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The Reciprocal Relationship between Sexual Arousal and Disgust as Evidenced in Automatic Approach-Avoidance Behavior

Jessica Hinzmann, Charmaine Borg, Johan R. L. Verwoerd, and Peter J. De Jong

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Sexual encounters imply exposure to stimuli that in other contexts typically elicit disgust-induced avoidance. To explain why people nevertheless tend to show sexual approach, it has been proposed that heightened sexual arousal may temporarily inhibit disgust. In line with this, studies have found that sexually aroused individuals showed heightened willingness to approach disgusting stimuli. Because automatic processes are critically involved in sexual behaviors, we examined whether the impact of sexual arousal extends to automatic responses to disgust-elicitors. To test the proposed reciprocal relationship between sex and disgust, we also investigated whether disgust reduces automatic sexual approach. In Study 1, 116 female participants (M = age 19.53) were assigned to a sexual arousal or control condition and performed a speeded approach-avoidance task to assess automatic responses to disgusting stimuli. In Study 2, 174 female participants (M = age 22.14) were assigned to a disgust, sexual arousal, or control condition and performed an approach-avoidance task involving both sex and disgust-relevant stimuli. Sexual arousal did not affect automatic responses to disgusting stimuli, and disgust did not influence automatic responses towards sexual stimuli. The reciprocal relationship between sexual arousal and disgust that was previously found for controllable responses did not extend to automatic responses.

From an evolutionary perspective, disgust and sex seem to be adaptive but conflicting forces. Disgust, on the one hand, has been conceptualized as a disease avoidance mechanism (Curtis & de Barra, 2018; Curtis, de Barra, & Aunger, 2011). As a first line of defense, disgust evolved to protect humans from contamination by pathogens that are invisible but nevertheless omnipresent (Curtis, Aunger, & Rabie, 2004). Confrontation with a disgusting stimulus will typically elicit a strong urge to avoid or escape the stimulus, which may consequently help prevent exposure to pathogens, thereby promoting health and survival (Oaten, Stevenson, & Case, 2009). In line with this view, the inclination to respond with disgust (i.e., disgust propensity) appears to increase with lower immune status (Ersche et al., 2014). Similarly, women’s disgust propensity was shown to be relatively high during the first trimester of pregnancy when mother and fetus are most vulnerable to disease (Fessler, Eng, & Navarrete, 2005).

It has been proposed that disgust can be divided into three functional domains: pathogen disgust, sexual disgust, and moral disgust (Tybur, Lieberman, & Griskevicius, 2009; Tybur, Lieberman, Kurzban, & DeScioli, 2013). Pathogen disgust is assumed to function as a “behavioral immune system” preventing contact with and consumption of infectious microorganisms, as described earlier (Schaller, 2006; Schaller & Duncan, 2007). Sexual disgust is assumed to be evolved to avoid partners and behaviors that may jeopardize one’s reproductive success, thereby shrinking the pool to those likely to contribute to the production of healthy offspring. Lastly, moral disgust is assumed to be related to social transgressions. It promotes distance from social relationships with norm-violating individuals that may impose costs on oneself or on members of one’s social network. Thus, in the broadest sense, disgust motivates avoidance of stimuli and individuals that may pose a threat to our survival.

The current study focuses on pathogen disgust and how this type of disgust may be involved in sexual behaviors. Sex is obviously critical to uphold survival by means of procreation. However, in apparent conflict with its survival relevance, sex involves massive exposure to pathogens and thus a high risk of disease transmission. For instance, a simple mouth-to-mouth kiss has an enormous risk of contamination, with an average bacteria transfer of 80 million per intimate kiss of 10 seconds (Kort et al., 2014). Given the disease-avoidance function of disgust, it...
may not come as a surprise that stimuli involved during sex (e.g., semen, saliva) are among the strongest disgust elicitors (Rozin & Fallon, 1987). Thus, if stimuli that are inherent to sexual behavior are strong disgust elicitors, the question arises of how we are able to engage in sexual behaviors in the first place. How can we explain that disgust-induced avoidance tendencies are apparently sometimes overruled, allowing for sexual behaviors?

One possible explanation could be that sexual engagement temporarily reduces the disgust eliciting properties of particular stimuli. In line with this, there is empirical evidence showing that heightened sexual arousal can temporarily reduce feelings of disgust as well as disgust-induced avoidance, thereby potentially facilitating sexual approach behaviors. For example, in an experimental study, Stevenson, Case, and Oaten (2011) investigated whether sexual arousal may reduce the disgust properties of specific stimuli in male participants. To evoke sexual arousal, the experimental group was asked to watch erotic pictures of female models. Because sexual arousal is both an affectively pleasant and an arousing state, the fact that disgust and disgust-induced avoidance are reduced when sexually aroused can equally likely be the result of being in any affectively pleasant and/or any arousing state. Therefore, the control groups were asked to watch non-sexually affectively pleasant arousing or non-sexual affectively unpleasant arousing pictures. All participants were then exposed to various sex-related and non sex-related disgust elicitors that were derived from different sensory modalities (i.e., visual, tactile, auditory, and olfactory). Results showed that participants in the experimental group reported less disgust towards sex-related disgust elicitors as compared to participants in the control groups who were not sexually aroused. Similarly, Ariely and Loewenstein (2006) examined whether sexual arousal may increase male participants’ willingness to engage in various sex-related behaviors. To elicit sexual arousal, the experimental group was asked to fantasize and use self-stimulation (i.e., masturbation). Findings demonstrated that participants in the experimental group gave more affirmative responses to scenarios such as “having sex with someone who is extremely fat” or “getting sexually excited by contact with an animal” as compared to participants in the control group who were not sexually aroused. These items may generally be considered as disgusting, and in fact the latter scenario is involved in the Disgust Scale (DS; Haidt, McCauley, & Rozin, 1994).

The observation that feelings of disgust are reduced when sexually aroused is not only restricted to an affective level but also translates to a behavioral level such that heightened sexual arousal reduces disgust-induced avoidance. Borg and de Jong (2012) asked female participants to rate and perform various (sex and non sex-related) tasks in the laboratory setting. An example of a sex-related task was lubricating a vibrator, whereas an example of a non sex-related task involved taking a sip of juice with a large insect in the cup. Sexual arousal was evoked by means of erotic movies in the experimental group. The experimental group not only rated the sex-related stimuli as less disgusting but also engaged in more of these (sex and non sex-related) disgusting behaviors compared to women in the control group who were not sexually aroused. Together, these findings indicate that heightened sexual arousal can reduce subjective feelings of disgust and disgust-induced avoidance, thereby possibly facilitating sexual approach.

