

THE ROLE OF CHILDHOOD EXPERIENCES IN THE DEVELOPMENT OF DISGUST SENSITIVITY:
A PRELIMINARY STUDY ON EARLY MORAL MEMORIES

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Abstract

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Objective: Disgust is a basic emotion evolved to safeguard our omnivorous species from contagion. Although the factors eliciting disgust typically involve concerns related to physical contamination, physical disgust responses are also prompted by moral transgressions, (i.e. cannibalism, pedophilia, betrayal). The link between the general propensity to experience disgust (i.e. “Disgust Sensitivity”) and morality, in particular in the deontological domain, is supported by an increasing amount of data on clinical and non-clinical sample. Evolutionistic explanations of this link posit that disgust evolved to indicate the presence of a threat to the integrity of the individual not only in the physical domain but also in the social and moral domain.

In addition to the evolutionary point of view, this link could also be better investigated in terms of individual development. To the best of our knowledge, literature is scarce regarding which early experiences are associated to high DS. Therefore, this study aims to explore the content of early memories associated with disgust. Based on the strict link between disgust and morality, we hypothesized an association between DS and early memories of moral criticism.

Method: 60 non-clinical participants filled in measures of DS. They were then presented with an auditory disgust induction, after which they recalled early memories through the technique of the “affect bridge”. 10 independent raters assessed the emotional content of the memories on visual-analogical scales.

Results: Results showed a positive association between disgust sensitivity and the propensity to experience deontological guilt. There was also a significant positive association between disgust sensitivity and moral memories, in particular relating to early experiences of being the object of contempt, moral criticism, anger, and of being held responsible.

Conclusions: These data directly support the centrality of early morally-loaded interpersonal experiences in the development of DS, confirming the link between disgust and morality also at the level of individual historical development.

Key words: disgust, morality, deontological guilt, imagery, early autobiographical memories, early maladaptive schemas

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Since Darwin’s theorization, disgust has been considered a universal emotion that has the adaptive function to protect the body from contamination, through contact or incorporation, by harmful substances (Ekman & Friesen, 1975; Rozin & Fallon, 1987). The person who feels disgust tries to get the disgusting substance away; moreover, if the disgust is severe, the feeling of revulsion may be accompanied by nausea, vomiting, and activation of the autonomic nervous system (Zajonc & McIntosh, 1992).

Although disgust is usually experienced in association with contamination agents, verbal, facial and body expressions of disgust are also observed, across cultures, in response to social behavioral

violations, such as robbery, pedophilia, incest etc. (Haidt et al., 1997). The recognition that disgust also operates beyond food, has led to the development of multiple theoretical models (Haidt et al., 1997; Olatunji et al., 2007b). Some theorists, including Miller (2004), more in line with a traditional model of disgust (Rozin et al. 2008) argued the centrality of the function of protecting the self from food, objects, unwanted conditions that refer to our animal nature and our being mortal. Others theorists have expanded the function of disgust into multiple distinct domains; in particular one recent evolutionary-adaptive framework may be salient to better understanding the heterogeneity of this emotion (Tybur et al., 2009, 2010). This model is

comprised of pathogen, sexual, and moral domains of disgust sensitivity (Olatunji et al., 2007a, 2012; Tybur et al., 2009, 2010, 2013), three clusters of situations not directly linked to the protection from pathogens that have evolved in order to regulate choices regarding important issues such as sexual and moral, facilitating individual, cultural, and evolutionary adaptation.

Disgust has therefore evolved to indicate the presence of a threat to the integrity of the individual, not only in the physical domain but also in the social and moral domain (Tybur et al., 2009).

People vary in the degree to which they experience disgust toward pathogen-related cues (Tybur et al., 2018). This variability, among other things, is associated to personality, psychopathological tendencies, moral and political sentiments (Tybur & Gangestad, 2011). Specifically, a large amount of empirical studies supports the association between disgust and morality (LaRosa & Mir, 2013; Vartanian et al., 2021) and there is evidence that people use their feelings of disgust as embodied information about social events, that disgust increases the severity of moral criticism (Eskine et al., 2011; Wheatley & Haidt, 2005) and that individuals are more prone to consider certain actions as being immoral if they have an inclination to be easily disgusted (Horberg et al., 2009; Inbar et al., 2009). Moreover, the emotion of disgust has been linked both at the psychological and at the neural level, to another emotion, namely guilt.

More specifically, in the framework of a dualistic thesis of guilt (Mancini & Gangemi, 2021), which distinguishes two different types of guilt: the Deontological Guilt (DG - related to the transgression of an internalized moral rule) and the Altruistic Guilt (AG - elicited by the failure of an altruistic goal) (Mancini & Gangemi, 2021), the connection of disgust with morality seems to be particularly strong in the deontological domain. Indeed, the association between deontological guilt and disgust has been highlighted both at a behavioral (D'Olimpio & Mancini, 2014; Giacomantonio et al., 2019; Liuzza et al., 2019; Mancini et al., 2022; Parisi et al., 2021) and at a neural level (Basile et al., 2014; Borg et al., 2008). More specifically, the propensity to feel guilty for having trespassed a moral norm or a moral authority has been found to be positively associated to disgust sensitivity; conversely, the propensity to experience altruistic guilt has been negatively linked to disgust (Mancini et al., 2022). These data support the view that disgust and altruism have opposite evolutionary functions.

In the face of a sick individual, for example, healthy observers have two conflicting behavioral strategies: the altruistic strategy of helping, driven by empathy and compassion, and the selfish strategy of avoidance, driven by disgust and fear of contamination. Situation like the one described may lead to contradictory emotions and a motivational conflict between approach and avoidance, between helping and self-protection (Steinkopf, 2017).

However, to the best of our knowledge, studies are scarce investigating how this link is formed in the mind of individuals. Thus, here we aimed to investigate the origins of the relationship between disgust, guilt and morality also in terms of individual development, shedding light on individuals early sensitizing experiences reinforcing it. To this aim we used a retrospective approach targeting autobiographical memories evoked by the emotion of disgust.

