Group Processes & Intergroup Relations
2004 Vol 7(4) 333–353

GPIR

Evolved Disease-Avoidance Mechanisms and Contemporary Xenophobic Attitudes

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From evolutionary psychological reasoning, we derived the hypothesis that chronic and contextually aroused feelings of vulnerability to disease motivate negative reactions to foreign peoples. The hypothesis was tested and supported across four correlational studies: chronic disease worries predicted implicit cognitions associating foreign outgroups with danger, and also predicted less positive attitudes toward foreign (but not familiar) immigrant groups. The hypothesis also received support in two experiments in which the salience of contagious disease was manipulated: participants under high disease-salience conditions expressed less positive attitudes toward foreign (but not familiar) immigrants and were more likely to endorse policies that would favor the immigration of familiar rather than foreign peoples. These results reveal a previously under-explored influence on xenophobic attitudes, and suggest interesting linkages between evolved disease-avoidance mechanisms and contemporary social cognition.

KEYWORDS disease, immigration, intergroup attitudes, threat

> History teaches us that society has no shortage of means available to dehumanize 'undesirable' groups. The grave risks of this process are magnified when combined with the threat of infectious disease. (Markel, 1999)

HISTORICAL analyses of stereotypes, prejudice and exclusionary intergroup behavior reveal a tendency to associate foreign peoples with disease. Ethnic outgroups are often blamed for outbreaks of epidemic diseases, and these outbreaks can inspire violently xenophobic reactions to outsiders (Goldhagen, 1996; Markel, 1999; Oldstone, 1998). Foreigners are also associated with semantic concepts that connote disease. This association is evident in xenophobic propaganda, in which ethnic outgroups are likened to non-human vectors of disease, such as rats, flies, and lice (Suedfeld & Schaller, 2002). The associative link between foreign peoples and disease shows up consistently in the social science literature on immigration.

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7:4; 333–353; DOI: 10.1177/1368430204046142

Anti-immigrant literature in ancient Rome likened outsiders to detritus and scum (Noy, 2000). Anti-immigrant attitudes in England have been linked to beliefs that foreigners eat disturbingly unclean foods (roots, frogs, haggis and other foods 'fit only for dogs'; Stat, 1995, p. 192). And in the United States, Markel and Stern (2002, p. 757) write, 'Despite the dramatic changes in demography, the meaning of citizenship, and the ability to treat and cure acute and chronic diseases, foreigners were consistently associated with germs and contagion.'

Remarkably, this topic has received virtually no empirical attention in the psychological literature on intergroup stereotypes and prejudice. There are, of course, many additional psychological processes implicated in intergroup relations, and so there are many other unrelated personality factors and contextual variables that may contribute to xenophobic attitudes (see Fiske, 1998, for a review). In fact, there are many other kinds of disease-irrelevant threats that can contribute to intergroup anxieties and prejudices (e.g. Stangor & Crandall, 2000; Stephan, Ybarra, & Bachman, 1999). Still, given the apparent historical importance of disease in shaping societal-level reactions to foreign peoples, it seems fruitful to consider closely its analogous role in the psychology of individuals. That is the purpose of this article. We employ an evolutionary framework to derive—and then empirically test—the hypothesis that people who feel most vulnerable to contagious diseases are likely to react especially negatively toward subjectively foreign (but not familiar) outgroups.

Disease-avoidance mechanisms and intergroup attitudes

A number of theoretical models have suggested ways in which contemporary intergroup cognition and behavior may reflect psychological mechanisms that evolved a long time ago (e.g. Kurzban & Leary, 2001; Neuberg, Smith, & Asher, 2000; Reynolds, Falger, & Vine, 1987). The common evolutionary logic underlying these perspectives is summarized by Kurzban and Leary (2001): (a) The contemporary human mind evolved in response to adaptive problems imposed by the environments in which ancestral populations lived; (b) for the past several million years of this evolutionary history, ancestral populations lived in social groups; (c) specific adaptive problems associated with group life may have given rise to specific psychological mechanisms that facilitate negative perceptions of and reactions to individuals associated with specific sorts of groups. In other words, certain prejudicial attitudes may have conferred adaptive benefits within ancestral environments, and now—even though contemporary environments are very different in very many ways—the processes underlying those prejudicial attitudes persist.

Within this broad evolutionary framework, different theoretical models identify links between specific adaptive problems of the past and specific psychological processes in the present. One model links the adaptive utility of cooperative coalitions with contemporary tendencies to exclude and exploit members of outgroups (Kurzban & Leary, 2001). Another model links the adaptive utility of status hierarchies with contemporary tendencies to express domination over outgroups (Sidanius & Pratto, 1999). Another model links the adaptive utility of avoiding potentially dangerous intergroup encounters with contemporary tendencies to perceive outgroups in derogatory ways (Schaller, 2003). Yet another model links the adaptive utility of avoiding harmful pathogens and parasites with contemporary prejudices against individuals who are perceived, at some heuristic level, to be potential carriers of pathogens or parasites (Kurzban & Leary, 2001; Park, Faulkner, & Schaller, 2003). It is this disease-avoidance model specifically that informs the current investigation.

Disease-avoidance and prejudicial person perception

People typically experience feelings of uneasiness and even disgust when they encounter individuals perceived to be carriers of contagious disease. These psychological experiences—and the behavioral avoidance that they precipitate—may have evolutionary roots

(Kurzban & Leary, 2001; Rozin, Haidt, McCauley, & Imada, 1997). The logic is straightforward. In ancestral environments, many communicable parasites and diseases were hazardous to individuals' health. Behavioral tendencies that helped individuals to avoid infection would have been adaptive. One adaptive tendency would have been the selective avoidance of individuals who were especially likely to be carriers of contagious diseases.

A prerequisite for behavioral avoidance is some set of psychological mechanisms that facilitate learning and detection of cues that heuristically indicate the possible presence of contagious diseases. Thus, individuals may be perceptually sensitive to superficial physical features such as lesions, disfigurements, and other morphological abnormalities. (Cues such as these are, of course, highly imperfect indicators of disease; however, evolution of a cue-recognition mechanism requires only a modest correlation between the presence of the cue and the actual presence of disease; see Kurzban & Leary, 2001.) In addition to these and other morphological cues that heuristically connote disease, it is also likely that individuals are especially sensitive to superficial cues indicating that an individual is subjectively foreign to one's own group. There are several reasons why subjectively foreign peoples might have become heuristically associated with disease. First, contact with previously unknown populations brings with it an increased risk of encountering contagious diseases to which one has no acquired immunity (Diamond, 1999). Also, individuals from foreign cultures are more likely to engage in subjectively strange customs (pertaining to hygiene, food preparation, etc.) that may violate local customs that inhibit transmission of disease. Consequently, individuals are likely to be especially adept at learning to detect a wide range of cues that—within their local social environment—discriminate between familiar and foreign peoples.

Cue learning and perception is, by itself, insufficient to cause behavioral avoidance. Another prerequisite is the activation of psychological mechanisms that translate perception into action. Thus, in order to facilitate behavioral avoidance, it is likely that there are evolved mechanisms through which the perception of disease-connoting cues elicits a specific affective reaction, and activates cognitions in which the perceptual object is associatively linked to semantic concepts that connote disease and more generally motivate behavioral avoidance. The affective reaction is likely to be that of disgust. Disgust probably evolved primarily as a means to inhibit the ingestion of poisons and other harmful agents, but it plays an important role in interpersonal avoidance as well; disgust is elicited by subjectively 'offensive' people and motivates physical distancing from those people (Rozin, Haidt, & McCauley, 2000). Schiefenhövel (1997) notes that people often display disgust reactions when speaking about ethnic outgroups, and Rozin et al. (1997, p. 73) suggest that 'disgust in humans serves as an ethnic or outgroup marker'. Cognitive responses are likely to be varied. They may include a wide variety of moralist judgments and beliefs (Haidt, 2001). They may also include stereotypical beliefs in which disease-relevant characteristics such as 'dirty' or 'unhygienic' are attributed to subjectively foreign groups. Most obviously, perhaps, these cognitive responses are likely to precipitate xenophobic attitudes—attitudes indicating that foreigners are to be avoided, excluded, and otherwise kept at a distance.

