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Original Article

Regional Differences in Pathogen Prevalence and Defensive Reactions to the "Swine Flu" Outbreak among East Asians and Westerners

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Abstract: Research has found that contagion-minimizing behavioral tendencies are amplified in pathogen-prevalent regions. We investigated whether reactions to the "swine flu" outbreak of 2009 were stronger among East Asians than Westerners, populations residing in regions that now enjoy comparable advances in healthcare but that are characterized by relatively high and low historical pathogen prevalence, respectively. In a survey, East Asians reported greater concerns about infection, especially from foreigners. Analyses of international air travel data around the time of the outbreak provided corroborating evidence: Immediately following the outbreak, airports in the Asia–Pacific region lost more international traffic relative to their Western counterparts, and East Asian airlines reported greater declines in international traffic compared to Western airlines. These differences are unlikely to reflect objective threat posed by swine flu (whose casualties were concentrated in the Americas); rather, they appear to reflect culturally adapted behavioral patterns forged and sustained by regionally variable levels of pathogen prevalence.

Keywords: air travel, behavioral immune system, culture, pathogens, swine flu

Introduction

Disease-causing pathogens have threatened the wellbeing of organisms for a very long time, resulting in the evolution of complex immune systems in hosts. But the immune system is not a final solution, because pathogens themselves continue to evolve the ability to penetrate their hosts' immune systems. A more reliable defense would involve preventing infection in the first place — via, for instance, behavioral avoidance (Kurzban and Leary, 2001; Loehle, 1995; Møller, Dufva, and Allander, 1993). Indeed, avoidance of infected conspecifics has been observed in many animals, including humans (e.g., Crandall and Moriarty, 1995; Goodall, 1986; Kavaliers and Colwell, 1995; Kiesecker, Skelly, Beard,

and Preisser, 1999). This form of defense has been called the *behavioral immune system* (Schaller and Duncan, 2007; Schaller and Park, in press).

In humans, the behavioral immune system has been implicated in social rejection of individuals perceived to pose contagion risks, which may manifest as xenophobia and appearance-based prejudice (Faulkner, Schaller, Park, and Duncan, 2004; Navarrete and Fessler, 2006; Park, Faulkner, and Schaller, 2003; Park, Schaller, and Crandall, 2007). Furthermore, human cultures are characterized by distinct traditions and interpersonal styles (e.g., use of culinary spices, wariness of strangers) that may serve to minimize pathogen transmission (Schaller and Murray, 2010; Sherman and Billing, 1999).

Much like physiological immune responses, behavioral defenses incur operational costs (e.g., elevated energy expenditure, potentially unnecessary vigilance) and thus are likely to be functionally contingent upon vulnerability, being amplified when the risks of infection are heightened. Indeed, people who are — or perceive themselves to be — more vulnerable to disease tend to exhibit stronger defensive reactions. Chronically or experimentally heightened concerns about disease have been found to be associated with lower self-rated extraversion and openness to experience (Duncan, Schaller, and Park, 2009; Mortensen, Becker, Ackerman, Neuberg, and Kenrick, 2010), as well as stronger prejudicial reactions against culturally foreign individuals (Faulkner et al., 2004). One study found that women in the first trimester of pregnancy (whose immune responses are naturally suppressed and who are thus actually more vulnerable to disease) tend to exhibit stronger ethnocentrism and xenophobia (Navarrete, Fessler, and Eng, 2007).

Importantly, a similar functional contingency appears to operate at the cultural level as well. Pathogen prevalence varies across world regions, and contagion-minimizing norms — such as retrained sexual behavior and xenophobia — tend to be amplified in regions with higher pathogen prevalence where they are more likely to confer net benefits (Schaller and Murray, 2008). This line of theory and research has shed new light on the origins of broad cultural differences, such as those captured by the individualism–collectivism dimension (Markus and Kitayama, 1991; Triandis, 1995): Higher pathogen prevalence has been found to be associated with higher collectivism, a cultural pattern that includes inclinations toward conformity, adherence to tradition, and sharper ingroup–outgroup boundaries (Fincher, Thornhill, Murray, and Schaller, 2008). Furthermore, recent research has found that the associations between pathogen prevalence and psychological outcomes are specific to non-zoonotic parasites — those that have the capacity for human-to-human transmission — bolstering the argument for the role of pathogen avoidance in cultural variation (Thornhill, Fincher, Murray, and Schaller, 2010).

