DISEASE PREVALENCE AND CONFORMITY

by

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ABSTRACT

The fitness costs and benefits of conforming to ones ingroup vary depending upon the dangers inherent in the immediate environment. In threatening environments, conformity is likely to be more beneficial than it is in less threatening environments. One specific threat that has had a profound selective influence on humans is infectious disease. Therefore, it was predicted that cultures inhabiting regions where risk of disease transmission is high would have more conformist orientations. Across four divergent measures of conformity, this was shown to be the case. Laboratory manipulations of disease, however, did not change levels of conformity. In two laboratory studies in which participants made judgments about either physical quantities (such as weight or volume) or about subjective liking for abstract art, participants did not conform more to normative information when disease was made salient compared to control conditions. Implications are discussed.

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Dedicated to the memory of my cousin,

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1 GENERAL INTRODUCTION

Levels of conformity differ greatly across individuals (e.g. Asch, 1956) as well as across culturs (Bond & Smith, 1996). But why is this so? Although a combination of factors surely exists at both levels, a cost-benefit approach suggests that conformity should be most beneficial in contexts where threats are especially high. Infectious diseases, which have represented a ubiquitous threat throughout human history (Wolfe, Dunavon, & Diamond, 2007), are one such type of threat that should make conformity differentially adaptive across different contexts. Does greater threat from infectious diseases predict higher levels of conformity? To address this question, results are reported from both the cultural and individual levels of analysis.

1.1 Conformity across Time and Cultures

Conformity has been a popular topic of investigation at least since the inception of the Asch (1952, 1956) paradigm. However, as with most social psychological phenomena, the lion's share of conformity research has taken place in the United States, a country that typically stresses the importance of individual freedoms and the importance of not conforming (Hofstede, 1986; Markus, Kitayama, & Heiman, 1996). The popularity of Asch-style experiments, however, has recently allowed a standardized comparison of levels of conformity across countries. Bond and Smith (1996) performed a meta-analysis of 133 Asch-style conformity studies across 17 countries and found extensive cross-cultural variation in the average effect size of these studies. The only explanation for these regional differences that is offered by the authors, however, is that collectivist values strongly influence levels of conformity. This explanation, of course, simply moves the causal question back one step and does not address the environmental preconditions that may have led conformist or collectivistic values to emerge in some cultures more prominently than in others. For the current investigation, a cost/benefit analysis will underpin the theorizing that will help to elucidate *why* these cultural differences may exist.

1.2 Specific Costs of Conformity

Conformity confers specific and important costs at the individual and at the cultural level of analysis. The most important cost to unequivocally conforming is that many opportunities for innovation may be missed. This can be illustrated using the classic example of the evolution of the hammer (from Hough, 1922): for millions of years, our ancestors' "hammers" (which were required largely for food extraction) consisted of a bone or rock with no handle. This design was surely inefficient (and sounds downright preposterous by today's hammer standards), yet these hammers functioned adequately enough to serve the needs of thousands of generations. One of our innovative hominid ancestors, however, discovered that a much more functional hammer could be rendered by attaching a stick to a rock or bone. Although he or she may have been seen as a deviant at the time, our ancestor's invention eventually became the norm, and surely led to countless feats of ancestral engineering. Innovations such as these would first confer advantages at the individual level when they were novel, and then at the group level as they became the group norm, allowing this group to outcompete rival groups and rival species. Had this early human inventor been driven more to conform, however, a two piece hammer may not yet exist or have gained popularity, and we could still be extracting our food by smashing its casing with a rock.

1.3 Specific Benefits of Conformity

Two main characteristics of human life have made conformity in many situations integral to humans' success as a species. The first characteristic that requires a tendency to conform is that humans live in large groups, and therefore large-scale cooperation entails at least some level of conformity between individuals (Henrich, 2003). The second, and probably more prominent, aspect of human life that makes conformity essential is that we are currently the only ultra-cultural species on the planet. Humans are unique in that they are almost completely dependent upon learning cultural information in order to successfully navigate the social and physical environment (Heine, 2008). Therefore, humans have a predilection when learning to either emulate the most successful individual (Henrich & Gil-White, 2001) or to copy the behaviours that are most common in the population (Henrich & Boyd, 1998). The latter of these strategies, termed *conformist transmission*, has been essential in the spread and maintenance of cultural practices and norms and is likely responsible for the stabilization of group cooperation (Henrich & Boyd, 2001). These forms of learning are essential for humans to successfully navigate uncertain social and physical environments, and to avoid the dangers inherent in these environments.

Nutrition offers a good example of the dangers inherent in human environments. A trial-and-error approach to finding nutritive and non-poisonous foodstuffs is simply not feasible for a culturally-dependent species. Therefore, many norms that govern food choice and preparation exist due to their ability to eliminate threats inherent in unprepared food, such as harmful germs. Conforming to norms such as these would have been highly adaptive in uncertain ancestral environments.

1.4 Conformity: Cost/Benefit Tradeoffs

Given that conformity confers important costs and benefits, it stands to reason that conformity should be differentially beneficial based upon severity of dangers within the physical environment. In environments that are especially dangerous or uncertain, conforming to cultural norms is likely to maximally beneficial, given that many of these norms presumably have been successfully established and transmitted due to their adaptive significance. For example, norms governing food preparation should be especially important in regions where the risk of germ transmission from food is especially high; conversely, in non-threatening environments the benefits of deviating from prescribed norms may outweigh the costs, since this nonconformity allows for the possibility of adaptive innovations and discoveries. One such norm that governs food preparation is the use of spices. Spices have the benefit of possessing natural antibiotic properties, yet they offer little to no nutritive value and are costly to cultivate. Therefore, the use of spices should be especially beneficial, and therefore especially common, in regions where their antibiotic properties have the most utility. Sherman and Billing (1999) have indeed shown this to be the case: the use of spices is most common in areas where risk of disease transmission is especially high.

1.5 Overview of the Present Investigations

From the fact that disease influences the relative weights of the costs and benefits of conformity, hypotheses can be drawn at both the group level and the individual level of analysis. At the group level, cultures living in regions that have historically been afflicted by higher levels of disease should have cultural norms that stress the importance of conformity, in order to buffer against disease transmission. Four separate cross-cultural measures are used to test this hypothesis in the current investigation. The question that this cross-cultural investigation does not address, however, is the mechanism by which disease might influence conformity. This mechanism could be genetic, it could be developmental and phenotypic, or it could be based upon cultural transmission and be largely independent of genes. Alternatively, this mechanism could operate proximally, in which inputs from the immediate environment (such as threat of disease) lead to the most appropriate, context-dependent response (such as higher behavioural conformity).

Of these four possible mechanisms, only this proximal mechanism allows for research at the individual level of analysis. Therefore, in Part 3, two laboratory studies investigate the possibility that disease influences conformity via a proximal, context-dependent mechanism.

2 DISEASE PREVALENCE AND CROSS-NATIONAL DIFFERENCES IN CONFORMITY

This investigation was focused at the cross-cultural level, using regions (mostly countries) as the unit of analysis. Some regions included are territories within larger countries (i.e. Hong Kong); however, in the interest of efficiency, "country" will hereafter refer to all regional units of analysis. Conceptually, it is easy to see why conformity should be higher in regions of high disease: in regions where disease threat is especially high, conforming to cultural norms should be especially important, given that many of these norms are likely to serve as buffers against disease transmission. On the other hand, the benefits of nonconformity, such as the increased possibility of innovation and creative problem-solving, may outweigh the costs in regions where the risk of disease transmission is low. Therefore, the logical hypothesis is that countries that have historically suffered from higher levels of infectious disease will have higher scores on conformity measures and lower tolerance for non-conformist behaviours.

Utilising the conceptual background of evoked culture (for review see Gangestad, Haselton & Buss, 2006) has led to the prediction and validation of several other hypotheses regarding disease and cultural outcomes. Generally, regions historically suffering from high levels of pathogen prevalence should be more likely to have developed and sustained cultural practices and values that serve to buffer against the threat of infection. In the mating domain, for example, it should be particularly important in regions of high disease to be tenacious in evaluating cues in a potential mate that connote not only the current absence of disease but also evidence of genetic material likely to produce a strong immune system in offspring. In humans, as well as in many other species, both the absence of disease and a strong immune system are generally connoted by a high level of bilateral symmetry (Moller, 1996). Facial bilateral symmetry, in turn, is universally attractive in humans (Thornhill & Gangestad, 1999), presumably because it is a good predictor of health and immunity. Gangestad and Buss (1993) therefore predicted that the value placed in physical attractiveness should be higher in regions of higher disease. Across a 29-country sample, that is exactly what they found. Other notable specific cultural outcomes predicted by the prevalence of disease include levels of polygyny (Low, 1990), and the level of parental effort devoted to offspring (Quinlan, 2007).