The role of autobiographical memories on negative emotional experiences has long been of interest to researchers in psychology. They can play a central

role in the moment by moment appraisal of individuals (Conway & Pleydell-Pearce, 2000); both external and internal cues trigger specific autobiographical memories that are encoded with features related to specific situations and context of the daily life (Mace, 2005; Pillemer, 2003). Typically, this triggering mechanism is a continual unaware process (Conway & Pleydell-Pearce, 2000; Roediger, 1990). Consequently, autobiographical memories that are related to frequently encountered themes or emotions in people's lives should then be frequently activated and should have, over time, an enduring influence on theme-related outcomes. For instance, according to Schema Theory, early memories are strictly connected both to development and the activation of early maladaptive schemas (EMSs) EMSs are defined as stable, broad pervasive themes regarding oneself and one's relationship with others, developed through the interactions between innate temperament and early adverse relational experiences during childhood, when one or more of five basic psychological needs (secure attachment, autonomy, realistic limits, self-directedness, and playfulness) are not satisfied by the caregivers (Young et al., 2003).

Therefore, this study aims to explore the content of early autobiographical memories evoked by disgust and their association with individual levels of disgust sensitivity in a non-clinical sample.

Relevant to the present work, emotion research showed that disgust sensitivity develops largely based on modelling the context and intensity of parents' disgust reactions (Stevenson et al., 2010; Widen & Olatunji, 2016). Interestingly, a retrospective observational study using imagery rescripting (IR) showed that Ocd patient (a clinical population characterized by enhanced levels of disgust sensitivity) reported stressful memories of parental blame/reproach and guilt inducing contents (Basile et al., 2018).

Therefore, the current study aims to explore the early memories underlying disgust sensitivity and to investigate their content, in order to identify any associations with morality.

Given the common nature of disgust, morality and guilt supported by the literature, we expect to observe:

- a positive association between current dispositional and reactive disgust measures and current guilt propensity measure, selectively for guilt related to a moral norm violation;
- that higher disgust reactivity and sensitivity levels would be associated to childhood memories with higher levels of moral content;
- a positive association between Early Maladaptive Schemas in the Rejection and Inhibition/domain and pathogen disgust sensitivity measures.

Materials and methods

Participants

Sixty subclinical participants (27 female, 38.57%) were recruited through a snowball sampling procedure (Goodman, 1961) by means of an advertisement, diffused by the School of Cognitive Psychotherapy (SPC). Mean age was of 32.63 years ($SD = 7.10$; range = 26-70). Subjects between the ages of 18 and 65 were included. Instead, subjects with Psychosis, Bipolar Disorder and Substance Abuse were excluded. In the total sample only 3 subjects have reported depressive and/or anxiety symptoms.

All subjects were Caucasian and held a BA or MA equivalent degree. All participants were provided a

digital informed consent form and gave their informed consent prior to inclusion in the study by choosing to proceed with the surveys. Procedures were carried out in accordance with the principles of the Declaration of Helsinki and were approved by Guglielmo Marconi University Ethical Committee (Protocol Date. 24-03-2019)

Procedure

Due to the pandemic, the whole procedure was carried out online through the survey platform Question Pro (www.questionpro.com). The experimental protocol, which will be described below in detail, consisted of: a) signature of the informed consent b) baseline measures (pre) c) 4-minutes disgust induction d) recall of early memories, starting from the emotion of disgust induced previously e) writing subjective rating of the memory features (e.g. age at the time of the memory, related thoughts and emotions).

The whole procedure took place at two different times: on the first day the participants signed the informed consent and completed the baseline measures and after a week, they were presented with a disgust induction based on which they were asked to recall an early memory. After the recall, each participant was asked to write the evoked memory and to evaluate related emotions. All participants agreed to voluntarily contribute to the research without receiving any form of payment.

Baseline measures

Socio-demographic information were collected through an *ad hoc* format on QuestionPro (www.questionpro.com).

The Young Schema Questionnaire short version (YSQ-S3). The YSQ - Short Form 3 (YSQ-S3 - Young, 2005) is a 90-item questionnaire that assesses 18 Early Maladaptive Schemas (EMSs). EMSs are defined as stable, broad pervasive themes regarding oneself and one's relationship with others, developed during childhood and elaborated throughout one's lifetime (Young et al., 2003). They would develop through the interactions between innate temperament and early adverse relational experiences during childhood, when one or more of five basic psychological needs (secure attachment, autonomy, realistic limits, self-directedness, and playfulness) are not satisfied by the caregivers (Young et al., 2003). EMSs can be grouped into five domains: Disconnection and Rejection, Impaired Autonomy and Performance, Impaired Limits, Other-Directedness, Overvigilance and Inhibition (Young et al., 2003). Each domain is assessed according to five items (i.e., statements such as "I haven't had someone to nurture me, share him/herself with me, or care deeply about everything that happens to me.") scored on a 6-point scale ranging from 1 (completely untrue of me) to 6 (describes me perfectly). The YSQ-S3 has acceptable levels of overall reliability and validity, and for Italian version specifically (Aloi et al., 2020).

In the Italian version of the questionnaire test-retest reliability, ICC (95% CI), ranged from .755 (.665-.819) for Entitlement to .943 (.930-.953) for Failure, showing an excellent stability. The McDonald ω coefficient of the 18 EMSs ranged from .698 (Enmeshment) to .893 (Failure), indicating very good reliability. The first-order factors model shows the best fit (CFI .79; TLI .77; RMSEA .054 (.053-.055); SRMR .073). Moreover, the validation study revealed adequate internal consistency

ranging from $\alpha=0.53$ (Unrelenting Standards) to $\alpha=0.81$ (Impaired Autonomy). In the present study, the α coefficients of the schema domains were found to be ranging from $\alpha = 0.73$ (Impaired Limits) to $\alpha = 0.90$ (Disconnection/Rejection), with a total scale α coefficient of 0.96.

