HEURISTIC CUES AUTOMATICALLY ACTIVATE DISEASE COGNITIONS DESPITE RATIONAL KNOWLEDGE TO THE CONTRARY

by

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ABSTRACT

According to one adaptive perspective on social cognition, the perception of facial disfigurement activates an evolved disease-avoidance mechanism, and in so doing automatically triggers disease-relevant cognitions. The present study used the implicit association test (IAT; Greenwald, McGhee & Schwartz, 1998), a computer-based reaction-time methodology to provide an especially strong test of the alleged automaticity of this disfigurement-disease linkage. The methods were designed to measure who is more likely to be implicitly linked to the concept "disease"– (a) a person who is known to be healthy but who has a facial disfigurement, or (b) a person who is known to be infected with a contagious disease but who looks just fine. The findings suggest that the tendency to associate disfigurement with disease is automatic and can actually override explicit rational knowledge to the contrary. Some limitations and implications of the study are discussed.

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Introduction

Imagine you are walking into a committee meeting you attend on a monthly basis. You are one of the last people to arrive, and find there are only two empty chairs. You know enough about the other people in the room to know that one of the seats is next to Jake, a man with a contagious disease, although he shows no outwards signs of being ill. The other seat is next to Bob, a man with a large facial birthmark, who you know is the picture of health. Who do you want to sit next to? You may be using the rational information you have available and consider that staying away from Jake will decrease your chances of catching an illness. On the other hand, you may find Bob's obvious birthmark disquieting, and think about the seat next to Jake, whose condition is not so readily apparent. In trying to make this decision you are utilizing different kinds of information regarding the health status of both men. Which leads to a very interesting question: what information do people actually use to recognize people who are diseased?

We face this type of question on a daily basis. Sitting on a bus, standing in line, anytime we are around other people, we are constantly perceiving cues from others and using them to make decisions about their health status. This assessment of others happens so frequently that we may not even be aware we are doing it. But it serves a vital purpose: helping us notice cues that could indicate illness, and allowing us to adjust our behavior appropriately.

The Psychological Immune System

Disease recognition is important. Recent examples of human/pathogen interaction vividly demonstrate the devastating costs contemporary diseases and pathogens can exact on humans. The AIDS epidemic, as well as the emergence of SARS and the West Nile virus, are current examples of the ubiquity of communicable disease in human populations. Historical examples of the severe consequences of illness abound. Foreign European diseases such as influenza, smallpox and tuberculosis wiped out up to ninety percent of the native populations in America

because they lacked immunity to these particular illnesses (Guerra, 1993). The European plague outbreak in the Middle Ages killed millions (Lippi & Conti, 2002). Prehistoric examples show a similar pattern of results. Paleoparasitologists have collected evidence from a wide range of mediums (Chilean pre-historic skeletons to Peruvian pre-Columbian mummies and various latrines) in a wide range of locations (South America to Greenland). Results indicate that humans and parasites have been involved in co-evolution dating from at least 10 000 years before present (Araujo & Ferreira, 2000). Of the major threats to human survival, one of the most important and consistent has been the presence of pathogens.

Considering the history of disease and contamination threats we have been exposed to, and the possible severity of outcome if one does become infected, it should not be surprising that humans have developed mechanisms to decrease the chances of becoming infected. The most obvious adaptation is the physical immune system. This complex system is composed of a vast array of cell types, each with a specific role in preventing and fighting parasites, bacteria, viruses and other pathogens. It prevents most foreign particles from entering the body, and identifies and destroys those that do get through the initial defense.

Along with the physical immune system, humans also have psychological systems that recognize and prevent disease. These mechanisms work together in a complex pattern to identify possible health threats. The key roles include recognizing perceptual cues indicating the presence of pathogens, activating cognitions that indicate the presence of potential contamination or contagion, and activating an affective response that motivates behavioral avoidance. The recognition of perceptual cues that indicate the presence of pathogens is akin to the physical immune system noticing a germ that has entered the system. The pathogen presence cognitions are similar to the white blood cells mobilizing to contain the germ and minimize potential negative effects. The affective response is the psychological first line of defense and has a role

similar to the external components of the immune system, like the skin. It automatically prevents contact with any potentially contaminating foreign body.

The Role of Disgust

The affective response that prevents contact is the emotion of disgust. Disgust, one of the basic six emotions identified by Darwin (1872/1965), has been around longer than humans have existed as rationally thinking beings (Phillips, 1997). The behavioral manifestations of disgust (nausea, the "disgust face" of a wrinkled nose and gaping mouth with protruding tongue and avoidance) are theorized to function so as to prevent the incorporation of toxins into the body (Rozin & Fallon, 1987). At its most basic level, disgust's primary function is to prevent the ingestion of those things displaying cues of inedibility (Rozin, Haidt & McCauley, 2000; Rozin & Fallon, 1987). At its most abstract level, the moral contamination of committing unethical actions elicits feelings of disgust in the same way as physical contamination, generalizing disgust to domains as far removed from food (Haidt, McCauley & Rozin, 1994).

Between these extremes lies the "disease avoidance" function of disgust. There is abundant evidence that disgust is fundamental to the avoidance of disease and diseased people. This type of disgust reaction occurs in situations where the focus is avoiding physical contact with, even the smell or sight of, bodily fluids or malformed individuals. Support comes from recent research showing that when presented in the same contexts, substances that are the color and consistency of bodily fluids elicit disgust while substances with similar consistency but unnatural color do not (Curtis, Aunger & Rabie, 2004). Disgust is particularly well-suited to disease avoidance functions because it draws attention to honest indicators and possible transmitters of pathogens such as pus, feces and mucus. Many pathogens cause their hosts to produce and excrete excess bodily fluids, and use these fluids as vehicles for transmission, therefore this class of disgust elicitors can be directly linked to infection avoidance.

Disgust can be elicited by other classes of health related stimuli. Haidt, McCauley and Rozin (1994) found seven domains of disgust elicitors, four of which (body products, hygiene, death and body envelope violation) are clearly related to situations and actions with heightened possibilities of pathogen transference. For example, in the domain of body envelope violation, actual or imagined contact (tactile or visual) with any internal body part (organ, blood, bone) that is, or is visible from, outside the body activates disgust feelings. Interestingly, this effect is amplified if the body envelope violation shows signs of infection or rot (Curtis et al., 2004). Intact bodies also elicit disgust if they too display cues indicating they may be harboring an illness. Photos of a man displaying symptoms such as pallor, red spots and sweat elicit more disgust than photos of the same man with no visible symptoms (Curtis et al., 2004).

Perceptual Cues and Cognitions of Pathogen Presence

The emotion of disgust is only one part of a larger system of evolved cognitive mechanisms designed specifically to prevent getting infected by pathogens. Recognition of perceptual cues indicating presence of pathogens and activation of cognitions indicating potential contamination and contagion are also important parts of the psychological disease avoidance system. Kurzban and Leary's (2001) theory of the evolved origins of stigma which outlines the theoretical argument for the role of perceptual cues in the system, is summarized below.

Contagious human illness results from pathogens or parasites that have invaded the body. Parasites invade a host and use the host's resources for survival, reproduction and transmission to new hosts. This can cause deviations in host development in subtle ways, such as preventing the attainment of genetically determined symmetry, height or muscle mass, or in more obvious abnormalities such as swelling, lesions, open sores, infection, fever, and in many cases, death. Humans are adept at identifying physical characteristics that at some level may be indicative of health status (as shown by the range of health related cues that elicit disgust). However, not all parasites cause the same kinds of reactions in their hosts, and not all physical cues are due to

pathogens; therefore we cannot be certain that any particular cue is actually indicative of parasite presence. This leads to a dilemma: how do we think about cues that might or might not be indicative of contagious illness?