When "swine flu" (influenza virus A subtype H1N1) made headlines in April 2009, contagion-minimizing measures were quickly prescribed and implemented around the world. In keeping with alerts issued by the World Health Organization, governments advised citizens to avoid crowds and to refrain from making nonessential trips, particularly to Mexico where the outbreak originated (Smith, 2009). Moreover, various quarantine measures were imposed on individuals suspected of being infected, especially if they were foreigners (e.g., McCullogh, 2009). Changes in people's behavior had real economic effects, especially in Mexico (e.g., Gibbs, 2009).

While increased vigilance and decreased traveling are functional responses to a

pathogen outbreak, the logic of functional contingency described above suggests that such responses may be especially pronounced among people socialized within cultures with more elaborated contagion-minimizing norms and practices. In the present research, we investigated whether defensive reactions were stronger among East Asians than Westerners, populations residing in regions that now enjoy comparable healthcare but that are characterized by relatively high and low levels of historical pathogen prevalence, respectively (for estimates, see Murray and Schaller, 2010).

The 2009 outbreak of swine flu was worldwide; thus, there was no reason to suspect any differences in objective risk of transmission between East Asians and Westerners. However, East Asians, due to their region's historically higher pathogen prevalence (which has been linked to their amplified contagion-minimizing tendencies), may have reacted especially vigilantly. We tested the hypothesis that disease-avoidance reactions were stronger among East Asians than among Westerners.

We tested this hypothesis in two ways. First, we conducted a survey (in November and December 2009) in which individuals of East Asian and Western cultures were asked several questions pertaining to their concerns about contracting disease (Study 1). Although useful, self-report survey data have a number of limitations. Thus, we also examined the phenomenon in the "real world" by analyzing air traffic volumes in different world regions around the time of the outbreak (Studies 2 and 3).

Study 1

Methods

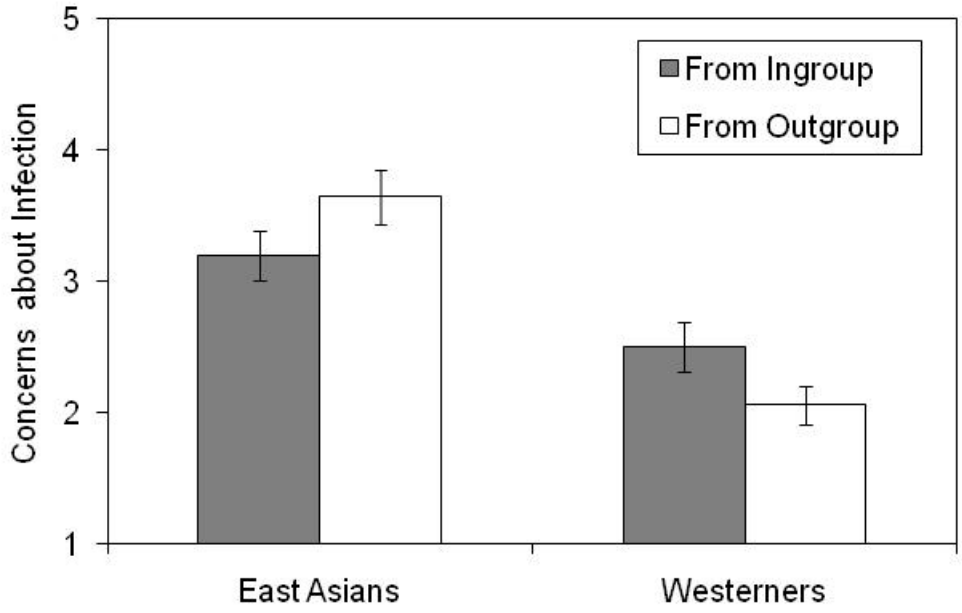
The survey was completed online by 62 East Asian and 52 Western individuals. Participants were recruited via advertisement posted on university-based websites and social networks. Most of the participants were university students or recent graduates. In the East Asian sample, 31 were Japanese, 23 were Hong Kong Chinese, and eight were South Korean (25 men, 37 women; mean age = 23.31 years, *SD* = 7.42). In the Western sample, 28 were Dutch, eleven were British, and the rest had a variety of Western European and North American backgrounds (15 men, 37 women; mean age = 24.81 years, *SD* = 4.65).

The threat of swine flu was subsiding at the time of the survey (winter 2009). To make the threat of disease salient, participants were asked to read a short excerpt about influenza taken from Wikipedia, after which they were asked to rate several items: (a) concerns about infection from ingroup individuals (e.g., friends, colleagues), (b) concerns about infection from outgroup individuals (e.g., immigrants, foreign students), and (c) concerns about traveling abroad in light of disease threats. The order of these three items was randomized across participants. Participants responded on a seven-point scale with anchors "not at all concerned" (1), "somewhat concerned" (4), and "extremely concerned" (7).

