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Running head: DISGUST DOMAINS AND CONTAMINATION FEAR IN OCD

Different disgust domains specifically relate to mental and contact contamination fear in obsessive-compulsive disorder: evidence from a path analytic model in an Italian clinical sample

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Abstract

Both contact contamination (CC) and mental contamination (MC) fears – which combined represent the most common manifestation of obsessive-compulsive disorder (OCD) - have been widely associated with disgust propensity (DP). However, extant research explored this relationship using measures assessing only pathogen-related disgust, not taking into account the potential role played by sexual and moral disgust, despite literature about MC suggesting that this might be particularly relevant. In Study 1 the psychometric properties of the Italian version of the Three Domains of Disgust Scale (TDDS) were assessed in a large Italian community sample. Exploratory and confirmatory factor analyses confirmed the three-factor structure of the TDDS. The scale also showed good internal consistency and construct validity. In Study 2, the differential patterns of relationships between CC and MC and the three disgust domains were explored in an Italian clinical OCD sample using a path analytic approach. The TDDS-Pathogen subscale was a unique predictor of CC while the TDDS-Sexual subscale was a unique predictor of MC, after controlling for anxiety and depression. Surprisingly, the TDDS-Moral subscale was not a predictor of either domain of contamination fear. Limitations and clinical implications are discussed.

Keywords: obsessive-compulsive disorder; disgust; disgust propensity; contamination fear; mental contamination

Introduction

Obsessive compulsive disorder (OCD) is a severe psychopathological disorder characterized by the occurrence of repetitive thoughts, urges, or images, which are experienced as intrusive and unwanted (i.e., obsessions), and by behaviors that the individual feels the need to perform (compulsions), which are aimed at preventing or reducing anxiety or distress, or preventing some undesired event or situation entailed by the obsession (American Psychiatric Association, 2013). The rates of the disorder are similar around the world, although there may be regional biases towards particular forms of OCD such as those involving contamination (Nedeljkovic, Moulding, Foroughi, Kyrios, & Doron, 2012).

Among the OCD symptom dimensions, only Contamination and, to a lesser extent, Symmetry (but not Responsibility for harm and mistakes and Unacceptable thoughts) dimensions were found to be significantly and moderately correlated with disgust propensity (DP; David et al., 2009; Melli, Chiorri, Carraresi, Stopani, & Bulli, 2015c; Olatunji, Williams, Lohr, & Sawchuk, 2005; Schienle, Stark, Walter, & Vaitl, 2003). Contamination-related OCD (C-OCD) is consistently found to be a distinct symptom dimension of OCD (Bloch, Landeros-Weisenberger, Rosario, Pittenger, & Leckman, 2008), and it is the most common symptom manifestation of OCD (Foa et al., 1995; Rasmussen & Eisen, 1992). Contamination-related obsessions are accompanied by compensatory behaviors (e.g., washing, cleaning, checking) designed to remove the contaminant and to protect the individual from threat of illness and other negative outcomes. A large body of research has underlined the role of DP in C-OCD; (David et al., 2009; Olatunji et al., 2005; Olatunji, Sawchuk, Lohr, & de Jong, 2004; Schienle et al., 2003), in particular using the Dimensional Obsessive-Compulsive Scale (DOCS; Abramowitz et al., 2010; Melli et al., 2014b) and its Contamination subscale (Melli et al., 2017a; Melli et al., 2014b; Melli et al., 2015c; Melli, Chiorri, Stopani, Bulli, & Carraresi, 2017c; Melli, Moulding, & Poli, 2016; Olatunji et al., 2010), highlighting the relevant role of DP in contact contamination fear.

In general, contamination fear is considered to be the fear of coming into direct or indirect contact with a person or item that is perceived to be dirty or harmful (i.e., contact contamination; Rachman, 2004). However, as described by Rachman (2004), contamination can also occur in the absence of contact with an external object (mental contamination; e.g., by merely observing or thinking about something unclean, immoral or undesirable). Rachman (2004, 2006) described some of the main differences between these two kinds of contamination as including the nature of the contamination process (resulting from physical contact vs. occurring in the absence of direct contact), the effectiveness of washing (washing is helpful when the contaminant is physical, but ineffective when it is not), the perceived source (a known and tangible source for contact contamination vs. an intangible and obscure source for mental contamination), the kind of source (inanimate dirty/harmful substances for contact contamination vs. usually human persons for mental contamination), the vulnerable persons (self and others for contact contamination vs. uniquely self for mental contamination), and the range of contamination provocations (dirt, germs or harmful substances vs. thoughts, memories, betrayal, etc.). Nearly all previous research on contamination fear has focused on contact contamination; as such, an examination of contamination fears and their relationships with disgust is both timely and important.

Research has recently demonstrated that the tendency to experience disgust is also related to mental contamination (MC; Fairbrother, Newth, & Rachman, 2005; Herba & Rachman, 2007; Radomsky, Rachman, Shafran, Coughtrey, & Barber, 2014; Travis & Fergus, 2015). MC was a partial mediator of DP effects in triggering contamination fear (Carraresi, Bulli, Melli, & Stopani, 2013; Melli, Bulli, Carraresi, & Stopani, 2014a), and, in particular, of contamination fear based upon disgust avoidance (Melli et al., 2017a). Furthermore, DP has been shown to be a unique predictor of MC following sexual trauma (Badour, Feldner, Babson, Blumenthal, & Dutton, 2013; Badour, Ojserkis, McKay, & Feldner, 2014). Overall, these studies highlight the relevant role of DP in the expression of MC as well.

Disgust has been conceptualized as a basic emotion with an associated negative valence that facilitates a rejection or revulsion response that is implemented in order to promote behavior that reduces the probability of exposure to pathogens (Davey, 1994; Olatunji & Sawchuk, 2005). However, as other lines of disgust research have underlined, sexual concepts (Borg, de Jong, & Schultz, 2010) and non-infectious social transgressions (Cannon, Schnall, & White, 2011) are able to elicit disgust as well. Over the past two decades, the theoretical model proposed by Rozin, Haidt and McCauley has become the gold standard in the field (Haidt, McCauley, & Rozin, 1994; Rozin, Haidt, & McCauley, 2016). This model proposes that the disgust system evolved from a toxin-based food-rejection system (distaste) that motivates pathogen avoidance and comprises four domains: core disgust (e.g., revulsion towards food, animals and body products), animal reminder disgust (e.g., aversion towards sex, corpses, bad hygiene and body envelope violations), interpersonal disgust (e.g., rejection for contact with strangers or undesirable individuals) and moral disgust (e.g., aversion towards moral violations protecting social order) (Rozin et al., 2016). This also led to the development of the 32-item Disgust Scale (DS; Haidt et al., 1994). Subsequent suggestions for the refinement of the DS, consisting of the removal of seven items, including the four sexual disgust items, led to the development of the DS-Revised (Olatunji et al., 2007b).