The Three Domain of Disgust Scale (TDDS). The TDDS (Poli et al., 2019) is a self-report questionnaire composed of 21 items that investigate the disgust sensitivity in different situations. In line with the 3-factor model of Tybur and colleagues (Tybur et al., 2009), the items investigate the propensity to disgust on 3 different subscales corresponding to the 3 domains of emotion: core disgust (e.g., of the item "Stepping on a dog's excrement"), sexual disgust (e.g., of the item "Hearing two strangers having sex") and moral disgust (e.g., of the item: "As a student, cheating to get good grades"). Participants are asked to rate for each item the intensity of the disgust evoked on a 6-point Likert scale ranging from 0 (not at all) to 7 (extremely disgusting). The sum of the scores on all items constitutes a general index of the subject's tendency to feel disgust.

The three-factor solution showed adequate fit indices (CFI = .95; TLI = .93; RMSEA = .07). Cronbach's alpha showed good reliability for all of the subscales (Pathogen: $\alpha = .80$, Sexual: $\alpha = .87$, Moral: $\alpha = .81$).

The Moral Orientation Guilt Scale (MOGS). The MOGS (Mancini et al., 2022), is a 17-item measure that allows the assessment of different types of guilt propensities according to individuals' moral orientation. The analysis of its latent structure pointed at 4 factors: "Moral Norm Violation" (MNV), which assesses the fear of having outraged an authority and the attempt to prevent guilt by conforming to moral norms; "Moral Dirtiness" (MODI), measuring the tendency to experience moral disgust towards oneself; "Empathy", specifically assessing the tendency to feel guilty for the misfortune of others; and "Harm", measuring the propensity to feel and prevent guilt resulting from harming others. The four factors model obtained excellent goodness of fit indices, as suggested by the confirmatory analysis (df = 113; CFI: 0.988; RMSEA: 0.035[0.02–0.048]; SRMR: 0.061). The MOGS has shown good construct validity, and the four subscales and the entire MOGS presented good reliability indices (α MNV = 0.82; α Harm = 0.81; α Empathy = 0.82; α MODI = 0.70; α Total = 0.87).

Disgusting images. In order to test state reactivity to disgust, participants were presented with 10 physical disgusting images and 10 morally disgusting images from a structured dataset: the International Affective Picture System (IAPS – Lang et al., 2008). Images average Valence and Arousal values were matched between image samples obtaining two groups, consisting of 11 images each, equivalent between each other on an emotional level (all P s > 0.05) (see Appendix A). All participants were exposed to all images, randomly ordered across participants, and expressed the intensity of the evoked experience on a Visual Analogue Scale (VAS) ranging from 0 (not at all) to 100 (very much).

Disgust induction. After online completion of baseline measures, in line with the procedure used in a previous study by Ottaviani et colleagues (2013), the emotion of disgust was induced by listening an *ad hoc* audio script (see Appendix B). The audio script was pre-recorded in two different versions (male/female voice), in order to facilitate the identification of the participants. The instructions required participants to listen to a vivid description of a scene and to identify as much as possible in the event of the protagonist. The

duration of the script was 4 min.; it was stored as audio files (16-bit wav-files) in the lab PC and presented via head phones. Due to the pandemic situation, the presentation and listening of the audio script were carried out online through the survey platform Question Pro (www.questionpro.com). An initial pilot test assessed whether these scripts served to elicit disgust. To do so, 40 non-clinical subjects (19 F) received an invitation by email to contribute to a research project and a link to the online structured format. After collecting informed consent, in order to detect baseline emotional state, participants were asked to rate different emotions (i.e. sadness, disgust, fear, anger, guilt, pride, shame, self-disgust) on a VAS ranging from 0 (not at all) to 100 (very much). Immediately afterwards, each participant was invited to listen to the script (in the corresponding version - male voice vs. female voice). At the end of the listening session, everyone was asked to rate the intensity of the emotions evoked by the audio script on the VAS again. The scripts were effective in increasing disgust as well as self-disgust, shame and sadness (see Appendix C for a table containing paired-sample t-tests comparing pre-induction to post-induction VAS scores).

Early memories recall. Early memories were investigated using the Imagery Assessment technique (Young et al., 2003), an experiential imaginative technique which, establishing an *affect bridge* (also known as float back technique – Young et al., 2003), associates current experiences with emotionally coherent early experiences.

The protocol employed was an adaptation to the group setting (see Appendix D) of the standard procedure described by Young et al. (Young et al., 2003).

All participants were asked to recall, starting from the disgust emotion experimentally induced, an emotionally coherent early memory. They were then asked to imagine the contextual, environmental and relational features of the evoked situation.

Participants reported their recalled memory in writing. Moreover, each of them also reported the possible influence that the recalled past experience had on their self-image. Furthermore, they were asked to report the intensity of each emotion experienced in the memory (i.e. sadness, anxiety, anger, guilt, shame, physical disgust and moral disgust) on a VAS ranging from 0 to 100.

Moreover, 10 independent evaluators were asked to examine each memory and subsequently to rate memories emotional content on a VAS ranging from 0 to 100. Specifically, they were asked to rate how much each memory entailed the following emotional content: feeling to be the object of contempt; disgust; anger; moral judgement; reproach; feeling held responsible or feeling left alone.

Statistical analysis

Three participants reported that the story was not effective in eliciting disgust (i.e., they reported 0 on the Disgust VAS of the Induction Check). Therefore, they were excluded from the analysis and the final sample was composed by 57 participants. Descriptive statistics (i.e. mean and standard deviation) were used to depict the affective pattern evoked by the induction. Notably, the intensity of all the emotions (i.e. disgust, sadness, anxiety, anger, guilt, shame) were assessed on a Visual

Analogue Scale ranging from 0 to 100.