Moderating influences on disease-avoidant reactions to foreign peoples

Responses designed over evolutionary time to avoid recurrent threats not only confer potential functional benefits; they entail potential costs as well (e.g., avoidant behavior consumes calories and distracts resources from other functional activities). Therefore, these responses are more functional in some situations than others. They are most functional under conditions in which the benefits most clearly outweigh the costs. As with most other evolved psychological mechanisms, evolved disease-avoidance mechanisms are likely to be engaged flexibly, depending on additional information bearing on the relative costs and benefits of response.

The actual benefits of a xenophobic response to foreigners were likely to be very low (and outweighed by costs) under conditions in which foreign peoples are far away, or under conditions in which perceivers are invulnerable to disease. The benefits were likely to be higher under conditions in which perceivers were actually vulnerable to the interpersonal transmission of infectious agents. Therefore, just as other evolved psychological mechanisms are moderated by a variety of functionally-relevant local variables (Conway & Schaller, 2002; Gangestad & Simpson, 2000), the disease-avoidance process that inspires xenophobic responses to foreign peoples is likely to have evolved in such a way that it is sensitive to, and moderated by, variables influencing the extent to which perceivers feel personally vulnerable to disease.

Chronic perceptions of vulnerability to disease Evolved threat-avoidance mechanisms may be pan-human, but there is considerable variation across individuals in the tendency for these mechanisms to be triggered. For example, disgust is a universal human emotion, but some people tend to be more sensitive to disgust than others (Haidt, McCauley, & Rozin, 1994). Similarly, for a variety of reasons bearing both on genetic heritage and social-learning processes, some people are likely to feel more vulnerable to disease than others. Regardless of the origins of individual differences in perceived vulnerability to disease, these individual differences are likely to moderate the activation of evolved disease-avoidance mechanisms in the domain of person perception. Previous research has, in various ways, revealed relations between individuals' self-perceived vulnerability and negative reactions to others who actually are diseased, as well as to others who are stigmatized by characteristics—such as physical disability—that heuristically connote disease (Bishop, Alva, Cantu, & Rittiman, 1991; Crandall, Glor, & Britt, 1997; Herek & Capitaniato, 1998; Park et al., 2003; Rozin, Markwith, & Nemeroff, 1992). This analysis suggests a testable hypothesis that has not previously received empirical attention: individual differences in perceived vulnerability to disease may predict xenophobic reactions to members of subjectively foreign ethnic groups. We tested this specific hypothesis in one set of four studies reported here.

Contextually aroused perceptions of vulnerability to disease Just as evolved mechanisms are responsive to chronic individual differences, they are similarly responsive to input from temporary contextual variables (Schaller, 2003). Any contextual information that implies increased vulnerability to disease might also amplify negative reactions to categories of people heuristically associated with disease. Disease-relevant stimuli in contemporary environments are abundant and include, for example, news stories about the latest disease epidemic, advertisements for hygienic products that make salient the omnipresence of germs and bacteria, and disgust-eliciting objects like sewers and odorous garbage cans. Even when these contextual stimuli do not explicitly implicate foreign outgroups as a source of disease, they may nevertheless trigger xenophobic responses to foreign peoples. This specific hypothesis—that temporarily-heightened vulnerability to disease amplifies negative reactions to foreigners—was tested in an additional set of two studies reported here.

Overview of studies

We conducted six studies to examine the effects of chronic and contextually-aroused perceptions of vulnerability to disease on xenophobic reactions to foreign peoples. Four studies were correlational: we examined the extent to which xenophobic attitudes were predicted by self-reported chronic perceptions of vulnerability to disease. In addition, we conducted two experiments, which included procedures designed to experimentally manipulate perceptions of vulnerability to disease. Across all studies, participants' attitudes toward subjectively foreign or familiar outgroups were assessed. Based on the reasoning outlined above, we expected that participants who felt (either chronically or temporarily) more vulnerable to disease would

react more negatively toward subjectively foreign outgroups, but not toward outgroups who were subjectively familiar.

Our conceptual analysis implies that the predicted effects should be observed primarily on measures that assess specific attitudes toward target groups marked by characteristics connoting foreign-ness. These effects are less likely to occur on measures that assess non-target-specific attitudes. All studies included target-specific attitude measures to test the predictions. In addition, several studies included additional measures that were not target-specific (these measures assessed attitudes toward immigration in general); this allowed us to examine the extent that the predicted effects were restricted to specific target groups.

The conceptual analysis also implies that the predicted effects are likely to be observed on measures that assess attitudes more directly relevant to functional behavior, such as physical avoidance or social exclusion. Consequently, all studies included measures that seem directly relevant (e.g. implicit associations between the target group and danger, attitudes about the immigration of target groups to participants' local area). These measures were the primary focus of our analyses.

It is less clear how strongly the underlying process might compel perceivers to attribute very specific traits to target groups. It seems plausible that, even in the absence of direct supporting information about unknown peoples, perceivers might be more likely to judge these peoples more negatively on specific traits that seem logically relevant to disease (e.g. unclean). However, the affective system (disgust) that presumably underlies the disease-avoidance process tends to compel a rather diffuse set of negative associations (Haidt, 2001). Moreover, in the absence of actual information supporting specific attributions, participants may be reluctant to offer specific stereotypical judgments. To explore the possibility of effects on trait attributions, several of the studies included measures assessing participants' judgments of target groups on a variety of traits both relevant and irrelevant to disease.

Studies 1–4: perceived vulnerability to disease correlates with xenophobic attitudes

Assessment of perceived vulnerability to disease

In order to test the hypothesis, we developed a questionnaire measure to assess individual differences in chronic perceptions of vulnerability to disease. This 'perceived vulnerability to disease' (PVD) measure included 14 items that assessed general beliefs about personal susceptibility to illness (e.g. 'I have a history of susceptibility to infectious disease', 'My immune system protects me from most illnesses that other people get'), and discomfort with behaviors that connote a higher risk of germ transmission (e.g. 'I prefer to wash my hands pretty soon after shaking someone's hand', 'I'm comfortable sharing a water bottle with a friend'). Each item was followed by a 7-point response scale with the endpoints labeled 'Strongly Disagree' and 'Strongly Agree.' All items were scored such that higher values indicated greater perceived vulnerability (6 items were reverse scored). An overall PVD score for each participant was computed by averaging responses across all 14 items.

Preliminary psychometric evaluation indicated that the PVD scale had adequate internal validity (Cronbach's alphas were typically in the range from .70 to .80 across multiple samples). Indicators of discriminant validity were also encouraging: It was not meaningfully correlated with conceptually irrelevant constructs (e.g. social desirability, self-esteem, locus of control), and was correlated—modestly—with only one of the Big Five personality dimensions, neuroticism (John & Srivastava, 1999; *r*s of .20 and .22 across two samples). Convergent validity was indicated by positive correlations between PVD and a measure of 'belief in a dangerous world' (Altemeyer, 1988; *r*s typically ranged between .30 and .40 across samples), and with sensitivity to disgust (Haidt et al., 1994; *r*s ranged between .22 and .53 across subscales assessing disgust in different domains).

The PVD measure was administered to participants in Studies 1–4. In each study, we examined correlations between overall PVD score and the various measures assessing intergroup attitudes. Studies 1 and 2 focused

on attitudes toward African outgroups. Africans were expected to be perceived as culturally foreign to participants (all participants were students at the University of British Columbia, which is a campus populated predominantly by peoples of East Asian and European heritage, but with very few students of African heritage). Studies 3 and 4 examined attitudes toward several other outgroups that a separate sample of UBC students rated as either subjectively foreign or familiar.