Considering the key shortcomings of the model theorized by Haidt and colleagues, Tybur and colleagues (Tybur, Lieberman, & Griskevicius, 2009; Tybur, Lieberman, Kurzban, & DeScioli, 2013) proposed a recent functional model, conceived within an evolutionary framework, in which the emerging function of disgust developed as a protective mechanism related to food rejection but subsequently, additional functions evolved to preserve organisms from other types of stimuli. The authors proposed three evolutionarily adaptive domains of DP, including: 1) pathogen disgust (e.g., aversion towards pathogens that may increase the chance of getting ill); 2) sexual disgust (e.g., aversion of sexual partners and behaviors that would jeopardize one's long-term reproductive success); and 3) moral disgust (e.g., aversion towards individuals who transgress moral norms, threatening the integrity of critical social networks and social structures).

Pathogen disgust serves the rejection of invisible physical contagious agents from contamination of the body, and is elicited by stimuli related to body products and rotten foods, thus facilitating the disease-avoidance purpose. Through the stimulation of the urge to avoid the disgusting cue, pathogen disgust likely facilitates the withdrawal from the physical contact or ingestion of pathogens (Curtis, de Barra, & Aunger, 2011; Oaten, Stevenson, & Case, 2009). Since body wounds, exchange of bodily fluids and physical proximity increase the opportunity for the transmission of pathogens, sexual behavior obviously represents a risk for the transmission of disease. Accordingly, there is a high probability that pathogen disgust may arise during sex.

Conversely, sexual disgust is not implied in any risk related to sex, but specifically refers to disgust elicited by potential sexual partners. Intrinsic mating quality and genetic compatibility may elicit sexual disgust towards potential sex partners as an evolved solution to the adaptive problem of avoiding biologically costly mates and sexual behaviors. A mate's intrinsic quality is expressed by features regarding objective physical attractiveness, such as body symmetry, facial attractiveness, body shape (e.g., Thornhill & Gangestad, 2006), regardless of genetic compatibility. Instead, genetic compatibility is referred to as a potential partner's genetic similarity to oneself – rather than intrinsically low genetic quality – which is regulated by factors such as major histocompatibility complex (Jan Ejsmond, Radwan, & Wilson, 2014) and genetic similarity (e.g., siblings, parents, offspring). Both mates' intrinsic qualities and genetic compatibility can reduce reproductive success, and observing such physical features (e.g., bodily deformations, extreme obesity) in a potential sex partner may elicit sexual disgust, evolved to facilitate avoidance of sexual partners and behaviors that may jeopardize long-term reproductive success (Tybur et al., 2009; 2013).

Considering the results found by Badour and colleagues, where DP was a unique significant predictor of MC, and that in MC the perceived contaminant is expected to be of human origin, sexual disgust may exhibit a stronger relationship with MC than with contact contamination. In addition, it has been recently shown that high levels of sexual disgust were associated with a

reduced number of sex partners and that individuals with high levels of moral disgust were more likely to show moral behavior towards sex partners (Zhang, Zheng, & Zheng, 2017).

Finally, witnessing others' moral transgressions may elicit a moral form of disgust in observers, evolved to protect the integrity of critical social networks and social structures (Tybur et al., 2009; 2013). When elicited in witnesses, moral disgust would serve to coordinate condemnation of particular acts committed by transgressors that may threaten individuals' social integrity. When elicited in the actors, moral disgust may activate already internalized sociomoral rules and increase their stringency (Wheatley & Haidt, 2005), helping the actor prevent future infringements of social norms. Moral disgust may be also elicited by sexual behaviors that infringe important sociomoral rules. Relying on stringent sociomoral standards would increase the probability that a particular sexual behavior will be experienced as a transgression and will evoke moral disgust directed to the self, to the witnessed behavior or to the transgressor (Koukounas & McCabe, 1997).

Consistent with a three-factor model, Tybur and colleagues introduced a new measure of DP, the Three Domains of Disgust Scale (TDDS; Tybur et al., 2009), showing that factor analyses divided DP into domains related to pathogens, sexuality, and morality. Olatunji and colleagues (2012) supported the three-factor model and found evidence for the validity of the pathogen and sexual disgust subscales, along with strong associations with contamination subscale of the Padua Inventory (Burns, Keortge, Formea, & Sternberger, 1996), while the validity of the moral disgust subscale was found to be limited. Subsequently, Olatunji, Ebesutani, & Kim (2015) highlighted that TDDS items are highly multidimensional and that a general disgust dimension is able to explain half of the variability in the items of the total score while the remaining variability is explained by the specific disgust domains and other sources of variance. Interestingly, pathogen disgust showed the most significant relationship with an obsessive-compulsive disorder (OCD) symptom latent factor above and beyond the general disgust factor.

Unfortunately, a large amount of research that has studied the role of DP in contact contamination or in MC used the Disgust Scale-Revised (DS-R; Melli, Chiorri, & Smurra, 2013;

Olatunji et al., 2007b) or the Disgust Propensity Questionnaire (DPQ; Melli et al., 2017c) that mainly investigate pathogen disgust, not taking into account the roles of sexual and moral disgust (Tybur et al., 2009; 2013). Nevertheless, there is evidence supporting the notion that MC can be either triggered (Elliott & Radomsky, 2009; Fairbrother et al., 2005; Herba & Rachman, 2007; Radomsky & Elliott, 2009) or re-evoked (Badour et al., 2013; Fairbrother & Rachman, 2004) by mental images or thoughts related to betrayal or immorality (e.g., Elliott & Radomsky, 2009; 2012; Fairbrother et al., 2005; Herba & Rachman, 2007; Rachman, Radomsky, Elliott, & Zysk, 2012). Furthermore, Rachman (2004; 2006) hypothesized that sexual assaults were likely to result in MC and basic research has often linked sexuality and appraisals of disgust/self-disgust and contamination, and morality/immorality (de Jong & Borg, 2015). These findings suggest that moral and sexual disgust may be mainly implicated in both clinical and nonclinical manifestations of MC (Radomsky, Coughtrey, Shafran, & Rachman, 2018).