To test if current level of disgust propensity would be positively associated to guilt propensity, Spearman non parametric correlations were performed in order to check the link between dispositional and reactive disgust (as measured by the TDDS and the disgusting images, respectively) and the propensity to guilt feelings (as measured by the MOGS scores).

Moreover, descriptive statistics (i.e. mean and standard deviation) were employed to observe the dominant affective patterns evoked by the memory recall and independent raters' assessments for each type of experience (i.e., being the object of contempt; physical disgust; anger; reproach; moral criticism; being held responsible; feeling left alone).

Furthermore, in order to investigate our second hypothesis (i.e., that higher disgust reactivity and sensitivity levels would be associated to childhood memories with a higher level of moral content), a non parametric Spearman correlation was performed between the three subscale of the TDDS (i.e., pathogen, moral and sexual disgust), the self-reported reactivity to disgusting images and the content of the memories as assessed by the independent raters.

Finally, Spearman correlations were performed between pathogen disgust measures and EMS measures. Significant results were corrected for multiple comparisons using the Bonferroni correction.

Results

Induction Check

Mean and standard deviations for all 6 the emotions are reported in **table 1**. As it can be observed, disgust is the dominant affective state, followed by shame and sadness.

Table 1. Mean and Standard deviations of the emotions VAS levels after the induction

Emotions after induction	Mean	SD
Sadness	38.33	33.035
Fear- Anxiety	30.32	25.654
Anger	12.12	20.105
Guilt	17.11	25.115
Shame	44.74	34.073
Disgust	73.77	23.717

Correlation between current Disgust and Guilt propensity

Correlations between baseline disgust and guilt propensity measures in our sample revealed a positive association between Disgust Sensitivity (as measured by TDDS) and the propensity to experience guilt when violating a moral norm and disobeying to a moral authority (as reflected by MNV scores). Additionally, the reactivity to both physically and morally disgusting images, was associated to the propensity to experience MNV Guilt and Empathy Guilt. All other comparisons were not significant when corrected (all $P > .05$; **table 2**).

Table 2. Each row represent the association between a guilt propensity subscale (as measured by MOGS) and dispositional disgust measures (as measured by TDDS and disgusting Images). MOGS Subscales are reported in the table with their acronyms: MNV= Moral Norm Violation Guilt; MODI= Moral Dirtiness Guilt; Empathy= Empathic Guilt; Harm=Harm Guilt. TDDS subscales are: PathogenD= Pathogen Disgust; SexualD= Sexual Disgust and MoralD= Moral Disgust. Moreover, Physical D_Images= Physically disgusting images and MoralD_Images= Morally disgusting images

	<i>rho</i>	<i>P</i>	<i>Adj.P (Bonferroni P<.0025)</i>
MNV_PathogenD	.422	.001	<.002*
MNV_SexualD	.426	.001	<.002*
MNV_MoralD	.380	.004	ns
MNV_PhysicalD_Images	.545	.000	<.002*
MNV_MoralD_Images	.537	.000	<.002*
MODI_PathogenD	.269	.043	ns
MODI_SexualD	.187	.163	ns
MODI_MoralD	.218	.104	ns
MODI_PhysicalD_Images	.372	.004	ns
MODI_MoralD_Images	.389	.003	ns
Empathy_PathogenD	.241	.07	ns
Empathy_SexualD	.368	.005	ns
Empathy_MoralD	.127	.348	ns
Empathy_PhysicalD_Images	.493	.000	<.002*
Empathy_MoralD_Images	.452	.000	<.002*
Harm_PathogenD	.115	.395	ns
Harm_SexualD	.129	.337	ns
Harm_MoralD	.091	.501	ns
Harm_PhysicalD_Images	.308	.020	ns
Harm_MoralD_Images	.166	.219	ns

Note. According to Bonferroni correction the threshold for significant alpha values was set to $P<.0025$.

Emotions experienced during memory recall

Mean and standard deviations for all 6 the emotions are reported in **table 3**. As it can be observed, sadness is the dominant affective state experienced during memory recall, followed by shame and physical disgust.

Table 3. Mean and Standard deviations of the emotions VAS levels experienced during memory recall

Emotions during recall	Mean	SD
Sadness	59.35	33.663
Fear- Anxiety	39.39	33.368
Anger	30.47	31.904
Guilt	34.37	37.166
Shame	47.53	36.056
Moral Disgust	31.74	36.351
Physical Disgust	39.00	36.671

Means and standard deviations for all memory contents are reported in **table 4**. As it can be observed feeling left alone was rated as the dominant memory content, followed by reproach.

Table 4. Ratings of memory content (Means and standard deviations) according to independent raters (VAS)

Experiences in the memories (VAS)	Mean	SD
Contempt	15.89	23.44
Physical Disgust	10.35	20.51
Moral criticism	16.22	21.47
Anger	16.23	24.62
Reproach	29.16	28.25
Held responsible	16.18	22.86
Feeling left alone	45.50	27.04

Correlations between disgust sensitivity and memory content

Spearman correlations results showed a significant positive association between participants' propensity to pathogen disgust and the experiences of being the object of contempt ($\rho = 0.38$, $\text{Adj.p} = 0.03$); anger ($\rho = 0.41$, $\text{Adj.p} = 0.03$); moral criticism ($\rho = 0.33$, $\text{Adj.p} = 0.05$) and of being held responsible ($\rho = 0.39$, $\text{Adj.p} = 0.03$) in the memories (see **table 5**).

Some examples of early memories evoked by participants are reported in **table 6**. Furthermore, there was a positive (although weaker) association between participants' propensity to sexual disgust and the experiences of being the object of moral criticism ($\rho = 0.32$, $\text{Adj.p} = 0.05$) and of being held responsible ($\rho = 0.32$, $\text{Adj.p} = 0.05$). Additionally, there was a positive association between the reactivity to physically disgusting images and memories in which participants were the object of contempt ($\rho = 0.33$, $\text{Adj.p} = 0.05$) and anger ($\rho = 0.32$, $\text{Adj.p} = 0.05$). Finally, we found a positive association between the reactivity to morally disgusting images and memories in which participants were being held responsible ($\rho = 0.36$, $\text{Adj.p} = 0.04$). All the correlations can be found in **table 5**.