The hypothesized relation between PVD and intergroup attitudes is clearly directional; individuals who perceive themselves to be more vulnerable to disease are expected to react more negatively toward subjectively foreign ethnic groups. Given this clear directional prediction, when correlations consistent with this hypothesis are observed, we report *p* values associated with directional (i.e. 'one-tailed') tests of the statistical null hypothesis. When correlations are observed that are not obviously predicted by the hypothesis, we report *p* values associated with more conservative nondirectional tests of the null hypothesis, and explicitly identify them as 'two-tailed'. Exact *p* values are reported throughout, so that readers can employ alternative strategies of statistical inference if desired.

Study 1

An initial test of the hypothesis emerged from a study that was designed primarily to test hypotheses distinct from those under consideration here (additional results are reported in Schaller, Park, & Mueller, 2003; Study 2). The study employed the 'implicit association test' (IAT; Greenwald, McGhee, & Schwartz, 1998; Rudman, Greenwald, Mellott, & Schwartz, 1999) to assess implicitly activated semantic associations with the social category 'African'.

Participants were 52 undergraduate students at UBC. All participants first completed a set of questionnaires, one of which was the 14-item PVD measure. Participants then completed two IAT tasks, presented in counterbalanced order, that were developed to assess implicit associations between Africans and specific evaluative characteristics. One IAT was designed to assess associations with 'unpleasant'; the other IAT was designed to assess associations with 'danger'. The IAT procedures are described in detail elsewhere (Greenwald et al., 1998; Schaller et al., 2003); therefore, these methods are described in abbreviated form here.

Both IAT tasks were presented on IBM-compatible computers. Participants were presented with a series of forced-choice categorization trials, and were instructed to respond as quickly as possible. On each trial, a stimulus (i.e. a word or a picture) was presented in the center of the computer screen, along with two response categories (e.g. 'unpleasant' and 'pleasant') presented on the upper left and upper right sides of the screen. Participants responded by pressing one of two keyboard keys: either the *E* key, corresponding to the response category on the upper left side of the screen, or the *I* key, corresponding to the response category on the upper right side of the screen.

On an 'unpleasant/pleasant' IAT, participants judged whether words were unpleasant or pleasant, and on a 'danger/safety' IAT, participants judged whether words connoted danger or safety. For both IAT tasks, participants also judged the ethnicity of faces: participants of Asian backgrounds judged whether faces were African or Asian and all other participants judged whether faces were African or European. Each IAT task consisted of distinct blocks of trials; in two critical blocks, participants completed both word and face categorization trials. In the first critical block, the same keyboard key was used to indicate that faces were African and words were unpleasant (in the 'unpleasant/pleasant' IAT) or connoted danger (in the 'danger/safety' IAT). Responses on trials in this block were expected to be relatively fast if participants implicitly associated African faces with 'unpleasant' or 'danger'. In the second critical block, keyboard responses were changed, so that different keys were used to indicate 'African' and 'unpleasant'/'danger'. Responses on trials in this block were expected to be relatively slow if participants implicitly associated African faces with 'unpleasant' or 'danger'. The difference in average response times within each of the two critical blocks of trials (mean *rt* in the 2nd critical block minus

mean *rt* in the 1st critical block) served as an indicator of the extent to which Africans were differentially associated with 'unpleasant' or 'danger'.

Results reported elsewhere (Schaller et al., 2003) revealed that there was a general tendency among participants to differentially associate Africans with both 'unpleasant' and with 'danger'. The key question here is whether variability in these responses was associated with individual differences in perceived vulnerability to disease. Correlations revealed that PVD had a negligible relation with the unpleasant/pleasant IAT index ($r = .05$, $p = .351$), but positively predicted the danger/safety IAT index ($r = .24$, $p = .045$).

These results provide initial evidence that individual differences in PVD predict negative implicit attitudes about people of African heritage. Interestingly, PVD did not predict the extent to which Africans were associated with unpleasant characteristics in general; but it did predict the extent to which Africans were associated with danger. This pattern of results suggests that chronic feelings of vulnerability to disease may be associated specifically with threat-relevant beliefs, which are likely to stimulate avoidance behaviors, but are not as strongly associated with other negative beliefs that are less functionally relevant to threat-avoidance.

Study 2

The predictive effects of PVD were also examined in a second study that was originally designed for a different primary purpose. Participants in this study were 82 undergraduate students at UBC. All participants completed several questionnaires, including the PVD measure. They were then presented with a one-page written passage that began, 'There is a country in Central Africa, which for the purposes of this study we will refer to as Krasnee, that has been experiencing a great deal of civil unrest in recent years. A number of people from this country are trying to leave.' The passage went on to describe a group of Krasneeans who, for various reasons, were seeking to immigrate to Vancouver, Canada, where participants in the study lived.

Open-ended and rating scale techniques were then used to assess attitudes toward Krasneeans. Participants were first asked to 'Write 5 words that you feel describe Krasneeans', and were also asked to draw a picture representing 'what you would imagine a typical Krasneean to look like'. One coder, working from a master list, counted the number of words indicated by each participant that connoted some sort of danger or threat. Four additional coders looked at each drawing and rated on a 10-point scale the demeanor of the Krasneean(s) depicted in the drawing (1 = most unfriendly; 10 = most friendly). The four sets of ratings were standardized and then averaged to create an index of the perceived friendliness of the typical Krasneean (Cronbach's alpha = .92).

Additional measures of participants' attitudes toward Krasneeans employed rating-scale techniques. Participants were asked to rate, on six separate 9-point scales, the extent to which Krasneeans were *likeable*, *hostile*, *trustworthy*, *open-minded*, *ignorant*, and *poor*. To assess attitudes toward immigration, participants were also asked to rate, on five point scales, the extent to which they agreed with various statements. One item specifically assessed attitudes toward Krasneean immigration, and read, 'None of the Krasneeans applying for citizenship should be allowed to immigrate to Canada', and four additional items assessed attitudes toward Canadian immigration policies in general (e.g. agreement with the statement, 'Canada's immigration policies are too strict'). Participants' scores on these four items were combined to create a composite index of general anti-immigration attitudes.

Of primary interest as an indicator of xenophobia were responses to the item 'None of the Krasneeans applying for citizenship should be allowed to immigrate to Canada.' Results revealed a modest positive correlation between PVD and endorsement of this statement ($r = .21$, $p = .032$): individuals with higher PVD scores more strongly opposed Krasneean immigration.

There was little relation between PVD and anti-immigration attitudes in general ($r = .13$, $p = .117$). On the measures assessing specific beliefs about the characteristics of Krasneeans,

PVD scores correlated weakly with the number of danger-relevant traits participants used to describe Krasneeans (r = .14, p = .099), but correlated more strongly with the demeanor of the Krasneeans represented in participants' drawings (r = –.31, p = .002): Those with higher PVD scores drew less friendly looking Krasneeans. PVD correlated with ratings of Krasneeans on two trait characteristics: *likable* (r = –.33, p = .002), and *trustworthy* (r = –.22, p = .025). Individuals with higher PVD scores rated Krasneeans to be less likable and less trustworthy. There were negligible relations between PVD and ratings of *hostile*, *open-minded*, *ignorant*, or *poor* (–.16 < rs < .06).

These results complement those of Study 1 and reveal PVD predicted exclusionary attitudes toward a specific African immigrant group. There was some additional evidence that PVD predicted some more specific trait-based beliefs about the immigrant group as well. One could argue that the perceived characteristics predicted most strongly by PVD (unfriendliness, unlikability, and untrustworthiness) are traits that, when observed in others, typically motivate attempts to avoid close contact. Characteristics that less clearly motivate avoidance (e.g. 'ignorant' or 'poor') were not predicted by PVD. Nor did PVD meaningfully predict the perception of hostility; although perceived hostility certainly connotes a danger to be avoided, the danger it connotes is not functionally relevant to disease avoidance. It is interesting too that, although PVD predicted opposition to immigration from the specific target group, it did not as strongly predict anti-immigration attitudes in general. This perhaps provides some initial evidence that chronic feelings of vulnerability to disease underlie attitudes reflecting disease-avoidance concerns with subjectively foreign, but not familiar outgroups. We conducted additional studies to more directly explore this possibility.