To our knowledge, no study to date has evaluated the possible differential roles of pathogen, sexual and moral disgust in contact contamination and mental contamination; we propose that identifying specific disgust predictors of contact and mental contamination would be helpful in directing clinical treatment, as they are likely to be of use to therapists interested in novel targets in the treatment of those struggling with contamination fears. Study 1 was designed to assess the factor structure, reliability and construct validity of the TDDS in a large Italian non-clinical sample. Study 2 was carried out to examine which domains of the TDDS, using a path analysis approach, were able to differentially predict mental and contact contamination fear in a heterogeneous clinical OCD sample. The following were hypothesized: (1) pathogen disgust would relate more strongly with contact contamination fear, while sexual and moral disgust would relate more strongly with mental contamination; and (2) pathogen disgust would be a major predictor of contact contamination fear, while sexual and moral disgust would be a major, unique predictor of mental contamination, independent of negative mood.

Study 1

Material and methods

PARTICIPANTS

The sample consisted of 1077 (56.9% Female) community participants ($M = 37.78$ years; $SD = 14.50$; range 16-83) who responded to advertisements requesting potential volunteers for psychological studies in Central Italy. In terms of education, 52.8% of the participants had a medium level of education (12-13 years, high school degree), 33.5% had a higher-level degree (16 or more years, bachelor's degree or Ph.D.) and the remaining 13.7% had a low level of education (8 or less years, primary or secondary school). Most were employed (51.9%), 26.4% were undergraduate university students, and the remaining 21.7% were housemakers, unemployed, or retired. Regarding marital status, 44.7% were single, while 49.0% were married or cohabiting, 4.4% were divorced, and 1.9% were widows or widowers.

MEASURES

Three Domains of Disgust Scale (TDDS; Tybur et al., 2009). This 21-item self-report scale investigates DP on three subscales: pathogen disgust, sexual disgust and moral disgust. Participants are asked to rate each item on a six-point Likert scale from 0 ('not at all') to 7 ('extremely disgusting'). The original version of the scale showed a tri-factorial structure in different samples and good psychometric properties. The Italian translation of the TDDS was carried out through a mixed forward- and back-translation procedure (Behling & Law, 2000). The authors and one bilingual Italian-English psychologist independently translated the English version of the TDDS into Italian. After consensus among translators was achieved, an Italian-English researcher blind to the original version translated this preliminary version back into English. Discrepancies emerging from this back-translation were discussed with the primary original author of the scale until a consensus was reached on the final formulation of the items. In addition, before being used in this study, the newly developed Italian version of the TDDS was administered to ten naïve participants in order to check the understandability of the items, which were all found to be easy to understand and to respond to.

Disgust Propensity Questionnaire (DPQ; Melli et al., 2017c). This nine-item scale was recently developed to assess individual disgust propensity in Italian samples. Participants are asked to rate each item on a five-point Likert scale ranging from 0 ('not at all') to 4 ('very much'). The scale was found to have a one-factor structure, good internal consistency ($\alpha = .85$), adequate test-retest reliability (ICC = .85) and construct validity (e.g., correlation with the DS-R = .69). In the current study, this scale showed good internal consistency ($\alpha = .88$).

Guilt Sensitivity Questionnaire (GSQ; Melli, Carraresi, Poli, Marazziti, & Pinto, 2017b). This ten-item self-report measure has been recently developed to assess guilt sensitivity (the extent to which the experience of guilt is negatively evaluated by the individual) in Italian samples. Response choices are scored from 1 ('strongly agree') to 5 ('strongly disagree') and total scores range from 11 to 55. The scale was found to have a one-factor structure, excellent internal consistency ($\alpha = .91$) and construct validity. In the present study internal consistency was also excellent ($\alpha = .91$).

Depression Anxiety Stress Scales-21 (DASS-21; Antony, Bieling, Cox, Enns, & Swinson, 1998; Clara, Enns, & Cox, 2001). This 21-item scale is the short version of the DASS (Lovibond & Lovibond, 1995), a self-report questionnaire listing negative emotional symptoms. It has three subscales measuring depression, anxiety and stress. Participants rated how often a particular symptom was experienced in the previous week on a scale ranging from 1 ('did not apply to me at all') to 4 ('applied to me most of the time'). The original DASS-21 has shown good psychometric properties and its Italian version (Bottesi et al., 2015) has replicated the three-factor structure of the original version and has shown adequate internal consistency (α 's in the range .74-.92), test-retest reliability (r 's in the range .64-.74), and construct validity. In the current study all the subscales showed good internal consistency (α 's between .84 and .90).

PROCEDURE

All participants volunteered to take part in the study after being presented with a detailed description of the procedure, signed a written consent form and were treated in accordance with the Ethical Principles of Psychologists and Code of Conduct (American Psychological Association,

2010). All participants completed the TDDS, and the questionnaire took between 3 and 10 minutes to be completed. A subsample of 540 participants completed all the aforementioned measures. The batteries took between 10 and 25 minutes to be completed. The scales were administered in counterbalanced fashion to control for order and sequence effects. No external incentives were offered for participating in this study.

Results

FACTOR STRUCTURE

The factor structure of the TDDS was investigated through a cross-validation procedure. The sample was randomly divided into two sub-groups using the SPSS 18.0 “random sample of cases” function with the sub-group size set at “approximately 50%”. An exploratory (common) factor analysis (EFA) was carried out using data from one sub-group ($n = 540$); a confirmatory factor analysis (CFA) was then performed using data from the second sub-group ($n = 537$).

Since a substantial number of items in both subgroups showed values of skewness and kurtosis that fell outside the $[-1; +1]$ range recommended by (Muthén & Kaplan, 1985) for using maximum likelihood estimator (see Table 1), factor analyses were performed in Mplus 6.1 using the mean and variance adjusted weighted least squares estimator (WLSMV; Muthén, duToit, & Spisic, 1997). When using WLSMV estimator, Mplus 6.1 provides fit indices for EFA analogous to those of CFA, i.e., the Tucker-Lewis Index (TLI) the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA). Following Marsh, Wen, & Hau (2004), values $\geq .90$ were considered as adequate and $\geq .95$ as optimal for the TLI and the CFI, and values $\leq .08$ as adequate and $\leq .06$ as optimal for the RMSEA.