Although no cross-cultural investigation has focused on the effects of disease on conformity *per se*, two recent lines of research have involved higher-order constructs that are germane to this investigation.

The first such line of research focused on collectivism, which is largely defined by conformity to one's ingroup and wariness of outgroup members (Sagiv & Schwartz, 2005)—two characteristics of cultures that should be especially important in regions of high disease prevalence. Using this conceptual framework, Fincher, Thornhill, Murray, and Schaller (2008) predicted that collectivism would be positively associated with regional disease prevalence, and that individualism would be negatively associated with regional disease prevalence. Across two measures of collectivism and two measures of individualism, this is exactly what they found.

The second relevant higher-order construct that has been linked to disease prevalence comes from the Big Five theory of personality: Openness to Experience. Since this trait is partly characterized by behaviours and thinking styles that are non-normative and nonconventional (see John & Srivastava, 2001, for review), it should therefore be more risky in more threatening environments. Using this reasoning, Schaller and Murray (2008) predicted, and found, that Openness to Experience was associated with regional historical disease prevalence across three different cross-cultural investigations of personality.

These two aforementioned higher-order constructs are conceptually disparate abstractions, yet they share a common and more concrete thread of conformity. Although the recent results involving these two constructs are consistent with the current conceptual hypothesis linking historical disease prevalence to conformity, these results are indirect and nonspecific. Therefore, the specific prediction that historical disease prevalence is responsible, at least in part, for cross-cultural differences in behavioural conformity remains untested.

2.1 Overview of the Current Investigation

The goal of the current investigation was to determine if divergent cross-cultural measures of conformity and nonconformity are consistently predicted by regional levels of historical disease prevalence. A total of four measures were employed that were appropriate for these purposes.

Two independent cross-cultural measures were assessed that capture the value of conformity within a region. One measure of conformity comes from the domain of experimental social psychology: the Asch (1952, 1956) paradigm. Since its inception some 55 years ago, dozens of Asch-style studies have been performed around the world. The level of conformity will be quantified as the average effect size of these studies performed within a country, which should be higher in regions of higher disease due to the increased benefits of conformity.

A second measure of the importance of conformity within a culture comes from the World Values Survey (www.worldvaluessurvey.org). This survey is now administered in 97 countries around the world, where between 1000 and 1500 members of each nation are administered the 250-item survey. Four full waves have been completed between 1981 and 2002. The item germane to the cross-cultural conformity comparison is the value that is placed on child obedience in each nation. The conceptual hypothesis suggests that child obedience should be higher in environments that have historically contained more disease-causing pathogens.

Two divergent and independent measures of the tolerance towards nonconformity within a region were also assessed for the present cross-cultural analysis. One measure is the percentage of people in a culture that are left-handed. Although many researchers have attempted to fit genetic models to handedness (e.g. Annett, 1978; Levy & Nagylaki, 1972), more recent and sophisticated analyses suggest that handedness differences between individuals is due more to sociocultural forces rather than genetic variance. For example, there exists no more concordance for handedness in monozygotic twins than in dizygotic twins (McManus, 1985). Furthermore, East Asian immigrants to North America (which is a less "tight" culture) develop a much higher percentage of left-handedness than their counterparts who remain in the tighter cultures of East Asia (Hardyck, Petronovich, & Goldman, 1976). The current most tractable consensus of the mechanism that underlies handedness is that while cultural gene pools ubiquitously and equally favour the majority of the population to be right-handed, cultural forces (such as differing parenting practices, or the tightness of a culture) play an integral role in determining the actual handedness ratio within a given culture. Harry Triandis (1995) sums up effectively the relationship between tightness (conformity) within a culture and left-handedness:

> Tightness may be gauged by determining the percentage of people who are left-handed. This works well because in all cultures the right hand is considered the correct one, but in cultures that are tight there is pressure for those who are naturally left-handed to become right-handed (p. 56).

Due to lower tolerance for general deviance in high disease regions, it is hypothesized that the percentage of left-handedness will be lower in regions of higher disease.

A second nonconformity measure involves personality variation. Recent cross-cultural investigations (e.g. McCrae et al., 2005; Schmitt et al., 2007) have gathered Big Five personality trait data from dozens of countries around the world. Differences in mean trait ratings have been examined to test the relationship between disease and more risky personality characteristics (Schaller & Murray, 2008). An additional measure lying within these data is the variability that exists in reported personality traits among members of a culture (i.e. the standard deviations around mean trait levels within each country). This within-country personality variation offers an indicator of tolerance for non-conformity/tightness, as explained by Gelfand et al. (2007):

> Societal tightness-looseness affects variance across individuals in individual attributes (e.g., attitudes, beliefs). There will generally be less variance across individuals in tight versus loose societies (p. 19).

Therefore, since tolerance for deviant personalities should be lower in higher disease regions, it is predicted that an inverse relationship will exist between historical levels of disease within a country and contemporary levels of personality variation within that same country.

2.2 Method

2.2.1 Measure of Historical Disease Prevalence

The measure of historical disease prevalence was taken from Murray and Schaller (in press). This disease index provides a historical disease measure for 230 geopolitical regions (mostly countries) of the world, which comprise over 99% of the world's population. All of the disease scores utilized from this index are based on the historical prevalence of 9 disease-causing pathogens. The 9 diseases coded were: leishmania, schitsoma, trypanosoma, leprosy, malaria, typhus, filaria, dengue, and tuberculosis. Epidemiological atlases (National Geographic Society, 2005; Rodenwaldt and Bader 1952-1961; Simmons, Whayne, Anderson, and Horack,1944) were used to estimate the prevalence of each of these nine diseases in each region. For eight of these diseases (all but tuberculosis), prevalence of each disease was based primarily upon epidemiological maps provided in *World-Atlas of Epidemic Diseases* and in *Global Epidemiology*. A 4-point coding scheme was employed: 0 = *completely absent or never reported,* 1 = *rarely reported,* 2 = *sporadically or moderately reported,* 3 = *present at severe levels or epidemic levels at least once.* The prevalence of tuberculosis was based upon a map contained in the National Geographic Society's *Atlas of the World* (2005), which provided incidence information in each region for every 100,000 people. Prevalence of tuberculosis was coded according to a 3-point scheme: 1 = *3-49,* 2 = *50-99,* 3 = *100 or more.* To ensure that the different disease prevalence indices were computed on a common scale of measurement, all 9 disease prevalence ratings were standardized by converting them to *z*-scores. Each overall disease prevalence index was then computed as the mean of z-scores of the items included in the index.

Although this historical measure of disease prevalence provides a much more crude measure than the epidemiological estimates that are available for contemporary disease severity, we chose to use the historical measure for two important and related reasons. Firstly, from a theoretical standpoint, having the disease measure temporally precede our conformity measures makes a stronger case for causality (for a review of the conditions necessary to make causal claims with correlational data, see Campbell & Stanley, 1966). Secondly, using the above reasoning, past research has used this historical measure (Fincher, Thornhill, Murray, & Schaller, 2008; Murray & Schaller, in press) and demonstrated that it does indeed predict a wide array of cross-cultural differences better than does a much more sophisticated contemporary measure (the Global Infectious Diseases and Epidemiology Online Network; www.gideononline.com/). Although this index of historical disease prevalence comprises only a thin slice of diseases that afflict humans, previous analyses demonstrate that, due to its strong relationship with contemporary disease prevalence as well as absolute latitude (which has been used as a crude proxy for disease prevalence, see Epstein, 1999) it is an externally valid measure of historical disease levels (see Schaller & Murray, 2008, for review).

2.2.2 Conformity Measure #1: Asch-Style Effect Size

Bond and Smith (1996) provide a meta-analysis of 133 conformity studies that have been performed involving Asch-type (1952, 1956) line-judgment tasks. Although the majority of these studies have taken place in the United States (97 of 133), they have been performed in 16 other countries across 5 continents, producing reliably different results. Other countries included in this analysis are Great Britain, Japan, Belgium, Brazil, France, Fiji, Canada, Holland, Germany, Hong Kong, Portugal, Zimbabwe, Zaire, Ghana, Kuwait, and Lebanon. The effect sizes are calculated by subtracting the rates of wrong judgments in the control group from those in the experimental group, and using the standard deviation of the experimental group as the denominator). The effect sizes of these 133 studies have a range of 0-3.2. For countries with more than one Asch-style study included in the Bond and Smith (1996) analysis, the effect size was computed by calculating the unweighted average of all of the studies performed in that country.

