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Pathogen disgust and interpersonal personality

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ABSTRACT

The behavioral immune system includes motivational systems for avoiding contact with pathogens, including those transmitted by other people. Motivations to avoid others may depend not only on the perceived risk of infection but also on perceived benefits of social interaction. Based on this idea, we hypothesise that more agreeable people may experience less disgust towards other people, but not necessarily less disgust towards other pathogen sources. Using two existing samples, we tested whether agreeableness and other personality factors related more to disgust towards human than non-human pathogen cues. As predicted, agreeableness negatively correlated with disgust towards human pathogen cues but not with disgust towards non-human pathogen cues. In contrast, extraversion had no relation with disgust towards human or non-human pathogen cues. These findings suggest that disgust felt towards others may reflect a trade-off between pathogen avoidance and the preferred quality of interpersonal relationships, but not the preferred quantity of relationships. Implications of these findings for understanding the relation between disgust and interpersonal attitudes and behaviours are discussed.

1. Introduction

The idea that disgust functions to motivate people to avoid infectious stimuli is widely accepted (Curtis & Biran, 2001; Oaten, Stevenson, & Case, 2009). This is why objects that are most likely to harbour pathogens, like rotten meat or feces, elicit disgust across cultures (Curtis, Aunger, & Rabie, 2004). The avoidance of potentially pathogenic objects is not without costs, though. For example, when the source of potential infection is a fellow human, a strong disgust response could jeopardize opportunities for beneficial social interaction. People may thus experience less disgust towards pathogen cues emanating from a person if they anticipate or depend on benefits of positive social interactions. Interpersonal pathogen disgust, therefore, may not depend only on the perceived level of threat from pathogen transmission, but on a trade-off between the costs and benefits of contact (Tybur, Lieberman, Kurzban, & DeScioli, 2013). The primary aim of this paper was to investigate how agreeableness – a personality trait related to the tendency to have harmonious interpersonal contacts – relates to disgust sensitivity towards pathogen cues on other people. Although extraversion also influences interpersonal behaviour, it reflects a preference for a high quantity of social interactions, rather than for high quality and harmonious encounters. For this reason, we expect that agreeableness – rather than extraversion – should relate to interpersonal disgust.

1.1. Pathogen disgust and expected value of contact

The level of disgust experienced depends not only on perceived infectiousness, but also on perceived benefits of physical contact with the stimulus. Experienced disgust can be viewed as an integration of these costs and benefits – what can be thought of as a motivational state reflecting expected value of contact (Tybur et al., 2013). The expected value of contact for a food, for example, would depend on perceived infectiousness of the food (e.g., via odors, colors, or textures associated with decay), a person's nutritional state (e.g., sated versus starving), and the food's perceived nutritional benefits. To a particularly hungry person, even mouldy corn might become palatable (Hoefling et al., 2009). This logic also applies to disgust towards people. Consider parent-offspring interactions. The sight and smell of feces are typically treated as pathogen cues, but parents feel little-to-no disgust towards their own baby's diaper, presumably because the benefits of contact with offspring outweigh the costs of contact with pathogens (Case, Repacholi, & Stevenson, 2006). As a final example, the benefits of contact with a high quality mate may outweigh potential infection costs, resulting in low (and perhaps absent) disgust towards potentially infectious behaviours like kissing and intercourse (Borg & de Jong, 2012).

Of course, the benefits of physical contact extend beyond offspring care and mating. Many social interactions require physical contact or close proximity. Since the avoidance and rejection associated with disgust impair harmonious social interaction, disgust experienced towards people with pathogen cues should reflect a trade-off between the likelihood of pathogen transmission and the benefits of interaction. The estimated benefits of interaction might be sensitive to a variety of factors,

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including the nature of the relationship, the individual's current need for affiliative or collaborative behaviour, the trustworthiness of the target, and the target's ability to confer benefits. Importantly, some of these factors might covary with personality traits such as social trust, empathy, and agreeableness, which index expected benefits from social interaction. Indeed, one recent study found that people high in generalised social trust reported lower pathogen disgust sensitivity (Aarøe, Osmundsen, & Petersen, 2016) measured using the Three Domain Disgust Scale (Tybur, Lieberman, & Griskevicius, 2009).