The issue of determining the number of factors to extract was determined by performing dimensionality analyses on the polychoric correlation matrix of TDDS items through parallel analysis (PA) with optimal implementation (Timmerman & Lorenzo-Seva, 2011). On the basis of the recommendations of Buja & Eyuboglu (1992), PA was performed on 1000 random correlation matrices obtained through permutation of the raw data and following Longman, Cota, Holden, &

Fekken (1989) both the mean eigenvalues and the 95th percentile eigenvalues were considered. This analysis was performed with FACTOR8 (Lorenzo-Seva & Ferrando, 2006). PA suggested the extraction of three factors both when mean percentile was considered and when 95th percentile was considered. This result suggested the three-factors solution was most appropriate.

EFA was hence performed on the first sub-group ($n = 540$) with the number of factors to extract set to 3, GEOMIN rotation. Following the criteria stated above, the three-factor solution showed adequate fit indices (CFI = .95, TLI = .93, RMSEA = .07) and all the items substantially (i.e., $\geq .49$) loaded on its own factor, as shown in Table 1. Factor correlations were in the range .22-.54¹.

[Table 1]

CFA was then used on the second sub-group ($n = 537$). Consistently with the EFA results, the three-factor model showed a good fit (CFI = .94, TLI = .93, RMSEA = .07) and all the items substantially (i.e., $\geq .52$) loaded on its own factor in the standardized model. Factor correlations were in the range .48-.61. In summary, the results of the factor analyses showed that the three-factor solution met all the criteria for an adequate fit.

ITEM ANALYSIS AND RELIABILITY

Table 1 also displays the results of item and distribution analyses. Cronbach's alpha showed good reliability for all of the subscales (Pathogen: $\alpha = .80$; Sexual: $\alpha = .87$; Moral: $\alpha = .81$). Corrected item-total correlations were never smaller than .45, and the mean inter-item correlation was in the range .36-.49, which are considered adequate values for narrow constructs (Clark & Watson, 1995). In no case was the alpha-if-item-deleted higher than the computed alpha, suggesting that all items contribute to the internal consistency of their subscale.

CONSTRUCT VALIDITY

¹ The table showing the full set of factor loadings and cross-loadings is available as supplemental material for interested investigators.

It was predicted that the TDDS-Pathogen and the TDDS-Sexual scores would be more strongly correlated with the DPQ, than with the GSQ and the DASS-21 subscale scores. It was also predicted that the TDDS-Moral scores would be more strongly correlated with the GSQ than with all other measures, including the DPQ. We indeed expected that TDDS-Pathogen and – to a lesser extent – TDDS-Sexual scores would be strongly related to other DP measure scores that mainly assess pathogen disgust, while TDDS-Moral scores would be related to GSQ, in that guilt has been conceptualized as a self-conscious moral emotion signalling anticipatory and consequential reactions to the self (Tangney, Stuewig, & Mashek, 2007). There could be an overlap between moral disgust and guilt sensitivity, as being more sensitive to guilt could well leave individuals vulnerable to feeling morally disgusted about themselves. As shown in Table 2, correlation between TDDS-Pathogen and DPQ was .62, whereas correlations between TDDS-Pathogen and other measures ranged from .12 to .26. A *z contrast* test (Westen & Rosenthal, 2003) was used to compare compare the strengths of the correlations. As expected, TDDS-Pathogen scores were significantly ($z = 19.51, p < .001$) more strongly correlated with disgust propensity as assessed by the DPQ than with guilt sensitivity, depression, anxiety and stress. Correlation between the TDDS-Sexual and DPQ was .35, whereas correlations between TDDS-Sexual and other measures ranged from .01 to .23. As expected, TDDS-Sexual scores were significantly ($z = 10.57, p < .001$) more strongly correlated with disgust propensity as assessed by the DPQ than with guilt sensitivity, depression, anxiety and stress. Correlation between TDDS-Moral and GSQ was .22, whereas correlations between TDDS-Moral and other measures ranged from -.10-.19. As expected, TDDS-Moral scores were significantly ($z = 4.94, p < .001$) more strongly correlated with guilt sensitivity than with disgust propensity as assessed by the DPQ, depression, anxiety and stress. These results indicate that the scale has excellent construct validity.

[Table 2]

Discussion of Study 1

The present study aimed to evaluate the psychometric properties of the Italian version of the TDDS in a community sample, and to replicate its factor structure and reliability, as a precursor to the second clinical study. Exploratory and confirmatory factor analyses supported the expected three-factor measurement model of the TDDS items. All of the TDDS subscales also showed good reliability and construct validity, though unexpectedly the correlation between TDDS-Moral subscale and GS was low, and TDDS-Pathogen and TDDS-Sexual disgust subscales actually showed larger correlations with GS than TDDS-Moral disgust subscale. This may be due to a limited validity of the moral disgust subscale, consistent with Olatunji et al. (2012, 2015). Unfortunately, this study did not assess the temporal stability of the scale nor its sensitivity to change (e.g., in treated patients). Moreover, further studies should confirm the three-factor structure and the construct validity of the scale in clinical samples, although this would require large sample sizes to pursue. Bearing in mind the limitations described above, this study provided evidence that the Italian version of the TDDS retains the sound psychometric properties of the original English-language version and suggests that this measure can be confidently employed in clinical and research settings in which sexual and moral disgust domains are of interest.

Study 2

Material and methods

PARTICIPANTS

Initially, 117 patients with OCD were referred to an Italian private center for adult psychotherapy for evaluation and treatment. During the routine assessment phase patients were interviewed by one of the members of the research team (all doctoral-level psychologists experienced in diagnosing psychiatric disorders) using the Anxiety Disorder Interview Schedule IV (ADIS-IV; Brown, Di Nardo, & Barlow, 1994) and the Yale-Brown Obsessive-Compulsive Scale-Second Edition (Y-BOCS-II; Storch et al., 2010 – Italian version in Melli et al., 2015a) – to establish diagnoses. All cases were audio-recorded and reviewed in supervision meetings, and all diagnoses were reached by consensus (inter-rater reliabilities were excellent: ADIS-IV: $\kappa = .92$; Y-

BOCS-II: ICC = .96). Some participants had one or more current secondary diagnoses, comprising anxiety disorders (social phobia [$n = 3$], panic disorder [$n = 5$] and generalized anxiety disorder [$n = 10$]) and mood disorders (major depressive disorder [$n = 31$]). Potential participants with a secondary or tertiary diagnosis of OCD were excluded ($n = 7$). Five participants were excluded as they were under 18 years old. The presence of psychosis, current mania, and/or substance dependence were other exclusionary criteria ($n = 2$).