There is also evidence that heightened disgust may interfere with the generation of sexual arousal. More specifically, it was demonstrated that women who watched disgusting pictures before a pornographic video reported less sexual arousal than women exposed to neutral or fear-inducing pictures (Fleischman, Hamilton, Fessler, & Meston, 2015). Additionally, a recent study showed that the smell of a disgusting odor can attenuate sexual arousal in men even at a genital level (Borg, Oosterwijk, Lisy, Boesveldt, & de Jong, 2019). Thus, there is evidence that heightened disgust feelings can inhibit the development of sexual arousal, which in turn may inhibit sexual approach behaviors. Therefore, the relationship between disgust and sexual arousal can be seen as mutually inhibitory, with the stronger force overruling the other (De Jong, van Overveld, & Borg, 2013).

The available evidence for the findings that sexual arousal and disgust can inhibit each other is mainly restricted to self-reports and controllable behaviors. These are subjective reports or deliberate behaviors that individuals are aware of and can reflect upon. Current dual process models emphasize the importance of differentiating between this type of reflective (controlled) and reflexive (automatic) responses, as both may be differentially involved in people’s behavior (e.g., Strack & Deutsch, 2004), including sexual behaviors (e.g., Borg, de Jong, & Schultz, 2010). In the same vein, current information processing models of sexual behaviors (e.g., Janssen, Everaerd, Spiering, & Janssen, 2000) assign a critical role to more reflexive, automatic processes in sexual behavior. Thus, it is important to complement the available evidence by investigating whether the same inhibitory relationship extends to automatic responses that individuals may be unaware of, unable to report about, and deliberately act upon. The current study was therefore designed to investigate whether (i) sexual arousal attenuates automatic avoidance of disgusting stimuli (Studies 1 and 2), and (ii) heightened disgust reduces automatic approach of sexual stimuli (Study 2).

### Study 1

The aim of Study 1 was to investigate our first hypothesis, namely that participants who are sexually aroused will demonstrate less automatic avoidance tendencies away from disgusting stimuli than participants who are not sexually aroused. Automatic approach-avoidance tendencies were assessed with an irrelevant feature paradigm (De Houwer, Crombez, Baeyens, & Hermans, 2001). Thus, in the current task, the required
response was determined by stimulus features that were unrelated to the sex/disgust content of the pictures, namely the format of the image frame (landscape vs. portrait). This same approach was successfully employed in previous research (e.g., Neimeijer, de Jong, & Roefs, 2015; Neimeijer, Roefs, Ostaín, & de Jong, 2017; Peeters et al., 2012; Van Gucht, Vansteenkoven, van Den Bergh, & Beckers, 2008; Van Hemel-Ruiter, de Jong, & Wiers, 2011; Veenstra & de Jong, 2010; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011; Wiers, Rinck, Kordts, Houben, & Strack, 2010). In this study, we used both the joystick (e.g., Rinck & Becker, 2007) and the manikin (De Houwer et al., 2001) version of the approach-avoidance task. This allowed us to explore whether the joystick and manikin versions differ in their sensitivity as a measure of automatic approach-avoidance tendencies with regard to sexual and disgusting stimuli (cf. Krieglmeyer & Deutsch, 2010).

Method

Participants

Participants were 116 heterosexual female students from the University of Groningen aged 18 to 32 years ($M = 19.53, SD = 1.97$) who reported no sexual complaints. Because men and women may vary both in their responses to disgusting and sexual stimuli, using a mixed sample could add undesirable method variance to the design thereby reducing the sensitivity of the design to test the core hypotheses. We therefore used a homogenous sample of one sex. Since the majority of the available student participants at our faculty are women, for pragmatic reasons we decided to restrict our sample to female participants in both Study 1 and Study 2. They were recruited through the university credit system and received course credits for their participation. Participants were randomly allocated to one of two approach-avoidance task versions (feedback-joystick, manikin) and further randomly assigned to one of the three experimental conditions (sexual arousal, general arousal, neutral). There were 60 participants who used the feedback-joystick version (20 sexual arousal condition, 20 general arousal condition, 20 neutral condition). There were 56 participants who used the manikin version (17 sexual arousal condition, 18 general arousal condition, 21 neutral condition). Power analysis using GPower (Erdfelder, Faul, & Buchner, 1996) with power = .80 and an alpha level of .05, indicated that to reliably detect differences between conditions with a medium to large effect size (Cohen’s $f^2 = .30$), we needed a total sample of at least 111 participants. Thus, the current study had enough power to reliably detect differences with a medium to large effect size.

Materials and Measures

Experimental Manipulation. In order to induce sexual arousal a female-friendly pornographic movie (“De gast”) involving sexual intercourse between a man and a woman was presented to the participants. In order to induce general arousal in the first control group a movie with adrenergic activities (“Try before you die”) was shown, similar to the approach of Stevenson et al. (2011). This movie involved scenes of extreme sports such as skydiving, abseiling, and bungee jumping aimed to increase adrenaline. In the second control group, participants were presented with a neutral movie (i.e., a train ride). These movies were successfully used as experimental manipulations in past research (Borg & de Jong, 2012). Corresponding soundtracks were presented through head phones.

Stimulus Pictures. The stimuli used in the approach-avoidance tasks consisted of two categories (disgust, neutral). Each category involved five images resulting in 10 images (see online supplementary material) that were randomly displayed during the approach-avoidance task. Stimuli in the neutral category were selected from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). Stimuli in the disgust category were selected by the research team. Based on the definition of pathogen disgust (e.g., Tybur et al., 2009), criteria for the selection process involved images to represent objects which are likely to contain infectious agents as well as a clear contamination risk if a person was to come in contact with them, and to motivate proximal avoidance of such stimuli (see online supplementary material).

Implicit Measures.