Correlations between EMS and Pathogen Disgust

Spearman correlations results showed a significant positive association between participants' propensity to pathogen disgust and Mistrust / Abuse ($\rho = 0.29$, $p = 0.025$); Self-Sacrifice ($\rho = 0.26$, $p = 0.047$); Unrelenting Standards ($\rho = 0.39$, $p = 0.002$) Grandiosity ($\rho = 0.26$, $p = 0.049$) and Punitiveness ($\rho = 0.32$, $p = 0.014$). However, when corrected for the Bonferroni adjustment for multiple comparisons, the only significant association was between Unrelenting Standards and Pathogen

Table 5. Spearman correlations between disgust sensitivity and memory content

Memories content	Disgust	Spearman Rho	P.Values	p_adj (fdr)
Contempt	Pathogen	0.387	0.003	0.03
Physical Disgust	Pathogen	0.164	0.22	0.34
Moral criticism	Pathogen	0.333	0.01	0.05
Anger	Pathogen	0.419	0.001	0.03
Reproach	Pathogen	0.165	0.22	0.34
Held responsible	Pathogen	0.393	0.002	0.03
Feeling left alone	Pathogen	0.069	0.61	0.68
Contempt	Sexual	0.277	0.03	0.10
Physical Disgust	Sexual	0.177	0.18	0.34
Moral criticism	Sexual	0.326	0.01	0.05
Anger	Sexual	0.229	0.08	0.18
Reproach	Sexual	0.112	0.40	0.49
Held responsible	Sexual	0.324	0.01	0.05
Feeling left alone	Sexual	0.254	0.056	0.14
Contempt	Moral	0.183	0.17	0.33
Physical Disgust	Moral	0.053	0.69	0.73
Moral criticism	Moral	0.138	0.30	0.42
Anger	Moral	0.126	0.343	0.45
Reproach	Moral	0.057	0.67	0.73
Held responsible	Moral	0.173	0.19	0.434
Feeling left alone	Moral	0.020	0.88	0.88
Contempt	Images (Physical Disg.)	0.337	0.01	0.05
Physical Disgust	Images (Physical Disg.)	0.151	0.26	0.38
Moral criticism	Images (Physical Disg.)	0.23	0.07	0.17
Anger	Images (Physical Disg.)	0.32	0.01	0.05
Reproach	Images (Physical Disg.)	0.16	0.21	0.34
Held responsible	Images (Physical Disg.)	0.25	0.05	0.14
Feeling left alone	Images (Physical Disg.)	0.11	0.37	0.47
Contempt	Images (Moral Disg.)	0.280	0.03	0.10
Physical Disgust	Images (Moral Disg.)	0.125	0.35	0.45
Moral criticism	Images (Moral Disg.)	0.210	0.11	0.24
Anger	Images (Moral Disg.)	0.31	0.01	0.06
Reproach	Images (Moral Disg.)	0.108	0.42	0.49
Held responsible	Images (Moral Disg.)	0.369	0.005	0.04
Feeling left alone	Images (Moral Disg.)	0.033	0.80	0.83

Table 6. Examples of early memories evoked by participants

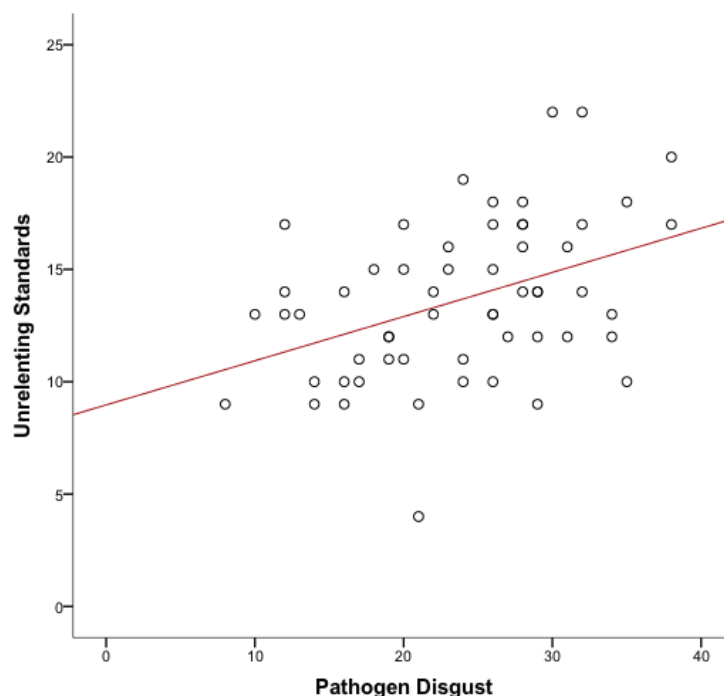
Tdds pathogen disgust score	Early memories	Self image
32	<i>Before going to work, my mother asked me to reheat the dinner. Since I was talking to a friend on the phone, I forgot about the dinner and it got burned. When my mother came back she got very angry, she insulted me, saying that I was incapable and even physically attacked me</i>	<i>Today the judgment of others influences me a lot because I think that to be loved I have to guarantee good 'performances'</i>
21	<i>I was skateboarding with a friend. I fell off my board and I got injured on my knee. I ran home bleeding. I was afraid because the wound was deep. My grandmother took care of me and I felt immediately better</i>	<i>Today I feel confident because I was very much loved</i>

*Written informed consent was obtained from the individuals for the publication of any potentially identifiable data included in this article

Disgust (see **figure 1**). All other comparisons were non-significant (All p s >.05).

related to self-disgust (Olatunji et al., 2015). After all, the link between disgust and contamination often calls

