## DISEASE AVOIDANCE MECHANISMS AND THEIR IMPLICATIONS

by

Lesley Alexandra Duncan

M.A., University of British Columbia, 2005

B.A., University of British Columbia, 2002

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#### ABSTRACT

Pathogens and parasites posed significant fitness threats to our ancestors. As a consequence of these enduring threats, there are likely to have evolved a set of cognitive and affective systems designed to facilitate the behavioral avoidance of disease-causing pathogens and their carriers – including individuals who are already infected. The behavioural immune system is a suite of attentional, affective, cognitive, and behavioural responses which function to decrease the probability of contracting pathogens by activating aversive responses to indirect cues that heuristically connote the presence of infectious agents. These cues, however, are at best probabilistically related to the actual presence of pathogens, because the majority of pathogens are too small to be detected. Specific hypotheses were developed to test the influence of pathogen avoidance motivations on three aspects of social cognition. The first focuses on individual variation in concerns with pathogens. The second topic addressed pertains to the types of physical features that act as triggers to activate the behavioural immune system. The third topic addressed the extent to which pathogen avoidance mechanisms play a role in the way we learn cues which connote pathogen presence. In conclusion, this thesis provides evidence which is consistent with the operation of a psychological system which functions to prevent the transmission of infectious threats. The results reported here represent both a substantial contribution to our understanding of the subtle effects of these processes on early cognitive process and a starting point for the application of our existing knowledge to solving real world problems that have great potential for providing social and theoretical rewards.

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## LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
FA	False Alarm
Н	Hit
IAT	Implicit Association Task
LSD	Least Significant Difference
OCD	Obsessive Compulsive Disorder
PVD	Perceived Vulnerability to Disease

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#### **CHAPTER 1: INTRODUCTION AND OVERVIEW**

Infectious diseases, pathogens, and parasites have been a consistent threat to human fitness and have a long shared history with the human species (Araujo & Ferreira, 2000). The specific aspect of this shared past on which this thesis will focus is the powerful impact that our lengthy co-existence with disease causing pathogens and parasites has had on human reproductive fitness. Briefly, pathogens increase their own fitness by mobilizing their host's resources to serve their own fitness goals. These goals are frequently at odds with the goals of the host. Therefore, as potential hosts, we increase our own fitness by preventing infection. This can be accomplished by developing increasingly sophisticated pathogen detection and avoidance abilities. The evolutionary implication of this relationship for humans is that those individuals who were best able to avoid contracting pathogens had the best chance of surviving and reproducing, setting the stage for the evolution of sophisticated anti-pathogen/parasite defenses. This thesis focuses on the influence that this co-existence has had on our contemporary psychological systems in general, and person perception more specifically.

In the course of Chapter 2, I describe how the physical or "real" immune system is an example of this type of adaptation, which will lead into a discussion of the adaptive trade-offs that occur. In the case of the physical immune system, there are great benefits to being able to fight off those pathogens who do manage to invade our bodies. However, the immune system does not operate without a cost to the individual. Activating and maintaining immune processes (e.g. fever) is expensive in terms of caloric resources, as well as being physically debilitating in terms of opportunities for activity or social interaction. In addition to costs, the physical immune system also has limitations – it can only fight germs once they enter the body, it cannot prevent them from getting in. Since the system is expensive to run, it would be beneficial to have defenses which would prevent germs from entering our systems. One way to achieve this initial defense is by avoiding close contact with sources of infection (Loehel, 1995). To achieve this behavioral avoidance requires psychological mechanisms to coordinate both the identification and subsequent behavioral avoidance of any potential source of infection, including conspecifics who may be especially likely to harbor them (Schaller & Duncan, 2007).

The next section of the introduction provides evidence of behavioral avoidance of contagious conspecifics in non-human animals ranging from lobsters (Behringer, Butler, & Shields, 2006) to chimpanzees (Goodall, 1986). Although there is a great deal of diversity in the specifics of these systems, they share one important characteristic: each system picks up on indirect cues of pathogen presence, a necessity since pathogens and many parasites are not directly detectable.

I then explain the pathogen avoidance system in humans, the behavioral immune system, which is a specialized set of mechanisms that coordinate cognitions, attention, associative learning, emotion and behavior with the unconscious goal of avoiding contacting and contracting infectious diseases. A brief summary of the requirements for effective pathogen avoidance functions follows. The first step in avoiding pathogens is learning which cues are indicative of pathogen presence. Pathogens are not directly detectable; therefore we must rely on potentially fallible cues to signal their presence. Once these cues are learned, the system should be hypervigilant to these cues, because the costs of contracting an infectious disease (e.g., debilitation, death) are especially high. The specific processes by which the behavioral immune system achieves behavioral avoidance are still unknown, but the general process is hypothesized to be the following: an individual notices a cue that connotes pathogen presence (in either their social or physical surroundings), which elicits an emotional response (disgust) and disease related cognitions, which contribute to the behavioral avoidance of the eliciting stimulus.

There are two dilemmas inherent in the operation of the Behavioral Immune System. The first is a signal detection problem which occurs because the cues that we rely on to indicate pathogen presence are necessarily indirect, and therefore fallible. As a result, we face balancing two kinds of inference error - a bias toward false positives, which results in unnecessary avoidance of disease cues, or a bias toward false negatives, which increases the chances that we will contact and contract pathogens. As outlined above, the adaptive solution is the avoidance of potential pathogen carriers. Therefore, the behavioral immune system evolved to minimize false negatives. Consequently, we are sensitive to an overly-general set of cues which connote potential pathogen presence and will therefore err on the side of false positive decisions where disease connoting cues are concerned. The implication of this default setting is that we may respond aversively to superficial cues that heuristically connote the presence of disease, even when those cues are wrong. This has further implications for person perception, prejudice and anti social behaviors.

The second dilemma in the behavioral immune system involves balancing the functional costs and benefits associated with overgeneralization of possible disease connoting cues and the behavioral avoidance of individuals that result. These costs and benefits conceptually parallel those involved in the physical immune system, which effectively fights invading pathogens but is too metabolically expensive to run non-stop. The disease avoidance benefits of behavioral avoidance protect against contracting pathogens, but simultaneously limit reaping many benefits (e.g. reproduction) of social interaction. It is proposed that the behavioral immune system solves this problem by being functionally flexible. What this means is that the sensitivity of the system to disease-relevant cues varies depending on extent to which potential benefits seem to outweigh costs. The optimum balance is one which minimizes costs and maximizes benefits. This variability can be seen at different levels of analysis – across individuals, contexts, and even across cultures. Aversive responses to parasite-connoting cues in others is likely to be stronger among people who chronically feel vulnerable to contagious disease (e.g. individuals with actual or perceived weak immune systems, individuals with contamination based Obsessive Compulsive Disorder; OCD) or under circumstances in which the threat of contagious disease is especially salient (e.g. among Mexicans during the NIHI (swine flu) outbreak in that country).

I then review evidence bearing on the behavioral immune system itself and on its implications for social cognition. One line of research focuses on the possibility that the emotion of disgust evolved as an adaptive response to communicable threats (Curtis & Biran, 2001; Curtis, Aunger, & Rabie, 2004). Research which documents our tendency to respond aversively to a range of truly diseased people demonstrates the functioning of this system when disease cues are correctly identified (Bishop, Alva, Cantu, & Rittiman, 1991; Crandall & Moriarty, 1995). There is also evidence that functional flexibility of chronic concerns with disease influences the perception of healthy and sick looking individuals (Welling, Conway, DeBruine, & Jones, 2007). Taken further, there is a growing body of research which finds that overgeneralization of disease cues causes prejudice towards various groups of individuals who deviate from the perceiver's expected prototype, displaying cues which connote pathogen presence. The range of these cues is quite striking – they include physical deviations such as disfigurement (Duncan, 2005) disability (Park, Faulkner, & Schaller, 2003) and obesity (Park, Schaller & Crandall, 2007) and result in behavioral avoidance, negative cognitive associations and prejudicial attitudes. They also include more abstract deviations such as subjective ethnic or cultural foreignness. For example, individuals who are chronically concerned with disease are especially likely to hold xenophobic and/or ethnocentric attitudes (Faulkner, Park, Schaller, & Duncan, 2004; Navarette & Fessler, 2006; Hodson & Costello, 2007). Some of these studies also show evidence of individual and contextual level functional flexibility. Finally, I will review research that investigates the effects of functional flexibility at a cross-cultural level, including findings that disease concerns influence broader aspects of social interaction including mate choice and personality (Gangestad & Buss, 1993; Schaller & Murray, 2008).