In situations where there is uncertainty in the cues that signal important information, the most adaptive decision rule is to err on the side of caution and make the least costly, although more frequent error (Haselton, Buss & DeKay, 1998; Nesse, 2005). In this case, the possible consequences of interacting with an infected individual (debilitation or death) are worse than the alternative (a missed opportunity to interact with another). The system, which is biased towards making false positives, will therefore err on the side of labeling healthy people with some type of physical deviation as sick. The behavioral result of this psychological mechanism is the avoidance of close and prolonged contact with individuals who display cues that could be indicative of illness. In other words, we overgeneralize cues that in some situations are predictive of health status and apply them to situations that merely resemble those where they are applicable. Specific to the topic at hand, people perceive faces that are morphologically deviant as less healthy than more average faces (Zebrowitz & Rhodes, 2004); however, overgeneralization of adaptive cues is not limited to health relevant person perception (Zebrowitz, Fellous Mignault & Androletti, 2003). The disease avoidance system does not rely solely on honest cues. It uses a wide range of rational and heuristic cues that activate disease cognitions, some of which may be only weakly correlated with the presence of actual disease. The final result of the system is the stigmatization of individuals who display morphological deviations because they automatically activate disease cognitions.

Cues that Rationally and Heuristically Indicate Disease

Of the information available when trying to determine the actual health status of an individual, objective health information, such as verbal labels or real symptoms, provides the information we process at a rational level. The information contained within the verbal label of

any formally diagnosed condition can be, and is, used to appropriately modify our thoughts and actions. For example, a major factor that predicts social rejection of unhealthy others is the severity of their condition. Non-treatable diseases such as AIDS are considered much more severe than illnesses like the flu, and predict maximum social stigma (Crandall & Moriarty, 1995). This demonstrates that when reliable information is available, we consider the actual symptoms, communicability and consequences of the illness when making decisions about another person's health.

However, as much as we may like to think that we are entirely rational, and act solely on objective information, we do not. Our decisions are also influenced by a wide range of heuristic cues that provide information above and beyond (and sometimes in spite of) rational knowledge. These heuristics are not as fine-tuned as we like to think they are. They are crude. They rely on sources of information that can be misleading and imprecise. They can lead to irrational decisions, yet their role cannot be underestimated. A wide range of cues, from cultural foreignness to attractiveness, provide quick and dirty answers when little or no rational information is available.

Cultural foreignness has been studied as perceptual cue indicative of pathogen presence. Although it may seem like an odd health-relevant heuristic cue, a closer look reveals it is not so far-fetched. People that seem unfamiliar culturally may also be different physically, hosting unfamiliar pathogens that our immune system is unequipped to deal with. This was the case when North American Natives were exposed to European diseases, with devastating results. At an automatic level of processing, we implicitly associate disease with people who are from countries or cultures that we know little about, or that seem particularly unfamiliar, more than with people from equally distant but more familiar countries (Faulkner, Schaller, Park, & Duncan, 2004). Other evidence shows that pregnant women in their first trimester (the phase of pregnancy when both mother and fetus are most vulnerable to disease) report more negativity

toward outgroups, and favoritism for the ingroup, than do women further along in their pregnancy (Navarrete & Fessler, 2005).

We also rely on the physical features of others as sources of heuristic cues. Physical features, and especially facial features, frequently display honest information about an individual's health status. Thus, it is not surprising that we automatically use information from these sources to make health judgments. Most of the facial features and traits that are considered attractive are in some way linked to, or indicative of, health status. These include unblemished skin, symmetry, and averageness, among others. Individuals who are considered unattractive have faces that deviate (usually fairly subtly) from these norms. Unattractive individuals are generally considered less healthy than their more attractive counterparts (Zebrowitz & Rhodes, 2004). Following this logic, when health threats or parasite loads are of particular concern, the importance of ensuring that the people with whom you will be spending time are in good health should be higher. Therefore, if attractiveness is used as a heuristic indicator of health, in places where illness is a higher threat, attractiveness should be valued more. A multi-nation study looking at the value of attractiveness in a potential mate shows just that. Cultures with higher parasite prevalence place more emphasis on physical attractiveness than do cultures with low parasite prevalence (Gangestad & Buss, 1993).

The physical cues used as heuristics are not limited to those that indicate facial attractiveness. More generalized morphological deviance is also used as a heuristic cue of ill health. People who deviate from the physical norm in any number of ways are considered less healthy than those who are closer to average physically. Morphological deviance encompasses any body, or body part that does not fit the perceiver's norm for the human body. This can include discoloration, extreme size, missing limbs and any number of other possible deviations. Pathogens interfere with normal bodily functions, and cause a wide variety of symptoms, such as discoloration, swelling, and malformation of limbs, therefore, it should not be surprising that

many types of morphological deviation are used as heuristics to automatically make health judgments. Park, Faulkner and Schaller (2003) showed that without any explicit health knowledge, implicit associations between the semantic concept of disease and individuals with physical disabilities are stronger than associations of disease concepts and able-bodied individuals. The same association pattern has been shown with obese individuals and disease concepts, when compared to normal weight individuals (Park, Schaller, & Crandall, 2005).

We can see that we rely on a wide range of crude visual heuristics for cues to indicate the health of others when rational knowledge is not available. We also know that we actively process the accurate information provided in formal diagnosis of health conditions when it is available. What we do not know is how the information provided by these two sources is integrated when the heuristic cues suggest a different conclusion than the rational information. The initial reactions to contradictory health cues could provide answers to the question of what happens when sources of information do not agree.

When Honest and Heuristic Cues Conflict

All of the previous research has been done in one of two conditions. In the first type of situation, only rational information is available. That available knowledge is used, and results in appropriate changes in cognitions. In the second type of situation, only heuristic information is available. Photos of unattractive, disabled or obese people are shown and perceivers are able to make health judgments based only on the information they have, which are visual indications of health status. What remains unknown is how we use each type of information if provided with both. It seems logical that if the information is complementary, the perceiver will make a more accurate assessment in this situation then would be the case if they were simply relying on one type. But imagine a more interesting and potentially more revealing scenario, such as the one described in the opening vignette. In this situation the individual who looks healthy is actually contagious, and the one with the morphological abnormality is completely healthy. Here, the

rational knowledge and heuristic cues are providing conflicting health information. In situations like this, how do we process information? There are two possibilities to consider.

The first is that perceivers will automatically ignore more general heuristic information when they have access to more reliable, rational knowledge. A study by Langer, Blank and Chanowitz (1978) demonstrated that people waiting in line to make copies would let another person jump the line to make one copy if their request simply resembled a legitimate reason (I need to use the machine now *because* I need to make a copy). As the number of copies to be made increased, people no longer relied on the format of the request, but instead analyzed the content of the request (the need to make a copy). This attention to the content revealed it was not a valid reason, and as a result, people would no longer allow the person to use the machine before they did. This is a classic example of the tendency to rely on fallible heuristics less when costs are high than when costs are lower. Successful disease avoidance is an important aspect of human survival, and missing relevant information has severe negative consequences therefore it seems likely that we would rely on the truthful and certain information available to us. Contracting most illnesses may no longer be a matter of life or death, but the costs of contracting an illness, be they physical or financial, are still enough to make disease avoidance a prominent goal. This may cause people to make a conscious effort to make a correct decision using the information provided in each specific situation (and not rely on decision making algorithms and heuristics), placing higher value on the rational knowledge they are provided and therefore base evaluations on the information that pertains only to that situation (Langer, 2000; Langer & Moldoveanu, 2000).

The second possibility is that in situations of conflicting information, heuristic cues automatically activate cognitions, producing an initial assessment of health status that is then tempered or overridden by rational knowledge. A dual-process theory of stigma perception (Pryor, Reeder, Yeadon & Hesson-McInnis, 2004) suggests this order of events; an automatic or

reflexive initial reaction to the cues displayed by stigmatized others is modified by slower rule-based or deliberate processes. Disease identification and avoidance mechanisms have been theorized to have adaptive, ancient roots (Kurzban & Leary, 2001). This suggests there was a functional advantage for those individuals who reacted the most appropriately to stimuli indicative of pathogen presence. Disgust is the initial reaction to physical abnormality; therefore it may be very difficult to out-think this gut-level reaction, and the implicit conclusions that result from it. In other words, despite our great cognitive abilities, we may have very little control over the way we automatically react to heuristic cues of illness.

