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Research report

Mating strategy, disgust, and food neophobia

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ABSTRACT

Food neophobia and disgust are commonly thought to be linked, but this hypothesis is typically implicitly assumed rather than directly tested. Evidence for the connection has been based on conceptually and empirically unsound measures of disgust, unpublished research, and indirect findings. This study ($N = 283$) provides the first direct evidence of a relationship between trait-level food neophobia and trait-level pathogen disgust. Unexpectedly, we also found that food neophobia varies as a function of *sexual* disgust and is linked to mating strategy. Using an evolutionary framework, we propose a novel hypothesis that may account for these previously undiscovered findings: the food neophilia as mating display hypothesis. Our discussion centers on future research directions for discriminatively testing this novel hypothesis.

Introduction

Food neophobia – an aversion toward novel or unfamiliar foods – is a psychological and behavioral tendency that protects organisms from ingesting toxins and other pathogens. Species with specialized diets restricted to a few specific food sources (e.g. koalas, vampire bats) generally do not exhibit food neophobia, whereas species with broad and varied diets do (e.g., Ratcliffe, Fenton, & Galef, 2003; Rozin, 1976).

Rats, for example, tend to be markedly neophobic. They only ingest small portions of novel foods. In the absence of adverse consequences, they may eat the food again in the future, but if they fall ill, they avoid ingesting it again (Rozin, 1976). They avoid eating more than one unfamiliar food at once, and if they fall ill after eating both an unfamiliar food and a familiar food, they assiduously avoid the novel food in the future (Rozin, 1976).

Such patterns of food neophobia have evolved in a diverse array of taxa with generalist diets, including birds (Greenberg, 1983), rodents (e.g., Barnett, 1958; Mitchell, 1976; Wong & McBride, 1993), pigs (Oostindjer, Muñoz, Van den Brand, Kemp, & Bolhuis, 2011), monkeys (Visalberghi & Addessi, 2000), and chimpanzees (Visalberghi, Myowa Yamakoshi, Hirata, & Matsuzawa, 2002). Like these other omnivorous species, humans are reluctant to ingest unknown food items (Birch, 1999; Cashdan, 1998; Pliner & Hobden, 1992). Among humans, food neophobia is especially strong in response to animal products compared to non-animal products (Martins, Pelchat, & Pliner, 1997; Pliner, 1994; Pliner & Pelchat, 1991) – a psychological design feature that may have evolved in humans as a result of the greater pathogenic threat posed by meat and animal products relative to non-animal products (Fessler, 2002; Fessler & Navarrete, 2003; Rozin, 2003).

The emotion of disgust, typically conceptualized as an evolved defense against pathogens and parasites, is an obvious candidate as a motivator of behavioral food avoidance (Curtis, Aunger, & Rabie, 2004; Haidt, McCauley, & Rozin, 1994; Tybur, Lieberman, Kurzban, & Descioli, 2013). Indeed, several researchers have proposed a link between disgust and food neophobia (e.g. Martins & Pliner, 2006; Nordin, Broman, Garvill, & Nyroos, 2004; Pliner & Pelchat, 1991; Pliner & Salvy, 2006). Surprisingly, however, few studies on food neophobia have actually measured its relationship to disgust, and none has directly investigated the hypothesis that individual differences in disgust are associated with individual differences in food neophobia. In their comprehensive review, Pliner and Salvy (2006) discuss the commonly assumed connection between disgust and neophobia, but the evidence adduced is typically unpublished (e.g., p. 76) or indirect (e.g., p. 79). Direct evidence of a connection between disgust and food neophobia, especially between trait-level disgust and neophobia, is lacking.

This empirical gap is exacerbated by the fact that the sparse research that does exist has been based on Haidt et al.'s (1994) original Disgust Scale (e.g., Björklund & Hursti, 2004; Nordin et al., 2004). The original Disgust Scale, while of great historical value in spurring empirical research, is psychometrically unsound, exhibiting an

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unstable factor structure and unsatisfactory reliability (Haidt et al., 1994; Olatunji, Sawchuk, de Jong, & Lohr, 2007).