Although there is a substantial amount of evidence supporting the hypothesized implications of the behavioral immune system, many questions remain unanswered. One of these questions concerns the range and relative strength of cues that may trigger the system. There is evidence that pathogen avoidance processes contribute to prejudice towards obese and disabled individuals; it may well be at the root of prejudices towards other groups of individuals who display cues which trigger disease avoidance emotions and cognitions. One possible cue is suggested by the obesity results – it may be the case

that extreme weight deviation in the form of emaciation also triggers the system. Another cue may be the predicable changes in facial features that occur as a result of aging.

There is also little known about the automaticity of the Behavioral Immune System. It is activated by cues that connote pathogen presence however, these cues are fallible and it may be the case that the provision of objective information about the health status of a person or situation may override the system. Another question focuses on the type of cognitions that are activated when pathogen relevant information is detected. There is little information which addresses the extent to which these cognitions are generally aversive or more specific to disease or contagion concepts.

Chapter 2 concludes with an overview of the goals of each of the following chapters in the thesis. Briefly, Chapter 3 provides a psychometric validation of the 15item version of the Perceived Vulnerability to Disease Scale. This validated scale provides a means of investigating the functional flexibility of the behavioral immune system by measuring chronic concerns with vulnerability to communicable disease and examining the relationships with a variety of outcome measures. The next four chapters provide background information and empirical tests, the results of which provide answers to each of the following conceptual questions: Chapter 4: How automatic are responses to facial disfigurement? Chapter 5: Is Extreme thinness a triggering cue of the disease avoidance system? How automatic are the responses to weight deviations? Chapter 6: Are old age features a triggering cue of the disease avoidance system? Chapter 7: How do we learn the cues associated with pathogen presence? Is observational social learning involved? Finally, Chapter 8 reports on how the results of these studies contribute to the functioning of the behavioral immune system, including the ways in which pathogen avoidance mechanisms influence person perception. It concludes by suggesting avenues for future research which build on the results of the studies reported in the previous chapters.

## CHAPTER 2. THE BEHAVIORAL IMMUNE SYSTEM: ITS EVOLUTION AND SOCIAL PSYCHOLOGICAL IMPLICATIONS

#### **Pathogens and Pathogen Avoidance Systems**

Parasites are an enduring part of human history, and as such have posed consistent threats to survival and reproduction (Maynard-Smith, 1978; Tooby, 1982). Infectious bacteria and viruses have existed on the planet far longer than people and other primates have; and as long as animals have had guts, there have been worms and helminthes that infected those guts (Brothwell & Sandison, 1967; Ewald, 1993; Van Blerkom, 2003). Parasites (organisms that exploit a host organism to grow, feed, and find shelter on or in) are defined by their relationship with their host, such that they divert some portion of the host's resources to achieve their own survival, reproduction and transmission goals. Pathogens are infectious biological agents that cause disease or illness for their host, most of which can be categorized as microparasites (e.g., viruses, bacteria, fungus). Although pathogens and parasites can be considered distinct classes of agents, they are both essentially microscopic predators and, for the purpose of this thesis, the terms will be used interchangeably.

Not all parasites are harmful, but many are. The European plague outbreak in the Middle Ages killed millions (Lippi & Conti, 2002). Bacterial diseases such as smallpox and tuberculosis wiped out up to ninety percent of the native populations in the Americas (Guerra, 1993). The influenza outbreak after World War 1 was the cause of death for millions people – many times more than the war itself (Patterson & Pyle, 1991). These are all relatively recent events, but the dangers posed by parasites are hardly recent phenomena. The very fact that humans and other animals have evolved extraordinarily

sophisticated immune systems attests to the antiquity of parasitic infections, to the enormous selection pressures that parasitic infections have exerted on animal populations, and to the fitness-conferring benefits associated with any adaptation that contributes to an anti-parasite defense system.

The immune system consists of two main components – the innate and the acquired. The innate system is the immediate response to infectious threat. It recognizes non-self entities in the body and activates a maximally efficient and non-specific general response to neutralize the threat (Kawai & Akira, 2006). Although an effective initial response, the innate immune response cannot confer long term resistance to any specific infectious agent. Instead, it identifies the threat for the acquired immune system and maintains the short term defense against invading agents that allows the adaptive system time to provide a strong, tailored response to the specific response, it is the acquired component of the immune system that retains a memory of the specific invader, associating the identifying characteristics of the pathogen with the tailored response. This memory allows for a more efficient, specific response the next time the same pathogen is detected in the body.

The immune system is just one kind of anti-parasite defense system, and while brilliantly effective in many ways, it has its downsides as well. The physiological mobilization of immunological defenses often consumes substantial metabolic resources, robbing individuals of energy that might be devoted to other fitness-enhancing tasks (Brown, 2003; Klein & Nelson, 1999; Lochmiller & Deerenberg, 2000). Specific features of immunological defense, such as fever (an adaptation designed to kill heatsensitive parasites; Nesse & Williams, 1995) and nutrient marshalling (which supports the required hypermetabolic rate required for immune function; Michie, 1996) are even further debilitating. In addition to the limited supply of metabolic resources, the immune system is restricted by the boundaries of physical anatomy. It can only combat infectious agents after they are detected within the individual's body. It cannot prevent contact in the first place.

Organisms, especially those belonging to longer lived species such as humans, are well-served by the existence of an immune system. But much research shows that they are best served when the immune system is engaged as infrequently as possible, to the extent that "one would predict selection has favored an immune strategy that minimizes the risk of developing a full blown, clinical infection" (pg. 5; Lochmiller & Deerenberg, 2000). In other words, an ounce of prevention is worth a pound of cure. It has been suggested that many animals, including humans, have an evolved capacity to detect symptoms of parasitic infection in others, and to respond with behaviors – such as behavioral avoidance and social rejection – that reduce the likelihood of contracting that infection oneself (Freeland, 1976; Eibl-Eibesfeldt, 1979; Kurzban & Leary, 2001; Schaller, Park, & Faulkner, 2003). It is entirely plausible, therefore, that selection pressures posed by parasites led to the evolution of an additional anti-parasite defense system as well, one designed to inhibit contact with infectious agents in the first place.

The operation of some sort of evolved pathogen avoidance system is supported by abundant evidence. There are a wide range of pathogen sources in the physical environment, and it is expected that we should overgeneralize cues from any potential source of infectious threat – be it a bodily secretion (e.g., feces), a vector of infectious

disease transmission (e.g., a mosquito), an inappropriate food source (e.g. spoiled fruit) or immediate surroundings (e.g., moldy bathrooms). Pertaining to foraging and feeding behavior, it has been found that sheep selectively avoid grazing on grasses contaminated with their own fecal waste (Cooper, Gordon, & Pike, 2000). People too show a disgust reaction and behavioral rejection toward foods that are potentially contaminated by parasites (Rozin, Millman, & Nemeroff, 1986).

However, it is not just foods and other objects that host potentially-dangerous parasites. Individuals of our own and other species do as well. Therefore is it not surprising that pathogen avoidance systems would also compel avoidance, and even outright rejection, of conspecifics that demonstrate symptoms of physical illness. Bullfrog tadpoles selectively avoid swimming in proximity to tadpoles infected with debilitating intestinal parasites (Kiesecker, Skelly, Beard, & Preisser, 1999). Healthy lobsters who are typically gregarious avoid interacting with conspecifics infected with a lethal virus (Behringer, Butler, & Shields, 2006). Laboratory mice selectively avoid mating with mice that are infected with parasitic viruses, protozoa and larval nematodes (e.g., Kavaliers, Colwell, Braun, & Choleris, 2003). Chimpanzees display fear and avoidance of individuals displaying behavioral anomalies resulting from polio (Goodall, 1986). Human beings demonstrate a tendency to maintain interpersonal distance from others who are described as diseased, largely as a function of the extent to which the alleged disease is perceived to be contagious (Crandall & Moriarty, 1995). The fact that behavioral avoidance occurs across a wide range of vertebrate species attests to the primitive evolutionary roots not only of the anti-parasite system itself, but also its effects on social behavior.

#### **Psychological Mechanisms Facilitating Behavioral Avoidance**

Any effective defense system requires the coordinated operation of at least two kinds of underlying mechanisms – mechanisms designed to detect cues signaling a threat, and other mechanisms that respond to those cues by mobilizing some sort of defensive response. This is certainly the case for the immune system. Specific mechanisms distinguish the difference between organic entities that belong in the body and those – like viruses – that do not. When pathogenic intruders are detected, other mechanisms within the system are triggered that attempt to repel those pathogens through a variety of physiological means (e.g., increases in body temperature to kill heat-sensitive bacteria; mobilization of cells that function specifically to attack and kill the cells of viral intruders). In an analogous fashion, successful avoidance of pathogens would also require mechanisms designed for detection and response.