Approach-Avoidance Task (AAT) – Manikin Version. Approach-avoidance tendencies were assessed using an approach-avoidance manikin task (De Houwer et al., 2001). Participants were randomly presented with a picture of two categories (disgust, neutral). A manikin appeared either above or below the stimulus. Participants were asked to move this manikin as quickly as possible with key presses towards or away from the stimulus (approach or avoid) according to a task-relevant feature (i.e., format of the image frame: landscape, portrait) that functions independent from the stimulus-content. Participants were instructed to approach all pictures with a portrait-oriented frame format and to avoid all pictures with a landscape-oriented frame format. The compatibility effect assumes that when the task instructions match the automatic response tendency of the participant in reaction to the stimulus-content (e.g., avoid disgust), the reaction time will be fast. In contrast, when the task instructions do not match the automatic tendency of the participant (e.g., approach disgust) the reaction time is assumed to be slower due to interference.
**AAT — Feedback-joystick Version.** Approach-avoidance tendencies were assessed using an approach-avoidance feedback-joystick task (Rinck & Becker, 2007). Instructions were the same as used in the approach-avoidance manikin task; however, instead of moving a manikin, participants were asked to pull or push (approach or avoid) a joystick that was placed in front of them. When pulling the joystick, the stimulus on the screen became bigger and when pushing the joystick, the stimulus became smaller. The joystick was returned to the starting position before a new stimulus appeared.

**Explicit Measures.**

**Disgust Propensity and Sensitivity Scale — Revised (DPSS-R).** The DPSS-R (Van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006) is a self-report questionnaire that measures disgust propensity (i.e., the inclination to feel disgust more easily) and disgust sensitivity (i.e., the inclination to feel disgust negatively). It involves two subscales, namely disgust propensity (DPSS-DP) and disgust sensitivity (DPSS-DS), which contain six items each. An example item of the DPSS-DP is “I avoid disgusting things” and an example item of the DPSS-DS is “I think feeling disgust is bad for me”. Participants are asked to report how often these statements apply to them on a five-point Likert scale ranging from 1 (“never”) to 5 (“always”). The DPSS-R was shown to be adequately reliable (α = .82), with alpha coefficients of .75 for the DPSS-DP and .74 for the DPSS-DS, which are comparable to those reported in the study of Van Overveld et al. (2006). It also demonstrated good psychometric properties in terms of factor structure, test-retest reliability, criterion validity, and prognostic value (Van Overveld, de Jong, & Peters, 2010).

**Visual Analogue Scale (VAS).** As a manipulation check and subjective appreciation of emotions, VASs were used. Participants were asked to indicate to what degree they experienced (a) sexual arousal and (b) general arousal. Additionally, they were asked (c) how pleasant and (d) how positive or negative they considered the movie clip to be. The VASs had a length of 10 centimeters and ranged from 0 (“not at all”) to 100 (“very much”).

**Procedure**
The data collection took place from November 2012 to January 2013. Participants were assessed individually in the psychological laboratory of the University of Groningen. The experiment started with an AAT practice block consisting of 60 trials with neutral stimuli. This number of practice trials was selected to ensure that participants had understood the task instructions. After the practice block, participants watched a five-minute video depending on the condition they were assigned to; following this they were asked to complete the VASs. Subsequently, participants performed four AAT experimental blocks consisting of 40 trials each, with randomly presented picture stimuli from the disgust and neutral categories (with different neutral pictures as were used in the practice block) and lasting approximately 90 seconds. Before each AAT experimental block, a corresponding two-minute movie clip was shown to maintain the experimental manipulation. In total, participants were exposed to 13 minutes of movie material and performed 160 AAT experimental trials. Pictures of each stimulus category were displayed 80 times in total, with 40 images having a portrait frame format and 40 images having a landscape frame format. After the AAT, participants were asked to complete the DPSS-R and were debriefed. The duration of the experiment was approximately 45 minutes.

**Data Reduction**
Concerning the AAT, as was done in previous research (e.g., Heuer, Rinck, & Becker, 2007; Klein, Becker, & Rinck, 2011) only reaction times of trials with initially correct responses were investigated. Reaction times were measured in milliseconds.

First, AAT-effect scores were computed for both disgusting and neutral stimuli. Per stimulus category (disgust, neutral), the median reaction times of the stimuli with the instruction to approach were subtracted from the median reaction times of the stimuli with the instruction to avoid (e.g., disgusting-avoid minus disgusting-approach). Consistent with a series of recent studies using reaction time-based performance measures (e.g., Neimeijer et al., 2017), we used median instead of mean reaction times as this seems to be the most robust way to deal with outliers without losing much information. Higher AAT-scores are indicative of an automatic tendency to approach rather than to avoid pictures, and negative effects reflect a tendency to avoid rather than to approach pictures. To index the automatic approach-avoidance of disgusting stimuli, the AAT-effect for neutral trials was subtracted from the AAT-effect for disgust trials to control for non-specific differences in approach and avoidance tendencies (e.g., Neimeijer et al., 2017). Negative AAT-tendency scores thus reflect a tendency to avoid disgust compared to neutral pictures, whereas positive scores reflect a tendency to approach disgust relative to neutral pictures.

**Statistical Analysis**
To investigate whether there were differences in DPSS-R scores between conditions, between-subjects ANOVAs for each subscale were conducted with task version and condition as the independent variables, and disgust propensity and disgust sensitivity as the dependent variables. To test whether the sexual arousal manipulation worked, and to check for unforeseen differences in elicited sexual arousal between participants assigned to the joystick versus the manikin version of the AAT, sexual arousal ratings were subjected to a 3 condition (sexual arousal, general arousal,
neutral) x 2 version (joystick, manikin) between-subjects ANOVA.

To test the hypothesis that sexual arousal would reduce disgust-induced avoidance tendencies, the AAT-tendency scores were subjected to 3 condition (sexual arousal, general arousal, neutral) x 2 version (joystick, manikin) between-subjects ANOVA.

Results and Discussion

Table 1 demonstrates the means and standard deviations of the DPSS-R.