2.2.3 Conformity Measure #2: Value of Child Obedience

This measure was obtained online from the World Values Survey, or WVS (www.worldvaluessurvey.org). Eighty-three countries comprise this analysis. Interviewees were presented with the following question: “Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five." Seventeen qualities were listed, such as hard-work, faith, and obedience. The conformity measure is the percentage of respondents within a country that indicate among their listed traits that obedience is an important trait for a child to learn. In many countries where more than one wave of the WVS has been completed and the question has remained unchanged over the four waves of the survey, a country's score was obtained by calculating the unweighted average of all of the waves completed in that country. The percentage of respondents who list "obedience" ranges from 6.5% (Japan) to 76.1% (Tanzania).

2.2.4 Nonconformity Measure #1: Left-Handedness

Operational definitions of what constitutes a left-handed person are largely variable across the laterality literature, and the measurement of left-handedness is largely unsystematic between different investigations. Therefore, the central operational definition that was employed for this investigation was that used by Perelle and Ehrman (1994), who conducted the largest systematic, cross-cultural handedness survey to date (13 countries; over 11000 individuals). The countries included in this survey were Australia, Belgium, Canada, England, France, Italy, Mexico, The Netherlands, New Zealand, Nigeria, Spain, Turkey, and USA. Along with having participants indicate on paper their handedness generally, these researchers also report which hand the participants write with. Although the general left-handedness reports are the item of interest for this study, the ancillary writing measure also proves useful for comparative purposes. To supplement the results reported by Perelle and Ehrman (1994), additional studies were located that used these same assessment tools as Perelle and Ehrman (and that reported both general left-handedness and writing-handedness). This criterion allowed handedness results from seven additional countries to be included in the analysis—Brazil (Brito, Brito, Paumgartten, &

Lins, 1989), Ireland (Greenwood, Greenwood, McCullagh, Beggs, & Murphy, 2007), Papua New Guinea (Connolly & Bishop, 1992), Ivory Coast and Sudan (Agostini, Khamis, Ahui, & Dellatolas, 1997), and Japan and India (Ida & Mandal, 2003)—creating a total sample size of twenty countries.

2.2.5 Nonconformity Measure #2: Personality Variation

The measure of personality comes from the Five-Factor Model of personality (from Costa & McCrae, 1992), in which agreeableness, conscientiousness, neuroticism, openness and extraversion are each further broken down into 6 facets. In an analysis of facet scores of the NEO-PI-R scores across cultures, McCrae (2002) reports means and the standard deviation about these means for each facet score *for each country* in *T*-score metric, across 33 countries. Each country's *T*-score and SD are expressed relative to the American sample's average, resulting in a mean American facet score of 50 and an SD of 10 for all 30 facets. McCrae (2002) notes that the variances are generalizable across all 30 facets; thus, a grand mean can be calculated for each country. Therefore, personality variability in each country is defined as the average standard deviation of reported personality across the 30 facets. For cases in which personality scores were reported for two cultural groups that share nearly-identical geographical regions (i.e. the Whites and Blacks of South Africa), the variation scores were pooled and averaged, arriving at a total sample size of 33 countries.

2.3 Results

2.3.1 Primary Analyses

The conceptual analysis suggests that nonconformity should be more costly in regions that suffer from higher levels of infectious disease; consequently, levels of conformity should be higher in regions characterized by higher disease prevalence. As hypothesized, historical disease prevalence strongly and significantly predicted both measures of conformity (all *p*'s are two-tailed unless otherwise noted). Asch-style effect-size ($N = 17$) was positively associated with disease prevalence, $r = .50$, $p = .04$. The percentage of people that consider child obedience important within a country ($N = 83$) was similarly positively predicted by disease, $r = .50$, $p < .0001$. Historical disease prevalence also significantly predicted both nonconformity tolerance measures. Historical prevalence was strongly and negatively associated with percentage of left-handedness in a country, $r = -.73$, $p = .0003$ ($N = 20$). Similarly, historical disease prevalence was strongly negatively associated with within-country personality variation, $r = -.52$, $p = .002$ ($N = 33$).

A convergent pattern of the several correlational analyses typically produces more inferential power than does interpretation of a single correlation (Abelson, 1995). However, the added power offered by several convergent correlations is drastically compromised if these dependent measures are highly intercorrelated. Therefore, it is important for the inferential power of the current analyses that the four conformity/nonconformity measure not be highly multicollinear. They are not: the average absolute value of the 6 intercorrelations between the dependent measures is low, $r = .30$, with a maximum absolute correlation of .62. This indicates that each dependent variable measures at least partly a unique facet of the conformity/nonconformity construct.

2.3.2 Contemporary Disease Prevalence: A Comparison

Previous investigations have found that historical disease prevalence is a better predictor of cross-cultural differences than is contemporary disease prevalence (e.g. Fincher et al., 2008). The causal hypothesis in this investigation predicts that this should be true for these data as well, given that a historical measure of disease prevalence temporally precedes the contemporary conformity/nonconformity measures. Thus, we obtained the same contemporary measure (GIDEON) that was used by Fincher and colleagues (2008). GIDEON (http://www.gideononline.com), an online database reporting current distributions of infectious diseases in each country, is updated weekly. The prevalence of 22 pathogenetic diseases was coded between the months of April and June, 2007, on a 3-point scale similar to that used by Murray and Schaller (in press). The magnitude of the relationships between the four conformity/nonconformity measures and the two measures of disease prevalence were then compared. The average absolute magnitude of the correlations between the (non)conformity measures and the index of historical disease prevalence was .56. The average absolute magnitude of the relationship between (non)conformity and the index of contemporary disease prevalence, on the other hand, was .51. The higher predictive power of the historical measure, then, provides support for the causal hypothesis.

2.3.3 Analyses Addressing Possible Confounds and Alternative Explanations

Demographic variables that are commonly cited as predictors of the development of cultural differences include economic development, inequality of wealth, population density, and life expectancy. Therefore, it is important to investigate whether disease exerts a unique influence on our conformity/nonconformity measures once these variables are controlled for. All specific betas and *p* values for disease prevalence and all confounds are presented in Table 2.1. For the sake of brevity in the below reporting, "unique predictor" refers to a beta that has a two-tailed *p* of .05 or less, and "marginal" refers to a *p* of .10-.05.

GDP per capita: Hofstede (2001) has suggested that economic development may be a large predictor of collectivism and its behavioural correlates, such as conformity. Therefore, gross-domestic product per capita information was obtained from www.worldbank.org for each country for the year 2004. With the exception of personality variance, this GDP measure correlated strongly and significantly with the conformity measures. Across the four regression equations, GDP per capita was then entered as an independent variable into a regression equation with the index of historical disease prevalence with each conformity/nonconformity measures a dependent variable. As summarized in Table 2.1, disease prevalence remained a significant predictor of 3 of the 4 conformity measures. Conversely, GDP per capita did not yield any significant betas (however, the GDP beta for conformity effect size was marginally significant, $p = .09$, and would likely reach significance with a larger sample size). Median absolute β's were 0.53 for disease prevalence and 0.24 for GDP per capita, with median *p*'s of .02 and .40 respectively.

Table 2.1: Unique Effects of Historical Disease Prevalence, and Unique Effects of Possible Confounds

Dependent Measure:	**Asch Conformity**		**Value of Obedience**		**Left-Handedness**		**Personality Variation**	
	r	***p***	***r***	***p***	***r***	***p***	***r***	***P***
Zero-order relationship with disease*	.50 (17)	.04	.49 (83)	<.0001	-.73 (20)	.0003	-.52 (33)	.002
Standardized beta weights for historical disease prevalence and their associated *p* values when controlling for specific confounds.								
Effects of disease when controlling for_____	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***P***
GDP per capita	-.01 (16)	.99	.42 (70)	.001	-.64 (16)	.03	-.69 (31)	.002
Pop'n density	.62 (14)	.02	.54 (70)	<.0001	-.79 (16)	.0005	-.51 (32)	.005
GINI	.34 (12)	.22	.30 (62)	.02	-.61 (16)	.01	-.38 (30)	.07
Other threats	.45 (15)	.04	.59 (72)	<.0001	-.71 (16)	.002	-.55 (30)	.002
Standardized beta weights for specific confounds and their associated *p* values when controlling for historical disease prevalence.								
Effect of _____ when controlling for disease	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***P***
GDP per capita	-.63 (16)	.09	-.18 (70)	.17	.13 (16)	.64	-.29 (31)	.16
Pop'n density	-.16 (14)	.49	-.13 (70)	.23	.24 (16)	.19	-.05 (32)	.77
GINI	.47 (12)	.10	.34 (62)	.01	-.24 (16)	.27	-.21 (30)	.33
Other threats	-.47 (15)	.04	-.41 (72)	<.001	-.15 (16)	.41	.22 (30)	.19

* Number of countries included in analysis in parenthesis

Economic Inequality: Inequality of wealth distribution has profound influence within a culture (Hofstede, 2001), and has therefore been implicated in many cultural outcomes. The GINI index measures exactly this confound of interest: income inequality in within a country. These scores were obtained online from the World Factbook of the CIA (www.cia.gov/library/publications/the-world-factbook). Not surprisingly, GINI correlated strongly and positively with the conformity measures and negatively with our nonconformity measures. When GINI was entered into a regression equation with historical disease prevalence, however, it remained a unique predictor of one conformity measure (value placed on child obedience). By comparison, historical disease prevalence remained a unique predictor of the value of obedience and left-handedness and a marginal predictor of personality variation (p = .07). Median absolute β's were 0.36 for disease prevalence and 0.29 for GINI, with median p's of .05 and .19 respectively.