Study 3

In a third study, we used methods similar to the previous study to test the relation between PVD and attitudes toward potential immigrant groups. Unlike Study 2—which assessed attitudes only toward an immigrant group from Africa—in this study, the geographical origin of the immigrant group was experimentally manipulated: the group was described as being either from eastern Africa, eastern Asia, or eastern Europe. A separate sample of 23 UBC students rated immigrants from eastern Africa as subjectively foreign in general, and rated them as likely to engage in unusual practices in disease-relevant domains (e.g. hygiene and food preparation). In contrast, immigrants from eastern Asia and eastern Europe were rated as subjectively familiar, and were perceived to have hygiene and food preparation practices similar to those of participants themselves. Therefore, PVD is expected to predict negative attitudes toward African immigrants, but not toward East Asian and European immigrants.

Participants were 86 undergraduate students at UBC. All participants completed several questionnaires including the PVD scale. Participants then listened to a voice on audiotape, briefly describing an ethnic population identified as 'Saznians'. As in the previous study, the description stated that Saznians were seeking to immigrate to Vancouver, Canada. Participants were randomly assigned to hear, as part of the audiotaped message, that the Saznian homeland was either in 'eastern Africa', 'eastern Asia', or 'eastern Europe'.

Participants then rated the extent that they agreed with various statements using 5-point scales. The first item was of primary interest in that it assessed attitudes specific to Saznian immigration: participants rated the extent to which they disagreed or agreed with the statement, 'The Canadian government should allow the Saznians from [Africa/Asia/Europe] to enter Canada.' On an additional six items, participants rated the extent that they agreed with other general pro- or anti-immigration statements. A composite index of general pro-immigration attitudes was created by reverse scoring responses to anti-immigration statements and then averaging responses to all items.

As expected, the relation between PVD and endorsement of Saznian immigration depended

importantly on the geographical origin of Saznians (see Figure 1). When Saznians were described as African, there was a substantial negative correlation between PVD and endorsement of Saznian immigration ($r = -.38$, $p = .016$): individuals with higher PVD scores were less keen on the immigration of African Saznians. In contrast, correlations were slightly positive under conditions in which Saznians were described as either eastern Asian or European (rs were .15 and .16, respectively; both ps > .40, two-tailed). Further analyses (z tests comparing the magnitudes of these rs) substantiate the observation that the negative correlation observed in the Africa condition was distinct from the weak relations in the other two conditions, ps = .026 and .020, respectively.

PVD was also negatively related to pro-immigration attitudes in general ($r = -.22$, $p = .029$). This relation was not meaningfully moderated by geographical origin.

Overall, the results reveal some tendency for individuals who perceive themselves to be vulnerable to disease to have stronger anti-immigration attitudes in general. However, when expressing attitudes toward specific immigrant groups, PVD does not predict anti-immigrant attitudes equally. In this sample (drawn from a population comprised primarily of people of either European or East Asian ethnicity), PVD did not predict more negative reactions toward immigration of eastern European or eastern Asian outgroups, but it did predict more negative reactions toward immigration of an eastern African outgroup. These results are consistent with the hypothesis that PVD predicts negative reactions toward subjectively foreign, but not subjectively familiar ethnic groups.

Study 4

The results of the first three studies reveal a pattern of findings linking PVD with negative reactions toward African outgroups. These results are consistent with a psychological process in which ethnic foreign-ness serves as a

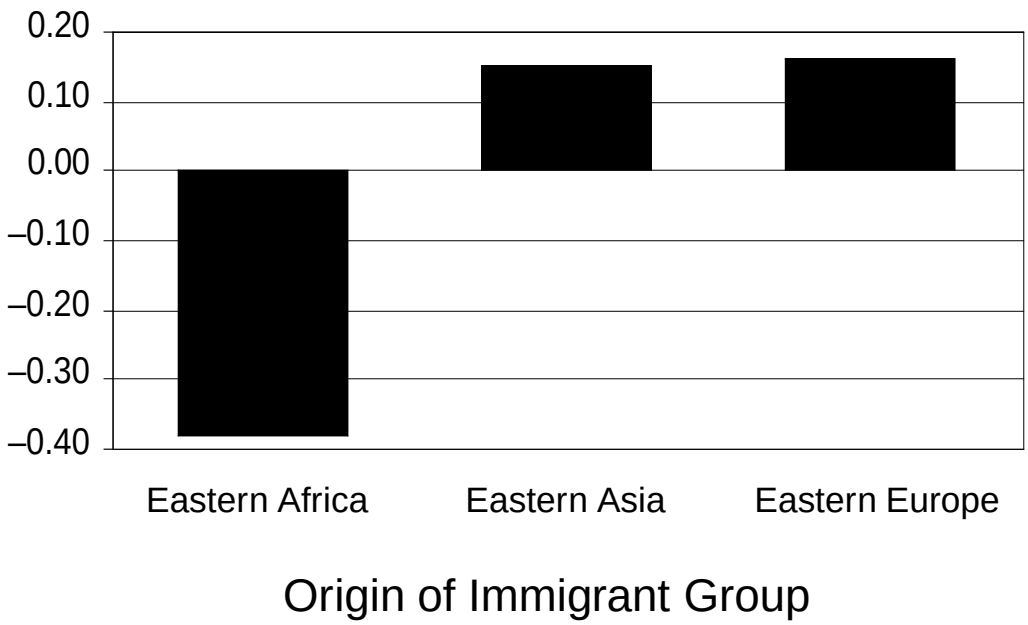

Figure 1. Correlations between PVD and pro-immigration attitudes as a function of the geographical origin of potential immigrants (Study 3).

cue that heuristically signals a threat of interpersonal disease transmission. These results are also consistent with a different process in which participants' reactions might be influenced by some rational assessment of the health risks associated specifically with Africa. Certain high-profile infectious diseases, such as Ebola and HIV, have been more notably epidemic in parts of Africa than in other parts of the world. Consequently, it could be argued, PVD might predict negative attitudes uniquely toward African peoples. This possibility is not uninteresting; but the implications—both conceptual and practical—are more profound if PVD predicts negative attitudes toward a broader range of subjectively foreign peoples. For this reason, in a fourth study, we assessed the relation between PVD and attitudes toward three non-African outgroups: immigrants from Peru, Qatar, and Sri Lanka. A separate sample of 23 UBC students (the same separate sample who rated the foreign-ness of the immigrant groups portrayed in Study 3) rated immigrants from Peru, Qatar, and Sri Lanka to be subjectively foreign overall and in cultural practices pertaining to hygiene and food. Therefore, PVD was expected to predict xenophobic reactions to all three of these groups.

Participants were 47 undergraduate students at the University of British Columbia, primarily of East Asian and European heritage (none were from Peru, Qatar, or Sri Lanka). Participants were first presented with a written description of a refugee group seeking to immigrate to Vancouver, Canada. The passage was identical for all participants except for the apparent geographical origin of the refugees. Participants were randomly assigned to one of three conditions in which they read that the refugees were from Peru, Qatar, or Sri Lanka. After first identifying the geographical origin of the refugees, and describing their harsh living conditions resulting from arid climate with low rainfall, the passage proceeded as follows:

> As a result of these living conditions, a large number of refugees from the plains of [Peru/Qatar/Sri Lanka] are seeking refugee status in Canada. They have told Canadian immigration officials that the standard of living in [Peru/Qatar/Sri Lanka] is unacceptably low and that its health and social systems do not meet the needs of [Peruvian/Qatar/Sri Lankan] people. The majority of these refugees are applying to live in the greater Vancouver area.

To assess attitudes toward immigrants from Peru, Qatar, or Sri Lanka, participants in each condition rated the extent that they agreed with three statements that assessed attitudes and beliefs pertaining specifically to the refugee group described. As in Study 3, one statement assessed whether participants felt the Canadian government should allow the refugees to enter Canada. Two other statements assessed whether participants felt the refugees might bring health problems or criminal problems into Canada.