Figure 1. Correlation between Unrelenting Standards scores and Pathogen Disgust measures across participants. According to Bonferroni correction the threshold for significant alpha values was set to $P < .002$



Discussion

The main aim of the present study was to explore the content of early memories connected to the emotion of disgust in order to investigate early experiences associated to disgust sensitivity. The effectiveness of the audio-story in inducing disgust was previously assessed by the pilot study which showed that after listening to the audio script, scores in the emotions of disgust, sadness, shame and self-disgust were significantly increased, while pride scores were significantly reduced (results of the pilot study can be found in Appendix C). Moreover, descriptive statistics measuring the intensity of the different negative emotions after the induction revealed an affective pattern characterized mainly by disgust, shame and sadness. The fact that affective pattern was primarily characterized by sadness and shame and not only by physical disgust could be ascribed to the particular content of the induction audio script which is likely to evoke self-disgust as well as physical disgust. Indeed, in the induction task, participants were asked to identify themselves with a person who stops taking care of himself both with regard to hygiene and letting himself go to sloth (see Appendix B). Self-disgust is a deeply painful self-conscious emotion directed respectively toward physical (physical self-disgust; e.g., “I find myself repulsive”) or behavioral aspects of the self (behavioral self-disgust; e.g., “I often do things I find revolting”) and involving the negative judgement of the whole self (e.g., defective, bad) as result of internally attributing responsibility for a transgression (Cororve & Gleaves, 2001; Tangney & Dearing, 2002; Visvalingam et al., 2022). About shame, internal body shame in particular arises in response to internal repugnance of one’s appearance (Visvalingam et al., 2022) and shame proneness may be closely

morality into play. In the Social Cognitive Chain of Being (SCCB - Brandt & Reyna, 2011) which translates the tendency of human beings to organize their moral world along a vertical dimension, feeling contaminated by disgusting substances implies a subjective loss of personal value: the contamination reduces the dignity of the person bringing him closer to the rank of beasts and exposing him to contemptuous reactions and distancing from others (Bandura, 1999; Goff et al., 2008; Horberg et al., 2009) in line with the magical idea that physical and moral corruption are the same thing (Mancini & Gragnani, 2003). Therefore, in our opinion, the affective bridge linking the induction script and the affective pattern experienced during memories recall might be based on the link between disgust, shame and moral nuances of both emotions.

As expected, results preliminarily support the strict link between disgust and morality in particular in the deontological domain. In line with previous findings (Mancini et al., 2022), our data confirmed a baseline positive correlation between dispositional disgust measures (TDDS and disgusting Images) and deontological guilt propensity (i.e. the MNV subscale of the MOGS). This first finding confirms previous observation connecting moral norm violation guilt and disgust sensitivity (Mancini et al., 2022). The tendency to experience guilt as a consequence of a moral norm violation is consistent with a dualistic thesis of guilt feelings (Mancini & Gangemi, 2021), according to which, deontological, but not altruistic, morality seems distinctively associated with the emotion of disgust. Consistently, neuroscientific findings have highlighted that the insula, a brain area involved in the processing of disgust (Tybur et al., 2013), selectively responds to deontological guilt stimuli and not to altruistic guilt ones (Basile & Mancini, 2011). Moreover, indirect

stimulation of the insula via transcranial direct current stimulation (tDCS) enhance disgust and morality in the deontological domain (Ottaviani et al., 2018). At the clinical level, this relation has important implications in the understanding of Obsessive Compulsive Disorder (OCD). Indeed, two studies of D'Olimpio and Mancini (2014) investigated whether inducing deontological versus altruistic guilt in healthy volunteers could activate checking behaviors and physical cleaning. 37 non clinical participants were asked to listen to different induction stories and then, to classify colored capsules or to clean a Plexiglas cube. Data showed that participants in the deontological group, compared with the control group, scored higher in doubts, checked and cleaned more.

Concerning the further correlation between the reactivity to both physically and morally disgusting images and the propensity to experience Empathy Guilt as well, it may depend on the content of the images shown to the participants. Viewing scenes in which someone is hurt or abused might trigger a pain or a guilt feeling simply because there is the realization of having been undeservedly fortunate with respect to someone else who was equally undeservedly unlucky (*survivor guilt* - O'Connor Lynn et al., 2000).

Unexpectedly, sadness (a non-intrinsically moral emotion) was the highest reported emotion during memory recall. This data might be the result of sadness being both "epiphenomenal" (i.e., emerging as secondary reaction to recalling negative events, particularly concerning the frustration of core needs) or primarily evoked through the self-disgust script. In a similar vein, three related studies (Overton et al., 2008; Powell et al., 2013; Simpson et al., 2010) have indicated that self-disgust, as measured by the newly revised Self-Disgust Scale (SDS - Moncrieff-Boyd et al., 2014), may interact with dysfunctional cognitions in the temporal prediction of depressive symptoms.

The independent raters' data showed that the content of participants' memories concerned the experience of feeling left alone as higher with respect to all other types of experiences. The experience of "feeling left alone" might include different types of experiences concerning the frustration of the core needs for secure attachment by the caregiver and the consequent feeling of emotional deprivation (Young et al., 2003). A recent study aimed to investigate the role of Early Maladaptive Schemas in loneliness of a sample of university students, showed that there is a positive relationship between loneliness and all schematic domains. The feeling of loneliness is related to and strongly influenced by the initial maladaptive schemas, especially the schemas of "Disconnection and Rejection" domain (Abedi et al., 2020). However, disgust sensitivity was not associated with the memory content "feeling left alone". Conversely, results showed a significant positive association between participants' sensitivity to pathogen disgust and the extent to which, according to the independent raters, participants' memories were related to the experiences of being the object of contempt, anger, moral judgement and of being held responsible. Our results further showed a positive association between the reactivity to both physically and morally disgusting images and memories in which participants were the object of contempt and anger and were being held responsible. Consistently, participants with high pathogen disgust scores presented higher scores in the schemas of Unrelenting Standards. Taken together these results seem to highlight the link between disgust sensitivity and a family atmosphere characterised by parental control, criticism and high expectations,