If this account is correct, then traits like dispositional trust (which reflects how much a person values social interactions), should relate to the level of disgust a person feels towards another individual displaying pathogen cues, but not the level of disgust felt towards a non-human pathogen cue, such as spoiled food. For similar reasons, Gangestad and Grebe (2014) suggested that disgust sensitivity towards human and non-human contaminants might differentially relate to interpersonal psychology, and Park (2015) found that human (but not non-human) pathogen disgust sensitivity predicted preferences for interpersonal space. Following these authors, the current study examines how personality relates to human and non-human item clusters from the Three Domain Disgust Scale (Tybur et al., 2009).

1.2. Pathogen disgust and interpersonal personality

Of the five (in the Big Five) or six (in the HEXACO) higher order personality factors, extraversion and agreeableness most clearly relate to social interaction. Whereas both personality factors influence social motivation, they do so in different ways: Extraversion relates to the preferred quantity of social interaction, whereas agreeableness relates to the preferred quality of social interaction (Costa, McCrae, & Dye, 1991). Hence, we consider each in turn.

1.2.1. Agreeableness

Personality researchers generally view agreeableness as the degree to which a person values harmonious and cooperative interpersonal interaction (Costa et al., 1991; Graziano, Habashi, Sheese & Tobin, 2007). Research has shown that agreeableness predicts more generous, cooperative and trusting behavior in economic games (Zhao & Smillie, 2015), including the dictator game and the prisoner's dilemma (Kagel & McGee, 2014). Agreeableness is also associated with real-world prosocial behaviours like helping strangers (Ozer & Benet-Martinez, 2006) and with efforts to avoid hostile interactions (Jensen-Campbell & Graziano, 2001). More agreeable people are also less likely to be prejudiced and hostile towards the targets of stigma, including obese people (Graziano, Bruce, Sheese & Tobin, 2007) and foreigners (Sibley & Duckitt, 2008). And perhaps of most relevance to the current investigation, agreeable people make more of an effort to control negative emotions when interacting with others (Meier & Robinson, 2004; Tobin, Graziano, Vanman, & Tassinary, 2000).

These lines of evidence suggest that the tendency to experience other-condemning and avoidant emotions like disgust might depend on a person's level of agreeableness. Low agreeableness individuals might discount the value of positive interactions with others in favor of avoiding pathogens. High agreeableness individuals, on the other hand, might have a higher threshold for experiencing disgust towards another person.

1.2.2. Extraversion

Existing work also suggests that pathogen-avoidance motivation should relate to the personality factor extraversion. Social interaction entails the risk of infection, so more pathogen-avoidant individuals may decrease their motivation for social interaction to reduce the frequency of contact with other people (Fincher & Thornhill, 2012). In support of this account, Schaller and Murray (2008) found that people in countries with more infectious disease are less extraverted. In an experimental study, Mortensen, Becker, Ackerman, Neuberg, and Kenrick (2010) found that participants rated themselves as lower in openness, agreeableness and extraversion after being exposed to pathogen cues.

Similar logic suggests that more disgust sensitive people, being relatively more motivated to avoid infection, might perceive social interaction as more costly and hence be less gregarious and extraverted (Schaller & Park, 2011). However, existing studies have not found a consistent relationship between pathogen disgust sensitivity and extraversion (Olatunji et al., 2012; Tybur, Bryan, Lieberman, Caldwell Hooper, & Merriman, 2011; Tybur & de Vries, 2013). Gangestad and Grebe (2014) investigated disgust sensitivity towards human and non-human pathogen items separately and found a *positive* relation between extraversion and human pathogen disgust but not non-human pathogen disgust. They interpreted this pattern as suggesting that extraverted people experience greater disgust towards human pathogen cues as a protective response to more frequent exposure to conspecifics. An additional aim of the current paper, therefore, was to investigate the relationship between extraversion and disgust sensitivity towards human and non-human pathogen cues.