#### Cue Detection and Response

Known pathogen detection mechanisms employ the organism's ordinary sensory organs as a means of recognizing parasite-connoting cues at a distance. Frogs use specific kinds of chemical signals for this purpose (Kiesecker et al., 1999). Salamanders rely on pheromonal markers (Maksimowich & Mathis, 2001). Many mammals use olfactory cues (Kavaliers et al., 2003), and surely people do too (Mandairon, Poncelet, Bensafi & Didier, 2009). (Hence our hyper-sensitivity to the smells of feces, rotting meat, and unwashed bodies.) However, given our highly-developed visual systems, it is likely that human parasite-detection mechanisms are sensitized to detect visual cues signaling possible parasitic infection. The use of visual cues also allows for the detection of many different kinds of fitness-connoting signals from a relatively safe distance, providing an additional advantage than if we relied on our less sensitive senses of touch or taste. It is important to note that it is the indirect cues of potential pathogen presence to which we are attuned and not the pathogens and parasites themselves.

Why might this be the case? Many sources of infection, including most bacteria, viruses, fungi, and helminthes, are too small to be seen with the naked eye. Detection of likely pathogen carriers is further complicated by the fact that there is no single cue, or set of cues, that reliably indicate the presence of pathogens. Each pathogen attacks its host in a way that best promotes its own survival, reproduction, and transmission; causing unique and often subtle damage to the host (e.g. the symptoms of chicken pox differ from the symptoms of polio which differ from the symptoms of the common cold). Each pathogen also has its own level of virulence, developmental timeline, and vector of transport between individuals of a host species. Although it may be difficult to detect the presence of pathogens, it is by no means impossible. There are categories of cues that are more reliably associated with infection than others, some of which are by-products of the human immune system attempting to fight off the infection. It is therefore likely that the cue detection mechanisms are attuned to the extent to which certain types of cues are likely to be honest indicators of pathogen presence.

A successful pathogen avoidance system should also be comprised, in part, by a set of mechanisms designed to respond in functionally-useful (i.e., fitness-enhancing) ways once a parasite-connoting cue has been detected. Behavioral avoidance of sources of infection is the functionally-relevant "goal" for which these mechanisms are designed. But behavior doesn't just happen; it is the product of underlying psychological reactions, associations between the eliciting cue and the appropriate set of responses. In humans, more so than in tadpoles and salamanders, there is reason to expect that these underlying psychological reactions involve attentional, affective and cognitive processes.

Attention is a limited resource. Our physical and social environments are complex. As a result of these two facts, it has been proposed that attentional mechanisms evolved in such a way that attention will be captured by cues particularly relevant to fundamental fitness-related needs, even in situations or environments where there are many distractions (Duncan, Park, Faulkner Schaller, Neuberg & Kenrick, 2007). There is little evidence available that directly addresses the allocation of attention to cues related to communicable threats (see Charash & McKay 2002 for an exception). However, one recent study found that disfigured faces were more likely to attract and hold attention than were normal faces, but only when contagious threat was made temporarily salient (Akerman, Becker, Mortensen, Sasaki, Neuberg & Kenrick, 2009). Research on attention to possible sources of non-communicable physical threats is also consistent with this perspective. For example, it has been found that snakes and other people displaying anger expressions attract (or hold) attention (Fox, Russo, Bowles, & Dutton, 2001; Öhman, Flykt, & Esteves, 2001; Schupp et al., 2004). Related to mating, another goal with important fitness consequences, it has been found that attention is functionally allocated to both potential mates and potential rivals (Maner, Gailliot, Rouby, & Miller, 2007; Duncan et al., 2007). Additionally, it is expected that the extent to which attention is selectively allocated to cues of pathogen presence will vary in response to regulatory cues in the immediate environment and individual motivations (Gangestad & Simpson, 2001, Schaller, Park, & Kenrick, 2007). Recent work in other fitness relevant domains

has shown similar influences on attentional processes (Maner, Gailliot, & Miller, in press).

Emotions, of course, are instrumental in motivating immediate behavioral reactions. Both fear and disgust have been shown to motivate behavioral avoidance of specific stimuli (see Woody & Teachman, 2000 for a review) and it has been suggested that pathogen avoidance motivations contribute to the specific phobias most closely related to pathogen transmission (Ware, Jain, Burgess, & Davey, 1994; Matchett & Davey, 1991; Olatunji, Sawchuk, Lohr, & de Jong, 2004). However, a growing body of evidence, which will be discussed in a later section of this chapter, indicates that disgust in particular is likely to be an important part of any pathogen avoidance system (Curtis & Biran, 2001; see Oaten, Stevenson & Case, 2009 for a review). While the capacity for disgust may have arisen originally to protect individuals from negative health consequences resulting from the ingestion of toxins and other food-based contaminants (Rozin & Fallon, 1987), the mechanisms involved in the disgust experience appear to have evolved to serve a parasite-defense function as well (Oaten, Curtis & Biran, 2001; Rubio-Gogoy, Aunger & Curtis, 2006). One line of evidence which speaks to the involvement of disgust in the avoidance of communicable threats is that it is elicited by the visual perception of skin lesions, runny noses, and other obvious symptoms of parasitic infection (Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001).

Disgust may motivate an immediate and impulsive avoidant response, but it is unlikely that the emotional experience alone can compel wariness about future interactions, nor can disgust alone precipitate more planful actions – such as coordinated efforts at quarantine and social exclusion – that help to eliminate the long-term threat posed by possibly parasitized individuals. To facilitate these kinds of fitness-relevant behaviors, a variety of cognitive processes must also be engaged. In humans it is likely that the detection of any parasite-connoting cue has immediate implications on higherorder cognitive processes involved in inference and memory. At the very least, it is expected that the detection of such a cue would trigger cognitions connoting disease (e.g., if you see my flushed cheeks and runny nose, semantic concepts relevant to disease may be automatically activated into your working memory) which may then influence the specific nature of inferences, attitudes, and other enduring social knowledge structures. These, in turn, are likely to have consequent effects on social decision-making and behavior, decreased likelihood of interaction with individuals who deviate from a norm, and a decreased likelihood of pathogen transmission.

In summary, a complex set of coordinated mechanisms is required to prevent the spread of pathogens by maintaining physical distance from potential hosts or other sources of communicable threat. This goal is achieved by attending to cues likely to connote pathogen presence which in turn elicit disgust, the affective component of the system. Disgust effectively initiates immediate behavioral avoidance, and cognitive processes are activated which associate the disgust eliciting cue with concepts related to disease and general aversion that result in longer term avoidance and more complex aversive cognitive associations with the pathogen connoting cue.

If these responses influenced reactions only to truly diseased individuals, it would still constitute a worthwhile topic of scientific inquiry, but would perhaps be of limited relevance to social psychological phenomena. In fact, however, this suite of mechanisms appears to operate in such a way that it often precipitates aversive reactions to individuals who are perfectly healthy. This appears to be a result of the necessary reliance of the detection mechanisms on indirect, and therefore imperfect, cues of pathogen presence. This in turn sets up two dilemmas which influence the activation and operation of the entire set of pathogen avoidance mechanisms. As a consequence, pathogen avoidance processes are directly implicated in many phenomena that lie squarely in the center of the social psychological literature. To understand why, it is useful to apply the logic of signal detection.

#### The Signal Detection Problem and its Solution: Oversensitivity and Overgeneralization

The cue detection system is not designed to respond to the presence of parasites, per se, but rather to the perceived presence of parasites as indicated by superficial sensory signals. Many of these cues, presumably, are probabilistically predictive of the presence of parasites. But even the most diagnostic of symptoms is highly imperfect. (Some healthy people cough, and some sick people do not.) The result is a classic signal-detection problem, with the potential to make both false-positive errors (a healthy person is erroneously perceived to be sick) and false-negative errors (a sick person is erroneously perceived to be healthy). Worth noting is that it is impossible to simultaneously maximize the ability to prevent both false-positive errors and false-negative errors. Therefore, any general tendency toward avoiding false-positives necessarily leads to an increase in the rate of false-negatives, and vice versa.