Population Density: Population density has been cited by some as a predictor of cultural tightness and other cultural differences (e.g. Gelfand et al., 2007); thus, it was necessary to be included as another possible confound. However, population density did not correlate significantly with any of our dependent measures and, not surprisingly, was not a significant predictor in any of the four regression equations. Historical disease prevalence, on the other hand, remained a significant unique predictor in all cases. Median absolute β's were 0.58 for disease prevalence and 0.15 for population density, with median p's of .003 and .36 respectively.

Other Factors Affecting Health and Mortality: Just as it can be hypothesized that conformity serves as a buffer against the threat of infectious diseases, it can also be hypothesized that conformity serves to buffer against threats that have nothing to do with disease at all. In order to provide a measure of threats leading to these other causes of mortality, we obtained life expectancy scores from the World Health Organization (www.who.int) which we regressed on the pathogen prevalence index, and saved the residual of this regression. These region-specific residuals represent variation in life expectancy within a region (such as poor diet, prevalence of violence, etc.) that is independent of disease. When this residual variable was entered into a regression equation with historical disease prevalence, mortality residual was a unique predictor of two of these measures: conformity effect size and the value of child obedience. By comparison, disease prevalence was a unique predictor of all four dependent measures. Median absolute β's were 0.57 for disease prevalence and 0.41 for other mortality, with median p's of .002 and .12 respectively.

2.3.4 Collectivism as a Possible Mediator

Collectivism is, in part, is characterized by a high value placed on ingroup conformity (Oishii et al., 1998; Triandis, 1995). Therefore, a high concordance would be expected between measures of individualism/collectivism and our measures of conformity. Recent research has also shown a strong empirical link between collectivism and disease (Fincher et al., 2008). Therefore, it is possible that collectivism mediates the relationship between disease prevalence and conformity, and eliminates the unique predictive effects of disease on the four conformity measures. To investigate this possibility, we used the four measures of individualism/collectivism used by Fincher et al. (2008), which were all shown in their analysis to be highly predicted by historical disease prevalence. Each of these individualism/collectivism measures was entered into a regression along with historical disease prevalence with each of the four measures of conformity/nonconformity being the dependent measure (16 regressions in

	Asch Conformity		**Value of Obedience**		**Left-Handedness**		**Personality Variation**	
	r	***p***	***r***	***p***	***r***	***P***	***r***	***P***
Zero-order relationship with disease*	.50 (17)	.04	.49 (83)	<.0001	-.73 (20)	.0003	-.52 (33)	.002
Standardized beta weights for historical disease prevalence and their associated *p* values when controlling for specific confounds.								
Effects of disease when controlling for_____	***β***	***p***	***β***	***p***	***β***	***P***	***β***	***P***
Collectivism (GLOBE)	.36 (11)	.41	.26 (44)	.16	-.65 (15)	.06	-.77 (24)	.02
Collectivism (Kashima)	.62 (13)	.08	.60 (53)	.001	-.56 (16)	.03	-.59 (29)	.07
Individualism (Suh)	-.13 (12)	.87	.50 (51)	.006	-.68 (15)	.03	-.60 (28)	.05
Individualism (Hofstede)	.25 (13)	.64	.50 (62)	.002	-.48 (16)	.15	-.31 (31)	.20
Standardized beta weights for specific measures of collectivism and their associated *p* values when controlling for historical disease prevalence.								
Effect of _____ when controlling for disease	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***P***
Collectivism (GLOBE)	.21 (11)	.64	.33 (44)	.07	-.09 (15)	.78	.34 (24)	.27
Collectivism (Kashima)	-.05 (13)	.87	-.16 (53)	.35	-.26 (16)	.29	.11 (29)	.73
Individualism (Suh)	-.76 (12)	.34	.03 (51)	.85	.19 (15)	.52	-.15 (28)	.63
Individualism (Hofstede)	-.37 (13)	.50	.01 (62)	.96	.32 (16)	.33	.24 (31)	.32

total). All of the associated betas and their corresponding *p* values are in Table 2.2.

Table 2.2: Unique Effects of Disease Prevalence and Unique Effects of Collectivism

* Number of countries included in analysis in parenthesis

As can be seen from Table 2.2, historical disease prevalence emerged as a stronger predictor of the four conformity measures in 13 of the 16 regression equations. Due to the high correlations between collectivism and disease prevalence, however, multicollinearity was an issue in some of the cases, making both (strong) predictors drop from significance. Within the 13 cases of disease emerging as a stronger predictor, 6 of these were significant at the .05 level, 4 were marginal ($.05 < p < .08$), and 3 were nonsignificant. In contrast, however, the most highly significant beta for the collectivism measures was for GLOBE collectivism predicting the value of child obedience, with a *p* of .07. Across the 16 regressions, median absolute β's were 0.53 for disease prevalence and 0.20 for collectivism/individualism, with median *p*'s of .07 and .51 respectively. Therefore, collectivism/individualism was not found to fully nor partially mediate the relationship between disease and conformity.

2.4 Discussion

This cross-cultural investigation provides support for the hypothesis that levels of conformity within a culture are predicted, at least in part, by the prevalence of disease-causing pathogens within the local ecology. This was true across 4 independent measures of conformity. This relationship, for the most part, remained significant when controlling for other variables that have been linked to cross-cultural differences in conformity. Conversely, controlling for disease usually eliminated the (often strong) correlational relationship between these various demographic variables and measures of conformity.

What is most remarkable about these cross-cultural results is that historical pathogen prevalence emerges as a stronger predictor of the four conformity measures than do four separate measures of collectivism. Given that conformity itself is encapsulated within the characteristics of what makes up the higher-order construct of collectivism, and that previous research has shown that disease prevalence strongly predicts collectivism (Fincher et al., 2008), it would not have been surprising to find that collectivism within a region fully mediates the relationship between disease and conformity. However, across the 16 possible combinations of collectivism and conformity measures, this historical pathogen prevalence measure emerged as a stronger predictor of the conformity measures in 13 of these trials. These results strongly indicate that, although disease prevalence may exert an influence on conformity indirectly through its influence on higher-order value systems such as collectivism, it also exacts its influence on conformity through a yet-undefined suite of cultural values that are independent of collectivism that dictate an individuals' maverick-like behaviour.

A limitation of such cross-cultural investigations is that they are necessarily correlational (see Cohen, 2007, for an extensive discussion on this issue). Although these results offer support for our hypothesis, it is important to bear in mind that this evidence is not directional. Thus, although potential confounding variables have been controlled for, a strong causal conclusion would be premature.

Although the causal hypothesis cannot be rigorously confirmed via this cross-cultural investigation, the theoretical underpinnings of this hypothesis are relatively well-established. Pathogens represent one of the strongest selective forces in human evolution (McNeill, 1976; Ridley, 1993). Pathogens exert this force through two related avenues. The first and most direct selective route, of course, is through mortality and morbidity; parasites have historically represented the most common cause of death for our ancient and even not-so-ancient ancestors, with diseases such as tuberculosis and influenza being leading causes of death as recently as two hundred years ago (Zinsser, 1934). The second selective route, borne of the first, is by way of sexual selection, in which mates are preferentially selected for that display markers that connote strong antipathogen resistance (Hamilton & Zuk, 1982; Zuk, 1992). Most biologists recognize the role that the omnipresent threat of disease plays in animal behaviour; however, the role that disease plays in human behaviour is only now being appropriately elucidated in psychology.