that results in the inevitable transgression of overly rigid rules of conduct; the direct consequence is the experience of feeling guilty for not having been worthy. In a view that sees normality and psychopathology as a continuum, these results might be especially interesting for the clinical population of OC patients. Previous data (Tenore & Basile, 2018) highlighted the role played by specific early sensitizing experiences in the history of OCD patients, for whom disgust and morality play a central role. In line with Mancini's cognitive model of OCD (Mancini, 2018) a recent contribute of Basile and colleagues (2018), supported the specific role of guilt-related early experiences in OCD patient's history. In comparing the content of IwR exercises between OCD and non-OCD patients, in order to explore eventual differences in their early negative childhood memories, authors found that OCD patients reported significantly more blame/reproach memories, expressing more guilt emotion and needs for acceptance. Clinical observation and gathering of obsessive patients' life histories reveal patterns and similarities in the description of family atmosphere and the typologies of parent-child interaction, particularly in situations of disapproval of the child's behaviour. Family climate is described as rigid and characterised by a marked attention to morality and normative behaviour. Moreover, parental reactions to transgressions of rules, not necessarily clearly understood by the child, are perceived by the child as incongruous and sometimes accompanied by affective distance and by a peculiar and punitive facial expression, represented by a "long face", that represents a threat to the continuity of the relationship (Tenore & Basile, 2018).

Furthermore, our data showed a positive (although weaker) association between participants' sensitivity to sexual disgust and the experiences of being the object of moral criticism and of being held responsible. The link between sexual disgust sensitivity and morality, in particular with regard to religiosity, is widely supported in literature. A growing literature has considered the role of disgust on the nature, extent, and expression of religious beliefs (Ritter et al., 2016), religious fundamentalism (Terrizzi et al., 2010; Tybur et al., 2010) and religious scrupulosity (Olatunji, 2008; Olatunji et al., 2005). In all religions, sin dirties the conscience and washing the body cleanses it (Zhong & Liljenquist, 2006). Many of the prohibited or sinful practice within Judeo-Christianity are sexual; Christians and Sikhs wash away their sins through baptism, while Muslims use the act of "wudu" (ablutions) to prepare for worship. A recent work aimed to clarify the relationship between discrete types of disgust sensitivity and specific forms of religious beliefs, suggested a positive relationship between sexual disgust and fear of sin. Thus, our results may be due, at least in part, to the catholic cultural background of the participants who were all Italians.

Our findings confirm the strict link between disgust and morality. They also advanced the understanding of the leading role that early relational experiences can play in explaining the association between disgust and morality. These results are particularly relevant for a better understanding of both the normal population and clinical subtypes, particularly Ocd patients. Our data are in line with previous one (Tenore & Basile, 2018; Basile et al., 2018) highlighted the role played by specific early sensitizing experiences in the history of Ocd patients, for whom disgust and morality play a central role. Empirical findings and clinical information collected about life stories of obsessive patients reveal similarities in the description of the family atmosphere, portrayed as morally rigid and excessively disapproving

of any transgressive behavior.

This evidence could open important perspectives both from a theoretical point of view and in terms of clinical practice. Research over the last two decades has shown that disgust sensitivity represents an important vulnerability factor for the development of various disorders (Moncrieff-Boyd et al., 2014; Olatunji & Sawchuk, 2005; Stasik-O'Brien & Schmidt, 2018; Valentiner et al., 2005). This is especially true for OCD, given the specific and central role that disgust plays in its etiology and maintenance, particularly in the contamination subtype (Davey, 2011; Olatunji et al., 2010). Disgust response is particularly resistant to intervention techniques usually effective on modulating the anxiety response, such as the Exposure technique with Response Prevention (E / RP – Luppino & Pontillo, 2018). Importantly, disgust is more easily induced than anxiety, but is difficult to extinguish over a longer period of time and with less stable outcomes over time (Ludvik et al., 2015; Mason & Richardson, 2010; Olatunji et al., 2007b; Olatunji & Wolitzky-Taylor, 2009).

A rather promising intervention technique, whose transdiagnostic effectiveness has been widely supported in recent years (Arntz, 2012; Morina et al., 2017; Tenore et al., 2020; Veale et al., 2015), is the Imagery Rescripting (ImR), an experiential technique, often integrated in the context of Schema Therapy and aimed at modifying the meaning attached to early aversive experiences (Hagenaars & Arntz, 2012). In line with previous studies that showed ImR effectiveness in reducing OCD symptomatology targeting patients' early experiences of guilt-inducing reproaches, future studies should explore the possibility of decreasing both disgust and morality in high disgust sensitivity subjects by the use of an ImR intervention on moral sensitizing memories.

Beyond this, several limitations need to be acknowledged.

The sample is small and rather homogeneous: the 57 participants were highly educated and this limits the generalization of our results. Future studies should include a more heterogeneous sample. Another limitation is represented by the use of self-report instruments, due to possible interpretative and response biases.

Moreover, our work is a retrospective study; a longitudinal one would have allowed us to draw more definitive conclusions about the link between disgust sensitivity and early experiences revolving around how morality is internalized (e.g., through punitive parenting style).

To conclude, taken together these findings confirm the strict link between disgust and morality and suggest that disgust, besides protecting the body, also protects the moral self, the purposes of dignity and the sense of belonging to the group. This link exist not only at the evolutionary level, but also at the level of individual development.