To address this problem and fill the extant gap in the neophobia literature, we tested the relationship between individual differences in trait-level disgust and food neophobia. Our goal was to use conceptually and psychometrically sound measures to directly test the relationship between food neophobia and disgust, a connection whose veracity is typically assumed rather than explicitly examined.

We also included *mating strategy* (Buss & Schmitt, 1993; Penke & Asendorpf, 2008) in our investigation because recent evidence demonstrates that mating strategy is a strong predictor of sexual disgust (Al-Shawaf, Lewis, & Buss, in press). If (a) disgust is related to food neophobia, and (b) mating strategy is related to disgust, then the present investigation raises the possibility of a heretofore undiscovered relationship between mating strategy and food neophobia. Such a finding would be unexpected and – unlike the link between disgust and food neophobia – neither intuitive nor suggested in any previous work.

Method

Participants and procedure

Two hundred and three women and eighty men (M_{age} = 18.89 years, SD_{age} = 2.81, age range = 18–50) were recruited from the psychology subject pool at The University of Texas at Austin. Participants arrived at the laboratory, provided informed consent to participate in the study, and were escorted by a researcher to a private room where they completed an online survey hosted by Qualtrics. Participants received partial course credit for their participation and were debriefed upon completing the study.

Measures

Disgust

The original Disgust Scale has become less current with the development of new, more psychometrically sound disgust measures (Olatunji et al., 2007; Tybur et al., 2013). Olatunji and colleagues advanced disgust research by developing an improved Revised Disgust Scale (2007), but subsequent work has revealed that this too suffers from conceptual and statistical limitations (Al-Shawaf & Lewis, 2013). The revised disgust scale proposes three facets of disgust: *core disgust*, *contamination-based disgust,* and *animal-reminder disgust*. The first two factors do not show sufficient evidence of conceptual or statistical distinctiveness (Al-Shawaf & Lewis, 2013; Tybur, Lieberman, & Griskevicius, 2009), and the third factor, *animal-reminder disgust*, is conceptually implausible from an evolutionary perspective (Al-Shawaf & Lewis, 2013; Fessler & Navarrete, 2005) – a view endorsed by nearly all disgust researchers (e.g., Chapman, Kim, Susskind, & Anderson, 2009; Curtis et al., 2004; Haidt et al., 1994; Tybur et al., 2013).

The recently-developed Three Domain Disgust Scale (TDDS), on the other hand, assesses three different kinds of disgust: *pathogen*, *sexual*, and *moral* disgust (Tybur et al., 2009). There is compelling empirical evidence of the existence and distinctness of these three different types of disgust: the different cues that evoke them, the distinct cognitive mechanisms underlying them, the different behaviors they motivate, and their unique profiles of correlations with other psychological variables (Tybur et al., 2009, 2013).

The TDDS consists of 21 items that ask participants to rate how disgusting they find a variety of potentially repellent situations on a 7-point Likert-type scale (0 = not at all disgusting, 6 = extremely disgusting). The TDDS includes three seven-item subscales, one for each of the distinct forms of disgust. Sample items from the *pathogen disgust* subscale include "Seeing some mold on old leftovers in your refrigerator" and "Seeing a cockroach run across the floor." Sample items from the *sexual disgust* subscale include "A stranger of the opposite sex intentionally rubbing your thigh in an elevator" and "Performing oral sex." Sample items from the *moral disgust* subscale include "A student cheating to get good grades" and "Intentionally lying during a business transaction."

We measured all three forms of disgust to contrast two competing hypotheses: (1) the possibility that the proposed link between disgust and food neophobia is specific to the pathogen domain, and (2) the possibility that food neophobia is related to other facets of disgust as well. *Prima facie* reasoning suggests a connection specifically between pathogen disgust and food neophobia, but as a first exploratory investigation into the relationship between food neophobia and disgust, we used all three subscales of the TDDS.