1.3. Predictions

Whereas previous studies have not found a consistent relation between agreeableness and pathogen disgust (Olatunji et al., 2012; Tybur et al., 2011; Tybur & de Vries, 2013), we predicted that NEO-PI agreeableness would be negatively correlated with human pathogen disgust but not with non-human pathogen disgust, since non-human contaminants do not require a trade-off between pathogen avoidance and harmonious social interaction. In addition, we expected that human pathogen disgust would be most strongly related to the NEO-PI agreeableness facets of trust, tendermindedness and altruism, because these traits are most closely related to a person's motivation to have harmonious and cooperative relationships. We also expected the warmth facet from extraversion (e.g., "I really like most people I meet") to negatively correlate with interpersonal pathogen disgust, due to the prosocial nature of this facet.

NEO agreeableness is distributed between the emotionality, agreeableness and honesty-humility factors of HEXACO (Ashton & Lee, 2007; Ashton, Lee, & de Vries, 2014). Nevertheless, we expected consistent findings: agreeableness, especially the forgiveness, gentleness and patience facets, would negatively correlate with human pathogen disgust but not with non-human pathogen disgust.

We did not make specific predictions regarding the remaining personality factors, but we did seek to test whether they differentially relate to human and non-human pathogen disgust sensitivity.

2. Method

We tested our predictions using data from two existing samples that both measured disgust sensitivity with the Three-Domain Disgust Scale (TDDS; Tybur et al., 2009). The TDDS measures three types of disgust sensitivity, moral, sexual and pathogen disgust, using items rated on a scale from 0, "not at all disgusting", to 6 "extremely disgusting". Following Gangestad and Grebe (2014) and Park (2015), we separated the seven pathogen disgust items into two conceptually distinct clusters: one with three items relating to non-human disgust items (e.g. "stepping in dog poop"), and one with four human disgust items, (e.g. "standing close to a person who has body odor"). We tested how each cluster related to all personality factors and facets.

In the first sample (Tybur et al., 2011), 477 undergraduate students (67.7% female; $M_{age} = 19.89$, $SD_{age} = 3.06$) from the University of New Mexico completed personality assessments using the NEO Personality Inventory (NEO PI-3; McCrae, Costa, & Martin, 2005). The NEO PI-3 measures neuroticism, extraversion, openness, agreeableness and conscientious factors, with 48 items per factor. Each factor further breaks down into six eight-item facets, giving a total of 30 facets.

In the second sample (Tybur & de Vries, 2013), 476 adults from a Dutch internet panel (50% female; $M_{age} = 54.5$, $SD_{age} = 13.7$) completed personality assessments using the Dutch version of the revised HEXACO Personality Inventory (HEXACO-PI-R; de Vries, Ashton, & Lee, 2009; Lee & Ashton, 2004). This measures six factors, honesty-humility, emotionality, extraversion, agreeableness, conscientiousness and openness to experience, each with 32 items. The factors are further partitioned into four facets per factor, measured by eight items each.

3. Results

3.1. Sample 1 analysis

Zero-order correlations between overall pathogen disgust sensitivity, as well as human and non-human pathogen disgust sensitivity and the factors and facets of the NEO PI-3 are shown in Table 1. The last column of the table shows whether correlations between each personality factor or facet and human versus non-human pathogen disgust differed based on a *z*-test for dependent correlation coefficients (Lee & Preacher, 2013).

As predicted, agreeableness correlated differently with human and non-human item clusters – indeed, agreeableness correlated significantly (negatively) only with the human items. At the facet level, trust and tendermindedness were the only agreeableness facets that negatively correlated with human pathogen disgust. However, straightforwardness, but not altruism, related more strongly to human than non-human disgust.

In contrast to the findings of Gangestad and Grebe (2014), extraversion did not correlate significantly with human or non-human pathogen disgust. Also, contrary to predictions based on the view that human pathogen disgust should relate to preferred quantity of social interaction (Gangestad and Grebe; Schaller & Park, 2011), the gregariousness facet was unrelated to both human and non-human pathogen disgust. However, consistent with a connection between human pathogen disgust and preferred quality of social interaction, the warmth and positive emotions facets were negatively correlated with human pathogen disgust but were unrelated to non-human pathogen disgust.