Three additional statements assessed attitudes toward immigration in general. Responses to these last three items were combined to form a single index assessing pro-immigration attitudes in general. Ratings on all statements were made on 7-point scales.

Participants also rated the target immigrant group on a set of 13 specific characteristics. Five of these characteristics pertained to hygiene (sanitary, filthy, hygienic, clean, and dirty); the rest tapped into a variety of other evaluative traits (likeable, hostile, trustworthy, open-minded, ignorant, poor, lazy, and unintelligent). Ratings were made on 9-point scales. Following these procedures, participants completed various questionnaires, including the 14-item PVD measure.

A negative relation between PVD and endorsement of immigration of all three refugee groups was expected, and so analyses focused on the full set of data, collapsed across conditions. Results revealed a substantial negative correlation between PVD and attitudes toward immigration of the specified group ($r = -.40$, $p = .003$). (A negative correlation was observed regardless of whether the refugee group was described as originating in Peru, Qatar, or Sri Lanka: The *r*s in each of these conditions were –.30, –.36, and –.53, respectively.) The higher individuals' PVD scores were, the less willing they were to allow the group to immigrate.

PVD also predicted beliefs linking the refugee groups to health problems ($r = .34$, $p = .012$). There was a somewhat weaker correlation between PVD and beliefs linking the refugee groups to crime ($r = .25$, $p = .087$, two-tailed). There was also a negative correlation between PVD and the 3-item measure of pro-immigration attitudes in general ($r = -.38$, $p = .004$).

In contrast to these relations to the attitude measures, PVD did not strongly predict responses on the 13-trait rating items. Only three correlations exceeded .2 in magnitude. Two of these correlations were with traits pertaining to hygiene: The correlation with 'clean' was $r = -.25$ ($p = .046$) and the correlation with 'dirty' was $r = .22$ ($p = .073$). The other notable correlation was that between PVD and 'open-minded' ($r = -.29$, $p = .050$, two-tailed).

The results of this study reveal a strong relation between PVD and anti-immigrant attitudes toward three non-African foreign ethnic groups. Individuals with higher PVD scores were less willing to allow foreign outgroups to immigrate to Canada. They also held stronger beliefs that outgroups might bring disease problems to Canada and are less hygienic. To some extent, PVD also predicted beliefs about criminality—a result suggesting that the underlying process may be associated with a variety of attitudes that are not logically disease-relevant, but which nonetheless motivate exclusionary action. PVD also clearly predicted anti-immigrant attitudes in general.

It's also worth noting that although PVD clearly predicted xenophobic attitudes, it did not strongly predict the attribution of specific traits to the immigrant groups. The reason for this may lie partially in the nature of the affective state—disgust—that is linked conceptually to the disease-avoidance process. Disgust typically elicits crude evaluative attitudes (distaste, dislike) and behavioral attempts to reduce contact, but it may not immediately connote specific trait information of the sort connoted by other emotions, such as fear.

Discussion of Studies 1–4

These studies provide the first evidence that xenophobic attitudes are moderated by individual differences in perceived vulnerability to disease. Although the results on some ancillary measures (e.g. attribution of personal traits and characteristics, anti-immigrant attitudes in general) were somewhat inconsistent across studies, there was a consistent pattern of results on the primary measures assessing xenophobic attitudes within each study. Canadian students who perceived themselves chronically to be vulnerable to diseases were more likely to associate foreign peoples (Africans) with danger, and were less likely to endorse the immigration of foreigners (immigrants from Africa, Peru, Qatar, and Sri Lanka). Perceived vulnerability to disease predicted xenophobic attitudes towards specific immigrant groups that were subjectively foreign, but not toward other groups (immigrants from eastern Asia and eastern Europe) that were subjectively familiar.

These findings are consistent with an evolved disease-avoidance process in which subjective foreign-ness heuristically triggers cognitions that motivate avoidance and exclusion, especially among individuals who personally feel vulnerable to disease. However, these findings are correlational in nature, and so it is necessary to consider the possibility that the relation between PVD and xenophobic attitudes may be the product of shared variance with other individual difference variables that have nothing conceptually to do with disease. Several additional results address some of these 'third variable' alternative explanations. For instance, it might be argued that PVD is merely one indicator of a broader personality construct, such as neuroticism, that more directly predicts xenophobic attitudes. This alternative seems unlikely. Not only is PVD only weakly correlated with neuroticism (see results summarized above), but neuroticism is not consistently correlated with prejudicial attitudes. Some studies have shown modest positive relations between neuroticism and ethnic prejudice (Hebron & Ridley, 1965), other studies show little or no predictive effects of either neuroticism or anxiety (Maykovich, 1975; Orpen, 1973; Prentice, 1962) and at least one study reveals a negative correlation between neuroticism and

prejudice against ethnic immigrants (Ray & Kiefl, 1984). Potentially more plausible sources of spurious relations are other individual difference constructs pertaining to other specific threats and fears. For instance, PVD does correlate substantially with 'belief in a dangerous world' (BDW), and prior research reveals that BDW does predict prejudicial attitudes against ethnic outgroups (Altemeyer, 1988). We were able to directly address this specific alternative because participants in Studies 1–4 also completed Altemeyer's (1988) measure of BDW. For each study, we conducted regression analyses that included both PVD and BDW as predictors of the primary measure of xenophobic attitudes; results revealed that the predictive effects of PVD were not substantially reduced. We also created a composite dataset (N = 213), merging data from all four studies after first standardizing responses on the primary dependent measure (we reverse scored the values from Studies 3 and 4 so that, across all four studies, higher standardized values reflected more negative attitudes). Within this composite dataset, PVD and BDW were entered simultaneously as predictors. Results revealed a modest effect of BDW on xenophobic attitudes (beta = .13, p = .065, two-tailed) and—more importantly—a more substantial and unique effect of PVD (beta = .23, $p < .001$).

Although these analyses help rule out several specific personality constructs as viable alternative explanations for the effects of PVD, they cannot address all possible third-variable explanations. Consequently, we conducted two additional studies in which we attempted to experimentally manipulate the extent that people feel vulnerable to disease. This approach allowed us to more rigorously test the proposition that disease-avoidance processes contribute to xenophobic attitudes.

Studies 5 and 6: temporary salience of disease amplifies xenophobic attitudes

In two experiments, we manipulated participants' temporary perceptions of vulnerability to disease, and then assessed attitudes toward the immigration of subjectively foreign or familiar immigrant groups. In each study, participants randomly assigned to one experimental condition viewed a series of pictures that conveyed the ease with which bacteria and germs are transmitted in everyday life. The remaining participants (assigned to a control condition) viewed a series of pictures that conveyed the ease with which accidents occur in everyday life. All participants then completed measures assessing their attitudes toward one specific immigrant group, which—depending on another experimental manipulation—was either subjectively foreign or familiar. Participants in Study 6 also completed an additional measure in which they allocated government resources to attract immigrants from a variety of both foreign and familiar locations. In both studies, the conceptual hypothesis would be supported by evidence of interactions between the disease-salience manipulation and the foreign-ness of target groups: compared to participants in the control condition, participants in the disease-salient condition were expected to respond more negatively toward foreign—but not familiar—immigrant groups.

Pretesting

Prior to conducting these experiments, a separate sample of 26 UBC students pre-rated a set of eight immigrant groups representing areas of the world with very different climatic and geographic characteristics. These groups were immigrants from Taiwan, Peru, Poland, Nigeria, Scotland, Mongolia, Brazil, and Iceland. Participants rated each immigrant group on scales assessing how different the group was from participants themselves (e.g. how culturally and visually different they are). Participants also rated each group on several scales assessing how different they were in specific disease-relevant domains (e.g. how different their food preparation and hygienic practices are). Ratings were made on 9-point scales. On the basis of these responses, we computed an average foreign-ness score for each group. Immigrants from Nigeria were rated as most foreign overall (M = 5.89), followed by immigrants from Mongolia (M = 5.48), Brazil and Peru (Ms = 5.38), Iceland (M

= 4.62), Poland (M = 4.50), Taiwan (M = 4.33), and Scotland (M = 4.00).

