icelandic college students. *Scandinavian Journal of Psychology*, 48, 127-133.
- Smári, J., Ólason, D. Þ., Arnarson, Þ. Ö., & Sigurðsson, J. F. (2008). Mælitæki fyrir þunglyndi fullorðinna sem til eru í íslenskri gerð: Próffræðilegar upplýsingar og notagildi. *Sálfræðiritið- Tímarit Sálfræðingafélags Íslands*, 13, 147-169.
- Steinarsson, B. S. (2014). *Próffræðilegir eiginleikar íslenskrar þýðingar disgust propensity and sensitivity scale*. Unpublished BS-thesis: University of Iceland.
- Summerfeldt, L. J. (2004). Understanding and treating incompleteness in obsessive-compulsive disorder. *Journal of Clinical Psychology*, 60, 1155-1168.
- Summerfeldt, L. J., Kloosterman, P. H., Antony, M. M., & Swinson, R. P. (2014). Examining an obsessive-compulsive core dimensions model: Structural validity of harm avoidance and incompleteness. *Journal of obsessive-compulsive and related disorders*, 3, 83-94.
- Tallis, F. (1996). Compulsive washing in the absence of phobic and illness anxiety. *Behaviour Research and Therapy*, 34, 361-362.
- Tsao, S. D., & McKay, D. (2004). Behavioral avoidance tests and disgust in contamination fears: Distinctions from trait anxiety. *Behaviour Research and Therapy*, 42, 207-216.
- van Overveld, W. J. M., de Jong, P. J., Peters, M. L., Cavanagh, K., & Davey, G. C. L. (2006). Disgust propensity and disgust sensitivity: Separate constructs that are differentially related to specific fears. *Personality and Individual Differences*, 47, 1241-1252.
- Whiteside, S. P., & Abramowitz, J. S. (2004). Obsessive-compulsive symptoms and the expression of anger. *Cognitive Therapy and Research*, 28, 259-268.
- Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, 67, 361-370.