The between-subjects ANOVA with disgust propensity as the dependent variable showed no significant main effect of task version \(F(1, 109) = .43, \eta_p^2 = .01\), no significant main effect of condition \(F(2, 109) = .37, \eta_p^2 = .01\), and no significant interaction effect \(F(2, 109) = .44, p = .645, \eta_p^2 = .01\). Similarly, the between-subjects ANOVA with disgust sensitivity as the dependent variable demonstrated no significant main effect of task version \(F(1, 109) = .49, p = .484, \eta_p^2 = .01\), no main effect of condition \(F(2, 109) = 1.38, p = .254, \eta_p^2 = .01\), and no interaction effect \(F(2, 109) = 1.194, p = .307, \eta_p^2 = .02\). These findings indicated that there were no initial group differences with regard to disgust propensity and sensitivity.

Manipulation Check

Results of the analysis testing whether the sexual arousal manipulation worked showed a significant main effect of condition \(F(2, 109) = 92.50, p < .001, \eta_p^2 = .63\). Bonferroni post-hoc analysis confirmed that sexual arousal ratings were significantly higher in the sexual arousal condition \((M = 39.72, SD = 23.31)\) as compared to the neutral \((M = 1.54, SD = 4.05, p < .001)\) and general arousal condition \((M = 3.97, SD = 7.48, p < .001)\). No significant difference between the neutral and general arousal condition was observed \((p > .05)\). Unexpectedly, the effect of the arousal manipulation differed between the group of participants who were assigned to the joystick version and the group of participants assigned to the manikin version, as was evidenced by a significant interaction effect of condition and version \(F(2, 109) = 3.17, p = .046, \eta_p^2 = .06\). Participants in the joystick group who were assigned to the sexual arousal condition reported lower subjective sexual arousal \((M = 34.11, SD = 19.57)\) than participants in the manikin group \((M = 46.00, SD = 26.06)\). Moreover, participants in the joystick group who were assigned to the neutral condition \((M = 1.60, SD = 4.65)\) and the general arousal condition \((M = 5.55, SD = 9.57)\) reported higher subjective sexual arousal than participants in the manikin group who were assigned to the neutral condition \((M = 1.48, SD = 3.50)\) and the general arousal condition \((M = 2.22, SD = 3.64)\). These results indicate that the sexual arousal manipulation was more effective in the manikin as compared to the joystick group.

Hypothesis Testing

Table 2 shows the means and standard deviations of the AAT-effect scores for neutral and disgusting stimuli as well as the AAT-tendency scores as a function of condition and task version.

The intercept differed significantly from zero in a negative direction, \(F(1, 110) = 13.38, p < .001, \eta_p^2 = .11\) indicating that, overall, disgusting stimuli elicited automatic avoidance tendencies (of medium to large effect sizes). Additionally, a significant main effect of task version was observed \(F(1, 110) = 4.74, p = .032, \eta_p^2 = .04\), with AAT-tendency scores of the manikin task being slightly lower/more negative \((M = 59.43, SD = 109.86)\) as compared to the joystick task \((M = 15.08, SD = 109.45)\); see Figure 1 for a visual representation. These results suggest that the manikin task was a more sensitive procedure to measure automatic disgust-avoidance than the joystick task. The analysis testing hypothesis 1 showed no significant main effect of condition \(F(2, 110) = .47, p = .626, \eta_p^2 = .01\) and no significant interaction effect of condition and task version on AAT-tendency scores of disgusting stimuli \(F(2, 110) = 1.64, p = .199, \eta_p^2 = .03\). These results indicate that sexual arousal did not reduce the automatic avoidance tendencies elicited by the disgusting stimuli (sexual arousal condition: \(M = 48.56, SD = 110.59\); neutral condition: \(M = 38.98, SD = 136.16\); general arousal condition: \(M = 24.23, SD = 80.16\)). These findings do not support our first hypothesis that participants who are sexually aroused would show less automatic avoidance of disgusting stimuli than participants who were not sexually aroused.

Table 1. Mean values of the DPSS-R as a function of subscale, task version, and experimental condition

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Joystick</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sexual arousal</td>
<td>General arousal</td>
<td>Neutral</td>
<td>Sexual arousal</td>
<td>General arousal</td>
<td>Neutral</td>
</tr>
<tr>
<td>Disgust propensity</td>
<td>3.25 (0.37)</td>
<td>3.24 (0.56)</td>
<td>3.21 (0.60)</td>
<td>3.19 (0.45)</td>
<td>3.41 (0.58)</td>
<td>3.31 (0.62)</td>
</tr>
<tr>
<td>Disgust sensitivity</td>
<td>2.59 (0.58)</td>
<td>2.46 (0.49)</td>
<td>2.23 (0.61)</td>
<td>2.25 (0.46)</td>
<td>2.51 (0.67)</td>
<td>2.28 (0.85)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are given in parentheses.
Study 2

The first aim of Study 2 was to re-test our first hypothesis and to overcome the limitations of Study 1. These included a relatively small sample size (N = 116 divided over 3 conditions) that provided sufficient power only to reliably detect condition effects of medium to large effect size, no disgust category that was specifically related to sexual behaviors, and an experimental (sexual arousal) manipulation that may not have been strong enough. Therefore we used a larger sample in Study 2 to have sufficient power to reliably detect effects of small to medium size. Based on the results of Study 1, in Study 2 we specifically relied on the manikin approach-avoidance task because it seemed more sensitive as a measure of automatic approach-avoidance tendencies than the joystick task. Moreover, we introduced a new disgust category that is related to sexual behaviors. This category included sexual pictures that put attention on the contamination risk that is involved in sexual behaviors. Specifically, these focus on the body openings (mouth, vagina, anus) that come in contact with possible pathogen-containing substances (semen) in order to make the disgust-eliciting features more potent. To further optimize the study design, in Study 2 we intensified the experimental manipulations by presenting corresponding soundtracks to participants while performing the AAT trials.

The second aim of Study 2 was to investigate our second hypothesis, namely that participants who are disgusted will demonstrate more automatic avoidance tendencies away from sexual stimuli as compared to participants who are not disgusted. To check for pre-existing group differences in sexual excitability and inhibition, we included a trait measure of sexual excitability and inhibition.