Should this causal hypothesis be correct, another important issue that the current investigation does not address is the *mechanism* through which disease exacts its influence on conformity. The observed differences across cultures could emerge through a variety of profoundly different mechanisms. For example, the differences between cultures could be purely genetic. Traits such as Openness to experience, one of the higher-order abstractions that subsumes conformity, is at least partially heritable (Jang, Livesely, & Vemon, 1996), as are the behavioural tendencies towards individualism/collectivism (Bouchard & McGue, 2003). It is also known that pathogen prevalence can pose a selective force on gene frequencies within different human populations (Williamson, Hubisz, Clark, Payseur, Bustamante, & Nielson, 2007). Given the selective advantage that they have had in some environments, alleles associated with conformist tendencies could have been differentially selected for in areas of differing pathogen stress over the course of human evolution, resulting in more conformist genes in regions of high parasite stress.

The cultural differences could also be phenotypic or developmental in nature. This mechanism still operates at the genetic level, differently, in that genes are expressed differentially depending upon environmental inputs early in life. Considerable evidence suggests that many phenotypic differences are due not to genetic differences, but rather to differences in the expression of shared, common genes (Ridley, 2003). Thus, regional differences may be due to a type of evoked culture (Gangestad et al., 2006, Schaller, 2006), in which the observed cross-cultural differences in conformity represent the developmental plasticity of the human genome.

Conversely, the differences may not be due to genes whatsoever, and may simply be due to cultural transmission. Within human groups, culturally specific behavioural tendencies can emerge over time as a result of the information that gets shared and taught due to specific environmental pressures (Richerson & Boyd, 2005). Given that cultural practices and norms pertaining to disease avoidance are more adaptive in environments of high parasite stress, these norms, (such as those involving conformist behaviours) are more likely to be vertically and horizontally transmitted and to persist in regions where disease threat is higher.

Finally, this mechanism could operate at a proximal, cognitive level, wherein an evolved and chronic sensitivity to informational inputs from one's immediate environment (such as the immediate threat of disease) leads to the most appropriate, context-specific response. This proximal mechanism is analogous to the physiological immune system, which detects and responds to parasites by mounting a temporary and specific response (Janeway, Travers, Walport, & Shlomchik, 2001). Humans are very proficient at detecting disease threat within their immediate environment (Schaller & Duncan, 2007), and evidence exists that this detection leads to temporary antipathogen behaviours, such as xenophobia (Faulkner, Schaller, Park, & Duncan, 2004). This proximal behavioural immune system may also then respond to the perceived threat of disease by temporarily inducing less risky, and more conformist, behaviours.

It is not necessary that these mechanisms be mutually exclusive; in fact, gene-culture coevolutionary models (e.g. Feldman & Laland, 1996) would predict extensive feedback loops between mechanisms at different levels of analysis. For example, disease threat within a region influences which proximal behaviours are adaptive, determining which cultural norms develop, and in turn, influencing which phenotypes and genotypes are selected for in a population through sexual selection. These selected genotypes in turn reinforce the cultural norms that suit the environment for which they were optimally selected.

Although these mechanisms may not be mutually exclusive, further research can help to elucidate the strength and the degree to which each of these mechanisms influences behavioural conformity. The proximal mechanism, which would operate by responding to immediate environmental inputs, can be examined experimentally at the individual level of analysis. Such research should help to determine what role, if any, this proximal mechanism plays in the relationship between disease and conformity.

3 DISEASE SALIENCE AND INDIVIDUAL BEHAVIOURAL CONFORMITY

Disease has played an integral role in physiological and behavioural human evolution (Ridley, 1993); moreover, as the previous chapter illustrates, regional prevalence of disease appears to play a role in the existence of cross-cultural differences in conformity. What would be of great benefit to this specific line of research (and of benefit to the field of disease and behavioural research more generally) is the elucidation of the mechanism by which disease exacts its influence on conformity. Within the broader field of disease and behavioural research, some evidence exists for a proximal mechanism, which responds to inputs from the immediate environment (e.g. Faulkner et al., 2004; Navarette, Fessler, & Eng, 2007). However, no research has yet shown that temporary disease salience leads to higher temporary levels of conformity. Therefore, the possibility that a proximal behavioural immune system influences levels of individual behavioural conformity deserves closer examination.

3.1 The Behavioural Immune System

Although the physiological immune system has generally served humans well, the costs associated with its activation make it beneficial to behave in ways that minimize the chances of its activation in the first place. Big-brained animals such as humans, then, should have a type of *behavioural* immune system that serves as a first line of defense against pathogen transmission. This system responds to disease-connoting stimuli within the immediate environment by evoking a suite of emotions and cognitions that in turn induce functional behavioural responses (Kiesecker, Skelly, Beard, & Preisser, 1999; Schaller, 2006; Schaller & Duncan, 2007). One basic implication of such a system is aversion to others showing blatant disease-connoting cues, such as coughing or sneezing. This is indeed the case, and these aversive responses often result in the stigmatization of physically ill individuals (Crandall & Morairty, 1995).

A couple of lines of research lend support to the idea of a proximal behavioural immune system. In one laboratory study, Faulkner et al. (2004) found that research participants display more xenophobic attitudes when the threat of disease is made immediately salient. Given that our adaptive immune system calibrates itself specifically to combat pathogens within ones local ecology (Janeway et al., 2001), xenophobia is thought to have utility as an antipathogen defense mechanism (for review see Navarette & Fessler, 2006). Individuals are also more xenophobic when the real threat of disease transmission is especially high: Navarette, Fessler, & Eng (2007) have found that pregnant women show the highest levels of xenophobia during their first trimester of pregnancy, when their immune systems are the most suppressed.

The higher xenophobic responses observed when the perceived or real threat of disease transmission is especially high are logical within a cost/benefit framework. Risky social interactions, such as interacting with a foreigner who may possess novel pathogens, will be especially costly when the threat of disease transmission is high. However, in situations where threat of disease transmission is low, the benefits of risky interactions (such as making new alliances and gaining access to new resources) are more likely to outweigh costs associated with the low probability of exposure to novel pathogens.

Given that temporary disease salience increases aversive responses to risky social interactions, it is logical to suppose that disease salience may lead to the aversion of other risky behaviours as well, such as nonconformity. Nonconformity to group norms is likely to be especially costly in threatening environments, since many group norms serve fitness-enhancing functions specific to one’s local ecology. The benefits of nonconformity (such as innovation and discovery) may outweigh its costs, however, in less risky environments. Concordant with this reasoning is research showing that temporary changes in conformity can be induced in response to different types of threats.

3.2 Conformity: Experimental Manipulations

Previous research shows that individual's behavioural conformity is influenced by threat-connoting contexts. Griskevicius, Goldstein, Mortensen, Cialdini, and Kenrick (2006), for example, found that male participants conform more to a negative group evaluation of a piece of art when a self-protection motive is induced. Renkema, Stapel, and Van Yperen (2008) similarly showed that participants conform more to positive evaluations of abstract art when a feeling of existential threat is induced. Attitudes towards nonconformists appear to be proximally malleable as well. Mortality salience has been shown to increase dislike for those that transgress cultural norms (Pyszczynski, Greenberg, & Solomon, 1999); further, threat to an individual's meaning framework has been shown to increase punishment of hypothetical deviants (Proulx & Heine, 2008; Proulx & Heine, in press).

The above studies indicate that conformity can be manipulated via cues connoting various types of threat. However, no line of research to date has focused specifically on the threat of disease and its possible effect on conformity. Therefore, two studies were designed to examine the possible link between temporary disease salience and conformity. The hypothesis tested across both studies was that temporary salience of disease will increase conformity to normative ingroup information.

To investigate this hypothesis, the following two studies employed methods and measures used in previous research. Manipulation of disease threat was induced by photographs, a method successfully used by Park, Schaller, and Crandall (2007). However, multiple measures of conformity were used between the studies in to maximize the chances of detecting the possible proximal disease/conformity relationship.

3.3 Experiment #1: Perceptual Judgment Tasks

3.3.1 Method

The participants were 90 undergraduate students (52 females) from the University of British Columbia, who participated voluntarily for extra credit in a psychology course. Of this sample, 74.5% reported being of East Asian origin, 23.3% reported being of European origin, and 2.2% did not report their ethnic origin.