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Appendix A

IAPS Images average Valence and Arousal values

Domain	IAPS Name	IAPS Nr.	Mean Valence	Valence DS	Mean Arousal	Arousal DS
Moral	Police	2694	3.55	1.72	5.05	2.16
Moral	DrugAddict	2710	2.52	1.69	5.46	2.29
Moral	Jail	2722	3.47	1.65	3.52	2.05
Moral	Alcoholic	2752	4.07	1.84	4.30	1.94
Moral	Prostitute	4233	4.56	1.86	3.96	2.15
Moral	DrugAddict	2717	2.58	1.32	5.70	2.16
Moral	EroticFemale	4290	7.61	2.56	7.20	2.63
Moral	EroticCouple	4659	6.87	1.99	6.93	2.07
Moral	EroticCouple2	4810	6.56	2.09	6.66	2.14
Moral	HIVTattoo	9006	2.34	1.59	5.76	2.46
Moral	Heroin	9102	3.34	1.76	4.84	2.50
Fiscal	Mutilation	3150	2.26	1.57	2.26	1.57
Fiscal	OpenChest	3250	3,78	1.72	3.78	1.72
Fiscal	Snakes	1111	3,25	1.64	3.25	1.64
Fiscal	Spider	1201	3.55	1.88	3.55	1.88
Fiscal	Rat	1280	3.66	1.75	3.66	1.75
Fiscal	Vomit	9320	2.65	1.92	2.65	1.92
Fiscal	Garbage	9373	3.38	1.48	3.38	1.48
Fiscal	Dishes	9390	3.67	1.58	3.67	1.58
Fiscal	Snakes	1111	3.25	1.64	3.25	1.64
Fiscal	Spider	1201	3.55	1.88	3.55	1.88
Fiscal	Rat	1280	3.66	1.75	3.66	1.75

Appendix B

Audio Script (translated from Italian)

Find a quiet and comfortable place where you can sit without being disturbed.

Find a comfortable position and close your eyes. Slowly, focus on the rhythm of your breath, take a few seconds to feel your breath ... feel the air that you bring in from your nose and that goes through your body and step by step free your mind. If there are thoughts, images, put them aside and slowly let your mind become a white screen on which you will now begin to visualize a scenario ...

Don't be in a hurry ... take a few seconds ...

And now try to identify yourself as much as possible in the scenario that I will present you ... and imagine to be the protagonist.

(A FEW MINUTES OF SILENCE)

You are in your country house ... you came here a few days ago to rest for a bit. You haven't been in shape since yesterday, the doctor told you not to worry: you have nothing serious. You just need some rest.

You lie on the bed, look out the window ... now it's evening and you are shivering.

Suddenly, while you are relaxing, immersed in your thoughts, you feel the fever rise ... you have chills, you touch your forehead and feel that it is hot, you feel tired and weak and a little dizzy. Finally, your eyes close.

You settle more comfortably and fall asleep ... you sleep for many hours and when you wake up you realize that the temperature has dropped ...

You realize you are drenched in sweat ... the blankets are soaked and the mattress too ... you move and you smell bad.

You get out of bed ... you are soaked ... you arrive slowly in the bathroom because you want to take a shower but you find a nasty surprise waiting for you: not even a trickle of water ... once again, probably the aqueduct has been closed for construction works ...

You go back to bed ... you lie down ... you don't want to do anything ... you feel weakened and a little sore ... so you let yourself go ... in a kind of passive half-sleep.

You don't even know how many hours have passed when you open your eyes ... your bad smell has become unbearable: it is sharp, intense and annoying.

At the slightest movement the stench spreads ... it is really terrible: "how am I reduced!" you say to yourself "I'm gross!"

You look at yourself in the mirror on your right: your hair is dirty and sticky, you try to mess it up with your hands ... you feel your fingers get greasy and you see the dandruff falling on your shirt soiled with burr ... you have a stubble, you feel itchy all over ... your mouth is sticky, God knows for how long you have not brush your teeth ... you put your hand in front of your mouth and breathe in it ... "Ew ..." you say "How disgusting I am! My breath is terribly heavy ..."

You take a look at yourself ... your underwear is stuck to the skin from excessive sweat and it gives off a bad

smell ... the pillow case is very wrinkled and stained with yellow ... your hands smell of dirt, you have long nails and a little black ... "I'm really a waste" - you say to yourself - "how could I have reduced myself like this?"

Appendix C

Mean and Standard Deviation of the of the emotion VAS before and after induction - Pilot Study

Mean (SD)	Pre	Post	t	p
Sadness	2.03(1.3)	2.69(1.38)	-2.67	.011
Disgust	1.45(1.06)	3.38(1.41)	-8.49	.000
Fear	1.85(1.13)	2 (1.16)	-0.693	.492, ns
Pain	1.8(1.2)	2.21(1.25)	-1.646	.107, ns
Anger	2.52(1.34)	2.57(1.54)	-.200	.843, ns
Deontological Guilt	1.57(1.10)	1.90(1.28)	.540	.592, ns
Pride	2.64(1.32)	1.42(0.76)	6.855	.000
Shame	1.57(1.19)	2.47(1.36)	-3.724	.001
Altruistic Guilt	1.59(0.98)	1.47(0.8)	.797	.430, ns
Self-Disgust	1.57(1.10)	2.78(1.52)	-5.280	.000

Appendix D

Imagery for assessment Procedure - Adapted by Young et al. (2013)

Now let yourself be guided back in time by this sensation you feel on your body ... let the memory of an unpleasant moment of you as a child emerge spontaneously in your mind ... when you are alone or instead with mom, or dad, or both ...

Do not force the memory ... let it emerge spontaneously ... and when you have found a memory, imagine watching a film that flows in your mind ... Enter this film and become a part of it, experiencing all the events that arise ... in the present ... as if it were now ...

Where are you?

What do you see around you? Look around ...

Are there any particular noises?

Are there any particular smells?

Is there someone with you?

What is happening?

What emotion do you feel?

What do you think the person who is with you is thinking?

And what is this person feeling?

What would you need right now?

Who could satisfy your need?

Can you try asking?

If you asked, what happened to the satisfaction of your need?

If you didn't ask, why didn't you?

How do you feel at the end of this scene?