Method

Participants

Participants were 174 female students from the University of Groningen aged 18 to 35 years (M = 22.14, SD = 3.37). They were recruited through the university credit system and the paid participant platform of the university. Participants received course credit or a monetary reward for their participation. The majority of participants self-identified as heterosexual (88.5%) or bisexual (9.2%), and approximately half of the participants (48.3%) were in a stable relationship with intimate sexual contact at the time of the study. Most of the participants indicated they had watched pornographic movie material in their life (84.5%), of which 17.8% did not watch it regularly. Participants were randomly assigned to one of four experimental conditions [42 sexual arousal condition, 44 matched sexual arousal control (i.e., neutral long condition), 45 disgust condition, 43 matched disgust control (i.e., neutral short condition)]. Power analysis using GPower (Erdfelder et al., 1996), with power = .80 and an alpha level of .05, indicated that to reliably detect differences between groups with medium effect size (Cohen’s $d$ = .50), we needed a sample of at least 102 participants. Therefore, the current study had enough power to reliably detect differences with a medium effect size.

Materials and Measures

Experimental Manipulation. To induce sexual arousal, a female-friendly pornographic movie was used that involved sexual intercourse between a man and a woman. This movie was validated in the Sex Lab at Porto University and was shown to be effective in eliciting sexual arousal in previous research (Cera et al., 2016, 2017). To induce disgust, a movie involving a woman vomiting was shown. This movie...
research (e.g., Borg, Bosman, Engelhard, Olatunji, & de Jong, 2016; Bosman, Borg, & de Jong, 2016; De Jong, Peters, & Vanderhallen, 2002). In order to control for the exposure time, two control groups were used. Both involved a neutral movie (i.e., a train ride) as in Study 1; however, their exposure time matched the sexual arousal condition (control long) and disgust condition (control short). In total, participants were exposed to 15 minutes of movie material in the sexual arousal and control long condition, and 3.45 minutes in the disgust and control short condition. This time frame was selected because sexual arousal takes longer to be evoked as compared to feelings of disgust. In order to intensify the manipulation, the soundtracks of the corresponding movie material continued playing in the background while participants conducted the AAT.

**Stimulus Pictures.** The stimuli used in the AAT consisted of four categories (disgust, sexual, sexually disgusting, neutral). Each category involved five images, resulting in 20 images (see online supplementary material) that were randomly displayed during the AAT. The disgust and neutral category correspond to the stimuli used in Study 1. The sexual category involved stimuli from the erotic subset of the Nencki Affective Picture System (NAPS ERO; Wierzba et al., 2015). The sexually disgusting stimuli were selected by the research team and involved sexual content that focuses on the contamination risk that is involved in sexual behaviors (e.g., direct contact of semen and body openings). Some of the pictorial stimuli also reflected sexual behaviors that may be considered as costly (e.g., unprotected anal sex) and may therefore not only elicit pathogen but also sexual disgust. For our main hypotheses, all stimuli were presented in all experimental conditions, allowing us to explore whether sexual arousal enhances automatic approach of sexual stimuli, and whether disgust enhances automatic avoidance of disgusting stimuli.

**Implicit Measures.**

*AAT – Manikin Version.* As in Study 1, the approach-avoidance manikin task (De Houwer et al., 2001) was used to assess approach-avoidance tendencies. Instructions were the same as in Study 1. In this study we only used the manikin version because the results of Study 1 suggested that the manikin version was more sensitive as a measure of automatic disgust-avoidance than the joystick task.

**Explicit Measures.**

*Disgust Propensity and Sensitivity Scale – Revised (DPSS-R).* The DPSS-R (Van Overveld et al., 2006) was used to assess disgust propensity and disgust sensitivity (detailed description in Study 1). The DPSS-R was shown to be adequately reliable ($\alpha = .79$), with alpha coefficients of .71 for the DPSS-DP and .74 for the DPSS-DS, which are comparable to those reported in the study of Van Overveld et al. (2006).

**Sexual Inhibition (SIS) and Sexual Excitation (SES) Scales – Short Form (SF).** The SIS/SES-SF (Carpenter, Janssen, Graham, Vorst, & Wicherts, 2010) is a self-report questionnaire to assess the trait of sexual inhibition and sexual excitation. It contains 14 items and features one sexual excitation factor (SES) and two inhibition-related factors, one related to the threat of performance failure (SIS1) and one related to the threat of performance consequence (SIS2). An example item of the SES is “When I think of a very attractive person, I easily become sexually aroused,” an example item of SIS1 is “I cannot get aroused unless I focus exclusively on sexual stimulation,” and an example item of SIS2 is “If I can be seen by others while having sex, I am unlikely to stay sexually aroused.” Participants were asked to indicate how much they agreed with the items on a Likert scale ranging from 1 (“strongly agree”) to 4 (“strongly disagree”). The SIS/SES-SF demonstrated adequate test-retest reliability, with $r = .61$ for the SES, .61 for the SIS1, and .63 for the SIS2, in a sample of women (Carpenter et al., 2010). In the current sample, Cronbach’s alpha for the SIS/SES-SF was rather low ($\alpha = .58$) with .64 for the SES, .40 for the SIS1, and .67 for the SIS2. These scales were used as descriptive variables of trait sexual inhibition and excitation.

**Visual Analogue Scale (VAS).** As a manipulation check and subjective appreciation of emotions, VASs were used. Specifically, participants were asked to indicate the degree to which they experienced (a) sexual arousal and (b) disgust. Additionally, they were asked how much (c) happiness and (d) shame they experienced. The VASs were 10 centimeters in length and ranged from 0 (“not at all”) to 100 (“very much”).

**Procedure**

The data collection took place from April to June 2018. Participants were assessed individually in the psychological laboratory of the University of Groningen. The experiment started with an AAT practice block consisting of 10 trials with neutral stimuli. This number of practice trials is in line with common research practices (e.g., Rinck & Becker, 2007).

Participants were then asked to complete the VASs as a baseline measure. Subsequently, they were presented with seven minutes of movie material in the sexual arousal and control long conditions, and with 45 seconds of movie material in the disgust and control short conditions. To check whether the experimental manipulation worked, participants were again asked to complete the VASs. Then participants performed four blocks of 60 trials (approximately 120 seconds per block), with randomly presented picture stimuli from the sexual, sexually disgusting, disgust,
and neutral categories (with different neutral pictures as used in the practice block). This means that pictures of each stimulus category were displayed 60 times in total, with 30 images having a portrait frame format and 30 images having a landscape frame format. Before each AAT experimental block, the sexual arousal and control long groups were presented with a two-minute movie clip, whereas the disgust and control short groups were shown 45-second movie clips. In total, participants in the sexual arousal and control long groups were exposed to 15 minutes of movie material, and participants in the disgust and control short groups to 3.45 minutes. After the AAT, participants were again asked to complete the VASs. At the end, they completed the self-report questionnaires and were debriefed. The duration of the experiment was approximately 60 minutes.