Food neophobia

We measured food neophobia with the Food Neophobia Scale (FNS; Pliner & Hobden, 1992). The FNS is a robust, psychometrically validated, and widely used measure of individuals' willingness to try novel and unfamiliar foods (e.g., Knaapila et al., 2011; Olabi, Najm, Baghdadi, & Morton, 2009; Pliner & Hobden, 1992). The FNS instructs participants to rate their level of agreement with 10 statements such as "I don't trust new foods" and "I am constantly sampling new and different foods" (reverse scored) on a 7-point Likert scale (1 = disagree strongly; 7 = agree strongly). Scale items are composited to form a trait-level food neophobia score.

Mating strategy

We operationalized mating strategy with the Revised Sociosexual Orientation Inventory (SOI-R; Penke & Asendorpf, 2008). The SOI-R is a nine-item measure of an individual's cognitive, behavioral, and attitudinal disposition toward uncommitted sexual relations. Sample items include "With how many different partners have you had sexual intercourse without having an interest in a long-term committed relationship with this person?" and "I can imagine myself being comfortable and enjoying 'casual' sex with different partners." Inventory items are summed to form a composite SOI-R score, with higher scores reflecting a stronger proclivity for short-term mating.

Results

Disgust and food neophobia

To test the central hypothesis that individual differences in trait-level disgust are linked to food neophobia, we first conducted Pearson product-moment correlations between participants' FNS scores and their levels of pathogen, sexual, and moral disgust.

As predicted, food neophobia was positively correlated with pathogen disgust, $r(272) = .23$, $p < .001$. This pattern was significant among women, $r(195) = .24$, $p < .001$. Among men, this relationship was in the same direction, but did not reach statistical significance, $r(75) = .17$, *ns.* Also consistent with expectations, moral disgust was unrelated to food neophobia $r(272) = .07$, *ns* [men: $r(75) = -.08$, *ns*; women: $r(195) = .11$, *ns*] (Table 1). However, we uncovered an unexpected relationship between participants' food neophobia and their *sexual* disgust, $r(273) = .24$, $p < .001$ [women: $r(194) = .21$, $p < .01$; men: $r(77) = .28$, $p < .05$].

To ensure that the observed relationships between food neophobia and sexual disgust were not merely byproducts of the link between neophobia and pathogen disgust, we conducted partial correlations between food neophobia and each of these two disgust subscales while controlling for the other. Among both men and women, sexual disgust exhibited an independent link to food neophobia while controlling for pathogen disgust [men: $r(74) = .23$, $p < .05$; women: $r(192) = .153$, $p < .05$]. Among women, pathogen

Table 1
Zero-order correlations between individuals' food neophobia and their disgust and mating strategy.

	Food neophobia (FNS)		
Disgust subscale (TDDS)	Women	Men	Overall
Pathogen	.24***	.17	.23***
Moral	.11	–.08	.07
Sexual	.21**	.28*	.24***
Mating strategy subscale (SOI-R)			
Global sociosexual orientation	–.09	–.26*	–.16**
Behavior	.04	–.32**	–.09
Desire	–.05	.11	–.04
Attitude	–.17*	–.40***	–.25**

* $p < .05$, ** $p < .01$, *** $p < .001$.

disgust remained correlated with food neophobia after controlling for sexual disgust, $r(192) = .169$, $p < .05$. Intriguingly, however, the (non-significant) link between pathogen disgust and food neophobia among men disappeared entirely after controlling for sexual disgust, $r(74) = .01$, *ns*. Regression analysis revealed that neither the relationship between pathogen disgust and food neophobia [sex × pathogen disgust interaction $\beta = .34$, *ns*] nor the relationship between sexual disgust and food neophobia [sex × sexual disgust interaction $\beta = –.03$, *ns*] differed by sex.

Food neophobia and mating strategy

This relationship between sexual disgust and food neophobia, together with recent research identifying a link between sexual disgust and mating strategy (Al-Shawaf, Lewis, et al., in press), led us to explore the possibility of a relationship between mating strategy and food neophobia. Women's mating strategy was unrelated to their food neophobia [$r(191) = -.09$, *ns*], but men's sociosexual orientation exhibited a significant relationship with their food neophobia [$r(75) = –.26$, $p < .05$]; men with a stronger proclivity for short-term mating reported a greater willingness to eat novel, unfamiliar foods. Surprisingly, despite our finding of a relationship between mating strategy and food neophobia among men but not women, regression analysis revealed a non-significant interaction between sex and mating strategy in predicting food neophobia ($\beta = .20$, *ns*), suggesting no significant difference between men and women.