So which is it? Are we able to ignore the potentially misleading visual cues and make decisions purely based on the facts, or do we, as suggested by Norton Juster in *The Phantom Tollbooth* (1961), automatically jump to the island of conclusions and have to swim the sea of knowledge to get back?

Overview of the Present Study

How people automatically process health relevant information in general is influenced by at least two factors other than information availability: individual differences and disease salience, both of which will be addressed in the present study. Three individual differences are of particular interest: (1) information processing style, (2) sensitivity to disgust and (3) self-perceived vulnerability to disease. Differences in general information processing styles may affect performance on the IAT, as people who enjoy thinking about situations from various perspectives and think more than absolutely necessary may be less likely to rely on heuristics in general will be more likely to rely on situation specific, rational knowledge for decision making (Langer, 1992). Disgust is conceptualized as the affective (automatic) component of the psychological disease identification and avoidance system. People who are especially sensitive to cues that elicit any form of disgust may have stronger initial reactions to heuristic cues indicative of disease. Finally, people who have chronic feelings of vulnerability to disease are hyper-aware

of the possibility of contracting contagious illnesses, and feel that they are more susceptible to illness than other people. High self-perceived vulnerability to disease could affect how health relevant information is perceived and used (Park, Faulkner & Schaller, 2003; Faulkner, Park, Schaller & Duncan, 2004; Naverette & Fessler, 2005).

Temporarily increased disease salience at the time of the decision-making could also influence how health relevant information is processed. By manipulating the salience of the threat of communicable disease in the immediate environment, the causal role of disease awareness in differences in information processing can be investigated.

To properly address these questions requires a methodology capable of measuring general automatic reactions that is also sensitive to individual differences and temporarily salient contextual cues. One methodology that meets these criteria is the Implicit Attitude Test (IAT) (Greenwald, McGhee & Schwartz, 1998). The IAT is a computer-based reaction-time task that measures the relative speed at which people are able to categorize two types of information. The underlying logic of the test is that objects and concepts that are strongly implicitly associated (i.e. flower and pleasant) should be easier (and therefore faster) to categorize than objects and concepts that are weakly associated (i.e. insect and pleasant). The sensitivity of the IAT to changes in association strength due to individual differences, and to contextual manipulation, has been demonstrated in a variety of domains, including age, race and health-related prejudices (Dasgupta & Greenwald, 2001; Park, Faulkner & Schaller, 2003; Schaller, Park, & Mueller, 2003). In this study participants received conflicting heuristic cues and rational health knowledge about two individuals via photos and biographical information. One of the individuals had a large purple birthmark covering a large portion of one side of his face, a heuristic indicator of disease, but participants were told that the birthmark was not contagious and had no negative health consequences (thus providing rational knowledge that he is healthy). The second individual had no heuristic cues indicative of illness, but participants were told that

he had a very serious, contagious illness (thus providing rational knowledge of illness). Participants then completed an IAT categorizing photos of the two individuals with disease and health words. By measuring how long it took people to categorize pictures of someone who had a morphological abnormality with concepts of either disease or health, and comparing it with the time it took to categorize pictures of someone who looked relatively normal with the same two concepts, it was possible to identify which individual, and therefore which type of information, was more influential in determining initial perceptions of another's health status.

Competing Hypotheses

The conceptual perspectives relevant to the automatic processing of health relevant information each predict a different result. The first is based on the findings indicating that people rely on rational information when costs are high. This perspective suggests that when supplied with rational health information, people will discount the heuristic information and rely on the knowledge they know to be true, even in the early stages of processing. The second, based on the adaptive and affective nature of the disease recognition system, is that people will form a first impression based on heuristic cues, despite having truthful knowledge available.

These methods also allow the opportunity to detect effects of individual differences and the temporary salience of a functionally-relevant threat, as previous studies have found (Schaller, Park & Mueller, 2003; Maner, Kenrick, Becker, Delton, Hofer, Wilbur, et al., 2003). For example, a more mindful person may and read and process the rational information about more carefully. Then, if disease salience is temporarily increased the mindful individual may associate the new awareness of disease and contagious with the facts about who is actually contagious, arriving at a different decision about who is sick than someone who made the decision when only the heuristic knowledge is available.

Method

Participants

Fifty-one students (14 males and 37 females) from the University of British Columbia participated in exchange for extra credit in undergraduate psychology courses.

Procedure

Participants were told they would be participating in a study concerning the effectiveness of various methods of informing the general public about health issues and a few related computer tasks. They were informed they would be filling out questionnaires, reading information about a two people and two health issues, watching a slide show and doing two computer tasks. Informed consent was obtained, and the study began.

Individual Difference Measures

Participants completed a questionnaire package containing five individual difference measures which are included in the appendix. Two of these questionnaires were relevant to disease. The Perceived Vulnerability to Disease scale (unpublished) is an 18-item scale that measures individual differences in chronic perceptions of vulnerability to disease. It has two subscales which measure situational germ avoidance attitudes and general beliefs about personal vulnerability respectively. The Disgust Sensitivity Scale (Haidt et al., 1994) is a 32-item scale that assesses individual differences in sensitivity to domain specific disgusts, which are combined to obtain an overall disgust score.

One questionnaire was relevant to information processing. The Need for Cognition scale (Cacioppo & Petty, 1982) is an 18-item scale that measures individual differences in the desire to obtain and process information above and beyond the minimum required.

The two remaining individual difference measures were included to explore additional traits that could influence health related processing. The Belief in a Dangerous World scale (Altemeyer, 1988) is a 12-item scale that assesses individual differences in the extent to which

people are chronically pessimistic concerning the intentions of others. The Big Five Inventory Version 44 (BFI-V44; John, Donahue, & Kentle, 1991) personality trait scale was included. It is a 44-item scale that assesses the Big Five personality dimensions.

A demographic questionnaire was also included in the questionnaire package. It asked the participant's age, gender and ethnic background.

Upon completion of the questionnaires, participants completed an Implicit Attitudes Task (IAT), a computer-based reaction time task. The IAT involves categorizing pictures and words as quickly and accurately as possible in each of five blocks of trials. In this version of the IAT, pictures of flowers and insects were used as targets; pleasant and unpleasant words were used as attributes. The format of the IAT will be described in more detail below (see Dependent Measure: Implicit Association Task). Participants completed this initial version of the IAT only to familiarize them with the IAT procedures.

Target Persons

After completing the practice IAT, participants were reminded of the purpose of the study (to improve ways in which health relevant information is presented to the public). They were then presented with photographs and biographical information about two men, "Jake" and "Bob".

The photograph of Jake showed an attractive, dark haired man with no obvious facial blemishes. The biographical information about Jake, however, made it clear that he suffered from a contagious disease:

> Jake is a 31 year old web designer for an adventure travel company. He also started an online support group for people who have various forms of Tuberculosis, including the strain he suffers from, multi-drug resistant tuberculosis. The website has a chat room for individuals to share their stories, as well as information for the public such as:
>
> Multi-drug resistant tuberculosis (MDR TB) is an extremely virulent form of tuberculosis. Tuberculosis is a disease primarily affecting the respiratory system. It is contagious, and spread through coughing and sneezing. MDR TB is resistant to the drugs typically used in the treatment of the most common forms of tuberculosis, so curing someone is very difficult. Those who

> have MDR TB will are likely to experience a wide range of debilitating symptoms, including loss of appetite, fever, night sweats, and constant fatigue.
>
> In his spare time, Jake plays bridge, reads and writes book reviews for local papers.