These pretest results informed the methods used in the two experiments. In one experiment, participants indicated attitudes toward potential immigrants from either Nigeria (foreign) or Scotland (familiar). In a second experiment, participants indicated attitudes toward potential immigrants from either Mongolia (foreign) or Taiwan (familiar), and also completed an additional measure assessing relative preferences among all eight pre-rated immigrant groups.

Study 5

Participants were 57 undergraduate students at UBC. Participants first completed several questionnaires, including the PVD measure. They were then randomly assigned to one of two experimental conditions. In one condition, participants viewed a slide show designed to remind them of the various ways that diseases are transmitted in daily life, thus making the threat of contagious diseases especially salient. This 'Disease' slide show included 11 pictures that would ostensibly be used in a health education program (e.g. one slide pictures a woman unsuccessfully attempting to kill cartoon germs in her kitchen, and is titled 'The Horrors of the Kitchen Sponge and Family Pets'; another slide depicts a strand of hair surrounded by bacteria and is labeled 'Hair Bacteria. A microscopic view of a strand of hair and some of the typical bacteria that surround it'). The rest of the participants were assigned to a control condition, in which they viewed a slide show designed to make the threat of physical dangers especially salient. These slides were intended to make participants feel susceptible to a threat that was irrelevant to disease. This 'Accidents' slide show included 11 pictures that would ostensibly be used in a safety education program. (Two examples are 'School Bus Hazards' which depicts a girl bending over to pick up a book as a school bus is about to hit her, and 'Electricity and Water Don't Mix' which portrays a bathing woman surrounded by plugged-in electrical appliances.)

Participants viewed their assigned slide show twice; the first time they rated the educational informativeness of each slide on a 10-point rating scale, and after a second viewing they wrote a short paragraph describing their overall impressions of the slide show.

Participants were then told that the initial study was over and were asked to complete a questionnaire for an ostensibly unrelated study. The experimenter read aloud a brief description of a group seeking to immigrate to Vancouver. Participants were randomly assigned to hear that this group was from either Nigeria or Scotland. They then completed a questionnaire consisting of rating scale items assessing their attitudes toward the described immigrant group. These items were similar to those in Study 4: three items assessed specific attitudes toward the potential immigrant group, three items assessed attitudes toward immigration in general, and 13 items asked participants the extent that various traits are characteristic of the immigrant group.

In general, across all attitude and trait items, there was a general main effect for target group, in that participants tended to rate Nigerian immigrants less favorably than Scottish immigrants. On specific items, participants believed Nigerians were more likely to bring costly health problems to Vancouver, and rated Nigerians to be less sanitary, less clean, less open-minded, and as poorer and dirtier than Scottish immigrants (all ps < .05).

For the purpose of testing the hypothesis about disease-salience and xenophobia, the attitude item of central interest was the item assessing agreement with the statement: 'The Canadian government should allow [Nigerian/Scottish] immigrants to live in Vancouver.' PVD scores, particularly for the average of PVD items assessing discomfort with behaviors that connote a risk of germ transmission, predicted responses on this item; therefore the average score on this subset of PVD items was included as a covariate in a 2 × 2 (slide show condition × target group condition) analysis of covariance. This analysis revealed the predicted interaction, (F(1,52) = 6.00, p = .02). As depicted in Figure 2, participants in the control condition

were approximately equally likely to support immigration of Scots (M = 5.85) and Nigerians (M = 6.07), but those in the disease-salience condition were more likely to endorse the immigration of Scots (M = 6.36) and less likely to endorse the immigration of Nigerians (M = 5.53).

In contrast to the clear effects of the disease-salience manipulation on this dependent measure, there were weaker and inconsistent effects on other items. This failure to find effects across a broad range of items is consistent with the general nature of the PVD effects obtained in Studies 1–4. The effects seem to show up primarily on attitude items that bear most directly on physical contact and/or social exclusion. This may reflect the underlying behavioral function of evolved disease-avoidance processes. It is also possible that it reflects the operation of participants' self-presentational concerns: these students may be somewhat willing to explicitly express attitudes about governmental decisions bearing on desired and undesired immigrant groups, but may be less willing to overtly express stereotypical judgments about those groups.

The results depicted in Figure 2 provide initial support for the hypothesis that temporarily-heightened worries about vulnerability to disease can amplify xenophobic attitudes toward subjectively foreign (but not familiar) outgroups. Still, these results are limited. The purpose of the final study was to conceptually replicate and extend this finding by examining attitudes toward a broader range of potential immigrant groups.

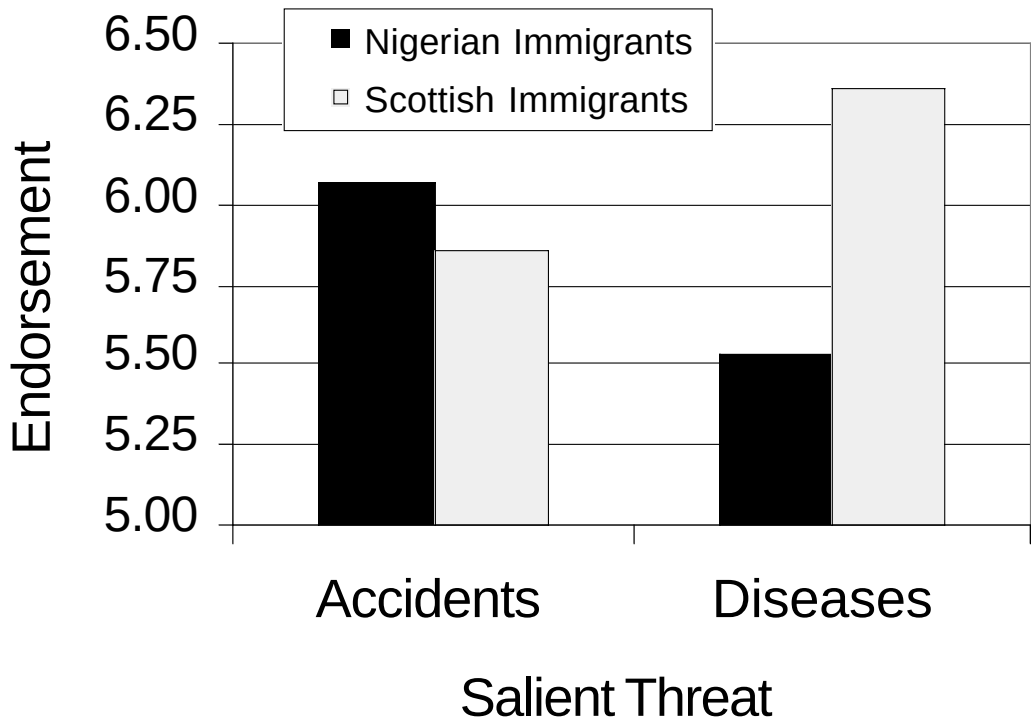

Figure 2. Interaction between disease salience and geographical origin of immigrants on endorsement of potential immigration (Study 5).

Study 6

The methods of Study 6 were similar to those of Study 5, with two main changes. One change pertained to the specific target immigrant groups that were described to participants: Mongolians and Taiwanese. In pre-testing (described above), Mongolian and Taiwanese immigrants were rated, respectively, as the second-most and second-least foreign of the eight pre-rated groups. The second change was the inclusion of an additional measure, in which participants indicated the percentage of a special government budget that should be allocated to help attract immigrants from each of the eight different pre-rated nations. This measure extends the analysis to include a broader range of subjectively foreign and familiar groups. In addition, it might also be expected to be less reactive to participants' self-presentation concerns.

Participants were 45 undergraduate students at UBC. Participants first completed several questionnaires, including the PVD measure, and then were randomly assigned to view either the 'Disease' slide show or the 'Accidents' slide show (this manipulation was identical to that in Study 5). Following this, participants heard a description about a specific immigrant group seeking to settle in Vancouver; they were randomly assigned to hear that the immigrant group was either from Mongolia (foreign) or Taiwan (familiar). Then, as in Study 5, they completed a set of rating-scale items assessing attitudes and beliefs about the specific target immigrant group.