Data Reduction

Again, only reaction times of trials with initially correct responses were investigated (see Heuer et al., 2007; Klein et al., 2011). For the analyses, AAT-tendency scores were computed as was done in Study 1.

Statistical Analysis

To examine whether there were differences with regard to the trait measures (DPSS-R and SES/SIS-SF) between conditions, independent sample t-tests for each subscale were conducted. The t-tests compared the sexual arousal to neutral long condition as well as the disgust to neutral short condition with regard to responses on disgust propensity, disgust sensitivity, sexual excitation, SIS1, and SIS2.

In order to investigate whether the manipulation worked, a 2 condition (sexual arousal, neutral long) x 2 type of VAS (sexual arousal, disgust) x 2 time (pre, post manipulation) mixed factor ANOVA, with the first factor being a between-subjects factor and the two last factors as within-subject factors, was performed. Similarly, a 2 condition (disgust, neutral short) x 2 type of VAS (sexual arousal, disgust) x 2 time (pre, post manipulation) mixed factor ANOVA, with the first factor being a between-subjects factor and the two last factors as within-subject factors, was performed.

Table 3. Mean values of the DPSS-R and SIS/SES-SF as a function of subscale and experimental condition

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Sexual arousal</th>
<th>Neutral long</th>
<th>Disgust</th>
<th>Neutral short</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disgust propensity</td>
<td>3.10 (0.55)</td>
<td>3.17 (0.55)</td>
<td>3.52 (0.54)</td>
<td>3.03 (0.59)</td>
</tr>
<tr>
<td>Disgust sensitivity</td>
<td>2.37 (0.62)</td>
<td>2.43 (0.74)</td>
<td>2.62 (0.65)</td>
<td>2.28 (0.67)</td>
</tr>
<tr>
<td>Sexual excitation</td>
<td>2.59 (0.41)</td>
<td>2.67 (0.43)</td>
<td>2.47 (0.40)</td>
<td>2.54 (0.45)</td>
</tr>
<tr>
<td>Sexual inhibition 1</td>
<td>2.38 (0.48)</td>
<td>2.44 (0.44)</td>
<td>2.33 (0.51)</td>
<td>2.35 (0.30)</td>
</tr>
<tr>
<td>Sexual inhibition 2</td>
<td>3.08 (0.56)</td>
<td>3.07 (0.55)</td>
<td>2.93 (0.64)</td>
<td>2.80 (0.50)</td>
</tr>
</tbody>
</table>

Note. Standard deviations are given in parentheses.

To examine our first hypothesis, two between-subjects ANOVAs with condition (sexual arousal, long neutral) as the independent variable were conducted. The first analysis involved the AAT-tendency scores of disgusting stimuli as the dependent variable, and the second analysis involved the AAT-tendency scores of sexually disgusting stimuli as the dependent variable.

To investigate our second hypothesis, a between-subjects ANOVA with condition (disgust, short neutral) as the independent and AAT-tendency scores of sexual stimuli as the dependent variable was performed.

Exploratory analyses were performed to investigate whether sexual arousal impacted on sexual stimuli, and whether disgust impacted on disgusting stimuli. For this, a between-subjects ANOVA with condition (sexual arousal, long neutral) and AAT-tendency scores of sexual stimuli as the dependent variable was performed, and similarly, a between-subjects ANOVA with condition (disgust, short neutral) and AAT-tendency scores of disgusting stimuli as the dependent variable was conducted.

Results and Discussion

Descriptive Statistics

Table 3 demonstrates the means and standard deviations of the self-report measures DPSS-R and SIS/SES-SF. Results demonstrated that the responses of participants in the sexual arousal and neutral long condition did not differ on any of the subscales (p’s > .05). However, responses of participants in the disgust and neutral short condition differed with regard to disgust propensity [t (86) = 4.06, p < .001] and disgust sensitivity [t (86) = 2.43, p = .017], with higher scores on both scales in the disgust group. Because the self-report questionnaires were administered right after the AAT, it is possible that the disgust manipulation influenced responses on disgust propensity and sensitivity. Yet, it cannot be ruled out that these differences were due to initial group differences. This suggests that the following analyses need to be interpreted with caution (e.g., apparent effect of disgust induction may in fact partly reflect an effect of high trait disgust). Lastly, no significant differences between the groups on the SIS/SES-SF
subscales were observed \((p’s > .05)\). These findings indicate that, except for disgust propensity and sensitivity in the disgust and neutral short condition, no initial group differences existed.

### Manipulation Check

Table 4 shows the means and standard deviations of subjectively reported sexual arousal and disgust as a function of time and condition.

Results of the manipulation check involving the sexual arousal and long neutral group showed a significant interaction effect of type of VAS, time, and condition \([F (1, 84) = 26.17, p < .001, \eta_p^2 = .24]\); see Figure 2 for a visual representation. Subjective sexual arousal responses in the sexual arousal condition were higher from pre to post manipulation, indicating that the experimental manipulation in the sexual arousal group worked as intended. Unexpectedly, subjective disgust responses also slightly increased from pre to post manipulation in the sexual arousal condition. Subjective sexual arousal and disgust responses in the neutral long condition were similar from pre to post manipulation.

Results of the manipulation check involving the disgust and short neutral group demonstrated a significant interaction effect of type of VAS, time, and condition \([F (1, 86) = 556.67, p < .001, \eta_p^2 = .87]\); see Figure 2 for a visual representation. Specifically, subjective disgust responses in the disgust condition were higher from pre to post manipulation, indicating that the experimental manipulation in the disgust group worked. Subjective sexual arousal responses in the disgust condition were similar from pre to post manipulation. Similarly, subjective disgust and sexual arousal responses in the neutral short condition were similar from pre to post manipulation.

### Hypotheses Testing

Table 5 shows the means and standard deviations of AAT-tendency scores.