In contrast, the photograph of Bob depicted a man with an obvious, dark colored facial birthmark covering most of the left side of his face. The biographical information about Bob made it clear that the facial disfigurement was merely a superficial birthmark that had no consequences on Bob's active lifestyle:

> Bob is a 35 year old Outdoor Pursuits Center manager. On top of his regular duties, he has founded a support group for people who have Port Wine Stain birthmarks, as he does. The group helps individuals cope with their birthmarks, as well as informing the general public about birthmarks. Some of the information is the following:
>
> Port Wine Stain birthmarks cause a reddish or purplish discoloration of the skin due to dilated capillaries. Port Wine Stain birthmarks occur most commonly on limbs or faces. It is a superficial condition that – in the absence of cosmetic surgery – will remain permanent. Although people are born with Port Wine Stain, as a person ages, the color may darken to red or purple and become more conspicuous, spreading over the skin. In time, Port Wine Stains may pebble, causing the development of small bumps that can begin to bleed without warning.
>
> When he isn't working, Bob enjoys rock-climbing, mountain biking and camping with friends.

Disease Salience Manipulation

Participants were told that the researchers were exploring methods of effectively informing the general public about Tuberculosis and Port Wine Stain birthmarks. Therefore, participants were asked to watch a computer-based slide show on another topic and to rate the slide show format as to its effectiveness in informing the public about each affliction. This slide show manipulation has been used successfully in previous investigations of context on health relevant stimuli (Faulkner et al, 2004)

Participants were randomly assigned to one of two slide show conditions: Disease salient or Accident salient. For each condition the slide shows had the same format: 10 slides (images and text), depicting potential dangers and/or precautions to take as preventative measures

In the Disease salient condition (n = 24), the slide content was constructed to increase the salience of the plethora of possible health threats attributable to communicable disease, germs and bacteria in everyday life. For example, one slide titled 'Airborne Disease' showed a simple schematic drawing of the flow of particles from the lungs of one individual into the lungs of the second person. Another slide ('How Anthrax Kills') showed a detailed schematic of the deadly course of the anthrax virus.

In the Accident salient condition (n = 26), the slide content was constructed to make salient a variety of non disease-related hazards. For example, one slide ('Electricity and Water Don't Mix') shows a cartoon of a woman in a tub with various small appliances plugged in around her. Another slide ('Hot Water Risk') shows an individual burning their finger with dangerously hot tap water.

After watching the slide show, participants were asked to rate the effectiveness of the format of the slide show for informing the public about (a) port wine stain birthmarks and (b) tuberculosis. These ratings were collected simply to substantiate the cover story, and were not analyzed.

Dependent Measure: Implicit Association Task

Upon completion of the effectiveness rating scales, participants commenced the IAT task. The purpose of the IAT was to measure the extent to which the semantic concept "disease" was relatively more likely to be associated with "Jake" or with "Bob". That is, it measured the extent to which "disease" is more likely to be automatically linked to a person who is known to be infected with a contagious disease but looks just fine (Jake), or to a person with a facial disfigurement who is known to be healthy (Bob).

The IAT task consisted of 140 trials split into five blocks. In each trial a word or photograph was to be being categorized. For this study, the words were categorized as either "disease" or "health" relevant, and the photographs of Jake and Bob were categorized as either "Jake" or "Bob". Two versions of the IAT task were used to control for order effects present in the methodology.

The stimulus words had been pre-rated for category applicability. Pre-rating was done by an independent sample of participants who responded to a questionnaire that asked: "On a 10-point scale, how unpleasant you would find associating with someone these words described?" The "disease" words (contagious, illness, infectious, sickness, epidemic) had a mean score of 6.23; the "health" words (healthy, nutritious, strong, hygienic, well) had a mean score of 2.2. These words were presented one at a time in random order (determined by the IAT software) from both lists of target words. The stimulus pictures of Jake and Bob had been matched for size (2 inches by 3 inches) and approximate proportion of subject to background in composition. Three pictures of Jake and three pictures of Bob were used in the IAT task. The pictures were presented in random order (selected by the IAT software) from the set of 6 images. Half the participants were randomly assigned to the version of the IAT task described in detail below.

In the first block of trials participants categorized words that appeared on a computer screen as either disease relevant or health relevant. To facilitate the categorization process in this and all further blocks of trials, the screen had category reminder labels visible throughout. In this block of twenty trials, the left side of the screen had the word "disease" displayed. The word "health" was displayed on the right hand side of the screen. Disease words were correctly categorized by pressing the 'e' key on the computer keyboard with the left hand. Health words were correctly categorized by pressing the 'i' key on the computer keyboard with the right hand (see Figure 1 for illustration of the IAT sequence).

In the second block of twenty trials, participants were asked to categorize pictures of Bob and Jake. The left side of the screen had the word "Bob" displayed, while the word "Jake" was displayed on the right. In this block, pictures of Bob were correctly categorized by pressing the 'e' key on the keyboard with the left hand. Pictures of Jake were correctly categorized by pressing the 'i' key on the keyboard with the right hand.

The third block of categorization trials is referred to as a critical block. Critical blocks consist of 40 trials in which both words and pictures used in the previous blocks are categorized using only two keys on the keyboard (as before). This necessitates that one type of word (either disease or health relevant) and pictures of one of the men (either Jake or Bob) were categorized using one key, while the remaining word type and the remaining man were categorized using the other key. For this block, disease words and pictures of Bob were categorized by pressing the 'e' key, and health words and pictures of Jake were categorized by pressing the 'i' key.

In the fourth block of 20 trials participants once again categorized only pictures of Bob and Jake. This time, however, correct categorization of the photos required reversing the keys used in previous blocks. Pictures of Jake were categorized by pressing the 'e' key with the left hand and pictures of Bob were categorized by pressing the 'i' key with the right hand.

The final block of trials was another critical block, which again required categorization of both words and pictures. In this block the word and picture pairings on each of the keys was reversed. Disease words and pictures of Jake were correctly categorized by pressing the 'e' key, health words and pictures of Bob were correctly categorized by pressing the 'i' key. The labels on the screen listed both categories on their respective sides ("Jake" and "disease" on the left and "Bob" and "health" on the right).

The IAT is based on the logic that categorizing conceptually compatible objects/ideas together is easier, as reflected in reaction times, than grouping incompatible objects/ideas. Therefore, participants should find the categorical arrangement in one of the critical blocks easier

than the other, depending on which man they associate with disease. If participants associate Bob with disease, they will have faster trial times on block 3 than they will on block 5, because "Bob" and "disease" are categorized using the same key in block 3. If they associate Jake with disease, they will have faster reaction times on block 5 than block 3, as "Jake" and "disease" are categorized using the same key in block 5.

The IAT effect is susceptible to an order effect bias. In general, categorizing the stimulus pairs in the first critical block is easier than in the second critical block, due to residual interference of the first order when completing the second. Therefore, the remaining half of the participants completed a version of the IAT in which the order of the critical blocks was reversed (as was the order of the Jake/Bob classification trial that immediately preceded it). Participants in this condition categorized "disease" and "Jake" on the same key in their first critical block (Block 3), and "disease" and "Bob" on the same key in the second critical block (Block 5). In this task, if participants associate Bob with disease, they will have faster times on block 5 than block 3. If they associate Jake with disease, they will have faster times on block 3 than on block 5. Using both orders of critical blocks eliminates any bias due to order effects on the overall IAT scores.

Prior to starting the task, participants were instructed to complete the task as quickly and accurately as possible. Upon completion of the IAT subjects were thanked for their participation and debriefed. At this time they were asked what they thought the study was about. Although some guessed it was somehow related to perceptions of others and disease relevant contexts, no participants expressed knowledge of the hypothesis being tested.