Of all the NEO factors, openness had the strongest negative relationship with pathogen disgust. Unexpectedly, the correlation with openness was significantly stronger for the human pathogen disgust than for the non-human pathogen disgust and this was the case for all of the openness facets except for actions.

3.2. Sample 2 analysis

Zero-order correlations between overall pathogen disgust sensitivity, as well as human and non-human disgust clusters, and the factors and facets of the HEXACO are shown in Table 2. The last column of the table shows whether correlations between the personality factor or facet differed between human versus non-human pathogen disgust based on *z*-tests for dependent correlation coefficients (Lee & Preacher, 2013).

Again, the agreeableness factor was negatively correlated with pathogen disgust sensitivity and was marginally more strongly related to human than non-human pathogen disgust. At the facet level, gentleness correlated more strongly (negatively) with human than non-human pathogen disgust. However, the forgiveness and patience facets of

Table 1
Correlations between NEO personality variables and pathogen disgust sensitivity.

NEO PI-3 factor	NEO PI-3 facet	Pathogen disgust			
		Overall	Non-human	Human	Difference (p)
Neuroticism		0.11*	0.11*	0.09	0.66
	Anxiety	0.13*	0.16*	0.07	0.04*
	Angry hostility	0.08	0.06	0.08	0.66
	Depression	0.03	0.04	0.02	0.66
	Self-consciousness	0.06	0.05	0.05	1
	Impulsiveness	0.11*	0.10*	0.10*	1
	Vulnerability	0.11*	0.11*	0.09*	0.66
Extraversion		−0.04	0.00	−0.06	0.18
	Warmth	−0.08	0.00	−0.12*	0.008*
	Gregariousness	0.03	0.05	0.00	0.27
	Assertiveness	−0.07	−0.09	−0.05	0.37
	Activity	0.01	0.02	0.00	0.66
	Excitement seeking	0.02	0.03	0.00	0.51
	Positive emotions	−0.07	0.00	−0.11*	0.01*
Openness		−0.24**	−0.10*	−0.29**	>0.001**
	Fantasy	−0.17**	−0.09	−0.20**	0.01*
	Aesthetics	−0.13*	0.01	−0.20**	>0.001**
	Feelings	−0.12*	−0.04	−0.16*	0.007*
	Actions	−0.19**	−0.13*	−0.20**	0.11
	Ideas	−0.20**	−0.08	−0.24**	>0.001**
	Values	−0.20**	−0.11*	−0.23**	0.007*
Agreeableness		−0.10*	−0.02	−0.15*	0.004*
	Trust	−0.15**	−0.06	−0.19**	0.004*
	Straightforwardness	−0.03	0.04	−0.07	0.01*
	Altruism	−0.04	−0.01	−0.05	0.18
	Compliance	−0.09	−0.05	−0.09*	0.37
	Modesty	−0.04	00	−0.06	0.18
	Tender mindedness	−0.07	0.02	−0.12*	0.002*
Conscientiousness		0.03	0.04	0.02	0.66
	Competence	−0.04	−0.02	−0.05	0.51
	Order	0.11*	0.08	0.11*	0.50
	Dutifulness	0.04	0.05	0.03	0.66
	Achievement seeking	0.03	0.02	0.03	0.82
	Self-discipline	−0.02	−0.02	−0.02	1
	Deliberation	0.00	0.03	−0.02	0.27

* significant at $p < 0.05$ level.
** significant at $p < 0.001$ level.

Table 2
Correlations between HEXACO personality variables and pathogen disgust sensitivity.