The final sample included 103 OCD patients (57.3% males), with a mean age of 32.3 (SD = 10.7) years. Of these, 55.3% of the participants had a medium level of education (12–13 years, high school degree), 33.9% had a high level (16+ years, bachelor's degree or Ph.D.) and the remaining 10.8% had a low level (eight or less years, primary or secondary school). Most of the participants were employed (42.8%), 31.1% were undergraduate university students, and the remaining 26.1% were homemakers, unemployed, or retired. Most were single (65.0%), while 31.1% were married or cohabiting, 2.9% were divorced, and 1.0% were widows or widowers. Twenty-nine participants out of 103 reported contamination-related symptoms or concerns as a primary complaint, as determined by the Y-BOCS-II.

MEASURES

Three Domains of Disgust Scale (TDDS; Tybur et al., 2009). As described above.

Vancouver Obsessional Compulsive Inventory - Mental Contamination scale (VOCI-MC; Rachman, 2006; Radomsky et al., 2014). This 20 item scale assesses mental contamination symptoms. Participants rate each item using a five-point scale that ranges from 0 ('not at all') to 4 ('very much'). The original VOCI-MC has shown excellent psychometric properties. The Italian version of the scale has shown a one-factor structure, good internal consistency (α 's in the range .85-.95), test-retest reliability ($r = .88$), and construct validity (Melli, Carraresi, Stopani, Radomsky, & Bulli, 2015b).

Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). This is a brief, 18-item, self-report questionnaire designed to measure obsessive-compulsive symptom presence and distress

on a 5-point Likert scale from 0 ('not at all disturbed') to 4 ('extremely disturbed'). The OCI-R assesses symptoms in six different dimensions including washing, checking, ordering, obsessing, hoarding, and mental neutralizing (three items each). The Italian version of the OCI-R has been found to have good internal consistency ($\alpha = .85$), excellent test-retest reliability ($r = .93$) for the total score, and adequate internal consistency (α in the range .60-.80) and test-retest reliability (r in the range .76-.99) for each subscale (Sica et al., 2009). In the current study, only the washing subscale was used as a measure of contact contamination symptoms.

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). This is a 21-item self-report inventory that assesses the severity of state anxiety. Statement choices are scored from 0 ('not at all') to 3 ('severely'). The original version has shown good psychometric properties (Beck et al., 1988), and the Italian version has shown a one-factor structure, good internal consistency ($\alpha > .80$), adequate test-retest reliability ($r > .62$), and good construct validity (Sica & Ghisi, 2007; Sica, Coradeschi, Ghisi, & Sanavio, 2006).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). This 21-item self-report inventory is used to assess depressive symptoms over the preceding two weeks. Response choices are scored from 0 ('absent') to 3 ('severe'). The BDI-II has shown good psychometric properties (Beck et al., 1996) and the Italian version of the BDI-II (Ghisi, Flebus, Montano, Sanavio, & Sica, 2006; Sica & Ghisi, 2007) has shown a one-factor structure, adequate internal consistency (α in the range .80-.87), test-retest reliability ($r = .76$), and construct validity.

PROCEDURE

After signing the consent form, participants were given a brief explanation of the study and asked to complete a set of self-report questionnaires that included the aforementioned measures. Questionnaires were presented in a counterbalanced fashion to control for order and sequence effects, and batteries took between 15 and 25 minutes to complete. A research assistant waited until the participant had completed all the questionnaires and provided assistance if the participant did

not understand the meaning of any question. No external incentives were offered for participating in this study.

Results

DESCRIPTIVE STATISTICS

Mean scores, standard deviations, ranges, and Cronbach's alphas for each measure are reported in Table 3. The sample mean scores on all measures fell within the normal range reported in other Italian clinical samples (e.g., Melli et al., 2015b; Sica & Ghisi, 2007). Internal consistency estimates for all measures were good or excellent (all Cronbach's alpha $\geq .80$).

[Table 3]

ZERO-ORDER CORRELATIONS

Table 3 shows the zero-order correlations between the TDDS subscales, the VOI-MC, the OCI-R, and the other study variables². *z contrast* test (Westen & Rosenthal, 2003) was used to compare compare the strength of the correlations. As expected, we found a strong ($r = .51$) correlation of the TDDS-Pathogen subscale scores with the OCI-R-Washing subscale scores, while the same showed only a weak correlation ($r = .25$) with the VOI-MC scores, indicating that the relationship between pathogen disgust and contact contamination is significantly stronger ($z = 3.59$; $p < .001$) than the one with mental contamination. Conversely, the correlation between the TDDS-Sexual subscale scores with the VOI-MC scores ($r = .48$) was significantly stronger ($z = 2.07$; $p < .05$) than the one with the OCI-R-Washing subscale scores ($r = .33$), although they were both moderate in magnitude. As expected, this finding indicates that the role of sexual disgust in mental contamination is significantly more relevant than the same in contact contamination. Unexpectedly, the correlation between the TDDS-Moral subscale scores and both the OCI-R-Washing subscale and the VOI-MC scores were not significant, indicating that moral disgust did not have the

² The table showing the full set of correlations among the study measures' subscales in Study 2 is available as supplemental material for interested investigators.

hypothesized role in mental contamination fear. All of the TDDS subscales showed weak or non-significant correlations with both the BDI-II and the BAI.

PATH ANALYSIS

A path analytic model was evaluated using Mplus 6.1. Some variables analyzed were slightly non-normally distributed: skewness ranged from -.59 to 1.32, and kurtosis ranged from -.67 to 1.02. To account for this slight violation of normality, the Robust Maximum Likelihood (MLR) estimator was used.

As expected, the TDDS-Pathogen subscale was a unique significant predictor ($\beta = .18, p < .001$) of the OCI-R-Washing subscale, when controlling for the effect of depression and anxiety, while it was a non-significant predictor of VOCI-MC. Conversely, the TDDS-Sexual subscale was a unique significant predictor ($\beta = .56, p < .001$) of the VOCI-MC, when controlling for depression and anxiety, while it was a non-significant predictor of the OCI-R-Washing subscale. Unexpectedly, the TDDS-Moral was a non-significant predictor of both the contamination fear measures.