Results

Scoring

The raw data collected by the IAT software requires cleaning before it is used to calculate a final score for each participant. Most reaction time tasks have excess variability in the

response latencies due to participant inattention or anticipation. To accomplish this, a scoring algorithm that minimizes the effect these types of bias was used (Greenwald et al. 2003). Subjects who had 10% or more trials in any block with response latencies less than 300 ms were eliminated, as were subjects with overall error rates greater than 20% on any block. One male participant with an error rate of 43% on one critical block was excluded from further analysis. (The mean error rate across both critical blocks for the remaining participants was 3.68%)

The scoring algorithm also details the steps that should be taken to transform the remaining data into IAT effect sizes (Greenwald et al., 2003). For each of the remaining fifty participants, four steps were taken to arrive at an individual IAT effect size. First, for each of the two critical blocks the mean of the response latencies for all trials in which the stimulus was correctly categorized was computed. Next, for each trial in which a stimulus was incorrectly categorized, the response time for that trial is replaced with the mean response time of the correctly categorized trials plus 600 ms, and the mean of all forty trials is re-calculated for each critical block. (The same result can be obtained by adding 15 ms to the mean latency of the correct trials for each incorrect trial in the block) Also computed is the standard deviation of the response latencies on all 80 trials across both critical blocks (prior to the correction of response times described above). The final step involved using the adjusted mean response latencies to calculate an IAT effect for each participant by subtracting the mean latency of one of the critical blocks from the mean latency of the other critical block and dividing the result by the participant's standard deviation. Regardless of the order in which participants completed the critical blocks, the IAT index was computed by subtracting the critical block in which "Jake" and "disease" were categorized together from the block in which "Bob" and "disease" were categorized together. Therefore, for each participant who completed the IAT in the order described in detail above, the IAT index was calculated using the following formula: (adjusted mean block 3 – adjusted mean block 5) / SD. For the participants who completed the IAT in the

alternate order, the IAT index was calculated using the following formula: (adjusted mean block 5 – adjusted mean block 3) / SD. If the mean IAT effect size is positive, it indicates participants associate the concept of disease with Jake (the man who really was diseased). A negative mean score indicates they associate the concept of disease with Bob (the healthy man with the superficial birthmark).

Is Disease Associated with Jake or with Bob?

The mean IAT effect was -0.20. This mean differed significantly from zero ($t(49) = 4.105$, $p < .001$). The negative value of this mean indicates that, in general, people associate Bob with the concept of disease.

Deeper investigation of the distribution of scores revealed 14 participants had positively valued scores and 36 had negatively valued scores (Figure 2). One participant had an especially negative IAT score of -1.10. This score could be considered an outlier by liberal standards because it is more than two standard deviations below the mean. Removing this individual from the analysis did not greatly influence the results ($M = -.18$, $t(48) = 3.94$, $p<.001$). Participants showed a clear tendency to implicitly associate the semantic concept of disease with Bob, the man with the birthmark, more than they did with Jake, who they knew had a contagious illness.

Individual Difference Variables

As can be seen in Figure 1, there was considerable variability in the IAT scores. The relationships between individual differences and IAT scores are listed in Table 1.

Individual differences in disease-relevant domains were expected to impact IAT performance. Specifically, chronic awareness of disease and sensitivity to disgust were predicted to increase the salience of physical cues, thereby increasing associations between morphological abnormality and disease, and affecting performance on the IAT. Analysis showed that there were no significant relationships between either subscale of the Perceived Vulnerability to Disease scale or the Disgust Sensitivity Scale and IAT scores.

Individual differences in mindfulness and information processing styles were also conceptually related to the task at hand. The degree to which people voluntarily process information above and beyond the minimum level required could have had a direct influence on IAT scores. Scores on the Need for Cognition scale, however, did not predict IAT performance.

The remaining individual difference measures were included as exploratory measures into some factors that could have had an impact on performance in the IAT. These included general fearfulness of the intentions of others, as measured by the Belief in a Dangerous World scale, as well as personality factors, measured by the Big Five Inventory V44. Scores on these scales did not predict IAT performance.

Of the various demographic features included in the analysis, gender was the only variable that had an effect on IAT performance. Males ($M = -.37$) were significantly more likely than females ($M = -.14$) to associate Bob, rather than Jake, with disease concepts ($t(48) = 2.32$, $p = .024$).

The lack of results for all the individual differences calls into question the scale reliability for this sample. It could be that the scales are not capturing the constructs they are designed to, which would explain the lack of expected relationships between conceptually related individual differences and IAT performance. To test this, tests of reliability (Cronbach's alpha) are conducted on each scale. The results exclude this possibility (Table 1). All but one of the scales (the germ aversion subscale of the PVD) had an alpha level of .80 or greater.

Disease Salience Manipulation

Temporarily increased disease salience could have affected how participants perceived Bob and Jake and affected who would be associated with disease and disease concepts. Mean IAT effects for both Disease salient and Accident salient conditions were -0.20. There was no disease salience effect on which man participants automatically associated with disease. The manipulation did not influence performance on the IAT.

Interactions between Disease Salience Manipulation and Individual Difference Variables

The individual difference variables and the disease salience manipulation did not predict IAT performance. However, there is reason to believe that interactions between individual difference variables and temporary disease salience that could account for some of the variance in the IAT scores. Individual differences in beliefs in a dangerous world have been shown to interact with a fear salience manipulation in predicting the amount of anger perceived in others (Maner, Kenrick, Becker, Delton, Hofer, Wilbur, et al., 2004) and with ambient darkness in predicting stereotype activation (Schaller, Park & Mueller, 2003). Preliminary analysis revealed interactions between disease salience condition and two individual difference measures, Belief in a Dangerous World (BDW) and Conscientiousness (see Table 2).

Regression analysis was used to test the interactions. Conscientiousness (as measured by the BFI 44) interacted significantly with the disease salience manipulation, $B = .18$, $\beta = .40$, $t = 2.96$, $p = .005$. For those participants who saw the disease salient slide show, conscientiousness was negatively correlated to IAT score ($r = -.45$, $p = .02$), a relationship that reversed ($r = .37$, $p = .07$) for participants who viewed the accident salient slide show. People low in conscientiousness did not differ in their IAT performance regardless of the disease salience condition. People high in conscientiousness were more likely to associate disease with Jake if they were in the disease salient condition and with Bob if they were in the accident salient condition. The interaction is graphed in Figure 3.

Interestingly, the relationship between BDW and IAT score followed the same pattern ($r = -.38$, $p = .07$ and $r = .32$, $p = .11$ respectively). A regression analysis test of the interaction showed a significant BDW x disease salience interaction, $B = .15$, $\beta = .38$, $t = 2.45$, $p = .018$. Low-BDW individuals did not differ in their IAT performance regardless of the disease salience condition. People who scored high on the BDW were more likely to associate disease with Jake

if they were in the disease salient condition and with Bob if they were in the accident salient condition. The interaction is graphed in Figure 4.

Discussion

Conceptual Implications

Participants demonstrated a clear tendency to implicitly associate the semantic concept of disease with Bob (the healthy man with the birthmark) more than with Jake (the normal looking man who they knew had a contagious illness). In other words, the information provided by a heuristic cue of health status was used at an automatic level despite the presence of rational knowledge. This result is consistent with the dual process model of reactions to perceived stigmas in others (Pryor, Reeder, Yeadon & Hesson-McInnis 2004) which suggests that when rational and heuristic sources provide conflicting information about the health of another person, it is the heuristic knowledge that influences automatic level semantic associations and categorical decision making.

These results are interesting only if we know that participants knew, at a rational level, that it was Jake, not Bob, who suffered from a contagious disease. Therefore, a separate small sample of participants (n=10) completed the study as described above, stopping just prior to the administration of the IAT. Instead of measuring implicit associations at this point, participants' rational knowledge was tested using questionnaires concerning the specific health condition each man had, including its effect on lifestyle and its communicability. All participants correctly identified which man was contagious, and which was not. This confirms that the rational knowledge was available at the time the IAT was completed – and solidifies the interesting conclusion that, despite their rational knowledge to the contrary, most participants implicitly associated the disfigured man with disease and the normal-looking man with health.

An area of conceptual concern is that conceptually related individual differences such as disgust sensitivity and information processing style did not predict the automatic activation of

disease cognitions. Neither did chronic or temporarily increased salience of communicable pathogens.