HEXACO PI-R factor	HEXACO PI-R facet	Pathogen disgust			
		Overall	Non-human	Human	Difference(p)
Honesty-Humility		−0.03	0.03	−0.07	0.02*
	Sincerity	−0.01	0.06	−0.06	0.005*
	Fairness	0.00	0.03	−0.02	0.25
	Greed-avoidance	−0.06	−0.02	−0.07	0.25
	Modesty	−0.02	0.04	−0.06	0.02*
Emotionality		0.23**	0.18**	0.22**	0.34
	Fearfulness	0.21**	0.14*	0.22**	0.06
	Anxiety	0.19**	0.18**	0.16**	0.63
	Dependence	0.09	0.05	0.10*	0.24
	Sentimentality	0.19**	0.16**	0.18**	0.63
Extraversion		0.01	0.01	0.01	1
	Social self-esteem	0.01	0.01	0.01	1
	Social boldness	−0.07	−0.01	−0.04	0.49
	Sociability	0.07	0.08	0.05	0.49
	Liveliness	0.03	0.04	0.01	0.49
Agreeableness		−0.17**	−0.10*	−0.18**	0.06
	Forgiveness	−0.16**	−0.11*	−0.16**	0.24
	Gentleness	−0.11*	−0.03	−0.15**	0.005*
	Flexibility	−0.07	−0.02	−0.08	0.16
	Patience	−0.16**	−0.13*	−0.15**	0.64
Conscientiousness		0.11*	0.12*	0.09	0.48
	Organization	0.17**	0.16**	0.14*	0.64
	Diligence	0.06	0.07	0.04	0.49
	Perfectionism	0.10*	0.10*	0.08	0.64
	Prudence	−0.05	−0.04	−0.05	0.82
Openness to experience		−0.11*	−0.13*	−0.07	0.16
	Aesthetic appreciation	0.01	−0.06	0.06	0.005*
	Inquisitiveness	−0.14*	−0.13*	−0.11	0.64
	Creativity	−0.07	−0.08	−0.06	0.64
	Unconventionality	−0.13*	−0.13*	−0.11*	0.64

* significant at $p < 0.05$ level.
** significant at $p < 0.001$ level.

agreeableness were not significantly more negatively correlated with human pathogen disgust.

Consistent with the findings form the first sample, the extraversion factor was not significantly correlated with pathogen disgust sensitivity, even when looking at human pathogen disgust separately.

In contrast to findings from the first sample, the negative correlations between openness and pathogen disgust sensitivity were weak and none of the facets were more strongly related to human than non-human pathogen disgust.

3.3. Pathogen disgust factor analysis

When the pathogen disgust data from Sample 1 was entered into a principal-axis factor analysis with oblimin rotation, the scree plot appeared to suggest a single factor (eigenvalues = 3.00, 0.96, 0.75, 0.69). However, when two factors were extracted, the items formed two interpretable groups, which were consistent with the two factors identified by Gangestad and Grebe (2014). Loadings for the first factor (non-human pathogen items) ranged between 0.39 and 0.69 (alpha = 0.61), and loadings for the second factor (human pathogen items) ranged between 0.40 and 0.68 (alpha = 0.71). All had cross-loadings below 0.2. The non-human and human item clusters were strongly correlated, $r = 0.52$.

When the data from Sample 2 was entered into a principal-axis factor analysis with oblimin rotation, the items again appeared to form a single factor (eigenvalues = 3.30, 0.90, 0.72, 0.63). Unlike the first sample, the items did not form two clearly interpretable groups, as one human item loaded with the three non-human pathogen items with loadings between 0.48 and 0.67, and the three other human pathogen items loaded between 0.47 and 0.80. When grouped conceptually into the four human (alpha = 0.78) and three non-human (alpha = 0.61) items, the clusters were, again, strongly correlated, $r = 0.56$.

4. Discussion

Results largely supported the prediction that human and non-human pathogen disgust would differentially relate to personality. Specifically, the prediction that agreeableness would negatively relate to disgust towards human, but not non-human pathogen cues, was supported, though not for every facet expected. Thus, findings were largely consistent with the hypothesis that a trade-off between avoiding the threat of infectious disease and establishing or maintaining positive relationships shape the degree of disgust felt towards others. Agreeableness inclines people to favour the benefits of harmonious social interaction, leading to reduced disgust towards people who have features that can be perceived as cues to pathogens.