Results

Cross-cultural differences were analyzed via *t* tests. Consistent with the hypothesis, East Asians expressed greater concerns than did Westerners on all three items (Cohen's *d*s = .48, 1.13, 1.17, respectively; all *p*s ≤ .01).[1] A key question was whether East Asians showed a tendency to be especially wary of cultural foreigners. Results showed that Westerners were more concerned about infection from ingroup than from outgroup individuals, $t(51) = 2.75$, $p = .008$, $d = .36$. This unanticipated effect may reveal a more "rational" response among Westerners, as interactions with ingroup members — and thus real opportunities for infection — are vastly more frequent than interactions with outgroup members. By contrast, East Asians were more concerned about infection from outgroup than from ingroup individuals, $t(61) = 2.84$, $p = .006$, $d = .29$. An ANOVA confirmed the interaction effect between cultural background and ingroup/outgroup concerns, $F(1, 112) = 15.42$, $p = 0.001$, $\eta_p^2 = .12$ (see Figure 1).

Figure 1. Concerns about catching infectious disease from ingroup and outgroup members among East Asians and Westerners (error bars indicate ± *SE* of the mean)



These results lend support to the hypothesis that disease-avoidance reactions were stronger among East Asians, and they are consistent with the view that East Asian cultures are characterized by heightened contagion-minimizing tendencies. The responses of

[1]Additional analyses revealed that the Chinese scored significantly higher than the Japanese on ingroup and outgroup concerns (perhaps reflecting Hong Kong's recent experience with SARS). Removing the Chinese eliminated the cultural difference in ingroup concerns; the remaining cultural differences remained significant. No nationality differences were found among Westerners. Gender did not moderate any of the effects.

Westerners, on the other hand, are consistent with a culture that is low on contagion minimization.

Did East Asians' higher concerns about infection and traveling abroad manifest behaviorally? We examined patterns of air travel around the time of the outbreak, via two sets of data: (a) airport passenger traffic across major world regions (Study 2) and (b) number of passengers carried by major airlines (Study 3). We predicted that following the outbreak, airports and airlines in East Asia experienced greater loss of international traffic relative to their Western counterparts. Although passengers' cultural backgrounds were unidentifiable in these data, it is highly probable that the largest segment of passengers going through these major regions or their airlines consisted of locals.