Information processing style, as measured by the need for cognition scale, was not related to increased implicit reliance on rational information, as hypothesized. One possible reason is that this scale measures a cognitive style, the degree to which people enjoy thinking above and beyond the minimum required. However, the construct most likely to be associated with increased use of situation specific rational knowledge is that of mindfulness. Since "having a particular cognitive style cannot be mindful, by definition, because it is precisely the sensitivity to the novel and, therefore, unexpected (i.e. nonalgorithmic) that is one of the key components of mindfulness" (Langer & Moldoveanu, 2000, p. 4), this result should not have been entirely unexpected.

Another predicted source of variance, individual differences in sensitivity to disgust was also not related to performance on the IAT. This could be due to exposure effects, such that by the time participants actually completed the critical blocks of the IAT, they had been exposed to the birthmark frequently enough that the reaction had degraded from the levels first exposure. It could also be that although discoloration is a strong enough heuristic indicator to form the initial association between the birthmark and disease, it is not as strong a disgust elicitor as seeping pus or body envelope violations. Both of these circumstances would have resulted in an overall floor effect of disgust sensitivity.

Neither temporarily nor chronically salient disease threat predicted how the men were perceived. Specifically, the disease salience manipulation to temporarily increase salience did not influence which man was implicitly associated with disease concepts. People who are chronically aware of threats of communicable disease, and score high on the PVD are not simply increasing attention to, or reliance on, heuristic cues, as predicted. This is somewhat surprising because PVD was found to predict xenophobic attitudes in two previous studies in which cultural

foreignness was conceptualized and presented as a heuristic indication of disease (Faulkner et al., 2004; Navarette & Fessler, 2005). However, in those studies people were thinking about groups of people, while this study focused on two specific individuals, situations which could involve different information processing mechanisms.

There were only two circumstances in which individual differences predicted the direction of implicit associations, both of which involved interactions between individual differences and manipulated disease salience. High scores on conscientiousness and belief in a dangerous world predicted the use of rational knowledge at an implicit level only when disease salience was made temporarily salient. Although individual difference and contextual interactions were considered as a possible result, conscientiousness and belief in a dangerous world were not hypothesized to be the variables involved.

To explain this pattern of results, it may be that highly conscientious people paid more attention to specific details when reading the biographical information at the start of the study, forming health status assessments of both individuals based on the rational information provided. They probably also paid more attention to the content of the slides in the experimental manipulation. Therefore, seeing the health relevant slides that depicted tuberculosis and airborne disease caused conscientious people to recall the individual to whom these bits of rational information pertained (Jake had tuberculosis) and had more opportunities to associate Jake and disease. The reverse may have been true for the accident manipulation, in which the slide content caused participants to recall the rational knowledge of Bob's extreme lifestyle, thereby strengthening the association between Bob and unhealthy concepts. Belief in a dangerous world showed the same pattern of results; people who were high on this scale and therefore more pessimistic about the intentions of those around them, were more likely to rely on rational information when disease threats were salient and on heuristics when personal injury due to accidents was salient. Chronic worry about the intentions of others could have the same effect

as conscientiousness, but due to different motivation. The uncertainty could cause these people to pay very close attention to available rational information about others, as a means of increasing their knowledge, and therefore being better able to predict how others may act. Regardless of the reason for obtaining rational information, once it has been processed, the disease salience manipulations may activate the same cognitions and associations in highly interpersonally pessimistic individuals as occur in highly conscientious individuals.

Methodological Issues

This study is a good first step into an area of social cognition that has not been addressed. However, there are a few issues methodological issues that should be addressed in future studies. The first is the slide show used to manipulate disease salience. Although this manipulation has been successful in previous studies (Faulkner et al., 2004; Park et al., 2003), in this study it seemed as though the only people for whom the experimental manipulation was successful were those who paid close attention to both the content of the biographical information and the content of the slide show. This could be due to the way it was introduced in the cover story. Participants were told that the format, not the content was the focus of the study, which could have decreased the attention to content details, and effectiveness of the manipulation. Making the manipulation more salient, possibly by having participants critique each slide to be sure they read and process the information on it, might help to make the manipulation equally effective for everyone.

The second methodological adjustment is the inclusion of a second IAT in the same study. Other work that uses the IAT as a dependent measure also generally uses a second IAT that associates the variable of interest (in this case the pictures of Bob and Jake) with the semantic concepts pleasant and unpleasant. The purpose of the second IAT is to ensure, in this example, that the association between Bob and Disease that was found, is not just the result of a more general negativity towards Bob.

Finally, future research could validate the heuristic value of the birthmark as cue to activate disease cognitions, while also trying to identify other cues such as extremely low weight or acne that activate heuristic, disease related cognitions.

The Bigger Picture

There is a lot of evidence supporting the robust finding that our gut level first reactions are based on heuristic cues (Gigerenzer & Kurzenhauser, 2005, Banaji & Greenwald, 1995). What this study adds is evidence that when applied to how we think about others, this can and does happen regardless of the availability of rational information. One implication of this finding is that simply making accurate rational information available may not be enough to prevent incorrect conclusions being drawn from uncertain heuristic cues. The individual difference and context interactions indicate that rational knowledge is only used at an automatic level when there are opportunities to facilitate the association of that knowledge with the individual it describes. Without the opportunity to challenge the conclusions we automatically arrive at, continued reliance on heuristic cues continues to strengthen heuristic based association. This could result in continued stigmatization and prejudice against people who simply activate category cues.

This finding suggests that future research should be directed towards discovering ways of providing accurate information about stigmatized others in such a way as to effectively change the automatic heuristic associations perceivers of the cues make. This would benefit not only those people who suffer errors of inclusion, who, like Bob, present cues that indicate a condition he does not have, but those who suffer errors of exclusion as well. These would be people who really are members of categories (in this case, really are ill), yet display no outward indications of their condition and therefore do not automatically activate cognitions. This is frequently the case with illnesses such as multiple sclerosis (Schwartz & Kraft, 1999), and can result in unnecessary interpersonal difficulties due to the lack of association of the ill individual with

concepts of disease, unless a conscious effort is made to overcome this assessment. Knowing how we use the information provided by physical cues can help to pin point what associations are not being made, and look for ways to facilitate them.

More generally, the overall finding of the study is consistent with research suggesting we generally use the easy, automatic information to make a preliminary assessment (Tversky & Kahnman, 1974). The concept of bounded rationality suggests that reliance on decision strategies that use only pieces of the available information is due to inherent limits on rational thought that depend on both the person doing the thinking and the environment they are in (Gigerenzer & Todd, 2001). Recent work on the use of 'fast and frugal' heuristics in many domains has found that when there is too much information to process, people will rely on heuristics (Marsh, Todd & Gigerenzer, 2004). Another study, investigating the use of heuristics by trained medical professionals, found that they frequently rely on only a few salient cues when making treatment decisions, yet rarely admit to doing so (Gigerenzer & Kurzenhauser, 2005). We can see that when given the choice, even in situations where information is available and the outcome is important, we will use heuristics to make initial assessments, only incorporating rational information in more attentive assessments if pressed to do so.

The way that this study has defined the heuristic cues thus far assumes that the obvious facial birthmark itself is the cue that indicates illness. Aside from simply being a different color, the birthmark also increases asymmetry and facial distinctiveness, two factors negatively related to facial attractiveness (Thornhill & Gangestad, 1999). Therefore it could be argued that the finding is more general and it is unattractive people who are implicitly associated with disease. If this is the case, does it decrease the value of the finding? Fortunately, it does not. Whether it is the birthmark specifically or unattractiveness more generally that people perceive and associate with disease, it doesn't negate the fact that heuristic cues activate disease cognitions at an automatic level despite the availability of honest, rational knowledge to the contrary. It is the

differential use of information which is interesting part of both the psychological and evolutionary story.

Comments on the Evolutionary Perspective

Evolutionary psychology is, above all, a theoretical a perspective for investigating how, and possibly why, our psychological systems function the way they do. It is based on the premise that the way we think and react to our contemporary environment is partially the result of the survival threats we have faced throughout the course of evolution. As it applies to this study, the evolutionary perspective predicted that if we have a set of psychological mechanisms whose function is to protect us from contagious pathogens (a result of a long shared history with pathogens and parasites) they should automatically recognize heuristic cues that could be indicative of illness and activate disease cognitions in response to them. The findings of this study are consistent with this line of reasoning.

