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Elevated disgust sensitivity in the first trimester of pregnancy
Evidence supporting the compensatory prophylaxis hypothesis

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Abstract

By motivating avoidance of contaminants, the experience of disgust guards against disease. Because behavioral prophylaxis entails time, energy, and opportunity costs, Fessler and Navarrete [*Evol. Hum. Behav.* 24 (2003) 406–417] hypothesized that disgust sensitivity is adjusted as a function of immunocompetence. Changes in immune functioning over the course of pregnancy offer an opportunity to test this notion. Relative to later stages, the first trimester of pregnancy involves substantial suppression of the maternal immune response, and both maternal and fetal vulnerability to pathogens are greatest during this phase; food-borne illnesses, in particular, pose a threat during the first trimester. Using a Web-based survey of 496 pregnant women, we compared participants in the first trimester with those in later stages of pregnancy. Results reveal heightened disgust sensitivity in the first trimester, notably including disgust sensitivity in the food domain. This pattern is not simply a consequence of elevated nausea during the first trimester, as, although disgust sensitivity and current level of nausea are correlated, first trimester women remain more easily disgusted in the food domain even after controlling for the greater incidence of nausea. These results provide preliminary support for

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the hypothesis that disgust sensitivity varies during pregnancy in a manner that compensates for maternal and fetal vulnerability to disease.

Keywords: Pregnancy; Disgust; Immunosuppression; Nausea

1. Introduction

Disgust, the emotion motivating avoidance of contact and rejection of oral incorporation, is elicited by many stimuli associated with pathogen transmission, suggesting that disgust is an adaptation that serves to guard against disease (Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001; Fessler & Navarrete, 2003b; Nesse, 1990). While behavioral disease avoidance has obvious fitness benefits, in many ancestral environments, it would also have entailed costs. In a world of limited and dispersed food resources, increases in dietary selectivity necessitate greater time and energy spent foraging, as well as greater exposure to predation and social conflict as a result of increased ranging behavior. These costs suggest that natural selection may have favored a pattern wherein the intensity of behavioral prophylaxis is facultatively adjusted as a function of the benefits offered thereby. Such benefits are, in part, a function of the individual's current level of immunocompetence—the more vulnerable the individual is to infection, the greater the relative value of behavioral disease avoidance and dietary selectivity.

Pregnancy is a time of marked changes in immune functioning. Because the conceptus is only 50% related to the mother, left to its own devices, the maternal immune system would attack the fetal allograft, a problem resolved through the suppression of the maternal immune system during pregnancy (reviewed in Fessler, 2002). Moreover, if rejection of the conceptus is to be precluded, immunosuppression must begin prior to invasive implantation and subsequent development. The first half of the luteal phase of the menstrual cycle, the period following the days when conception is most likely, therefore involves reductions in defensive inflammatory responses (reviewed in Fessler, 2001). Following the reasoning articulated above regarding trade-offs, Fessler and Navarrete (2003a) searched for a positive correlation between the degree of disgust sensitivity and presumed extent of reproductive immunosuppression, operationalized on the basis of self-reported position in the menstrual cycle. Although the authors failed to detect the predicted association, luteal phase reproductive immunosuppression is modest compared with that which occurs during actual pregnancy, and self-report is a relatively crude means of determining position in the menstrual cycle. To more conclusively test the hypothesis that female disgust sensitivity is adjusted as a function of the current level of immunocompetence, we therefore sought to examine individuals in whom the most dramatic such changes are to be expected, namely, pregnant women.

Systemic maternal immunosuppression is maximal during the first trimester; as pregnancy progresses, compensatory increases in phagocytosis occur, and immunosuppres-

sion becomes more localized at the feto–maternal interface (reviewed in Fessler, 2002). Disease poses a threat not only to the mother but also to the fetus. Organogenesis, a process highly vulnerable to perturbation, occurs primarily during the first trimester, and correspondingly, fetal infections are often most damaging during this phase (reviewed in Fessler, 2002; Flaxman & Sherman, 2000). Like the mother, the fetus too becomes increasingly buffered against infection as pregnancy progresses, with placentation, transfer of maternal gamma globulin, and development of the fetal immune system all enhancing the defense against pathogens after the first trimester (reviewed in Fessler, 2002). These patterns suggest that, if behavioral prophylaxis varies as a function of the costs of exposure to pathogens, then disease avoidance, and the emotional responses that underpin it, should be maximal during the first trimester. Food-borne illness is a particularly dangerous threat to the mother and fetus during the first trimester (reviewed in Fessler, 2002), hence, we can expect that any compensatory increases in disgust sensitivity should be especially marked in the food domain.