These findings support our hypotheses that pathogen disgust has a specific role in contact contamination, while sexual disgust has a specific role in mental contamination. Moral disgust, as assessed by the TDDS, seems not to have the expected significant role in mental contamination.

[Figure 1]

Discussion of Study 2

To the best of our knowledge, no previous studies has to date evaluated the possible differential role of pathogen, sexual and moral disgust in association with both contact and mental contamination. After validating the Italian version of the TDDS in a large Italian non-clinical sample, we investigated the possibility that disgust domains of the TDDS were able to differentially predict mental and contact contamination fear in an heterogeneous and relatively large clinical OCD sample, using a path analytic approach. It should be noted that in the path model not only could we

control for the effects of the predictors as in a "classical" regression model, but also for their indirect effects through the correlations among them and the correlation among criterion variables.

Consistent with our hypothesis, the TDDS-Pathogen subscale scores were moderately correlated with the OCI-R-Washing subscale scores, but only weakly correlated with the VOCI-MC scores, and path analysis revealed that the TDDS-Pathogen subscale was a unique significant predictor of the OCI-R-Washing subscale, over and beyond anxiety and depression. Previous research is in line with our findings as the TDDS-Pathogen subscale has been found to be moderately correlated with the Padua Inventory (PI; Burns et al., 1996) Contamination fear subscale in a non-clinical sample of 206 undergraduate students (Olatunji et al., 2012); in addition, the DP subscale of the Disgust Propensity and Sensitivity Scale-Revised (DPSS-R; van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006) has been found to be moderately correlated with PI-C in a non-clinical sample of 535 undergraduate students (Olatunji, Cisler, Deacon, Connolly, & Lohr, 2007a).

The DPSS-R-DP subscale was also found to be strongly correlated with the VOCI-MC in a sample of 72 adult women with a history of at least one instance of sexual victimization (Badour et al., 2014), while we only found a weak correlation between the TDDS-Pathogen subscale and the VOCI-MC. However, it should be considered that the DPSS-R assesses domain-independent disgust experiences (van Overveld et al., 2006) and that the sample used by Badour and colleagues suffered from sexual victimization while we investigated a sample of OCD patients.

Regarding sexual disgust, consistently with our hypothesis the TDDS-Sexual subscale scores were more strongly correlated with the VOCI-MC scores than with the OCI-R-Washing subscale scores, though both correlations were moderated in magnitude; furthermore, path analysis revealed that the TDDS-Sexual subscale was a unique significant predictor of the VOCI-MC, over and beyond anxiety and depression. Previous research showed that the TDDS-Sexual subscale was weakly correlated with the PI-C (Olatunji et al., 2012), while our results showed a moderate correlation between the TDDS-Sexual subscale and the OCI-R-Washing subscale. This difference in magnitude may be explained by different reasons: 1) we used a heterogeneous clinical OCD

sample instead of a non-clinical sample; 2) taking into account that avoiding infectious disease might also partially shape sexual strategies (Tybur, Inbar, Güler, & Molho, 2015) and the strong correlation we found in our sample between pathogen and sexual subscales (.54), it appears reasonable to hypothesize that increased DP (pathogen) levels may lead to increased levels of sexual disgust as well; 3) investment in avoiding infectious disease might also partially shape sexual strategies, in that, relatively restricted sexual strategies might function to avoid specifically sexually transmitted infections or pathogens that may be transmitted via close contact, though not necessarily genital contact (Tybur et al., 2015).

In accordance with this view, and for the first time, we showed that the TDDS-Sexual subscale scores were moderately correlated with the VOI-MC scores, and the magnitude of the correlation was significantly stronger than the one between the TDDS-Pathogen subscale scores and the VOI-MC scores. Previous research demonstrated that DP, assessed by the DPQ (Melli et al., 2017c), was moderately correlated with the VOI-MC scores in a clinical sample of 63 C-OCD patients (Melli et al., 2014a) and in a clinical sample of 168 OCD patients (Melli et al., 2017a); furthermore, the DPSS-R-DP scores were found to be strongly correlated with the VOI-MC scores in a sample of women that suffered from sexual victimization (Badour et al., 2014). However, in all the aforementioned studies the authors did not assess the specific domain of sexual disgust that may retain even stronger correlations with the VOI-MC scores. In addition, (Millar, Salkovskis, & Brown, 2016) examined the role of contact contamination (e.g., saliva, tongue intrusion) in an imagined betrayal scenario of a non-consensual kiss, perpetrated by a stranger or by a friend, compared with an imagined betrayal scenario not involving bodily contact (a theft), perpetrated by a stranger or by a friend, in triggering feelings of MC. Although the authors found significantly increased levels of reported sense of betrayal when the violations were perpetrated by a friend with respect to a stranger, independent of the contact condition, a significant sense of internal dirtiness, with subsequent urges to wash, were present only in the imagined non-consensual kiss scenario. This may lead to hypothesize that the betrayal scenario of the non-consensual kiss may trigger the

sexual disgust that resulted in feelings of MC and, since the betrayal scenario implied bodily violations, the subsequent feelings of internal dirtiness and urges to wash may be exerted by recruiting pathogen disgust that ultimately leads to washing rituals.

Contrary to our hypothesis, the TDDS-Moral subscale scores were not significantly correlated with the OCI-R-Washing subscale scores or the VOCI-MC scores, and path analysis confirmed that the TDDS-Moral subscale scores were not significant predictors of both measures of contamination fear. Although unexpected, this finding is consistent with a previous study in which the TDDS-Moral subscale scores were not correlated with the PI-C (Olatunji et al., 2012).

It may seem surprising that the TDDS-Moral subscale scores show a non significant correlation with the VOCI-MC scores, since it has been qualitatively reported that MC typically also includes elements or judgements related to morality/immorality (Coughtrey, Shafran, Lee, & Rachman, 2012; Elliott & Radomsky, 2009; 2012). However, these elements pertain to past experiences of violation or to the betrayal of an intimate and trusted relationship (Rachman, 2010; Rachman, Coughtrey, Shafran, & Radomsky, 2014; Warnock-Parkes, Salkovskis, & Rachman, 2012), and these experiences have not been addressed in any items of the TDDS-Moral subscale. In addition, Russell & Giner-Sorolla (2013) depicted the benefits of distinguishing between bodily violations (disgust expressed when moral codes related to the body are violated) and non-bodily violations (disgust expressed when other moral codes are violated), when investigating moral disgust, since it has been shown that moral disgust is primarily experienced when bodily norms are violated (e.g., sexual taboos, incest, pedophilia), while, in conditions of non-bodily violations (e.g., deception or betrayal), moral disgust is often associated with anger and hard to separate from it (Landy & Piazza, 2017).