We must be cautious, however, about making the claim that humans have an evolved disease-avoidance cognitive system based on the results of this study alone. Although the findings of this study are consistent with one necessary requirement for a psychological system to be considered an adaptation, that it respond automatically to functionally relevant stimuli, automaticity is not sufficient to prove that a system is evolved. Automaticity can also be the result of overlearning. Repeatedly evaluating an object in the same way (i.e. liking a painting) will result in automatic activation of the evaluation whenever that object is perceived (Fazio, Sanbonmatsu, Powell & Kardes, 1986). The auto-motive model by Bargh (1990) takes this idea one step further, suggesting that even such complex cognitive processes as goals can be so associated with the features of the situation in which they are used that they will become automatically activated by those environmental features. Both of these perspectives suggest that automaticity can be gained over the course of a single lifetime, and therefore, on its own cannot support the burden of proof for a psychological mechanism to be considered an adaptation. In

order to be considered to have 'exemplary' evidence of adaptation (which even then is not considered proof for an evolutionary explanation), a psychological mechanism must have evidence from at least 6 of 8 potential sources (psychological, hunter-gatherer and phylogenic, among others) to support such a conclusion (Schmitt and Pilcher 2004). These guidelines, although stringent, should not be taken to imply that any evolved cognitive mechanism will present itself in an identical manner in every individual. It is a misinterpretation of the evolutionary perspective to think that evolved mechanisms are, by definition, deterministic. This view discounts the utility of an evolutionary perspective. The evolutionary perspective seeks to discover how adaptive processes are affected by and function in contemporary societies. As such it allows, and expects, individual differences in personality, culture and experience to differentially affect the outcome of evolved psychological processes. One example of this type of work is a study by Gangestad and Buss (1993) in which the importance of physical attractiveness (thought to indicate health status) in a mate was looked at across 29 cultures and varying degrees of parasite load. They found that parasite prevalence predicted the value people place on attractiveness. In a broader sense, they demonstrated that an automatic adaptive process, the assessment of attractiveness in a potential mate, is more or less important as a result of an environmental condition, the prevalence of parasites. Our understanding of adaptive processes and social cognition in general will benefit from further studies that focus on the interaction of evolved processes and contemporary influences.

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Table 1. Correlations between individual difference measures and IAT scores

Variable	Cronbach's alpha	r	p
Perceived Vulnerability to Disease Germ Aversion	.67	-.03	.82
Perceived Vulnerability to Disease General Beliefs	.88	.17	.24
Disgust	.88	-.14	.35
Need for Cognition	.89	.06	.67
Belief in a Dangerous World	.83	.08	.58
Big Five Inventory (Personality)			
Extraversion	.84	.24	.09
Agreeableness	.82	-.06	.68
Conscientiousness	.85	.00	.98
Stability	.80	-.12	.42
Openness	.80	.04	.78

Table 2. Correlations between individual difference variables and disease salience

Variable	Disease r	p	Accident r	p
Perceived Vulnerability to Disease Germ Aversion	-.16	.46	.18	.37
Perceived Vulnerability to Disease General Beliefs	.04	.84	-.34	.09
Disgust	.13	.54	.14	.50
Need for Cognition	-.08	.72	-.05	.80
Belief in a Dangerous World	-.38	.07	.32	.11
Big Five Inventory (Personality)				
Extraversion	-.17	.42	-.32	.11
Agreeableness	-.05	.80	.14	.45
Conscientiousness	-.45	.03	.36	.07
Stability	.02	.92	.24	.23
Openness	.01	.95	-.07	.70

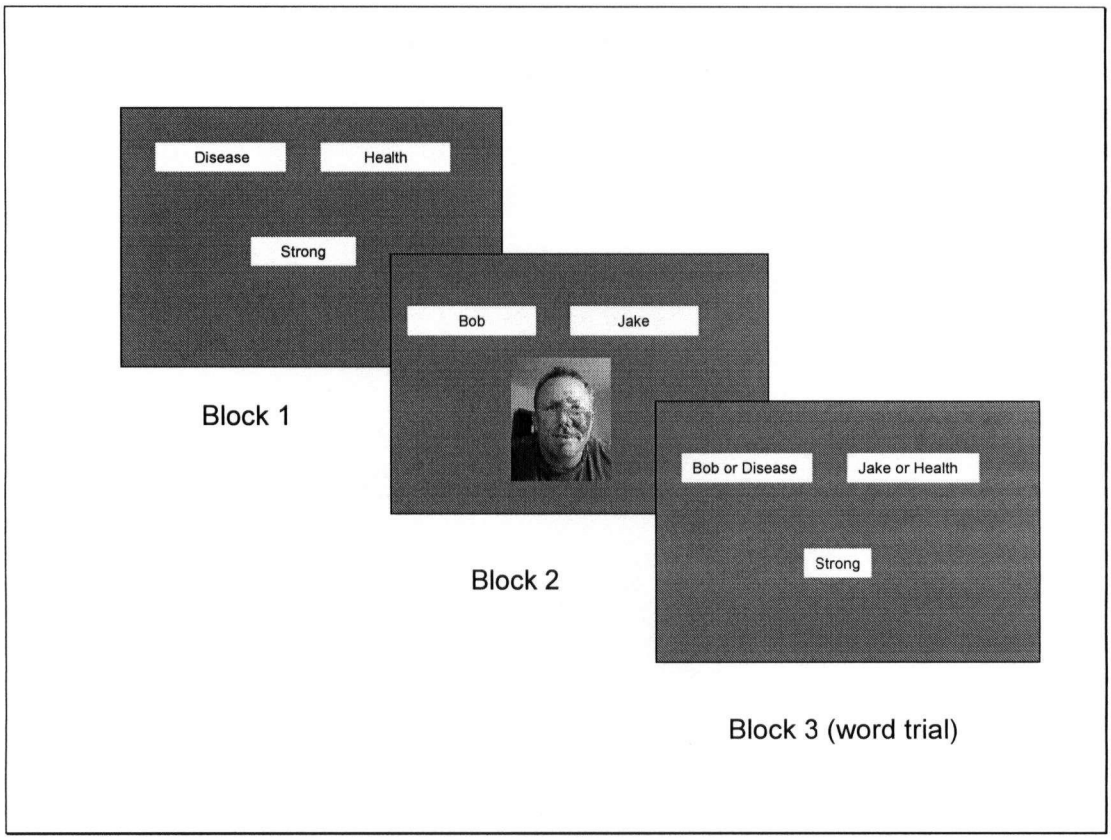

Figure 1. Schematic of the first three blocks of the implicit association test (IAT). These are the IAT screens as the participants see them. The labels remain in place for all trials in each block. The stimulus being categorized, words in Block 1 or the pictures in Block 2, are presented in the center of the screen and remain on the screen until the category key is pressed, at which point it is replaced by the next stimulus. In Block 3, the stimuli are both words and pictures in random order. Block 4 is the same as Block 2, except the name labels are reversed, so Bob is on the right and Jake is on the left. Block 5 is the same as Block 3, but the Jake and Bob placements introduced in Block 4 are maintained, such that Jake or Disease are on the left label, and Bob and Health are on the right.