Participants participated in groups of 2-6. Each group was randomly assigned one of three experimental conditions before they arrived at the lab. Participants looked at a set of colour photographs, the nature of which was dependent upon the experimental condition. In the Diseases Salient condition, participants looked at 8 pictures of humans with obvious ailments and diseases, such as measles. In the neutral control condition, participants looked at 8 pictures of furniture (the Furniture Salient condition). In the second control condition—designed to make disease-irrelevant threats salient—participants looked at 8 pictures of people pointing guns at the camera (the Guns Salient condition). Participants looked at each picture for approximately 5 seconds before being given the next picture by the experimenter, and were told to attend closely to each picture. Participants were told that the purpose of the experiment was to investigate how various types of pictures affect judgments, but they were not told explicitly what type of effect the pictures were expected to have.

After looking at pictures in one of the three conditions, participants were told that they would now make a series of perceptual judgments. This series of judgements entailed participants to visit 5 separate stations privately. Each station consisted of a perceptual judgment task that asked participants to estimate some physical quantity. Each subject started alone at a given station; the order in which the judgments were made and the specific starting station were random. These tasks included estimating the following: volume of a cylindrical carafe (actual volume = 1734 millilitres), number of grains of rice in a container (actual quantity = 6200 grains), number of pages in a book (actual pages = 761), weight of a mug (actual weight = 323 grams), and number of dots on a page (actual number of dots = 228). In each station there was also a normative estimate of the quantity, and participants were told before they began that these averages were gathered in a pilot survey from 10 fellow UBC students. The normative information given, respectively, was 1450 millilitres, 8585 grains, 728.2 pages, 361.3 grams, and 270.3 dots. Participants had 20 seconds at each station to make their judgment. The dependent measure was the average variance from the given normative information across the five judgments.

The amount of variance from the normative judgment was calculated by first calculating the raw difference score (the absolute value of the difference between the participants response and the normative info). Due to the natural proclivity for large positive skew in the variation scores (since the possible range extends to infinity), these scores were then natural log transformed. Because larger raw variance was present with larger quantities being estimated (i.e. grains of rice), a *z*-score was obtained for the natural log of each judgment to give equal weight to each variance score. The absolute value of these 5 *z*-scores was then averaged to determine each participant's deviation score.

Once participants made their 5 judgments they filled out demographic information, a Big Five personality inventory (from John, Donahue, & Kentle, 1991), a Perceived Vulnerability to Disease questionnaire (from Duncan, Park, & Schaller, 2008), and a disgust questionnaire (from Haidt, McCauley, & Rozin, 1994). Participants were then debriefed and were free to leave.

3.3.2 Results and Discussion

Given the hypothesis that disease salience enhances behavioural conformity, the average variance of participants' estimates from the normative estimate should be lower in the Diseases Salient condition compared to the control conditions. Results testing this hypothesis are presented in Table 3.1.

Table 3.1: Average Logged Variance between Experimental Conditions

Condition	**Average z-score: Logged Variance**	**Standard Deviation**
Diseases Salient	0.77	0.38
Guns Salient (Threat control)	0.75	0.28
Furniture Salient (Neutral control)	0.72	0.29
Total	0.75	0.32

As these results reveal, there was no support for the hypothesis. Differences between the experimental condition were small and nonsignificant, $F(2, 87) = .87$, $p = .42$.

Main effects of gender, country of birth, and ethnic background on conformity were nonsignificant, p's > .23. The absence of a main effect for ethnic background was unexpected, given the previous research documenting East Asian's higher adherence to ingroup norms compared to North Americans (e.g. Kim & Markus, 1999). Also contrary to expectations was the lack of association between the level of conformity to the normative information and reported openness to experience, $r = -.02$, $p = .85$ ($N = 90$).

An alternative hypothesis could be that an individual's chronic worry about disease influences levels of conformity. Park et al. (2007), for example, found that chronic concerns about pathogens (as measured by the PVD germ-aversive subscale) was related to higher stigmatization of obese people. However, conformity to the normative judgments was not associated with either of the PVD subscales, r's < .10, p's > .50.

The lack of main effects not only between experimental conditions but also between groups that have previously been shown to differ in levels of conformity (such as Asian participants compared to North American participants, see Bond & Smith, 1996) strongly suggests that either the experimental manipulation was ineffective or the dependent variable did not adequately measure the construct of interest. Therefore, it is important to address in turn each of these possible methodological shortfalls.

First, regarding the disease salience manipulation: simply viewing a series of still photos may not evoke much feeling of disease threat in participants. Or, if it does, it does not last long enough for it to have any measureable impact on their perceptual judgments. Although Park et al. (2007) successfully used a slide show of still images to evoke disease threat, the authors note that the effects of the manipulation were so short lived that only their first measurement after the manipulation was affected. This observation brings to light a significant oversight in the data collection process of the current experiment: because participants each filled out the same form for their judgments yet began at different stations, order effects cannot be analysed.

A couple of potential issues also exist with the dependent measure. The first issue is that all responses were open-ended and therefore, despite the fact that a normative average was present for each of the judgments, a problem with outliers arose in the analysis. Some perceptual judgments bordered on nonsensical. For example, in estimating the number of grains of rice in a jar, the normative average being 8553 (and the actual number about 6200), the estimates ranged from five-hundred to one million. However, a natural log transformation of these scores rendered results that paralleled results with raw scores.

A second issue with the dependent measure is that these types of judgments may simply be too objective to be influenced by a laboratory manipulation. The estimation of some physical quantity, such as number of grains of rice in a jar, may not be as susceptible to experimental manipulation as more subjective measures might be. Faulkner et al. (2004), for example, found that it was personal *attitudes* towards foreigners and foreign policy that was affected when disease was made salient.

This first behavioural conformity study did not find evidence for a proximal mechanism that links disease to conformity. However, circumspection is required when making any interpretation of these null results due to the many flaws in the study's design. Therefore, the second of the two experiments was designed to address some of the methodological shortfalls present in this first study.

3.4 Experiment #2: Art Evaluation

The aim of the second laboratory study was to address some of the design issues that existed in the first study. The hypothesis tested was the same: participants for whom disease is made immediately salient should show higher levels of conformity than those participants for whom threat of disease is not salient. For this second study, the experimental manipulation was made stronger, and two previously-successful dependent measures of conformity were used. One measure was taken from Renkema et al. (2008): these authors found that ratings of abstract art were closer to a given normative rating for participants in a state of existential threat. The second measure was borrowed from Kim and Markus (1999), who found that East Asians were more likely than Westerners to choose a pen of the majority colour, presumably due to a higher desire to fit in.

3.4.1 Method

Participants were 97 undergraduate students (76 females) from the University of British Columbia, who participated for partial course credit. These participants were an average age of 20.06 years; 67% of this sample was of East Asian ethnic background, 19.6% of European background and the remaining 13.4% of either South Asian or Middle Eastern Background. 50.5% of the sample reported being born in North America or Europe and 40.2% reported being born in East Asia.

Participants were randomly assigned to one of three experimental conditions (Diseases Salient, Guns Salient or Furniture Salient) in groups of two to six. The manipulation was accomplished through visual exposure to the same photographs as in Experiment #1. For Experiment #2, however, the participants were also told to try to keep the images fresh in memory as they would be asked questions about the photographs later. Once participants were done looking at each photograph (each was handed to them one by one), they went into their own private cubicles to complete the remainder of the study.

Once in their private cubicles, participants were given a booklet containing 24 pictures of abstract art (3 per page) that were to be rated by the participant. Participants were asked to rate their subjective liking of each of the pieces of art on a scale of 1-10. Below each picture was the normative information of the average UBC students' rating of the picture, on the same 1-10 scale. Participants were informed that this "average UBC student's rating" represented the average ratings given by fellow university students during a pilot study. These average ratings ranged from 1.9 to 9.1. To allow investigation of possible order effects, participants were told it was essential that they complete their ratings in the order that they were presented in the booklet. The central measure of interest was the average number of points by which participants varied from the normative information given across the 24 ratings.

Renkema et al. (2008) found that participants conform the most to positive normative ratings when existential threat is induced. Therefore, to check for effects of valence of normative ratings on participants' conformity, 8 of these pictures were normatively unpopular (with a normative rating below 4), 8 pictures were neutral (with a normative rating between 4 and 6), and 8 pictures were liked (with a normative rating above 6). This allowed the variance scores to be further split into variance from negative, mid-range, and positive normative information.

To buttress the effects of the experimental manipulation, during making the art ratings participants were twice given a "booster shot" of the manipulation, in that they were asked to write a few descriptive lines about the 3 manipulation photographs they remembered most vividly. This technique was successfully used previously by Griskevicious et al. (2006) to elongate the effects of an induced self-protection motive.