Evolutionary logic indicates that this dilemma will be resolved in favor of minimizing the error that poses the greatest costs to an individual's fitness, even though it results in an increased rate of making the other kind of error (Haselton & Nettle, 2006; Nesse, 2005; see also Gangestad, 2007, for a broader discussion of evolved signal

detection systems). To understand which type of bias is most adaptive, the costs of each type of error need to be determined. The fitness costs associated with false-negative errors (thinking an infected individual is healthy) result from a failure to distance oneself from a source of communicable threat and include contracting pathogens, suffering the resultant illness, physical debilitation, decreased social and reproductive opportunities, and even death. The fitness costs associated with false-positive errors (thinking a healthy individual is infected) result from avoiding interactions with non-contagious individuals and include decreased numbers of potential allies, benefactors and mates. In this case, as with most evolved systems designed for self-protection, the fitness costs associated with false-negatives are considerably greater than those associated with false-positives. And so the adaptive resolution is clear: we display a liberal bias and err on the side of falsepositives (Kurzban & Leary, 2001). Thus, we are hyper-vigilant for signs of sickness, and any such signal – whether it is actually a tubercular cough or merely some innocuous throat clearing, and whether it is a rash of infectious pox or merely some superficial allergic inflammation – is liable to trigger aversive emotional, cognitive, and behavioral reactions.

It is very unlikely that there was a finite and stable set of symptoms associated with parasitic infections in ancestral environments, just as there is no necessary or sufficient symptom in contemporary pathogenic infections. Different kinds of parasites would have produced different infectious symptoms. (The rash diseases – such as measles, mumps, and scarlet fever – are all evolutionarily ancient, as is tuberculosis, and all are associated with somewhat different specific symptoms). Different individuals are likely to have responded differently to the same kind of parasitic infection. (E.g., the

rhinovirus may manifest in a cough, or in a runny nose, or both, or neither). And parasitic species themselves – especially bacteria and viruses – evolve at an exceptionally rapid pace, an evolution that is reflected in the highly variable nature of infectious symptoms over time (Ewald, 1993). A signal detection system that was calibrated too tightly to specific kinds of symptoms would have resulted, over time, in many costly false-negative errors. Additionally, any tie to specific cues would likely have been exploited by pathogens who are equally motivated to increase their fitness at the expense of the host. More adaptive would be a system that had the potential to respond to a much broader and more crudely-defined range of sensory cues likely to indicate pathogen presence.

However, even though there is adaptive pressure towards hypersensitivity and overgeneralization, some criterion needs to be in place to prevent every individual and situation from activating the system. Therefore, instead of learning specific cues that are associated with pathogen presence, a more effective approach to pathogen detection is to learn the physical and behavioral characteristics of healthy, species typical prototypes, and treat deviations from this norm as cues indicative of potential pathogen presence. The use of this type of decision rule results in a system which errs not merely on the side of oversensitivity, but also on the side of overgeneralization: Any gross deviation from the species-typical norms in morphology and motor behavior may be implicitly interpreted as symptomatic of a parasitic infection, and so may trigger the behavioral immune response (Kurzban & Leary, 2001; Zebrowitz & Montepare, 2006).

Thus, we see that pathogen avoidance mechanisms likely operate in a manner analogous to the physical immune system. Just as the anti-pathogen defense system provided by the physicall immune system is hypersensitive to intrusion, and may be mobilized in response to organic matter that is entirely benign (or even beneficial, as in the case of organ transplants), this system would also have to respond in a hyper-sensitive and over-general way to the perceived presence of parasites in the sensory environment. This has obvious and far-reaching implications for social perception and behavior: Simply because people may display some superficial form of non-normality, we may respond to them – even if they are perfectly-healthy – as though they are carriers of some contagious disease.

#### The Cost / Benefit Problem and Its Solution: Functional Flexibility

Anti-parasite defense systems confer adaptive benefits, but they also cause the individual to incur costs any time they are triggered. For instance, when our immune system is mobilized by an actual parasitic infection, we typically suffer some form of temporary debilitation (e.g., energy loss associated with fever and nutrient marshalling). There are costs associated with the operation of psychological anti-parasite systems as well. For example, the required attentional, emotional, cognitive, and behavioral responses triggered by the cue detection system all consume metabolic resources. Additionally, because of the finite cognitive and attentional resources available to an individual at any moment, the allocation of resources to pathogen avoidance limits the extent to which other adaptive behaviors might be engaged. (E.g., disgust and behavioral avoidance are typically incommensurate with mating motives; Rempel & Baumgartner, 2003.) The social cost of limiting interactions with potentially valuable others is much less than the physical costs of contracting pathogens, but only to the extent that pathogens pose an actual threat. If there is very low threat of contracting communicable pathogens, the cost/benefit balance shifts away from favoring false negatives. Therefore, like many

adaptive psychological systems (including other systems involved in self-defense; e.g., Grillon et al., 1997; Maner et al., 2005; Schaller, Park, & Kenrick, 2007), the operation of the suite of anti-parasite mechanisms is likely to have evolved to be functionally flexible and responsive to regulatory cues. Aversive responses to potentially-parasitized others are most likely to be triggered when additional cues in the immediate environment indicate that the functional benefits of these responses are especially likely to outweigh the functional costs. Specifically, functional flexibility allows for contextual optimization of the system, fine tuning it to allow for a reduction in the likelihood of activation, and therefore maximization of social benefits when the level of communicable threat is low, while still maintaining a high level of activation when the communicable threat level is high, maximizing the fitness benefits of pathogen avoidance.

Several classes of regulatory cues are expected to influence the operation of pathogen avoidance processes. In particular is the criterion that is set for deviations from the norm to activate the system, and the extent to which this criterion is adjusted in response to different levels of communicable threat. Some cues may lie in temporary features of the immediate situation. Information present in any specific context may make germs and their potential transmission especially salient for a short period of time. Being able to detect these cues and adjust the activation of anti-parasite mechanisms would allow the individual to respond appropriately to short term fluctuations in the threat of common communicable pathogens (e.g., flu season), or the introduction of novel pathogens and epidemics (e.g., SARS).

Other cues may lie in chronic features of the local ecology. Chronic pathogen loads in the immediate environment vary from region to region. Therefore, in some geographical locations, relative to other locations, parasitic diseases have posed an especially strong threat to individual fitness. Thus it is not surprising that the intensity of this threat is manifested in persistent consequences on local rituals and norms pertaining to hygiene, food-preparation, and so forth that differ between cultures and locations (Sherman & Billing, 1999).

Yet other cues may lie in chronic individual differences in attitudes, traits, and temperament. People differ in the extent to which they are vulnerable (or, perhaps more importantly, *perceive* themselves to be vulnerable) to the transmission of contagious diseases. As with any other trait, and as demonstrated with the adaptive approach to the signal detection problem, there is no correct amount of concern to have regarding communicable threat. Specific contexts and situations will influence both the cost and benefits of hypersensitivity or unresponsiveness to cues which could connote the presence of communicable pathogens. Therefore, although anti-parasite mechanisms solve an adaptive problem, we should expect to see variability between individuals in the extent to which pathogens and parasites are perceived to pose a threat, which is in turn expected to influence the perception of and responses to potential sources of communicable threat.

Regardless of the locus of these regulatory cues – whether chronic or temporary, and whether rooted in the external environment or a perceiver's own idiosyncratic knowledge structures – the information they provide is likely to moderate the activation of pathogen avoidance responses. If one is unaware of (or feels invulnerable to) the threat of disease, the activation of the system is likely to be muted. On the other hand, if the threat of disease is highly salient (or if one feels highly vulnerable), the reactivity of the system is likely to be more pronounced.

#### **Contemporary Effects of Pathogen Avoidance Motivations**

The logic of functional flexibility provides a useful approach for testing the social psychological implications of the pathogen avoidance systems. For example, this approach suggests that the extent to which aversive reactions to specific kinds of people (even those who are objectively healthy) occurs might be based, in part, on the subtle psychology of anti-parasite defense. If these reactions are moderated by any of the classes of disease-relevant regulatory cues, it implies the operation of parasite avoidance processes. The principles of adaptive overgeneralization and functional flexibility suggest a broad range of implications for contemporary social cognition and behavior. Some of these implications have been empirically tested in recent years. This leads us to an obvious question: Is there any evidence that pathogen avoidance mechanisms are involved in contemporary person perception or social cognitive processes?