The TDDS-Moral subscale mainly describes non-bodily conditions in its items, so a partial overlap between moral disgust and anger may have generated the lack of prediction between the TDDS-Moral subscale and both measures of contamination fear. However, it could be hypothesized that even conditions of non-bodily violations, like betrayal, may be able to evoke MC, as described

by Rachman (2010). A trusted and intimate relationship may lead to consensual bodily violations, or involve consensual body intimacy, and these can become distrusted in the act of betrayal; friends may feel that their trust is violated by the actions of another and when this is extreme, such betrayal can be perceived as humiliating in ways that could in theory give rise to mental contamination; finally, normal manifestations of mental contamination may also arise as a result of less extreme violations (Radomsky et al., 2018). Furthermore, the analysis of the correlations among the three disgust domains of the TDDS and the subscales of the Moral Foundations Questionnaire (MFQ; Graham, Haidt, & Nosek, 2009) revealed that both the TDDS-Pathogen and the TDDS-Sexual, but not the TDDS-Moral, disgust domains were associated only with the moral dimension of purity/sanctity, in accordance with a view in which coming in contact with pathogens or being involved in immoral sexual activities generates a sense of internal dirtiness and impurity (Olatunji, 2008). Unexpectedly, the TDDS-Moral subscale scores were not associated with the moral dimension of purity/sanctity, though the latter identifies the body as “a sacred place that must not be violated by immoral actions”. These results may be explained by hypothesizing that tolerable moral violations (e.g., theft, lie and other non-bodily violations) may be preferentially associated with the moral dimension of harm/care and that suffering such non-bodily moral violations may frequently evoke disgust associated with anger; while, more severe moral violations (e.g., sexual assault, incest, pedophilia, homophilia, nazism and other bodily violations) may be preferentially associated with the moral dimension of purity/sanctity and that suffering such bodily violations may preferentially evoke disgust independently of anger (Russell & Giner-Sorolla, 2013). However, these more severe bodily moral violations have not been addressed by the moral subscale of the TDDS and these may partially explain why the TDDS-Moral subscale scores and the VOCI-MC scores were found to be uncorrelated. Nonetheless, it could be hypothesized that witnessing or experiencing sexual disgust-related violations may recruit and strengthen moral disgust, in order to prevent the re-experiencing of sexual disgust — and sexual disgust-related situations — through an appraisal of moral condemnation or self-condemnation. In addition, it has been shown that neural

correlations of domains of disgust are distinct but overlapping (Schaich Borg, Lieberman, & Kiehl, 2008; Vicario, Rafal, Martino, & Avenanti, 2017).

To conclude, our study does not support the role of moral disgust in predicting both contact and mental contamination fears in OCD patients, and identified sexual disgust as a unique predictor of MC and pathogen disgust as a unique predictor of contact contamination, over and above anxiety and depression. The following limitations should however be considered. 1) Our study is cross-sectional and the specific temporal order of the variables cannot be defined; alternative orders have not been ruled out and it is possible that these relationships are bi-directional in nature. Longitudinal studies are essential in order to draw conclusions about changes occurring within the individual over time. 2) We did not include a control group. Without a non-clinical control or other psychiatric comparison group, it is impossible to know whether the reported relationships are specifically relevant to OCD. Furthermore, as the sub-sample of participants who reported contamination-related symptoms as the primary problem was small, we could not appropriately study the relationships of interest in this subgroup. 3) Participants were self-selected; this might limit the generalizability of our conclusions. 4) Disgust and anger have often been found to be evoked together. Future research would benefit from the inclusion of measures of anger in order to disentangle the specific effect of disgust. 5) We included a single OCD symptom measure in our study, the OCI-R (Foa et al., 2002), future research could replicate our results using other dimensional OCD symptom measures. 6) As a measure that specifically assesses contact (and not mental) contamination does not exist, we used the OCI-R as a measure of contact contamination symptoms. However, two out of three items of the washing subscale of the OCI-R (Foa et al., 2002) are purely washing questions that do not refer to the trigger; it cannot be ruled out that washing behaviors were elicited by triggers pertaining MC, and not only contact contamination. 7) All of the data was derived from self-report measures; relying exclusively on self-report data tends to inflate associations among variables. 8) In the light of the findings of both Study 1 and 2, the TDDS-Moral subscale may retain limited validity since its items mainly pertain to non-bodily

violations that tend to evoke moral disgust in association with anger and, in addition, showed weaker correlations with the other TDDS subscales. Overall, this may represent a potential limitation also for the Italian version of the TDDS.

Despite these limitations, our study has the potential to inform both assessment-related and clinical decision making by fostering a better sense of which forms of disgust may be associated with contact vs. mental contamination. Indeed, the sexual (and perhaps moral) themes that are so often associated with mental contamination could be readily assessed via the TDDS and may well help the clinician to explore emotional and cognitive mechanisms associated with different manifestations of contamination fear in OCD. Furthermore, the recurring connection between MC and past traumatic experiences in patients' life events (like sexual assault, humiliation, and betrayal; Rachman, 2010), often related to sexual disgust, suggests the possible integration of approaches typically used in trauma treatment, such as Imagery Rescripting, or a focus on distinctions between past events and the present, with CBT techniques to reduce feelings of internal uncleanliness. The potential to elucidate cognitive targets of therapy based on appraisals and beliefs about disgust, about betrayal and other perceived violations is also quite promising. However, further research is needed to examine the underlying mechanisms of these constructs and to apply them in clinical populations to develop novel treatment approaches.

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Figure 1

Path analytic model (OCD sample; n = 103)

Note: Dashed lines indicate non-significant relationships. BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory-II; OCI-R = Obsessive-Compulsive Inventory-Revised; TDDS = Three Domains of Disgust Scale; VOI-MC = Vancouver Obsessional Compulsive Inventory-Mental Contamination scale.

* $p < .05$, ** $p < .001$.