Discussion

Food neophobia and disgust

Until now, existing empirical evidence has been insufficient to conclusively establish a link between disgust and food neophobia. The limited data adduced in support of this connection have been indirect or unpublished (e.g., Pliner & Salvy, 2006), based on questionable measures (e.g., Björklund & Hursti, 2004; Nordin et al., 2004), or exclusively focused on single items and specific foods rather than trait-level disgust (e.g., Martins & Pliner, 2006). The findings reported here therefore provide the first direct, sound empirical demonstration of a link between disgust and food neophobia.

The relatively small magnitude of the observed correlations between neophobia and disgust suggests that food neophobia is likely to be influenced by a variety of factors, of which disgust is only one. Indeed, organismic arousal, sensation-seeking, the degree of novelty in the environment, and social and cultural learning (Alley & Potter, 2011; Alley, Willet, & Muth, 2006; Archer & Sjödén, 1979; Birch, 1999; Hendy & Raudenbush, 2000; Hobden & Pliner, 1995; Loewen & Pliner, 2000; Pliner & Loewen, 2002; Pliner & Salvy, 2006; Walsh, 1993) are all known to influence individuals' food neophobia. Neophobia is likely a complex, multiply determined outcome, and our correlational data do not warrant causal conclusions. Nonetheless, the link established in the present study between trait-level disgust and trait-level neophobia contributes to our understanding of this phenomenon, and provides the first sound evidence that those who have higher levels of disgust sensitivity are also more food neophobic.

Food neophobia and mating strategy

The present study provides the first evidence of a relationship between food neophobia and mating strategy. Our findings present something of a puzzle with respect to the issue of whether this link is present in both sexes, or just among men. On one hand, sex-specific analyses indicated the presence of a relationship between mating strategy and food neophobia among men, but did not reveal such a relationship among women. On the other hand, regression analyses indicated that the relationship between mating strategy and food neophobia did not differ by sex.

This combination of results is a relatively straightforward consequence of null hypothesis significance testing, but is nonetheless paradoxical when one attempts to interpret its meaning with respect to the state of the world. On occasion, null hypothesis significance testing leads to such puzzling outcomes because statistical and probabilistic relationships differ from the certainty relationships that characterize formal deductive logic (e.g. Copi & Cohen, 2005). The present study's statistically possible but logically problematic finding is a good example: (1) men exhibit a link between mating strategy and food neophobia, (2) women do not exhibit such a link, and yet (3) the male and female links do not differ from one another. These findings result in an ambiguous picture of the relationship between mating strategy and food neophobia across the sexes. The resolution to this puzzle will depend on the cumulative body of evidence gained from future studies – evidence from replication attempts will be necessary to definitively resolve this question.

Food neophilia: a mating display?

This previously unknown connection between mating strategy and food neophobia calls for explanation. We proffer a preliminary hypothesis to be tested in future studies.

Researchers have suggested that men's disgust levels reveal important information about their immunological robustness to potential mates (Fessler, Pillsworth, & Flamson, 2004). On this basis, it has been hypothesized that men may down-regulate their expression of disgust as a mating advertisement (Al-Shawaf, Conroy-Beam, Asao, & Buss, in press; Fessler et al., 2004). A parallel logic undergirds the hypothesis we propose for food neophilia: if a willingness to try unfamiliar and potentially pathogenic foods is a sign of immunological robustness, and immune function is an important criterion in women's assessments of potential mates, then a demonstrated willingness to try unfamiliar foods could be an advertisement to potential mates of one's health and vitality.