Participants then completed an additional dependent measure, labeled the 'immigration advertising questionnaire'. At the beginning of this questionnaire, a short paragraph explained that the Canadian government was considering 'advertising' Canada as a suitable destination for potential immigrants around the world. This paragraph also explained that Canada had a finite amount of resources for this kind of advertising, and so it sought input on the way in which this advertising budget should be allocated to different countries from which potential immigrants might come. Participants were asked to indicate the percent of the total immigration advertising budget that should be spent in each of eight different countries: Taiwan, Peru, Poland, Nigeria, Scotland, Mongolia, Brazil, and Iceland. These were the same eight countries that had been pre-tested for perceived foreign-ness. Therefore, budget percentages that each participant allocated to the four countries pre-rated to be most foreign (Nigeria, Mongolia, Brazil, and Peru) were summed to compute a single index; and percentages allocated to the four countries pre-rated to be most familiar (Scotland, Taiwan, Poland, and Iceland) were summed to compute a second index. This allowed for a within-subjects comparison of budget allocations to attract foreign versus familiar immigrants. Participants in the disease-salient condition, compared to control participants, were expected to allocate relatively less of the budget to subjectively foreign areas.

The results on the attitude and trait-rating items indicated that, in contrast to Study 5, participants did not generally rate the subjectively foreign immigrant group (Mongolians) any less favorably than the familiar immigrant group (Taiwanese). A main effect for target group emerged on only one specific item: participants rated Mongolian immigrants to be poorer than Taiwanese ($t(43) = 2.69$, $p = .01$). Also in contrast to the results of Study 5, there emerged no interpretable effects of the disease-salience manipulation on these measures—including no evidence of the predicted interaction on the item assessing endorsement of the target group's immigration to Canada. The predicted interaction did emerge on the budget allocation measure. A 2 × 2 × 2 (slide show condition × target group condition × budget allocation index) repeated measures analysis of variance revealed the anticipated two-way interaction between slide show condition and budget allocation index ($F(1, 41) = 4.58$, $p = .038$). Whereas participants in the control condition allocated roughly equal amounts of advertising resources to foreign and familiar countries (47.48% vs. 52.52%, respectively), participants in the disease-salience condition allocated less advertising resources to foreign countries and more to familiar countries

(37.57% vs. 62.43%, respectively). Figure 3 depicts this interaction. A deeper examination of the budget allocations revealed that allocations to three of the four foreign countries (Nigeria, Mongolia, and Peru) were lower in the disease-salient condition. Thus, the effects of temporary disease salience extend beyond reactions merely to Nigerians (documented in Study 5) to other foreign peoples as well. These results reveal also that, although participants in the disease-salient condition did not express greater xenophobic reactions to Mongolian immigrants when they simply rated Mongolians alone (in the attitude rating scales), they did appear to do so when these reactions were embedded in a response context that allowed them to appear especially welcoming to other groups of immigrants—more familiar immigrants, of course.

An effect of PVD also emerged on the budget allocation measure: participants with higher PVD scores allocated less of the advertising budget to foreign areas ($r = -.24$, $p = .05$).

Discussion of Studies 5 and 6

Across both experiments, there emerged some evidence that temporarily-activated worries about disease led to more negative reactions to foreign, but not familiar, immigrant groups. Study 5 revealed evidence of this effect on an attitude item pertaining to support for the immigration of specific foreign and familiar

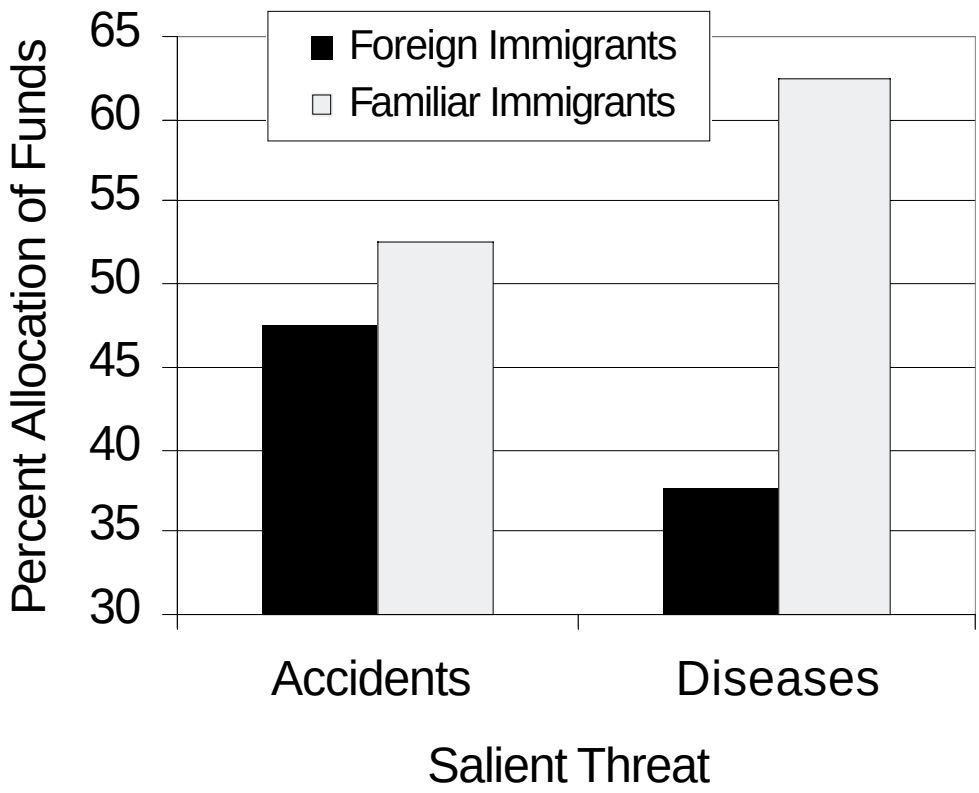

Figure 3. Interaction between disease salience and foreign-ness of geographical areas on allocation of immigration advertising budget (Study 6).

target groups. Study 6 failed to replicate this effect exactly on the same kind of attitude item rewritten to specify a different pair of target groups, but did conceptually replicate the effect on a different measure (a budget allocation measure) that assessed interest in attracting a greater variety of foreign and familiar immigrant groups. It is possible that the predicted effect emerged more clearly on this latter measure because, in contrast to the more straightforward attitude measures, participants may have been less likely to worry that their budget allocation choices were indicative of anti-immigrant prejudice. In any case, although there was some inconsistency in the results across the two experiments, both experiments yielded evidence consistent with the same conceptual hypothesis.

It is worth noting also that the effects of PVD documented in Studies 1–4 were also replicated on the budget allocation measure used in Study 6. Thus, this experiment not only substantiates the predicted effect of temporary disease worries on xenophobia, it also further documents the effects of chronic disease worries on xenophobia as well.

General discussion

The six studies reported here provide the first empirical evidence that chronic and temporarily-aroused feelings of vulnerability to disease contribute to negative attitudes toward foreign peoples. These findings are consistent with an evolved disease-avoidance model of contemporary stigma processes (Kurzban & Leary, 2001; Park et al., 2003), and they extend this model to a new domain of application.