Table 1

Item descriptive statistics, item analyses ($n = 1077$) and factor loadings from the exploratory factor analysis of the TDDS ($n = 540$) in Study 1

Item	<i>M</i>	<i>SD</i>	Range	SK	KU	r_{it}	α w/o	Pathogen	Sexual	Moral
1.	3.28	2.02	0-6	-.09	-1.27	.52	.79			.51
2.	2.22	2.02	0-6	.51	-.99	.63	.86		.62	
3.	3.62	1.82	0-6	-.20	-1.10	.54	.76	.61		
4.	5.38	1.33	0-6	-2.67	6.86	.48	.80			.65
5.	1.53	2.08	0-6	1.12	-.17	.65	.85		.85	
6.	2.28	1.79	0-6	.49	-.73	.50	.76	.63		
7.	2.32	2.02	0-6	.46	-1.05	.53	.79			.51
8.	1.93	2.11	0-6	.73	-.86	.72	.84		.85	
9.	2.72	1.77	0-6	.28	-.94	.58	.75	.71		
10.	5.16	1.32	0-6	-1.95	3.73	.49	.80			.53
11.	2.61	2.20	0-6	.25	-1.35	.58	.86		.55	
12.	3.10	2.07	0-6	-.01	-1.31	.50	.76	.57		
13.	4.21	1.98	0-6	-.83	-.60	.62	.77			.68
14.	3.18	2.38	0-6	-.11	-1.57	.66	.85		.70	
15.	4.17	1.59	0-6	-.59	-.49	.59	.75	.82		
16.	2.99	1.99	0-6	-.01	-1.20	.58	.78			.64
17.	3.56	2.25	0-6	-.38	-1.34	.61	.86		.59	
18.	2.81	2.12	0-6	.14	-1.35	.45	.78	.49		
19.	3.51	1.93	0-6	-.35	-1.00	.64	.77			.68
20.	2.82	2.45	0-6	.13	-1.63	.69	.85		.81	
21.	3.38	1.97	0-6	-.18	-1.17	.48	.77	.58		

Note: α w/o = Cronbach's alpha-if-item-deleted; KU = Kurtosis; *M* = Mean; r_{it} = corrected item-total correlation; *SD* = Standard Deviation; SK = Skewness; TDDS = Three Domains of Disgust Scale.

Loadings < .35 were not reported.

Table 2

Pearson's correlations among the Study 1 measures ($n = 1077$)

Measure	1	2	3	4	5	6	7
1. TDDS-Pathogen	-						
2. TDDS-Sexual	.48**	-					
3. TDDS-Moral	.36**	.46**	-				
4. DPQ	.62**	.35**	.19**	-			
5. GSQ	.26**	.23**	.22**	.29**	-		
6. DASS-21-Depression	.12*	.06	-.10*	.17**	.27**	-	
7. DASS-21-Anxiety	.18**	.15**	-.03	.21**	.25**	.69**	-
8. DASS-21-Stress	.15**	.01	-.05	.19**	.23**	.75**	.66**

Note: DASS-21 = Depression Anxiety Stress Scales-21; DPQ = Disgust Propensity Questionnaire; GSQ = Guilt Sensitivity Questionnaire; TDDS = Three Domains of Disgust Scale.

All correlations significant $p < .001$.

Table 3

Descriptive statistics and correlations among the study measures in Study 2 (OCD sample; $n = 103$)

Measure	<i>M</i>	<i>SD</i>	Range	α	1	2	3	4	5	6
1. TDDS-Pathogen	21.36	9.17	2-42	.80	-					
2. TDDS-Sexual	15.22	10.99	0-42	.85	.51**	-				
3. TDDS-Moral	27.24	9.43	0-42	.83	.22*	.34**	-			
4. OCI-R-Washing	3.50	3.48	0-12	.82	.51**	.33**	.06	-		
5. VOICI-MC	18.74	17.03	0-74	.93	.25*	.48**	.12	.67**	-	
6. BDI-II	21.06	13.87	0-55	.95	.25*	.21*	.19	.16	.28**	-
7. BAI	19.81	12.69	0-53	.92	.08	.20*	.07	.10	.23*	.75**

Note: α = Cronbach's alpha; BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory-II; *M* = Mean score; OCI-R = Obsessive-Compulsive Inventory-Revised; *SD* = Standard deviation; TDDS = Three Domains of Disgust Scale; VOICI-MC = Vancouver Obsessional Compulsive Inventory-Mental Contamination scale.

* $p < .05$, ** $p < .001$.

Highlights

- The Italian version of the Three Domains of Disgust Scale (TDDS) was validated
- The TDDS confirmed its three-factor structure and very good psychometric properties
- Relationships among the TDDS, contact and mental contamination were studied in OCD
- Pathogen and sexual disgust respectively predicted contact and mental contamination
- Unexpectedly, moral disgust was not a predictor of contact or mental contamination

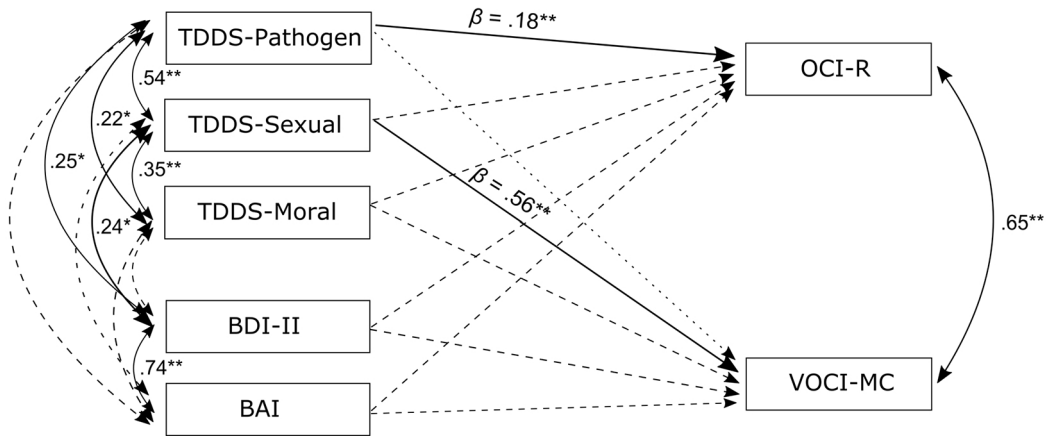


Figure 1