On this view, a willingness to try novel and unfamiliar foods may be, in part, a mating display that signals immunological competence (Hamilton & Zuk, 1982; Zahavi & Zahavi, 1997). Individuals with more robust immune systems may be better able to withstand the potential costs of eating unknown foods. Consequently, a willingness to expose oneself to new and unfamiliar foods conveys important information about one's health and the strength of one's immune system. If individuals select their mates partly on the basis of health and immunological competence, then the food-neophilia-as-mating-display hypothesis may explain the connection between mating strategy and food neophobia.

A consideration of sex differences in the fitness costs and benefits of trying novel foods may tentatively provide insight into why this connection was evident among men but not women. Among

humans, women shoulder the burden of greater minimum obligatory parental investment (Trivers, 1972). Consequently, they face more severe fitness costs as a result of injudicious mating decisions and have evolved choosier and more discriminative mating standards (Buss, 2003; Trivers, 1972). This well-established feature of human mating (e.g. Buss, 2003, 2012) may translate into higher standards for immune robustness.

Indeed, women prize health and immunological competence in mate selection (Buss, 1989; Gangestad & Thornhill, 1997a; Stevenson, Case, & Oaten, 2011; Thornhill & Møller, 1997; Tybur & Gangestad, 2011). Evidence shows that women declare "good health" to be important in a mate (Buss, 1989, 2003). They are turned off by signs of infection (Curtis et al., 2004; Ford & Beach, 1951), and are attracted to faces they perceive to be healthy (Henderson & Anglin, 2003; Jones et al., 2001), as well as physical features hypothesized to indicate health and robust immune function (Thornhill & Gangestad, 1993, 2006; Tybur & Gangestad, 2011). Advertising one's immunological robustness – for instance, by displaying food neophilic tendencies – should therefore result in particularly pronounced mating benefits for men.

Second, the fitness *costs* of imprudence with unfamiliar foods would have been more pronounced for ancestral women than men. Among humans, women have been under stronger selective pressures to protect themselves and their offspring (e.g., Curtis, de Barra, & Aunger, 2011), leading to behavior that is typically more prudent and less risky than that of men (e.g., Byrnes, Miller, & Schafer, 1999; Fessler et al., 2004). Moreover, women have been under stronger selective pressure to avoid infection because of their greater likelihood of transmitting pathogens to their offspring – in ancestral conditions, women undoubtedly spent a greater amount of time than men caring for offspring (Sear & Mace, 2008). Because of these stronger selective pressures on women, we would expect female food choice to be less open to influence by mating strategy.

Together, the greater mating-related benefits that men would have reaped and the greater fitness costs that women would have incurred as a consequence of using food neophilia as a mating display suggest that future research may reveal a more definitive sex difference in the relationship between mating strategy and food neophilia.

Is the link between food neophobia and mating specific to short-term *mating?*

The neophilia-as-mating-display hypothesis may shed light on the connection we discovered between men's food neophilia and their *short-term* mating orientation. Immunological competence has been hypothesized to be an important marker of genetic quality, or "good genes" (Fessler et al., 2004; Hamilton & Zuk, 1982; von Schantz, Bensch, Grahn, Hasselquist, & Wittzell, 1999), which women prioritize more in short-term than long-term mating (Buss & Schmitt, 1993; Gangestad & Thornhill, 1997b; Waynforth, Delwadia, & Camm, 2005), and whose importance increases at ovulation – when women's short-term mating psychology looms largest (Gangestad & Thornhill, 2008; Gangestad, Thornhill, & Garver-Apgar, 2005; Garver-Apgar, Gangestad, & Thornhill, 2008; Gildersleeve, Haselton, & Fales, 2014). Consequently, men's displays of food neophilia should be more relevant and more effective as mating advertisements in short-term than in long-term mating contexts.

In short-term mating contexts, women also experience increased attraction toward men who take risks and exhibit sensation-seeking behavior (Kelly & Dunbar, 2001; Kruger, Fisher, & Jobling, 2003). The relationship between short-term mating and food neophilia in the current study, together with the inverse relationship between sensation-seeking and food neophobia (Alley et al., 2006; Pliner & Hobden, 1992), suggests that food neophilia may be one tactic within a broader suite of sensation-seeking and exploratory behaviors that are more likely to be deployed by men oriented toward short-term mating. Future studies should investigate this possibility by including measures of sensation-seeking and risk-taking behavior.