#### Disgust

The evolution of disgust as a pathogen avoidance mechanism was explicitly put forth by Curtis and Biran in 2001. Since then, a theoretical shift has taken place in disgust research, such that there is an increased focus on the influence of adaptive pressures posed by communicable pathogens, and the role that disgust plays in motivating behavioral avoidance of sources of communicable threat. There have been three recent papers which have focused on the relationship between disgust and pathogen avoidance goals (Toronchuk & Ellis, 2007; Oaten, Stevenson, & Case, 2009; Tybur, Lieberman, & Griskevicius, 2009).

The first (Toronchuk & Ellis, 2007) argues that disgust is not just a basic emotion but a primary emotional system (see Panksepp, 1998), the development of which arose from original disease avoidance functions. The authors claim that as a primary emotional system, disgust "enables emotional responses to potentially infectious or noxious material, in advance of actual contact with such material" (pg 1800). (Panksepp (2007) contests the elevation of disgust to this status, claiming a lack of evidence required to meet the 'primary system' criterion.) The authors highlight the involvement of the neural systems involved in disgust (most research implicates the anterior insula and amygdala) and further suggest the foundation of disgust lies in links between the 'real' immune system and the central nervous system. Consistent with the pathogen avoidance systems discussed above, the primary emotional system of disgust is proposed to be an evolutionarily ancient response to communicable threat, which has the ability to coordinate complex psychological processes. In humans it works via learned associations which result in both immediate and long term decreases in the hedonic value of stimuli associated with physical illness.

The second paper uses the evidence in the existing literature to test 14 hypotheses which implicate disgust in an evolved psychological pathogen avoidance system (Oaten, Stevenson, & Case, 2009). Although evidence for certain hypotheses are limited, those most central to disgust serving a pathogen avoidance function are supported. Worth noting is that the specific hypotheses with the strongest support are the most consistent with the conceptualization of disgust as an adaptive response to sources of communicable threat. Specifically, the correspondence between cues connoting pathogen presence and disgust eliciting cues, and the ability of disgust eliciting cues to contaminate other objects with which they come in contact. The third paper investigates the possibility that disgust is an adaptive solution to pathogen avoidance and two other categories of adaptive problems, appropriate mate choice and selection of beneficial social partners (Tybur, Lieberman, & Griskevicius, 2009). Factor analysis of disgust elicitors found that the three hypothesized domains do indeed emerge as factors. This perspective on disgust differs in that it extends the role of disgust beyond a pathogen avoidance function. The authors suggest this approach is the most parsimonious explanation of the broad range of cues that elicit disgust, and it has the added benefit of using an a priori approach to understanding this complex emotion. The confirmation of a pathogen specific domain of disgust elicitors is again consistent with its role in pathogen avoidance.

Supporting the theoretical shift towards a pathogen avoidance function of disgust is a large body of empirical research (see Oaten, Stevenson, & Case, 2009, for a comprehensive review). Of these studies, the most compelling is a large, multinational survey in which participants rated the extent to which photographs of objects were disgusting (Curtis et al., 2004). Photographs were paired such that one photo in the pair depicted a disease-salient stimulus; the other was matched to be as similar as possible, without disease relevance (e.g. a smear of viscous fluid on a white towel which is either yellowish with a bit of red (disease) or bright blue (control). Results indicated disease relevant photos were considered significantly more disgusting than the controls. Worth noting is one pairing relevant to interpersonal pathogen cues. The pairing depicted a healthy and a fevered looking individual, and the fevered target was rated as twice as disgusting as the healthy control, suggesting deviations from the healthy norm do elicit
disease as predicted. The elicitation of disgust has also been implicated in actual immune activation (Rubio-Gogoy, Aunger, & Curtis, 2006).

Sensitivity to disgust has been shown to vary as a result of fluctuations in individual vulnerability to pathogens and situational learning. The first trimester of pregnancy involves substantial suppression of the maternal immune response, leaving both mother and fetus particularly vulnerable to pathogens. Women in their first trimester of pregnancy (relative to other trimesters) are more easily disgusted, consistent with the idea that variability in disgust sensitivity could function to compensate for maternal and fetal vulnerability to disease (Fessler, Eng, & Naverrette, 2005). Changes in sensitivity to specific domains of disgust elicitors also occur over the menstrual cycle (Fessler & Navarrette, 2003). Case et al. (2006) provided evidence that primary caregivers found the feces of their own offspring less disgusting than the feces of unrelated children, and that their offspring's feces became less disgusting over time.

The picture emerging from the literature on disgust shows much support for disgust serving a disease avoidance purpose. Although there appear to be some inconsistencies about the best lens through which to view this emotion, and the range of adaptive problems it developed to solve, that disgust is a first response to cues of potential pathogen presence is well supported.

#### Aversive Responses to Superficial Disfigurements and Disabilities

Within the social psychological literature there is now a substantial body of work documenting aversive responses to people displaying non-normative morphological cues of various kinds, including superficial facial anomalies (e.g., scars, birthmarks, substantial asymmetries; Rumsey, Bull & Gahagen, 1982; Edwards & Watson, 1980), and physically disabling conditions (e.g., paraplegia; Snyder, Kleck, Strenta & Mentzer, 1979). Of course there are many conceptually distinct psychological processes that might be triggered by these cues, and which might precipitate negative attitudes and behavioral aversions. Indeed, there have been many different psychological explanations offered for prejudices directed toward, for instance, people with physical disabilities, and many of these processes have nothing to do with parasite avoidance at all (for reviews, see Heatherton, Kleck, Hebl, & Hull, 2000). Is there reason to suppose that, in addition to these other processes, the specific processes implicated in pathogen avoidance also play a substantial role? Yes. Evidence in favor of that assertion emerges from studies designed do at least one of two things. They assess the specific kinds of semantic information that are cognitively associated with morphologically anomalous individuals. Or they test the extent to which these aversive responses are facilitated when perceivers feel more vulnerable to the potential spread of contagious disease, either as a result of chronic concerns with communicable threat or of cues in the environment that make this threat especially salient. Or they do both. These studies not only implicate pathogen avoidance mechanisms in reactions toward a variety of objectively non-contagious peoples, they also document novel phenomena whereby these reactions vary under predictable circumstances.

Park, Faulkner, and Schaller (2003) reported a pair of studies that implicate pathogen avoidance mechanisms in aversive responses to individuals who are physically disabled. There is a large literature documenting the fact that people are uncomfortable around others who are disabled, and often attempt to behaviorally avoid close contact with these others (e.g., Snyder, Kleck, Strenta, & Mentzer, 1979). Might the heuristic operation of anti-parasite processes contribute to this well-known prejudice result? If so, it follows that behavioral avoidance might be especially strong among individuals who are chronically concerned about the spread of contagious diseases. Consistent with this hypothesis, Park et al. (2003) found that individuals who score highly on measure of "perceived vulnerability to disease" (PVD; Duncan, Schaller, & Park, 2009) were less likely to report having friends or acquaintances with disabilities. In addition, Park et al. (2003) reported a study employing reaction time methods to assess the extent to which disabled individuals (compared to morphologically normal individuals) were implicitly linked to semantic information connoting disease. Results revealed that, not only were disabled individuals more likely than non-disabled individuals to be associated with disease, this effect was stronger among perceivers who scored more highly on either the PVD measure or on a measure assessing sensitivity to disgust.

It's worth noting that in this implicit association study, the disabled target individuals were described in such a way that, by any objective standard, they posed no realistic disease threat whatsoever. The results are therefore consistent with the conjecture that this system responds very quickly and automatically to visual cues of morphological anomaly, even when rational appraisal indicates the absence of any realistic threat. Duncan (2005) conducted a strong test of the alleged automaticity of the aversive cognitive response. Participants were provided with brief biographical sketches of two men, and each biographical sketch was accompanied by a facial photograph. One man had a very noticeable "port wine stain" birthmark on his face, but this birthmark was explicitly described as superficial and the man himself was described as strong and healthy. The other man looked just fine, but was described as suffering from a strain of drug-resistant tuberculosis. Participants then responded to a computer-based reaction time task, designed to assess which of the two men was more strongly associated with the semantic concept "disease". Results showed that, across all participants, there was a general tendency to associate disease with the facially-disfigured man (who was known to be healthy) more strongly than the man who was actually known to suffer from a contagious disease (but who looked normal). These results attest to the highlyautomatized nature of the disease-connoting inferences that are generated by the visual observation of morphologically anomalous features: Even when processes of rational appraisal explicitly indicate otherwise, anomalous features such as facial disfigurements implicitly imply the threat of contagious disease. The results are consistent with findings from a previous study that participants who interacted with a confederate who had a fake birthmark reacted physiologically as though the situation was threatening, while those who interacted in the same situation with the same confederates but when the birthmark had not been applied showed a physiological response pattern consistent with challenge, not threat. There was no difference in explicit ratings of the confederates (Blascovich, Mendes, Hunter, Lickel & Kowai-Bell, 2001).