#### Hypothesis 1

The overall pattern of the AAT-disgust scores was in the expected direction but of small effect size, and the intercept did not reach the conventional level of significance \([F (1, 84) = 2.92, p = .091, \eta^2 = .04]\). Thus, the overall automatic disgust-avoidance tendencies were less pronounced than in Study 1. The analysis testing the first hypothesis and involving generally disgusting stimuli showed no significant difference between the sexual arousal and neutral (long) conditions \([F (1, 84) = .38, p = .540, \eta^2 = .004]\), indicating that the sexual arousal manipulation did not influence (weaken) the automatic avoidance tendencies of disgusting stimuli.

The analysis testing the first hypothesis and involving sexually disgusting stimuli indicated that the sexual arousal manipulation also failed to affect automatic approach-avoidance tendencies of sexually disgusting stimuli \([F (1, 84) = .69, p = .690, \eta^2 = .002]\). However, the overall AAT
score of sexually disgusting stimuli did not differ from zero \(F(1, 86) = 5.11, p = .007\), indicating that the disgust effect size seems to imply that the sexually disgusting stimuli did not generally elicit automatic avoidance responses. This might have precluded any effect of heightened sexual arousal on the automatic responses to the sexually disgusting stimuli.

### Hypothesis 2
The analysis testing the second hypothesis and involving sexual stimuli showed no significant difference between the disgust and neutral short conditions \(F(1, 86) = .58, p = .450, \eta^2 = .007\), indicating that the disgust manipulation did not have an impact on the automatic approach-avoidance tendencies of sexual stimuli. However, it appeared that although the overall AAT-scores were positive (reflecting automatic sexual approach), the overall effect (independent of condition) was small and just fell short of statistical significance \(F(1, 86) = 3.88, p = .052, \eta^2 = .04\), which might have limited the sensitivity of the design to find inhibitory effects of disgust on automatic approach of sexual stimuli.

### Exploratory Analyses
The exploratory analysis involving sexual stimuli showed no significant difference between the sexual arousal and neutral long conditions \(F(1, 84) = .76, p = .384, \eta^2 = .009\), indicating that heightened sexual arousal did not strengthen automatic sexual approach tendencies. Although the AAT-scores were overall positive (reflecting automatic sexual approach), the effect was small and just fell short of statistical significance \(F(1, 84) = 3.97, p = .050, \eta^2 = .05\). Thus, overall this analysis showed a (non-significant) tendency to automatically approach sexual stimuli that was not enhanced by heightened sexual arousal.

The exploratory analysis involving disgusting stimuli showed no significant difference between the disgust and neutral short conditions \(F(1, 86) = .22, p = .637, \eta^2 = .003\), indicating that experimentally heightened disgust did not have an impact on the avoidance tendencies elicited by disgusting stimuli. Yet, the AAT-disgust scores were overall lower than zero, as was evidenced by the significant intercept \(F(1, 86) = 5.11, p = .026, \eta^2 = .06\). Thus, the outcome of this analysis indicated that overall, participants showed automatic avoidance of disgust stimuli, which was not inflated by experimentally heightened disgust.

### General Discussion
In the current two experimental studies we examined if sexual arousal would reduce automatic avoidance of disgusting stimuli. As a second aim, in Study 2, we also investigated if disgust reduces automatic approach of sexual stimuli. The findings showed that heightened sexual arousal did not influence automatic behavioral tendencies towards disgusting stimuli, and the induction of disgust did not have an influence on the automatic behavioral tendencies towards sexual stimuli.

### Influence of Sexual Arousal on Automatic Behavioral Tendencies Elicited by Disgusting Stimuli
The current findings were not in line with our first hypothesis. Specifically, we hypothesized that participants who are sexually aroused would show less avoidance tendencies away from disgusting stimuli than participants who are not sexually aroused. Although in both studies the experimental manipulation effectively increased sexual arousal, there was no difference in behavioral tendencies towards disgusting stimuli between the experimental and control conditions.

Especially in Study 1, participants generally demonstrated strong automatic avoidance from disgusting stimuli, which is in line with past research showing that people generally display automatic avoidance of unpleasant stimuli (e.g., Chen & Bargh, 1999; De Houwer et al., 2001). This is in agreement with the evolutionary function of (pathogen) disgust to avoid contact with, and contamination by, infectious threats (Schaller & Duncan, 2007; Tybur et al., 2009), thereby promoting one’s health and survival (Oaten et al., 2009). Although this general avoidance tendency was of medium to large effect size, there was no evidence that sexual arousal reduced this automatic avoidance tendency. To increase the statistical power and to improve the research design of Study 1, in Study 2, we increased the sample size and intensified the experimental manipulation of sexual
arousal. But also in Study 2, sexual arousal did not affect automatic disgust avoidance responses; however, it should be acknowledged that irrespective of condition the overall automatic disgust-avoidance tendency from the same core disgust stimuli as were used in Study 1 was only of small to medium effect size which might have reduced the sensitivity of the design to detect an influence of sexual arousal on automatic disgust avoidance tendencies.

To examine whether perhaps sexual arousal would especially affect sexual stimuli that signal contamination threats, Study 2 not only relied on core disgust stimuli but also included sexually disgusting stimuli that were contamination-relevant. However, this category of sexually disgusting stimuli did not elicit automatic avoidance, perhaps because of the ambiguous nature of these stimuli. Because these stimuli did not elicit automatic avoidance, this clearly limited the opportunity for sexual arousal to show its hypothesized properties to reduce disgust-induced avoidance.

Taken together, the findings of both studies provided no evidence to support the view that sexual arousal would reduce automatic disgust-induced avoidance. This is in apparent contrast with previous findings showing an inhibitory influence of sexual arousal on self-reported disgust and overt disgust-induced avoidance behavior (e.g., Ariely & Loewenstein, 2006; Borg & de Jong, 2012; Stevenson et al., 2011). Perhaps, then, the impact of sexual arousal on reducing disgust is restricted to reflective/controllable responses and does not extend to more reflexive behavioral (avoidance) tendencies. One explanation for this incongruence of disgust responses between explicit and implicit measures when being sexually aroused is that it may require deliberate appreciation of the disgusting stimulus in order to reduce its disgust evoking properties. In our study, individuals did not have the time to deliberately appraise the presented stimuli, which may have rendered their disgust avoidance tendencies relatively immune for the impact of heightened sexual arousal. However, it should be acknowledged that especially in Study 2, the overall tendency to automatically avoid disgusting stimuli was relatively small. This might have rendered the design not sufficiently sensitive to detect the hypothesized inhibitory effects of sexual arousal on automatic disgust avoidance.