Future research on disgust and food neophobia would also benefit from an investigation of personality, as several personality dimensions have been linked to both sensation-seeking (e.g. Eysenck & Zuckerman, 1978; Zuckerman, Bone, Neary, Mangelsdorff, & Brustman, 1972) and disgust (e.g. Druschel & Sherman, 1999; Haidt et al., 1994; Schaller & Park, 2011;), with effect sizes in the low to moderate range (e.g. extraversion-sensation seeking $r = .23–.44$, disgust-openness $r = –.28$, disgust-neuroticism $r = .23–.45$). Extraversion and openness to experience may be of particular importance to pathogen concerns (Schaller & Murray, 2008; Schaller & Park, 2011) as well as sexual disgust because of their role in promoting gregariousness, exploration, and seeking out novel experiences. Pathogen salience and "germ aversion" are associated with lower levels of extraversion and avoidant motor behaviors (Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010; Schaller & Park, 2011), and worldwide personality data reveal an inverse relationship between pathogen density and mean national levels of extraversion, short-term mating, openness to experience (Schaller & Murray, 2008). Investigating the relationships between food neophobia and these personality dimensions may therefore play an important part in achieving a more complete understanding of the connection between mating strategy, disgust, and food neophobia.

There are reasons to be circumspect in advancing the hypothesis that food neophilia is specifically a *short-term* mating display. Hypothesized markers of immunological competence are desirable in long-term as well as short-term mates (e.g. Buss, 2012). It would therefore not be surprising if men oriented toward long-term mating also engaged in displays of willingness to eat unfamiliar foods. It is also possible that the relationship we discovered between short-term mating and food neophilia reflects a more general connection between *mating effort* and food neophilia. Some of the items on the SOI-R – such as "With how many different partners have you had sex within the past 12 months?" – may be the outcome of effort invested toward mating in general – not necessarily short-term mating.

Caution is therefore warranted in drawing conclusions specific to short-term mating. Nonetheless, both possibilities – that short-term mating in specific or mating effort in general motivates exposure to unfamiliar foods – are consistent with the broader hypothesis of neophilia as a mating display.

This novel hypothesis is empirically testable. For example, future studies can test the effect of mating primes on neophobia, including both short-term and long-term mating primes, to disentangle the two possibilities described above. Future research can also incorporate audience presence as a key element of study design, as well as different audiences of varying composition such as same-sex versus opposite-sex, varying ages, and other key variables. The mating display hypothesis predicts that inducing a mating mindset in men should cause an increase in food neophilia – at least in front of an audience that includes attractive potential mates. Finally, the hypothesis that food neophilia conveys information about health and immune competence suggests the prediction that individuals who are sick or in poor health may have heightened food neophobia. These tests await future research.

The idea of food neophilia as a mating display is preliminary and subject to confirmation in future studies, as is the question of the presence or absence of sex differences in the mating strategy–food neophobia link. For now, the food-neophilia-as-mating-display hypothesis helps make sense of the newly discovered link between food neophobia and individual differences in mating psychology. More broadly, it may help us begin to connect the

psychology of food and mating, two evolutionarily critical but currently disconnected areas of research.

Conclusion

This study provided several novel findings: (a) the first direct empirical evidence of a relationship between trait-level disgust and food neophobia, (b) the first evidence of a connection between food neophobia and *sexual* disgust, and (c) the first evidence of a relationship between food neophobia and mating strategy. We propose the neophilia-as-mating-display hypothesis to explain the latter two findings, suggesting that men's willingness to try novel and unusual foods may signal their immune competence, thereby conveying important information to potential mates. Further research is needed to subject this hypothesis to convergent tests. If borne out by future research, this hypothesis would (a) parsimoniously explain current data, (b) accord well with established findings in the mate preferences literature, (c) fit neatly with known patterns of individual differences in food neophobia and (d) yield novel predictions that have the potential to spur new discoveries and, hopefully, to bridge the science of food behavior with other important domains of psychology.

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