#### Anti-Fat Attitudes

Previous research has suggested that negative attitudes toward fat people are rooted, in part, in personal ideologies and cultural value systems that prescribe hard work, self-denial, and willpower (Crandall, 1994; Crandall & Martinez, 1996). Consistent with this perspective, fat people are commonly stereotyped as lazy, and are especially strongly stigmatized when their obesity is attributed to personally-controllable causes (e.g., Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003). But fat people are also commonly stereotyped as dirty or smelly, and images of fat people tend to arouse disgust (Harvey, Troop, Treasure, & Murphy, 2002) – observations hinting at the possibility that anti-fat attitudes may also be rooted in the operation of anti-parasite processes. This possibility is entirely plausible, given our speculations about how these systems operate. If the detection system is sensitive to any gross deviation from morphological norms, then it's likely to activate aversive responses to individuals with bodies that are either skeletally thin or hugely obese. There has been very little research examining aversive reactions to super-skinny people, but some recent studies explicitly examined whether the heuristic operation of these mechanisms might contribute to anti-fat attitudes.

Park, Schaller, and Crandall (2007) examined whether anti-fat attitudes were predicted by individual differences in perceived vulnerability to disease – focusing specifically on a subscale that assesses wariness of germs and their transmission. Results indicated that these individual differences did indeed predict anti-fat attitudes: People who were chronically more concerned about germs also expressed a stronger dislike of fat people. Interestingly, this effect was especially strong when anti-fat attitudes were measured immediately after the visual perception of specific obese individuals – a result consistent with the idea that the pathogen avoidance mechanisms are hyper-sensitive to visual cues. It is worth noting also that the effect on anti-fat attitudes was statistically independent of the predictive effect of separate measures assessing attributions about willpower. This suggests that ideological processes and parasite-defense processes both contribute to anti-fat attitudes, but in different ways.

This last conclusion is further substantiated by another study reported by Park et al. (2007). This experiment assessed cognitions implicitly associated with obese

individuals, and examined the impact of a manipulation designed to make specific concerns temporarily salient. The results revealed that fat people (in contrast to non-fat people) were implicitly associated not only with unpleasant concepts in general, but also with specific concepts connoting disease. More importantly, the implicit association linking fat people (compared to non-fat people) with disease was amplified following a manipulation that made infectious pathogens especially salient. The amplifying effect of the pathogen-salience manipulation emerged only on implicit associations linking fat people to disease; it did not increase associations linking fat people with unpleasant concepts in general. In contrast, the fat / unpleasant association (but not the fat / disease association) was amplified following a procedure that made the value of hard work especially salient. These results further indicate that the functionally-flexible operation of pathogen avoidance mechanisms contribute to anti-fat prejudices. And, once again, they suggest that this pathogen-defense process operates independent of other processes that contribute to these pejorative perceptions.

These results not only have implications for understanding contemporary prejudices toward obese individuals, they also have some unique implications for understanding the operation of pathogen avoidance mechanisms. It might be perfectly logical to perceive dramatically under-weight individuals as potential parasite-carriers (given that many parasitic infections do result in substantial weight loss), but there is little logical basis to associate obesity with contagious parasites. Nor is there much reason to assume that truly obese individuals were evident in the ancestral environments during which the psychological systems which respond to communicable threats presumably evolved. The results of Park et al. (2007) therefore highlight the heuristic (non-rational) operation of the system. And they highlight its adaptive overgeneralization, such that anti parasite defenses are activated not merely by specific kinds of cues that were evident in ancestral environments; but rather appears to have evolved in such a way as to respond to any kind of apparent morphological deviation from population norms.

# **Responses to Physically Attractive and Unattractive Others**

It may not be only gross deviations from morphological norms that activate pathogen avoidance responses; some relatively subtle deviations may be used as well – at least in the realm of facial physiognomy. We know that our visual systems are highly attuned to facial features. We have specialized neurological equipment dedicated to the visual perception of faces (Kanwisher, 2000). Our subjective impressions of another's attractiveness are influenced by specific aspects of facial physiognomy (such as bilateral symmetry, and the extent to which the size of specific facial features match population prototypes) that we appear to process implicitly and without conscious awareness (e.g., Langlois & Roggman, 1990). It has been argued that these sorts of subtle morphological variables are predictive of an individual's health status and future health outcomes (Fink & Penton-Voak, 2002; Thornhill & Gangestad, 1999, 2006). Consistent with this argument, evidence reveals that not only are substantially anomalous faces judged to be less healthy, but so too are faces that are simply perceived to be subjectively less attractive (e.g., (Zebrowitz, Fellous, Mignault, & Andreoletti, 2003; Zebrowitz & Rhodes, 2004).

Gangestad and Buss (1993; see also Gangestad, Haselton, & Buss, 2006) report a particularly interesting finding bearing on the link between physical attractiveness and the presence of parasites. Employing a cross-cultural methodology to test a hypothesis about

functional flexibility, they found physical attractiveness was an especially highly prized attribute in a mate within societies that historically had a high prevalence of infectious parasites.

These lines of evidence have been interpreted as indicating that a subjective assessment of another's facial attractiveness serves as an indicator of that individual's genetic fitness. However, the same evidence is consistent with a process whereby individuals use facial attractiveness (or rather, *un*attractiveness) as a heuristic cue indicating the actual presence of potentially-contagious parasites. Is there any special empirical reason to suppose that unattractiveness really does trigger the suite of pathogen avoidance mechanisms? There may be. If attractiveness was simply a clue to genetic fitness, one might expect the impact of physical (un)attractiveness to be rather constrained in scope – exerting effects primarily in the domain of mating relations, but of limited impact in other domains of social life. In fact, however, physical attractiveness is valued – and physical unattractiveness compels aversive responses – across a broad range of social inferences and interactions (Biddle & Hamermesh, 1998; Eagly, Ashmore, Makhijani, & Longo, 1991; Matter & Matter, 1989). In addition, if attractiveness was merely a cue to genetic fitness, then one might expect the effects of pathogen-prevalence, described above, to be especially strong among female perceivers (because women are especially attentive to indicators of genetic fitness, whereas men are more likely to attend to the costs and benefits of short-term mating opportunities). In fact, however, the results of Gangestad et al. (2006) show the opposite effect: The moderating impact of pathogenprevalence was stronger among men than among women. These results certainly don't argue against the hypothesis that attractiveness serves as a heuristic cue for genetic

fitness. But they do suggest that something else might be going on as well. Physical unattractiveness may serve as a heuristic cue for the possible presence of parasites – and this may partially explain why unattractive people are viewed more negatively not only in the domain of mating, but across all contexts that involve the potential for interpersonal contact.

#### Xenophobia and Ethnocentrism

In human populations, cue detection mechanisms may be responsive not only to morphological cues, but also to a broader set of cues indicating that another individual is foreign to the local population. There are at least two plausible reasons why. First, contact with individuals from previously unencountered populations is associated with an increased risk of contracting contagious diseases to which one has no acquired immunity. Second, foreign peoples are likely to be unaware of, and more likely to violate, local customs (such as those pertaining to food preparation and personal hygiene) that serve as barriers to the transmission of disease. Thus, in contemporary social ecologies, the pathogen avoidance mechanisms may generalize beyond the tendency to respond to cues signaling morphological anomaly; they may respond to cues signaling cultural foreignness as well. Regardless of their local social environment, individuals may be especially adept at learning to detect a wide range of inferential cues that discriminate between familiar and foreign peoples. And when those cues are detected, they may promote the familiar emotional, cognitive, and behavioral responses associated with pathogen avoidance.

Consistent with this reasoning, Schiefenhövel (1997) observed that people often display disgust reactions when speaking about ethnic outgroups, and Rozin, Haidt,

McCauley, and Imada (1997, p. 73) suggested that "disgust in humans serves as an ethnic or outgroup marker." To more rigorously test this conjecture, Faulkner, Schaller, Park, and Duncan (2004) conducted a series of studies that exploited the logic of functional flexibility.

In one set of studies, Faulkner et al. (2004) tested whether chronic concerns of vulnerability to parasitic infections – as measured by the perceived vulnerability to disease (PVD) scale – predicted attitudes towards immigrants from various geographical regions. Results revealed that higher levels of PVD were related to stronger antiimmigrant attitudes – but only toward immigrants from subjectively foreign locations. There was no such effect on attitudes toward culturally familiar immigrant populations (regardless of whether these familiar immigrant populations constituted ethnic ingroups or outgroups).