At some point between 2 and 5 minutes of participants being in their own private cubicles, the experimenter entered (the exact time varied due to the experimenter having to visit multiple cubicles) and followed a procedure nearly identical to that of Kim & Markus (1999): she told the participant that, along with their credit, they were receiving a free pen for participating in the study. The experimenter then reached into a bag that contained orange- and green-barrelled pens and randomly pulled out five pens, and held them out for the participant to choose. If 5 of the same coloured pens were drawn from the bag, the experimenter dropped the pens back into the bag and drew 5 once more. Thus, there always existed either a 3-2 or a 4-1 majority of one colour. The participant's choice of colour and either the majority or minority coloured pen was recorded. The measure of interest was the proportion of participants choosing the majority-coloured pen in each experimental condition, in both the 3-2 and the 4-1 majority types. After making the art judgments the participants filled out the same set of questionnaires as in the first laboratory study

3.4.2 Results and Discussion

The results provide two tests of the conceptual hypothesis: Compared to controls, participants in the Diseases Salient condition were expected (1) to give art ratings that were, on average, closer to the normative ratings and (2) to choose the majority pen colour with higher frequency. Results testing these hypothesized effects are presented in Table 3.2 and Table 3.3 respectively.

Table 3.2: Raw Average variance from Normative Ratings between Conditions and across Valences (Standard Deviations in Parenthesis)

Condition	Variance from Negative	Variance from Neutral	Variance from Positive	Total Average Variance
Diseases Salient	2.23 (1.11)	1.87 (0.62)	2.18 (0.84)	2.09 (0.52)
Guns Salient	2.19 (0.85)	1.80 (0.48)	2.24 (0.81)	2.08 (0.44)
Furniture Salient	2.07 (0.85)	1.90 (0.63)	2.26 (0.83)	2.08 (0.51)
Total	2.16 (0.93)	1.86 (0.57)	2.23 (0.82)	2.08 (0.48)

Table 3.3: Percentage of Participants Choosing Majority-Coloured Pen between Conditions and across Majority Types

Condition	% of Time Majority Coloured Pen Chosen (3-2 Majority)	% of Time Majority Coloured Pen Chosen (4-1 Majority)	% of Time Majority Coloured Pen Chosen (Total)
Diseases Salient	64.3	75.0	66.7
Guns Salient	47.1	100.0	57.1
Furniture Salient	50.0	80.0	58.8
Total	53.5	84.6	60.7

The results provide no support for the hypothesis. For the art ratings, the average variances from the normative information (measured in raw points of the scale) were not different across conditions for any of the valences, *F's* < .30, *p*'s > .75. Likewise, the proportion of participants choosing the majority-coloured pen did not differ significantly between conditions in either majority type, *F*'s < .50, *p*'s > .50.

Past research has found that chronic concerns about disease are positively linked to constructs such as xenophobia and stigmatization of obese people (Faulkner et al., 2004; Park et al., 2007). An alternative hypothesis for the current study, then, could be that chronic concerns about disease are related to levels of conformity. Some support was found for this alternative hypothesis: a marginally significant correlation existed between the Germ Aversion subscale of the PVD and the average amount of variance across all 24 art ratings, $r = -.19$, $p = .07$ ($N = 95$). This association suggests that participants more chronically worried about germs tended to vary less from the normative information given. This small piece of evidence is compatible with the cross-cultural results discussed earlier; however, caution should be exercised to not over-interpret this simple correlation, as no third variables can be ruled out.

No main effects of place of birth or ethnic background (East Asia vs. North America) were present for majority pen choice or for amount of variance from normative art ratings any valence category (disliked, neutral, or liked), t's < 0.65, p's > .50. Furthermore, for participants born outside of Canada, number of years living in Canada was not significantly correlated with any conformity measure, r's < .20, p's > .30. These results are inconsistent with past research documenting higher conformity in non-Western cultures (e.g. Bond & Smith, 1996; Kim & Markus, 1999).

The lack of any differences between conditions fails to parallel Renkema et al.'s findings of higher conformity levels in the positive valence category for participants under existential threat. This null result, then, suggests that the Diseases and Guns Salient manipulations did not have their desired effect, and that these null results may be attributable to a weak or short-lived manipulation.

On the other hand, the lack of main effects of cultural background or birthplace, which run contrary to previous cross-cultural research (e.g. Kim & Markus, 1999), suggests that a design issue exists not with the independent variable but with the dependent measures. Although care was taken to follow the same successful dependent measure template that two previous studies used, the contextual conditions were not exact. The Kim and Markus (1999) study, for example, used participants in an airport, and had them choose their pen at the end of their study, when participants may have made a less noisy choice.

One other methodological consideration deserves note: in many of the previously discussed studies with successful threat manipulations (e.g. Faulkner et al., 2004; Renkema et al., 2008), participants received their prime during the "main" study, and filled out their dependent measures as part of an ostensibly unrelated study. This type of deception may be necessary in order for noise arising from suspicion or demand characteristics to be appropriately reduced.

3.5 Summary of Experimental Results

Across two separate studies, using multiple methods, no evidence was found that temporary disease salience influences behavioural conformity. Although Experiment #2 addressed some of the major design flaws of Experiment #1, the lack of replication of previous findings regarding both threat salience and main effects of cultural background suggests that methodological flaws may exist in both experiments.

A couple of possible methodological flaws are shared between these two experiments. One significant issue is the ingroup cited when giving the “normative” information against which the participants’ conformity was measured. It is possible that, in these university students, a group of unknown fellow university students’ ratings may be far too diffuse an ingroup to have any normative social influence. In fact, the university from which these samples were drawn is so large (about 40,000 students) and so ethnically diverse that a fellow “university student” may not invoke the concept of an ingroup member whatsoever. A second shared issue involves how participants recorded their answers. Even if a sufficient ingroup concept were evoked, it is possible that allowing participants to record their answers privately did not evoke the same need to conform to an ingroup than would have giving a public response, such as was done in the classic experiments of Asch (e.g. 1952), Sherif (1936) and others. Indeed, classic research suggests that individuals tend to conform more to real rather than simulated groups (Deutsch & Gerard, 1955; Levy, 1960). Overall, caution should be exercised when interpreting the multiple null results of the current experiments.

4 GENERAL DISCUSSION

A cross-cultural analysis indicates that behaviours and attitudes towards conformity may have been influenced, at least in part, by the prevalence of disease within the local ecology. Although levels of conformity within a region have been largely dismissed as an ancillary cultural syndrome of a much larger set of cultural values (such as collectivism; see Triandis, 1995, for review), these data show that disease prevalence is a unique predictor of conformity, across four divergent cross-cultural measures of conformity.

The results of the two laboratory studies found no support for a proximal mechanism of disease's effects on conformity; making disease temporarily salient did not influence individual behavioural conformity. It is important, then, that careful thought be put into why this pattern of results exists. Since the cross-cultural analysis is correlational in nature, it is possible that the conceptual hypothesis is incorrect. However, the combination of the strong theoretical underpinnings, the previously established research relating disease to more cautious personality types (e.g. Schaller & Murray, 2008; Fincher & Thornhill, 2008), and the care that was taken to control for confounding variables makes it increasingly unlikely that the cross-cultural relationships between disease and conformity are spurious. Therefore, if one grants validity to the cultural analysis, two possible central reasons exist for the pattern of results in the laboratory studies. One of these reasons involves the design of the experiments themselves; the second possible reason involves the mechanism by which disease exerts its influence on conformity.

Beyond the design issues discussed earlier that are inherent in the studies, two chronic issues with the sample population may be responsible for these null experimental results. This university sample (despite the fact that much of it was comprised of acculturated East Asians) was predominantly made up of what Henrich, Heine, and Norenzayan (2008) refer to as WEIRD participants (Western, Educated, Industrialized, Rich, and Democratic); for the purposes of this investigation I would add the letter "S" to this acronym, to stand for *sterilized*. Most contemporary young adults having the resources to attend a Western university have grown up in relatively clean, disinfected environments. Just as the physiological immune system can only identify and respond to threats from which it has had previous exposure, so too may the behavioural immune system only be properly developed in individuals that have previous exposure to threat of serious disease.

A second issue with these university participants is their chronic chimerical exposure to threats throughout their lifespan. Most participants in this study have likely been extensively exposed to grotesque disease-like images via various media, such as television and the internet. This previous exposure may have caused desensitisation, leading to university participants in studies such as these to consider disease morbidity to be something that happens in economically depraved parts of the world and that presents no real threat to themselves.