Study 2

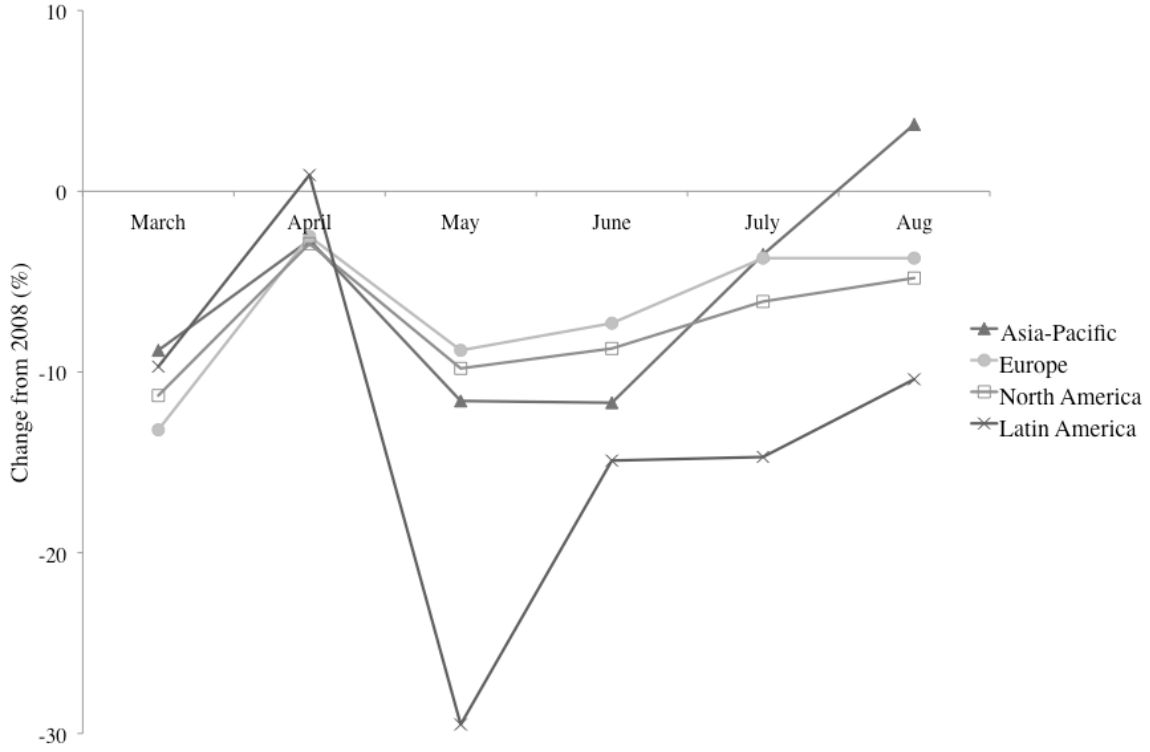
Methods

Airports Council International (ACI; www.airports.org), an organization of airport operators worldwide, compiles a monthly report of passenger traffic for different world regions. For the present investigation, we focused on four of the regions covered by ACI: Latin America, Europe, North America, and Asia–Pacific. We obtained data for international and domestic traffic during the months surrounding the outbreak (March to August 2009) and computed monthly 2008-to-2009 percent changes. As these data represent approximately 96% of the worldwide air traffic volume, we did not employ inferential statistics.

Results

Figure 2 shows the percent change data for international airport traffic across the four regions. The data for Latin America (which includes Mexico) demonstrated that international air traffic was closely linked to the swine flu outbreak: In May, this region experienced a 2008-to-2009 loss of about 30%, and from June to August, losses of about 10-15%. Declines in domestic air travel were less severe and recovered more quickly.

Figure 2. 2008-to-2009 percent changes in international airport traffic from March to August across world regions



How did Asia–Pacific compare with Europe and North America? In April, 2008-to-2009 changes in international traffic were similar across the regions (losses of 2.7% in Asia–Pacific, 2.5% in Europe, and 2.9% in North America). Asia–Pacific then saw substantial declines in international traffic in May (11.6%) and June (11.7%), declines which were about 2-4% greater than those of Europe (May: 8.8%, June: 7.3%) and North America (May: 9.8%, June: 8.7%). These are not trivial numbers: Had Asia–Pacific seen declines comparable to those of Europe and North America, their airports would have handled another 1.6 million passengers during these two months. By contrast, there was little 2008-to-2009 change in domestic traffic across all three regions.

Although these results are broadly consistent with the hypothesis, they are limited as Asia–Pacific here includes not only East Asia, but encompasses India to Australia. Thus, we conducted a more focused analysis in Study 3.

Study 3

Methods

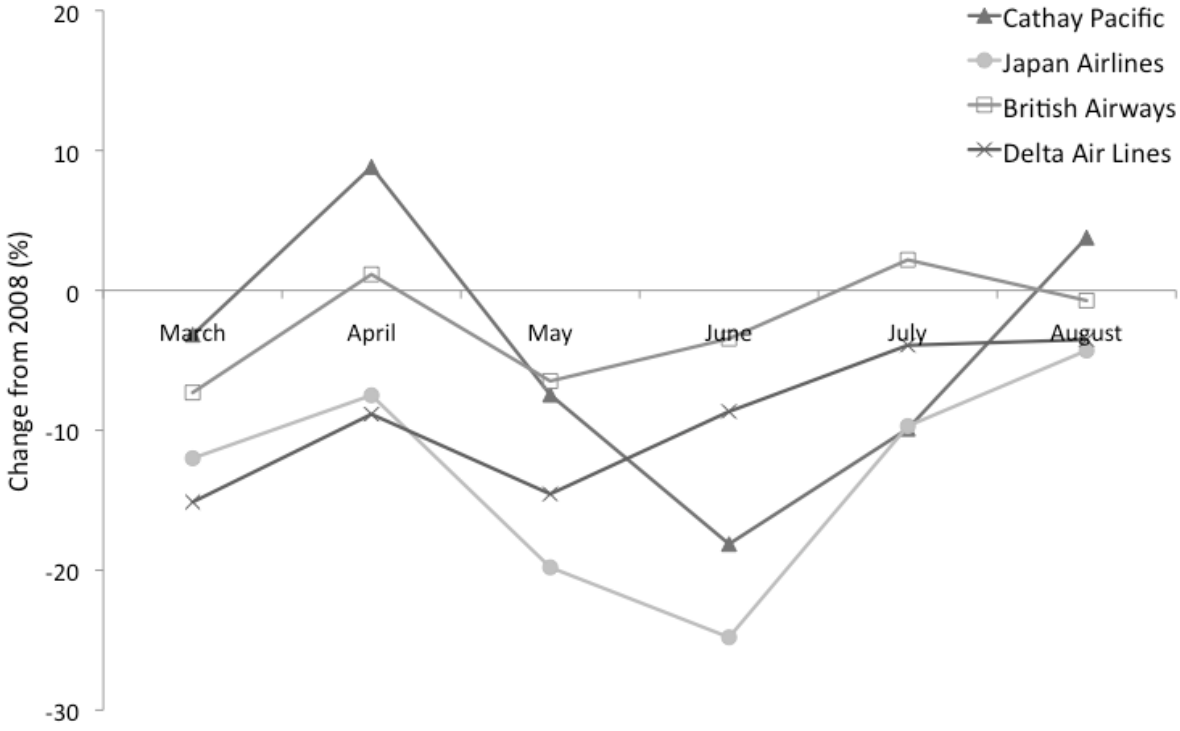
In this study we sampled two East Asian (Hong Kong, Japan) and two Western (United Kingdom, United States) societies of comparable economic development and