The contribution of the pathogen avoidance motivations to xenophobic attitudes was also implicated in a pair of experiments reported by Faulkner et al. (2004). In both experiments, participants were first exposed to brief slide show that either made salient the potential dangers posed by germs and germ-transmission, or (in a control condition) made salient other dangers that were entirely irrelevant to disease (e.g., electrocution). Results from both experiments revealed more strongly xenophobic attitudes after germs (rather than disease-irrelevant threats) were made salient. For instance, in one of these experiments, participants in Vancouver were told about a government program designed to recruit new immigrants to Canada, and were asked to indicate how much money should be spent attempting to recruit immigrants from a variety of different countries that had been pre-rated as either culturally familiar (e.g., Taiwan, Poland) or unfamiliar (e.g., Mongolia, Brazil). Participants who had been exposed to the control slide show allocated roughly equal amounts of money to recruit immigrants from both familiar and unfamiliar places, but those for whom germ transmission had been made salient were much more likely to allocate money to recruit immigrants from familiar rather than unfamiliar places.

These findings are complemented by additional work. In a set of studies, Navarrete and Fessler (2006) observed that not only does perceived vulnerability to disease predict more negative attitudes toward foreign peoples (xenophobia), it also predicts more positive attitudes toward one's own cultural ingroup (ethnocentrism). In a second study, they found that another disease-relevant individual difference variable – sensitivity to disgust – also predicts both xenophobia and ethnocentrism. Hodson & Costello (2007) also found sensitivity to disgust, specifically interpersonal disgust, was negatively related to liking of immigrants and foreign ethnic groups, and was positively related to liking of ingroups.

These results do not diminish the importance of the many other psychological processes that contribute to xenophobia and ethnocentrism. There is no doubt that these phenomena are multiply-determined. Plenty of previous research documents the influence of processes pertaining to fear, mistrust, conflict, and social identity, and mere categorization. But the fact of those processes also exist should not blind us to the apparent role of a less obvious process that also contributes to these phenomena: The hypersensitive and over-generalized operation of a psychological system designed to protect our bodies from contact with parasites.

# Cultural Level Effects of Pathogens

Recent research has gone beyond the effects of pathogen avoidance systems in individuals, and looked at the effects of pathogen levels on culture. The prevalence rates of infectious diseases vary considerably by geographic location (Guernier, Hochberg, & Guegan, 2004). This influences the extent to which pathogens pose an actual threat, and thus the value of approaching or avoiding novel individuals or situations. Using the logic of functional flexibility, hypotheses have been generated regarding the effects of regional levels of pathogen load on aspects of social interaction and cultural norms.

One such hypothesis is that in areas with higher pathogen loads, adherence to cultural norms (which are proposed to have been influenced, in part, by the goal of preventing pathogen transmission) will be higher, as the potential costs of deviating from them are high. Using nation-level means and a recently developed index of pathogen load across 230 geo-political areas (Murray & Schaller, in press), results of correlational studies are consistent with this hypothesis. People report higher levels of collectivism, which places more value on acting in the best interest of the group over the individual, in countries with higher pathogen levels (Fincher, Thornhill, Murray, & Schaller, 2008). Personality traits related to a general tendency to be gregarious (extraversion) and willing to try new things (openness to experience) are negatively related to pathogen load (Schaller& Murray, 2008). Additional relationships between regional pathogen load and broader culturally influenced outcomes have also been found. Mating structures, parenting style, and culinary practices are related to regional level of pathogen prevalence (Low, 1990; Quinlan, 2007; Sherman & Billng, 1999).

# The Behavioral Immune System

What emerges from this review is a substantial amount of evidence consistent with the hypothesized operations of a set of psychological mechanisms which evolved to function as an initial stage of protection against communicable threat. These results come from many different of areas of psychology, and range from disgust to individual level reactions to specific types of deviation, and from cognitive activation to broad cross cultural differences in personality variables. Previous work has suggested that in humans this suite of pathogen avoidance mechanisms be called the *behavioral immune system*<sup>1</sup> (Schaller & Duncan, 2007). The behavioral immune system is the complex, coordinated set of attentional, affective, cognitive and behavioral mechanisms described above that allow individuals to detect the potential presence of parasites in the objects and individuals around them, and to engage in behaviors that prevent contact with those objects and individuals. As we have seen, this system has implications that reach far beyond the behavioral avoidance of diseased individuals. Although the results available in the current literature have added greatly to the understanding of the behavioral immune system, there are still a large number of questions which remain unasked and unanswered.

## Toward a Better Understanding of the Behavioral Immune System

The empirical research reviewed in the preceding section suggests that the behavioral immune system has implications for a broad range of psychological responses to people who, in fact, may be completely healthy. The results demonstrate the value of examining additional implications of pathogen avoidance motivations, and in better

<sup>&</sup>lt;sup>1</sup>It might be more fitting to call it the *psychological* immune system because, at least in humans, the system involves emotions and cognitions as well as behavior. But to do so may create confusion, as the term "psychological immune system" has been used previously to refer to a very different set of processes that have nothing whatsoever to do with parasite-defense; see Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998.

understanding the attentional, affective, inferential, cognitive and behavioral processes involved in the behavioral immune system. However, the findings reviewed above by no mean represent a comprehensive understanding of the behavioral immune system and its implications.

There are still broad issues that have not been addressed with empirical studies. For example, although the behavioral immune system displays some evidence of functional flexibility, there is currently no evidence which addresses how individual levels of concern with communicable threat are established, nor is there a validated instrument which can be used to measure these levels. There is also little known about how the system calibrates signal detection mechanisms and responses to adjust to temporary changes in the salience of communicable threat. It is possible that some cues activate the system regardless of the level of perceived threat, while other cues are only interpreted as connoting infectious threat when the perceiver feels especially vulnerable to contagious threat. If this is the case, we need to know how the behavioral immune system alters the cue detector's criteria or threshold levels. Does it allocate more attention to scanning the environment for cues (so that we detect cues we would otherwise miss) or is there a smaller range of deviations from the prototype that are considered normal (a nose that was only considered somewhat crooked is perceived as very asymmetrical)? Alternatively, it may be the case that the behavioral immune system doesn't so much adjust sensitivity to cues, but instead adjusts the intensity of the response to deviations, such that increasing the salience of communicable threat causes greater aversive responses to the same cues. Still other questions concern the extent to which the

system operates automatically, or requires additional cognitive resources to adjust to changes in chronic or temporary concerns with communicable threat.

There are at least four avenues of research which would provide much needed information about the influence of pathogen avoidance motivations on psychological processes. These include testing: the range and type of cues that may activate the behavioral immune system, the extent to which the system responds automatically to cues which connote pathogen presence, the connotative specificity of the cognitions activated by cues which connote pathogen presence, and the way in which social cues indicative of pathogen presence are used. Each of these is explained in greater detail below.

#### **Potential Triggering Cues**

One of the unanswered questions concerns the range and relative strength of cues that may trigger the behavioral immune system. As summarized above, there is evidence that two specific deviations from the physical norm, physical disability and obesity, act as triggers for disease avoidance mechanism. Thus, there is evidence that prejudice towards people displaying these characteristics may well be due, at least in part, to aversive affective emotional and cognitive anti-parasite responses to an objectively non-contagious cue. However, it is highly unlikely that these are the only two morphological deviations which activate the behavioral immune system. It is equally unlikely that prejudices towards obese and disabled targets are the only ones which have their roots in pathogen avoidance motivations, especially if the behavioral immune system did evolve to use deviations from a norm as triggering cues.

Further research into the types of deviations from the healthy prototype that activate the system is warranted. One possible deviation which may act as a trigger is suggested by the results of the obesity studies. Obesity is at one end of the weight continuum. Emaciation is at the other extreme. It is therefore likely that deviation from a healthy weight in the form of being extremely underweight will also trigger the behavioral immune system. Interestingly, there is little documented prejudice towards exceptionally underweight individuals, despite the fact that weight loss is a symptom of many infectious conditions of consequence to the human species (Wolfe, Dunavan, & Diamond, 2007). This lack of research may be due in part to the positive value western cultures place on being thin (yet not emaciated). The possibility that emaciation acts as a cue has yet to be tested.