A very different, and more conceptually interesting, possibility for the null results at the experimental level is that the prevalence of disease does not exact its influence on conformity at the proximal level. A proximal individual-level mechanism, whereby individuals respond behaviourally disease-connoting cues within the immediate environment, is only one of four very plausible mechanisms that could exist within this relationship. The other three possible mechanisms each deserve consideration in turn.

One of these alternative mechanisms is purely genetic. This mechanism would entail that different types of genes have been selected for in different environments—genes conducive to conformist behaviours would have been more adaptive in regions of high disease whereas maverick-like genes would have been selected for in regions of lower disease. Research in behavioural genetics partly supports this mechanism. The Big 5 personality traits have estimated heritability components ranging between .60 and .40 depending upon whether twin studies (Henderson, 1982) or adoption studies are used (Pederson, 1993). Regardless of the differences in method, these studies indicate that personality and behaviour have a high genetic component. Traits specific to conformity have been examined by behavioural geneticists as well. Traditionalism, which reflects a preference for established behaviours and norms, correlates about .60 between identical twins separated at birth. Furthermore, the specific trait of "spontaneous nonconformity" has an intraclass correlation of .51 for monozygotic twins, yet an ICC of just .05 for dizygotic twins (Blonigen, Carlson, Krueger, & Patrick, 2003). Although this latter trait is intended to be of use only in clinical psychopathic populations, it nevertheless shows that some part of conformity is genetic. In fact, molecular geneticists have linked the trait of novelty seeking (which is largely antagonistic to traditionalist and conformist characteristics) to longer repeat versions of the D4DR gene (Benjamin, Patterson, Greenberg, Murphy, & Hamer, 1996; Ebstein et al., 1996).

What limits the plausibility of a genetic explanation for why cross-cultural differences in conformity exist, however, is that genetic evolution, relative to cultural evolution, is relatively slow. All modern humans share a common genetic African ancestor from about 160,000 years ago (Cann, Stoneking, & Wilson, 1987). Significant population-specific "selective sweeps" (i.e. fast changes in population genome frequencies, see Williamson et al., 2007, for review) must have occurred since the divergence from a common ancestor for this genetic mechanism to be plausible. Furthermore, dispersal of the subjects that are included in the cross-cultural analyses is likely to be much more recent, casting some doubt on the plausibility that cross-cultural differences in conformity is purely genetic.

A possible different type of genetic mechanism also warrants discussion. This mechanism is developmental in nature, wherein genes associated with conformist tendencies are differentially expressed depending upon disease prevalence within the local ecology. This type of phenotypic plasticity is a highly adaptive feature of humans and mammals more generally (Ridley, 2003), and has allowed humans to exploit the worldwide gamut of physical environments. This developmental mechanism may even begin in-utero, given the evidence that exists for foetal plasticity. Mammalian foetuses tend to "predict" their postnatal environments via cues obtained through the placenta and use this prediction to mount the most adaptive response (Gluckman & Hanson, 2005). Meadow voles, for example, are born with thicker coats in the fall than in spring in an attempt to survive the impending winter (Lee & Zucker, 1988), this coat length being influenced largely by placental transfer of melatonin, which signals day length. Furthermore, infant exposure to corticosteroids (hormones that are activated during stress responses), either pre- or post-natally, has been linked to numerous behavioural outcomes later in life (see Edwards & Burnham, 2001, for review). It is these stress hormones that are activated in response to disease threat. Research on rats and rhesus monkeys shows that prenatal exposure to corticosteroids has been linked to less social interaction, less exploratory behaviours in novel environments, and less sexual aggression in offspring (Takahashi, Haglin, & Kalin, 1992; Schneider, 1992; Curno, Behnke, McElligot, Reader, & Barnard, 2009). This pattern of results closely parallels recent cross-cultural findings showing that higher disease exposure within a region is linked to lower extraversion, lower openness to experience, and lower sociosexuality (Schaller & Murray, 2008). Furthermore, at least one clinical study shows that mothers treated with a certain stress hormone during pregnancy (dexamethasone) had children that were rated as more shy and less sociable 2 years postpartum (Trautman, Meyer-Bahlburg, Postelnek, & New, 1995). Although more research is needed, these lines of research seem promising in uncovering a developmental mechanism for the effects of disease on conformity.

A third possible mechanism has nothing to do with genes at all. The cross-cultural differences in conformity could possibly be the result of cultural transmission processes, in which different behavioural patterns and practices proliferate across different groups due to their fitness-enhancing characteristics in different environments. Culturally specific norms are known to develop in response to the environmental pressures imposed upon the information that is transmitted and taught within groups (Richerson & Boyd, 2005). Strong norms of conformity would have had fitness-enhancing properties in cultures of high disease areas and therefore these norms (and the specific groups that retained these norms) would have persisted across generations. On the other hand, regions in which disease risk was lower would have conferred advantages to groups and individuals that adopted more maverick-like norms.

This cultural learning mechanism possesses a developmental component as well: cultural norms and practices tend to be transmitted to and internalized by individuals early in life (Heine, 2008), and these behavioural patterns become somewhat more rigid as one ages. As mentioned earlier, the physiological immune system operates most efficiently and effectively against parasites with which it has already had contact (Janeway et al., 2001). The behavioural immune system may act similarly: in the absence of early cultural inputs to direct antipathogen behaviours, behavioural disease avoidance may be somewhat inefficient in adults or at least take some time to acquire.

These studies, which examine multiple levels of analysis and utilise multiple methods of enquiry, add to the growing body of psychological research that links disease prevalence to contemporary behaviours, attitudes, and cognitions. The results presented, however, leave many questions unanswered—questions that provide avenues for future research. For example, do the null experimental results indicate that "sterile" Western populations are impervious to manipulations of disease salience? Research during times of highly-publicized pandemics may be able to address this question, as well as performing these experiments in regions in which serious disease threat is real. Alternatively, could it be that *all* manipulations of disease salience are ineffectual in temporarily influencing behavioural conformity? All four mechanisms discussed here are backed by indirect empirical evidence. Although these mechanisms need not be mutually exclusive, longitudinal research at the human population level as well as non-human research at the individual level should help to articulate which of these mechanisms plays most prominently in disease's effects on conformity. The current research has wide applicability, as it can potentially allow for prediction of behavioural and attitude changes resulting from disease threats, at both the group and individual levels. Furthermore, knowledge of the specific mechanism would allow prediction of the timeframe in which these changes would be expected to occur.

4.1 Conclusion

Conformity, across four divergent cross-cultural measures, is strongly predicted by the historical prevalence of infectious disease within a region. The failure to find similar effects at the individual proximal level, however, indicates either that flaws exist in the experimental design or that this effect of disease on conformist behaviours and values does not operate at the proximal level. Disease may instead exact its influence on conformity via genetic selection, phenotypic expression, or cultural transmission processes. Indirect evidence exists for each of these mechanisms. Therefore, in order to elucidate the specific mechanisms at play, cross-cultural investigations should be complimented by longitudinal investigations within cultures. Research in non-human samples may also help to uncover this mechanism.

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APPENDIX

UBC Research Ethics Certificate of Approval

The University of British Columbia
Office of Research Services
Behavioural Research Ethics Board
Suite 102, 6190 Agronomy Road, Vancouver, B.C. V6T 1Z3

CERTIFICATE OF APPROVAL - FULL BOARD

PRINCIPAL INVESTIGATOR:	INSTITUTION / DEPARTMENT:	UBC BREB NUMBER:
Mark Schaller	UBC/Arts/Psychology, Department of	H07-02573

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:

Institution	Site
UBC	Vancouver (excludes UBC Hospital)

Other locations where the research will be conducted:
N/A

CO-INVESTIGATOR(S):
Damian Murray

SPONSORING AGENCIES:
Social Sciences and Humanities Research Council of Canada (SSHRC)

PROJECT TITLE:
Disease and Conformity

REB MEETING DATE:	CERTIFICATE EXPIRY DATE:
January 10, 2008	**January 10, 2009**

DOCUMENTS INCLUDED IN THIS APPROVAL:

DATE APPROVED:
January 30, 2008

Document Name	Version	Date
Consent Forms:		
Consent Form	N/A	November 30, 2007
Questionnaire, Questionnaire Cover Letter, Tests:		
The set of questionnaires	N/A	November 30, 2007
Other Documents:		
Debriefing sheet	N/A	January 25, 2008

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

Approval is issued on behalf of the Behavioural Research Ethics Board and signed electronically by one of the following:

Dr. M. Judith Lynam, Chair
Dr. Ken Craig, Chair
Dr. Jim Rupert, Associate Chair
Dr. Laurie Ford, Associate Chair
Dr. Daniel Salhani, Associate Chair
Dr. Anita Ho, Associate Chair