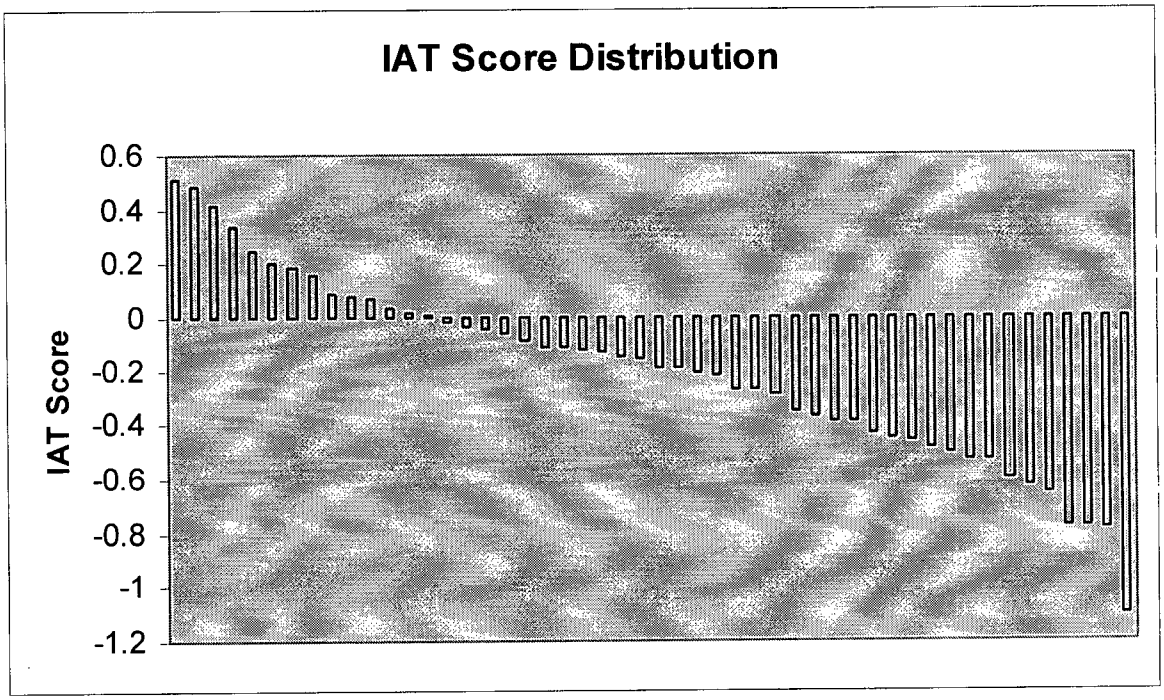

Figure 2. Score distribution for the implicit association test (IAT). Each bar represents a single participant's IAT score. Negative scores indicate Bob is associated with disease concepts more quickly than Jake. Positive scores indicate Jake is associated with disease concepts more quickly than Bob.

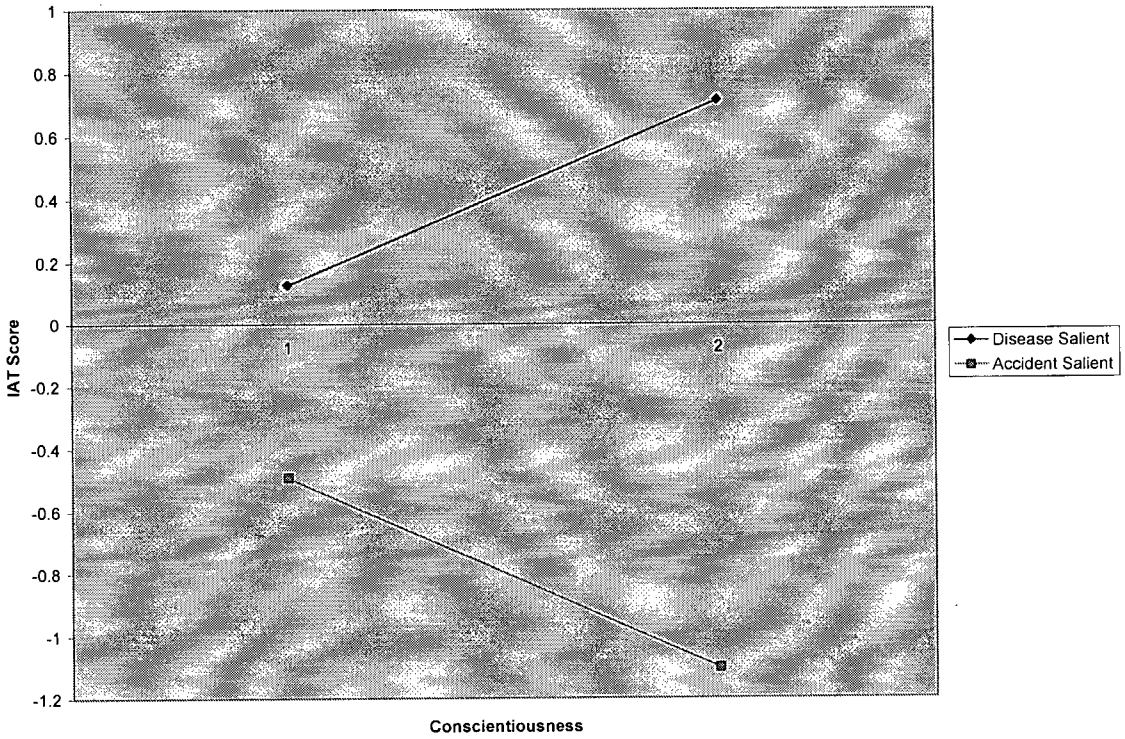

Figure 3. Interaction between Conscientiousness and Disease Salience

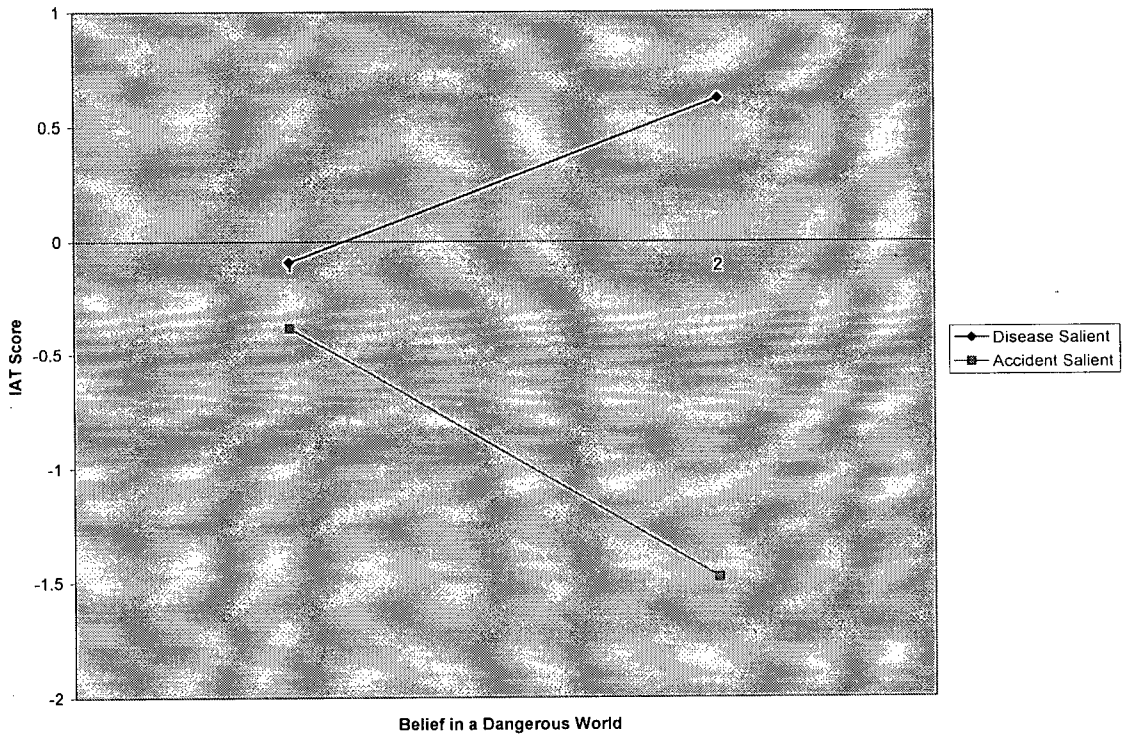

Figure 4. Interaction between Belief in a Dangerous World and Disease Salience