Particularly during the first trimester, pregnancy is often accompanied by nausea and vomiting (Lacroix, Eason, & Melzack, 2000). Pregnancy sickness may itself be a form of behavioral prophylaxis, as these changes may adaptively compensate for the enhanced vulnerability to infection by food-borne pathogens characteristic of the first trimester (Fessler, 2002; Flaxman & Sherman, 2000). Consistent with the notion that disgust is an adaptation that regulates disease exposure with particular emphasis on the risks entailed by ingestion, disgust is intimately linked to nausea, a subjective state associated with a loss of appetite (see Rozin, Haidt, & McCauley, 2000). Accordingly, given the expected appearance of heightened nausea during the first trimester, if the relationship between stage of pregnancy and food disgust sensitivity is to be clearly discerned, it is necessary to control for current level of nausea prior to examining variation in food disgust sensitivity. With these points in mind, employing a cross-sectional design, we sought to test the hypothesis that disgust sensitivity varies across pregnancy in a manner that compensates for changes in the vulnerability to disease.

2. Methods

2.1. Participants

Data were collected using a Web-based questionnaire. Participants were recruited through postings to pregnancy-related Web sites and listservs (list available on request). Participation was anonymous, and no compensation was offered. Six hundred ninety-one women participated. Responses were discarded for the following reasons: failure to answer any section of the survey, age younger than 18 or older than 50, or chronic health problems. Using these exclusionary criteria, 195 observations were discarded, resulting in a sample of 496 women, 155 in the first trimester (weeks 0–13; mean age=28.1 years, S.D.=4.9), 183 in the second trimester (weeks 14–26; mean age=28.7 years, S.D.=4.9), and 158 in the third trimester (from week 27 on; mean age=28.0 years, S.D.=4.8).

2.2. Measures

The questionnaire was composed of multiple, linked Web pages (the complete instrument is available at http://www.xba-ucla.com/Eng/Disgust&Pregnancy/OLD.html). The first Web page, presented prior to any disgust-related material, asked the participants to report their current level of nausea using a 16-point scale. Interspersed with filler questions (e.g., "Do you plan to choose a name for your baby before or after its birth?", etc.) intended to distract participants from ruminating on their nausea, subsequent pages queried the participant regarding her age, date of conception, chronic medical problems, and use of prescription medications. A separate Web page then presented the Disgust Scale (Haidt, McCauley, & Rozin, 1994) with one minor modification (Item 12, "I think homosexuality is immoral," was omitted due to its questionable utility). This 31-item questionnaire, employing both true/false and three-point Likert-type responses, measures disgust sensitivity in eight domains, namely, contact with animals (questions concern cockroaches, rats, worms, etc.), body products (items address mucous, excreta, etc.), sex (topics include bestiality, incest, and age-disparate unions), body envelope violations (questions concern wounds, exposed organs, etc.), death (contact with corpses, dead animals, cremated remains, etc.), hygiene (items address contact with toilets, personal cleanliness, etc.), magical contagion (beliefs concerning contagion at a distance, contagion due to similarity, etc.), and, of greatest relevance for the present investigation, food (items include "I might be willing to try eating monkey meat, under some circumstances" and "You are about to drink a glass of milk when you smell that it is spoiled").

3. Results

The compensatory prophylaxis hypothesis predicts that, due to the greater vulnerability to, and the greater costs of, infection in the first trimester, disgust sensitivity should be heightened during this period relative to subsequent phases of pregnancy; moreover, given that food-borne illness is particularly dangerous for the mother and the developing organism during the first trimester, this hypothesis predicts that elevations in disgust sensitivity should be especially marked in the food domain.

In examining the above predictions, we pooled responses from women who were in the second and third trimesters at the time of participation and compared these with the responses from women who were in the first trimester. We then conducted a multivariate regression in which the dependent variables were (a) the scores on each of the subscales of the Disgust Scale, calculated as per Haidt et al. (1994), (b) the sum of these scores, a measure of overall disgust sensitivity, and (c) the participants' reported level of nausea. Although disgust sensitivity varies by age (Fessler & Navarrete, 2003a; Quigley, Sherman, & Sherman, 1997), because participants did not differ significantly in age across trimester groups, this variable was not included. Trimester was the categorical predictor (coded as 1=first trimester, 0=second or third trimester). Because of the directionality of our predictions, all tests were one tailed.

Table 1
Results of multivariate regression analysis for the Disgust Scale and nausea measure

	M	S.D.	*t*	*p* value	*β*
General disgust					
1st trimester	17.23	4.35	2.14	.02	.21
2nd & 3rd	16.37	4.12			
Food disgust					
1st trimester	1.88	.79	2.42	.01	.23
2nd & 3rd	1.70	.77			
Animal disgust					
1st trimester	2.13	.80	1.46	.07	.14
2nd & 3rd	2.02	.83			
Body products disgust					
1st trimester	2.97	.92	2.33	.01	.22
2nd & 3rd	2.76	.97			
Sex disgust					
1st trimester	2.33	.53	1.59	.06	.15
2nd & 3rd	2.24	.58			
Body envelope violations disgust					
1st trimester	2.15	.84	1.43	.08	.14
2nd & 3rd	2.04	.82			
Death disgust					
1st trimester	1.85	1.27	0.44	.33	.04
2nd & 3rd	1.80	1.20			
Hygiene disgust					
1st trimester	1.74	1.02	−0.66	.25	−.06
2nd & 3rd	1.80	.93			
Magical contagion disgust					
1st trimester	2.17	.92	1.81	.04	.18
2nd & 3rd	2.01	.93			
Reported nausea					
1st trimester	2.49	3.25	7.53	.00	.69
2nd & 3rd	0.79	1.75			

$N=496$, $df=9$.
Responses to the dependent measures ranged as follows: Disgust Scale: 1–7; Nausea: 0–15.