Subjective perceptions of familiarity and foreign-ness appear to be fundamental to the activation of this underlying process. Individual differences in perceived vulnerability to disease predicted negative reactions only to subjectively foreign peoples, but not to subjectively familiar peoples. Similarly, contextual information that makes disease especially salient led to negative reactions to subjectively foreign immigrants, but not to subjectively familiar immigrants. (If anything, greater worries about disease were associated with even more favorable reactions to familiar immigrants; see especially the results from Studies 3 and 5.) Thus, the process underlying these effects appears to be conceptually distinct from other psychological processes that precipitate prejudicial attitudes toward a less-specified range of outgroups and social categories. This evidence of target-specificity and domain-specificity is consistent with an evolutionarily-informed meta-theoretical approach to prejudice processes in general. There are many different kinds of threat that may precipitate negative reactions to outgroups. These include symbolic threats at the level of self-concept and social identity, as well as perceived threats to political status, economic security, and physical well-being (Schaller, 2003; Sidanius & Pratto, 1999; Stephan, Diaz-Loving, & Duran, 2000). Different outgroups—defined by different features—precipitate different kinds of threat, and these different kinds of threat are associated with qualitatively different kinds of negative responses (Neuberg & Cottrell, 2002).

The results from several of these studies revealed some, albeit tentative, indication of domain-specificity in beliefs about subjectively foreign outgroups. For instance, in Study 1, PVD predicted implicit cognitive associations linking Africans to danger, but not to unpleasant semantic concepts in general. In several other studies, there was some evidence that PVD predicted beliefs linking foreign groups with specific kinds of traits that either connote uncleanliness or that typically motivate physical avoidance. However, these results were weak and inconsistent across studies, and bear further investigation. Many other evolved processes—such as those pertaining to fear—are associated with fairly domain-specific judgments and reactions. For instance, variables connoting vulnerability to intentional physical harm predict specific, functionally-relevant trait judgments about ethnic outgroups (Schaller et al., 2003). It is possible that an evolved disease-avoidance process (presumably linked affectively to disgust rather than fear) precipitates a less well-specified set of semantic associations. Given the interest that issues of

domain-specificity inspire among evolutionary psychologists (Kenrick, Sadalla, & Keefe, 1998), it will be useful for future research to investigate more thoroughly the domain-specificity of disease-based xenophobic reactions.

Empirical support for a disease-avoidance mechanism does not preclude the operation of additional adaptive mechanisms promoting xenophobic reactions to foreign peoples. The violation of local cultural norms not only signals the threat of contagion, but may also signal a threat to social efficiency and effective group functioning (Gil-White, 2001). Just as specific psychological reactions (such as disgust) may be associated with the perceived threat of disease, other reactions (such as contempt and moral disapproval) may be associated with the perception of norm violation (Boyd, Gintis, Bowles, & Richerson, 2003; Neuberg & Cottrell, 2002). A multifaceted evolutionary approach can help predict the circumstances under which subjectively foreign ethnic outgroups might most strongly elicit disease-avoidant reactions rather than reactions designed to maintain effective group functioning. If an outgroup violates norms that are particularly germane to disease (e.g. customs pertaining to personal hygiene, food preparation, or sex), then disease-avoidance mechanisms are especially likely to be engaged. However, if an outgroup violates other kinds of norms that are particularly pertinent to social efficiency (e.g. language use, reciprocity), then xenophobia might be predicted primarily by concerns with effective group functioning. In the present studies, we did not assess the extent to which target groups were perceived as foreign in these other kinds of normative domains; further research is needed to test predictions about the relations between specific domains of foreign-ness, the threats they imply, and the psychological reactions they elicit.

While the empirical results presented here are consistent with the underlying evolutionary model from which these hypotheses were derived, these results alone cannot rule out alternative accounts for the contemporary tendency of xenophobic attitudes to be pronounced in individuals who feel particularly vulnerable to disease. It might be argued, for instance, that the effects documented here may result from a rational assessment of the disease-relevant risks associated with particular immigrant groups (e.g. those from developing countries), rather than from the heuristic activation of evolved mechanisms. A rational risk-assessment process, however, implies that exclusionary attitudes should be based on attributions of disease-relevant traits to foreign peoples. While our findings occasionally indicated that PVD predicted such trait attributions, these effects were weak when obtained (see Study 4) and were inconsistent across studies; it seems unlikely that trait attributions mediate the relation between PVD and exclusionary attitudes. People may occasionally engage in a rational analysis when there are salient reasons (e.g. the recent outbreak of SARS) to associate specific groups with specific disease threats. However, the present findings suggest that there are additional non-rational processes that contribute to similar xenophobic attitudes.

Additional evidence for a non-rational process also emerges from statistical analyses that attend to the two kinds of items from which the PVD measure is comprised. Recall that some items measure beliefs about personal vulnerability to disease, while other items measure discomfort with situations in which germs are likely to be transmitted. In a sense, the first set of items assesses thoughtful considerations about disease susceptibility, while the second set assesses more emotion-based avoidant reactions. Across Studies 1–4, we found that the emotion-based 'germ-aversion' subscale typically exerted a stronger effect on xenophobic attitudes (mean r = .28 for the germ-aversion subscale, compared to a mean r = .16 for the subscale measuring more thoughtful beliefs about disease susceptibility). These results are consistent with other findings on PVD and prejudice (Park et al., 2003), and provide some indirect evidence that the xenophobia results are due less to a rational assessment of disease risk than they are to an automatically-activated aversion to heuristically threatening social situations.

Indirect evidence for an automated non-rational mechanism does not, of course, provide verification for the hypothesized role of evolutionary pressures in sculpting such a mechanism. No such verification can ever be produced by merely psychological research methods (Conway & Schaller, 2002). The value of this evolutionary level of analysis lies not in its explanatory necessity, but in its meta-theoretical utility in generating new discoveries and connecting different scholarly literatures—including qualitative analyses of anti-immigrant attitudes throughout human history (e.g. Markel & Stern, 2002), zoological studies of xenophobia in other primate species (e.g. Holloway, 1974; Southwick, Siddiqi, Farooqui, & Pal, 1974), and the extensive psychological literature on intergroup prejudice.

The utility of an evolutionary approach to contemporary psychological processes is maximized when it is considered in conjunction with more 'traditional' meta-theoretical approaches in the social sciences. Consider the processes of socialization and cultural change. One might argue that a process of cultural—not biological—evolution over the past several millennia has contributed to beliefs about foreigners that are functionally related to disease-avoidance concerns. As a result of contact with foreign populations and the inevitable co-occurence of disease outbreaks, cultural beliefs may have arisen that associate foreigners with disease and promote behavioral avoidance or social exclusion. These beliefs may be passed on inter-generationally, and so may become a permanent part of cultural knowledge. Of course, processes of cultural evolution are entirely compatible—and often necessarily inter-related—with processes of biological evolution (Boyd & Richerson, 1985; Kameda, Takezawa, & Hastie, 2003). For instance, the ancient Greek belief that foreigners possess an 'evil eye', which by itself was thought to cause illness (Nutton, 2000), may have emerged and persisted because it motivates avoidance or exclusionary behaviors in the presence of foreigners. Beliefs that are especially likely to emerge and persist within cultures are those that exploit fundamental emotional systems such as disgust (Heath, Bell, & Sternberg, 2001), and more generally are those that help individuals solve fundamental adaptive problems (Krebs & Janicki, 2004).

Concluding remarks

The research presented here provides a specific example of the value of evolutionary logic in psychological inquiry: reasoning about the recurrent adaptive problems imposed by ancestral human environments, and the cognitive mechanisms that arose to solve them, can yield novel hypotheses about psychological processes in the here-and-now (Conway & Schaller, 2002). We used this approach to generate the previously-untested hypothesis that individuals' feelings of vulnerability to disease have implications for the seemingly unrelated domain of intergroup cognition. Our findings provide support for this hypothesis and indicate that chronic and contextually aroused feelings of vulnerability to disease should be added to the list of psychological factors that contribute to xenophobic attitudes.

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Acknowledgements

This research was supported by a Natural Sciences and Engineering Research Council of Canada fellowship awarded to Jason Faulkner and a Social Sciences and Humanities Research Council of Canada grant awarded to Mark Schaller. We are grateful to Chris Crandall, Steve Heine, Doug Kenrick, and Ara Norenzayan for their helpful comments on drafts of this article. We also thank Gurbreena Dhanoa, Chloe Kelly, David Loran, and Jennifer Scott for their assistance in data collection.

Paper received 29 June 2003; revision accepted 12 March 2004.

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