**Influence of Disgust on Automatic Behavioral Tendencies Elicited by Sexual Stimuli**

The current findings also did not support our second hypothesis that participants who are disgusted would show weaker automatic approach tendencies towards sexual stimuli than participants who are not disgusted. Although the experimental manipulation effectively increased disgust, there was no difference in automatic sexual approach tendencies between the experimental and control conditions. Overall, participants tended to show automatic approach tendencies towards sexual stimuli. This is consistent with previous research using implicit measures that showed automatic approach responses to pleasant stimuli. For example, Houwer et al. (2001) demonstrated in an approach-avoidance manikin task that participants needed less time to approach positive stimuli than to avoid positive stimuli. It should be acknowledged, however, that the overall automatic sex-approach tendency (i.e., independent of condition) was relatively weak (small to medium effect size). In the absence of strong automatic sex-approach tendencies there might also have been limited room for disgust to reduce these approach tendencies. Thus, it might still be the case that in the context of sex stimuli that elicit stronger automatic approach tendencies disgust may attenuate automatic sex-approach behaviors.

In summary, the current findings did not provide any support for the view that disgust reduces automatic sex-approach tendencies. This finding seems in apparent conflict with previous research showing an inhibitory influence of disgust on self-reported sexual arousal (Fleischman et al., 2015). One explanation for this apparent inconsistency might be that the impact of disgust on sexual approach does not extend to reflexive responses and is limited to self-reported sexual arousal.

**Exploratory Findings**

In Study 1, we explored whether the joystick and manikin versions of the AAT would differ in their sensitivity as a measure of automatic approach-avoidance tendencies regarding sexual and disgusting stimuli. Because participants who used the manikin task showed stronger avoidance tendencies of disgusting stimuli as compared to participants who used the joystick task, the manikin task seemed more sensitive as a measure of automatic disgust avoidance behavior. Although not directly relevant to our study hypotheses, in Study 2 we explored the influence of sexual arousal on automatic approach tendencies of sexual stimuli, and similarly, the influence of disgust on automatic avoidance tendencies of disgusting stimuli. The findings did not indicate that heightened arousal would promote automatic sex-approach, or that heightened disgust would promote automatic disgust-avoidance responses. Thus, the automatic approach-avoidance tendencies appeared more generally highly robust against the influence of both heightened sexual arousal and heightened disgust.

**Limitations and Future Research**

Some limitations need to be mentioned. First, in Study 2, the sexual arousal induction not only heightened sexual arousal but also resulted in heightened feelings of disgust. The increase in disgust may be explained by the activities shown in the sexual arousal manipulation (i.e., fellatio, cunnilingus, penile-vaginal penetration) that involve massive exchange of pathogens and the fact that the sample consisted only of women, who demonstrate higher levels of disgust compared to men (e.g., Al-Shawaf & Lewis, 2013; Curtis et al., 2004; Haidt et al., 1994; Oaten et al., 2009; Tybur et al., 2009). The increase in disgust might have...
reduced the impact of heightened sexual arousal on automatic disgust-avoidance responses. Researchers might try to find movie materials that exclusively induce sexual arousal without concurrently also eliciting (some) disgust.

Second, the current studies used an irrelevant feature paradigm to assess automatic approach-avoidance tendencies. In this approach, participants may become increasingly proficient in ignoring the task-irrelevant stimulus content, thereby precluding the impact of stimulus content on participants’ approach-avoidance responses. It would therefore be relevant to replicate the current study using a task-relevant feature paradigm in which participants cannot ignore the disgust/sex content of the stimuli in the AAT (cf. Field, Caren, Fernie, & De Houwer, 2011; Lender, Meule, Rinck, Brockmeyer, & BLECHERT, 2018; Neimeijer et al., 2017). Perhaps such an approach would result in larger AAT effects which in turn may enhance the sensitivity of the design to find influences of arousal/disgust on participants’ automatic sex-approach and disgust avoidance responses.

Another strategy that might help to increase the sensitivity of the design to detect a possible influence of sexual arousal and disgust on automatic sex approach/disgust avoidance tendencies would be to use even more intense disgust and sex stimuli within the AAT. It might also be advisable to only use one target (sex or disgust) and one neutral reference category of stimuli. That is, the lower disgust-avoidance tendencies in Study 2 compared to Study 1 might at least partly be due to the fact that in Study 2 sexual stimuli were also included next to disgust in the AAT. The sexual stimuli might have elicited arousal that reduced the habitual disgust-elicited avoidance. Similarly, the inclusion of disgust stimuli might have reduced the sex-approach tendencies within the current AAT of Study 2.

Moreover, in both Study 1 and Study 2 we did not obtain any information about relationship status, hormonal contraceptives, or menstrual cycle status. We cannot exclude that differences between the groups with regard to these factors existed; however, due to the random allocation of participants in the groups, we expect that these factors were equally distributed across the groups. Nevertheless, it is relevant for future research to account for these factors.

The pictures that were used in the AAT and that fall under the disgust category were selected based on theoretical considerations (e.g., Tybur et al., 2009), and were not formally tested for their affective response. In order to ensure that the stimuli are indeed perceived as disgusting, it is important for future research to validate these stimuli.

Lastly, it needs to be mentioned that only women were included in the current studies. In light of research that has shown that women have higher levels of disgust than men (e.g., Al-Shawaf & Lewis, 2013; Curtis et al., 2004; Haidt et al., 1994; Oaten et al., 2009; Tybur et al., 2009), the generalizability of our results is limited to women. Therefore, it is crucial for future research to replicate the current study with men.

Conclusion
The current two experimental studies provided a first test of the influence of sexual arousal on automatic disgust avoidance and of the influence of disgust on automatic sex-approach tendencies. In apparent contrast to findings of earlier studies using explicit measures, no evidence emerged to indicate that sexual arousal would attenuate automatic disgust-induced avoidance or that disgust would attenuate automatic sex-induced approach responses. This seems to indicate that the impact of heightened sexual arousal and heightened disgust is restricted to subjective responses and does not extend to reflexive approach-avoidance tendencies.

Declaration of interest statement
The authors declare that they have no affiliation with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

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