analyzed international passenger numbers reported by each society's leading airline (Cathay Pacific, Japan Airlines, British Airways, Delta Air Lines). We obtained the relevant data from each airline's website and computed 2008-to-2009 percent changes for March through August.

Results

Figure 3 shows the percent change data for all airlines. An ANOVA with percent changes in April, May, and June as a within-subjects factor and cultural region (East Asia or West) as a between-subjects factor revealed a main effect of months, $F(2, 4) = 23.84$, $p = .006$, $\eta_p^2 = .92$, as well as an interaction effect, $F(2, 4) = 13.85$, $p = .016$, $\eta_p^2 = .87$. Across airlines there was a decline from April to May. But whereas the Western airlines showed signs of recovery in June (6.1% loss compared with 10.6% loss in May), the East Asian airlines reported even greater losses in June (21.5% loss compared with 13.7% loss in May).

Figure 3. 2008-to-2009 percent changes in international passenger numbers from March to August across airlines



These results corroborated those of Study 2: Immediately following the swine flu outbreak, avoidance of international air travel was more exaggerated in East Asia than in Europe and North America.

General Discussion

Survey results and air travel patterns indicated that reactions to infectious disease were stronger among East Asians than among Westerners. These findings are consistent with the influence of culturally variable contagion-minimizing norms, shaped by historical and contemporary pathogen prevalence (Schaller and Murray, 2010). A possible alternative account of the results is that regional differences in defensive reactions may reflect unbiased reactions to actual threat posed by swine flu. But this seems unlikely: Deaths attributed to swine flu (obtained from http://ecdc.europa.eu) were largely concentrated in the Americas. Nor do the findings seem to reflect reasoned reactions to historical pathogen prevalence (if so, Westerners should be particularly wary of going abroad where they may be more likely to encounter diseases). Rather, the reactions of East Asians show evidence of a culturally amplified behavioral immune system, calibrated to pathogen-prevalent environments.

The present results suggest that cultural background and disease threat salience may interact to produce the amplified defensive reactions. Patterns of air travel indicate that the largest cultural differences emerged in the two months following the swine flu outbreak (May and June), suggesting that the presence of a disease threat may temporarily trigger the exaggerated responses among East Asians. Not only do these findings contribute to the growing literature documenting the implications of the behavioral immune system (Schaller and Park, in press), they highlight previously unexplored predictors of traveling behavior. It is intriguing to contemplate the larger financial losses incurred by some airlines, simply because of their region's cultural patterns forged by higher pathogen prevalence.

While the present results are consistent with the hypothesis, there are some limitations. First, Studies 2 and 3 relied on the assumption that airports and their airlines handled passengers who are predominantly from their respective regions. Second, as with most research on the origins of cross-cultural differences, it is difficult to ascertain whether the observed effects are actually due to the hypothesized cause (i.e., pathogen prevalence). A large number of factors differentiate these two regions, and the present studies cannot rule out the possibility that one or more of these factors account for the observed pattern of results. (Of course, some of those factors may also be traced to variation in pathogen prevalence.) Nonetheless, it is worth noting that the present research observed patterns of behavior that were unanticipated from prior cross-cultural research that did not consider the role of pathogen prevalence.

The present results are best considered within the context of the burgeoning literature investigating links between pathogen prevalence and different psychological and behavioral patterns across cultures (e.g., Fincher et al., 2008; Schaller and Murray, 2008). This body of research lends credence to the hypothesis and confidence to our interpretation.

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