The regression analysis revealed that participants in the first trimester reported greater overall disgust sensitivity than did participants in the second and third trimesters, and the same was true with regard to disgust sensitivity measured on the food, body products, and

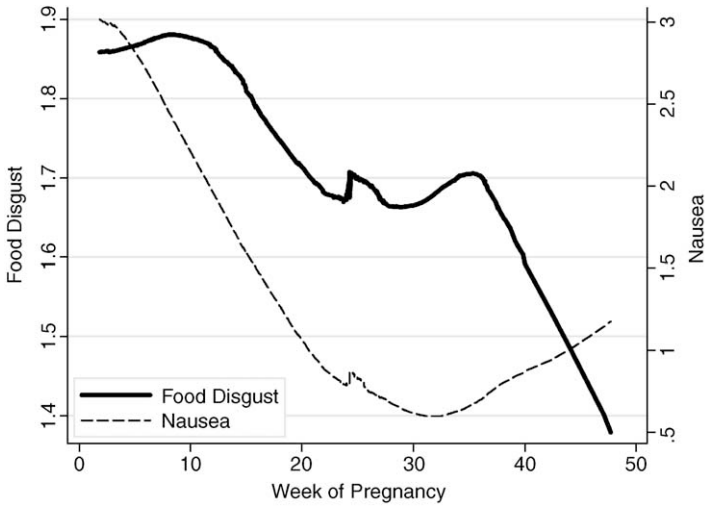

Fig. 1. Food disgust and nausea by week of pregnancy. Graph shows running-line locally-weighted least-squares.

magical contagion subscales. First trimester participants also reported more nausea (see Table 1).

Consistent with previous reports of a connection between nausea and disgust, a simple correlational analysis revealed that overall disgust sensitivity was positively related to the current level of nausea throughout pregnancy ($r=.12$, $p=.001$). To examine the mediating effects of nausea on food disgust sensitivity across trimesters, we conducted a multiple regression using disgust sensitivity towards food as the dependent variable, and trimester and current level of nausea as predictive covariates. The analysis revealed that, controlling for the effects of nausea ($\beta=.09$, $t=1.84$, $p<.05$), the first trimester elevation in disgust sensitivity in the food domain remained significant ($\beta=.17$, $t=1.71$, $p<.05$). Fig. 1 illustrates nausea and food disgust sensitivity across pregnancy.

4. Discussion

Many of the most powerful elicitors of disgust are objects or events that, in ancestral environments, would have posed a significant risk of pathogen exposure; disgust thus appears to be an adaptation (or a product of an adaptation) that functions to reduce the risk of disease by modifying behavior in the presence of potential contaminants. Because such modifications of behavior entail costs, we hypothesized that the ease with which disgust is elicited would systematically vary as a function of immunocompetence because the latter is a principal determinant of the benefits of avoiding pathogens. Pregnancy involves dramatic changes in immunocompetence, with the first trimester being a period during which the costs of exposure to pathogens are greatest; hence, we reasoned that, relative to women in the second and third trimesters, women in the first trimester should exhibit elevated disgust sensitivity. Moreover, because food-borne illnesses pose a particular hazard during this period, we

further predicted that this first trimester elevation in disgust sensitivity would be most marked in the food domain.

Consistent with our prediction, women in the first trimester exhibited greater overall disgust sensitivity than did women in later stages of pregnancy. In keeping with previous reports, nausea was also concentrated in the first trimester. Despite a correlation between disgust sensitivity and nausea, gestational phase and current level of nausea each contributed independently to disgust sensitivity. Specifically, congruent with the dangers that food-borne illnesses pose to women and their fetuses during the first trimester, disgust sensitivity in the food domain was elevated both in conjunction with and independent of increases in nausea during this period.

While the effect sizes in our results are relatively small, it is important to remember that a survey composed of written statements, being experience distant, is a crude means of assessing disgust sensitivity; more dramatic effects can be expected when participants are confronted with actual disgust-eliciting objects (see Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999). Accordingly, with the caveat that there are limits to the evidentiary value of a single questionnaire study, we interpret our results as indicating that an evolved mechanism employs multiple avenues to modify behavior in a prophylactic fashion during the first trimester. Increases in the ease with which nausea and vomiting are elicited decrease the likelihood that pathogen-bearing substances will be ingested and/or retained (Fessler, 2002; Flaxman & Sherman, 2000). In parallel with these changes, increases in the repulsion evoked by potentially contaminated foods reduces the likelihood that it will be necessary to call upon these more costly responses. Elevations in disgust sensitivity can thus be conceptualized as an adaptive first line of defense against the incorporation of pathogens during the first trimester.

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