Despite findings that cultures with more pathogens tend to be less extraverted (Schaller & Murray, 2008) and that people report less extraversion after viewing cues to pathogens, (Mortensen et al., 2010), we found no evidence for a relationship between extraversion and pathogen disgust sensitivity, even when looking at disgust sensitivity towards human pathogen cues specifically. Along with the finding that pathogen disgust sensitivity does not relate to geographical variations in pathogen prevalence (Tybur et al., 2016), this suggests that variation in pathogen disgust sensitivity may not be the variable that links perceived risk of pathogen transmission to decreases in the preferred quantity of social interaction.

One possible explanation is that being more introverted and less gregarious is an effective strategy for preventing encounters with human pathogen cues in the first place, but when an apparently infectious human is encountered, a person's level of extraversion does not affect motivation to inhibit feelings of disgust towards the infected person. Rather, given its potentially anti-social consequences when expressed towards others (Giner-Sorolla & Espinosa, 2011; Harris & Fiske, 2006), interpersonal disgust is influenced by the beholder's level of agreeableness.

4.1. Limitations, implications, and future directions

Analyses described here were able to test ideas proposed by Gangestad and Grebe (2014) and Park (2015) using the same disgust sensitivity instrument with larger samples and arguably more reliable personality measures. Hence, while they extended earlier work in some ways, they also shared limitations of this work. Namely, the item subsets proposed by Gangestad and Grebe were not developed to assess separate constructs, and the small number of items per subset limits their reliability. Low reliability attenuates effect sizes, so results found here might underrepresent the strength (and, sometimes, distinctiveness) of the relationship between personality and different facets of pathogen disgust. Further, exploratory factor analyses on these items did not consistently show the degree of distinctiveness between item subsets reported by Gangestad and Grebe. To better test the ideas discussed here and elsewhere, future work could develop instruments that better assess these potentially separate facets of pathogen disgust.

HEXACO agreeableness was only marginally more strongly correlated with human pathogen disgust than with non-human pathogen disgust and not every predicted facet (e.g. altruism) was more strongly correlated with human than non-human pathogen disgust. These inconsistencies may have been due to differences in the instruments used to measure personality, limitations with the instruments used to measure disgust sensitivity, or sample variance. Additionally, the cost of reporting interpersonal disgust in an anonymous questionnaire may be perceived as low, even to highly agreeable people, in comparison to costs of feeling and expressing disgust in real life interactions. Future studies using methods other than self-report might reveal stronger effects of agreeableness on interpersonal disgust.

Interpersonal disgust has been implicated in prejudice towards many groups, including foreigners (Navarrete & Fessler, 2006) and obese people (Lieberman, Tybur & Latner, 2012); potentially because these stigmatised groups have features that are perceived as cues to infectiousness (Kurzban & Leary, 2001). The current findings suggest that agreeableness might dampen the relationship between pathogen disgust and prejudice. However, agreeableness itself is negatively related to intergroup prejudice and discrimination (Sibley & Duckitt, 2008), so people who are low in agreeableness show greater prejudice towards various groups and also respond with greater disgust towards people displaying superficial infection cues. This raises the possibility that the link between disgust and prejudice might be explained by a shared variable: low levels of agreeableness.

Future research may find that other traits that increase pro-social motivation, or decrease anti-social motivation, also lead to reduced interpersonal disgust by increasing the expected value of social contact. Candidate variables include empathy, social value orientation and social trust. Aarøe et al. (2016) found a negative relationship between generalised social trust and pathogen disgust of a similar magnitude to the relationship between agreeableness and human pathogen disgust reported here. The authors interpreted their findings as suggesting that individuals strongly motivated to avoid pathogens reduce social trust as a disease avoidance strategy. The perspective presented in the current paper would instead suggest that highly trusting people's higher expectation of beneficial social interactions counteracts pathogen avoidance motives, leading to reduced interpersonal pathogen disgust.

Future studies may also investigate situational variables that might influence the expected value of contact and corresponding disgust output. For example, if a target is perceived to have cues to infectious disease but also other beneficial attributes, such as competence or generosity, would they elicit lower disgust than otherwise? Although disgust has been seen as a particularly insidious and harmful influence on interpersonal relations (Harris & Fiske, 2006; Hodson & Costello, 2007), the current findings suggest that disgust may be reduced by factors that increase the expected value of contact, including situational variables and the beholder's prosocial orientation.

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