Another set of cues which may connote pathogen presence are the predicable changes in facial features that occur as a result of aging. The physical characteristics of advanced age, which include wrinkles, loss of fatty tissue in the face and lips, hair loss and skin discoloration, result in facial appearance that differs substantially from the prototypical young person. There is much research documenting the presence of ageist attitudes, and many different mechanisms have been proposed to explain why elderly people elicit aversive responses in others (see Bugental & Hehman 2007, for a review). Pathogen avoidance processes have been neither proposed nor tested as possible contributors to ageism.

Although there are strong theoretical reasons to suggest we might use these types of deviations as cues which connote pathogen presence, criteria must be established to test whether these specific deviations from the norm are triggering cues which activate the behavioral immune system. For this thesis, two criteria must be met for physical cues to be considered triggers of the behavioral immune system. First, the cue should be associated with semantic concepts connoting pathogen presence, and therefore activate "disease" concepts into working memory. Although this association is necessary to confirm the cue's connection to infectious threat, it is not especially strong evidence of the operation of the behavioral immune system.

The second, and stronger, criteria to determine if a specific deviation acts as a triggering cue requires aversive responses to potential triggering cues are amplified when perceivers feel especially vulnerable to the potential spread of infectious disease. This functionally flexible response can manifest as a result of chronic concerns with communicable threat. It can also be temporarily enhanced by cues in the environment that make this type of threat especially salient. Or it may be the case that there are interactions between these two types of salience – such that individuals for whm communicable threats are chronically salient are especially likely to respond to environmental cues of increased threat level.

Thus for a deviation to be considered triggering cue of the behavioral immune system, it must fulfill two requirements: It must activate disease cognitions, and these associations with disease must be positively related to perceived level of communicable threat.

### Cognitive Processes: Automaticity

Beyond the types of cues which activate the system, there is also little known about the automaticity of the behavioral immune system. Why might this be a useful domain to investigate? The cues that connote pathogen presence and activate the system are fallible. In many situations, including those that lead to the evolution of the behavioral immune system, fallible but potentially correct information is better than no information whatsoever. However, in contemporary society, it is often possible to have objective knowledge about the communicable threat posed by another individual via medical diagnoses. In addition to the information provided by heuristic cues, it may be the case that the provision of objective information about the health status of a person or situation may override the activation of the system, either preventing the aversive response to cues that would otherwise connote pathogen presence, or initiating avoidance of superficially healthy individuals or situations. The relative strength and influence of objective versus heuristic cues on the activation of the inferential and cognitive components of the behavioral immune system, and the extent to which the automatic response to cues connoting contagious threat can be moderated, remains to be tested.

Prior to testing the extent to which responses to cues connoting pathogen presence are automatic, the criteria for automatic processing must be established. For the studies included in this thesis, the criteria will be based on the applicable aspects of the requirements for automaticity defined by Bargh (1989). Specifically, this definition requires responses (1) be unintentional, (2) be autonomous or capable of running to completion without conscious intervention, (3) be involuntary or not initiated by the conscious choice or will of the agent, and (4) be effortless or not consumptive of limited processing capacity (Bargh, 1989). Although each aspect of the criteria will not be addressed in every study (due to restrictions in study design), where appropriate, the relevant components of the criteria will be discussed in relation to behavioral immune system activation and processing.

## Connotative Specificity of the Cognitive Response

Another question which remains to be tested focuses on the type of cognitions that are automatically activated when cues connoting pathogen relevant information are detected and what implications the cognitions would have for the behavioral immune system. The little available information which addresses the extent to which these cognitions are generally aversive or specific to disease provides a starting point. Responses to disfigured, obese and disabled individuals activate disease concepts, and obese individuals also activate generally unpleasant concepts. But how specific are the disease concepts that are activated? It is possible that the cognitions that are activated are contagion specific concepts. Alternatively, it may be that the ancient roots of the behavioral immune system have not achieved the same level of complexity as the current understanding of pathogen transmission vectors, and are more generally unpleasant. Either outcome is plausible. The former suggests that the system involves a high degree of cognitive processing when cues are detected, such that the system is not simply identifying a morphologically anomalous individual as unpleasant, but as diseased. The latter, that the response to deviation may be more general, implies that the behavioral response activated by less specific concepts may be equally effective in initiating functional behavioral responses that no further advantage would be gained by increasing the complexity of the cognitive response to pathogen relevant cues.

Testing which of these outcomes actually occurs will provide much needed information about the cognitive processes activated by cues which connote pathogen presence. Thus, for the studies in this thesis that address this issue, activation of disease specific concepts (without the activation of more generally unpleasant concepts) will serve as an indication that the behavioral immune system is specific to pathogen relevant cognitions, while the activation of generally aversive concepts (with or without the activation of disease-specific cognitions, as disease is necessarily a negative concept) suggests the behavioral immune system relies on a more general cognitive response.

#### The Role of Learning and Development

If some psychological mechanisms are designed to detect parasite-connoting cues, then other mechanisms must exist to enable individuals to "know" what those cues are. Just as the physical immune system evolved to learn to recognize cues indicative of specific pathogens (e.g., the process through which individuals acquire immunity to a pathogen through prior exposure to it), so too the behavioral immune system surely employs mechanisms through which individuals learn that specific kinds of cues are indicators of potential parasitic infection. There are dozens of different learning mechanisms within the human repertoire, each with a unique evolutionary history (Moore, 2004). Some of these learning processes are highly domain-specific (e.g., Garcia & Koelling, 1966; Öhman & Mineka, 2001), whereas others are applied broadly across domains. To fully understand the behavioral immune system, it will be necessary to articulate just what specific learning processes are employed by the system, and to investigate the developmental trajectory through which individuals actually acquire knowledge of different kinds of parasite-connoting cues. It's possible, for instance, that there may exist adaptations that promote especially efficient social learning of certain kinds of parasite-connoting cues, whereas other kinds of cues are acquired less quickly and with greater variability across different developmental contexts.

The first step in this area of study is to investigate the extent to which we are attuned to perceive or look for cues in our social environment that may be indicative of communicable threat. Thus, instead of measuring reactions to others who display cues connoting they are harboring pathogens, the focus will be on the extent to which others' emotional expressions are used as an indication that there may be a source of communicable threat in the immediate environment. To determine if this is indeed the case, we must see that emotion expressions of disgust are more readily identified (either accurately or falsely) when pathogens are chronically and/or temporarily salient.

#### **Reliable Measurement of Chronic Concern with Communicable Threat**

A pragmatic issue in the investigation of functional flexibility is the need for a valid and reliable scale which measures individual differences in chronic feelings of vulnerability to disease. One measure that assesses beliefs about personal susceptibility to the transmission of infectious diseases and emotional discomfort in the presence of potential disease transmission which has been used, the Perceived Vulnerability to Disease scale (Faulkner, Park, Schaller & Duncan, 2004) suffers from a set of methodological inconsistencies and shortcomings. Specifically, there are different versions of the questionnaire, inconsistent scoring, and a lack of psychometric validation. These issues need to be resolved before the functional flexibility of the behavioral immune system can be properly investigated.

### **Overview of Goals of Empirical Chapters**

It is apparent that there is much work to be done before we can claim to fully understand the triggers, processes and implications of the behavioral immune system. This thesis represents a program of work designed to investigate the role of pathogen avoidance processes in as yet unexplored aspects of social psychological phenomena. The following is a summary of the conceptual goals and empirical tests reported in the following chapters.

Chapter 3 provides a psychometric validation of the 15- item version of the Perceived Vulnerability to Disease Scale. One of the major theoretical foundations of the behavioral immune system is the extent to which it is functionally flexible. One of the major impediments to investigations of the behavioral immune system was the lack of a self report instrument designed to measure chronic concerns with communicable threat. This validated scale provides a means of investigating the functional flexibility of the behavioral immune system by measuring chronic concerns with vulnerability to communicable disease and examining the relationship with a variety of outcome measures in the remaining chapters.

In Chapter 4, the conceptual focus was on the automaticity of cognitive responses to extreme facial disfigurement. Using the Implicit Association Task (IAT; Greenwald, McGhee, & Schwartz, 1998), the relative strength of a heuristic cue connoting pathogen presence (facial disfigurement) and objective knowledge of health status was tested by measuring the implicit association of a target with either facial disfigurement or a contagious illness with 'unpleasant' and 'contagious' concepts. This methodology also illuminated the extent to which the cognitions activated by facial disfigurement and contagious disease are specific to communicable threat (contagion) or more generally aversive (unpleasant).

Chapter 5 addresses conceptual questions that arose from the Park et al. (2007) study on obesity which found obesity is a heuristic cue which connotes pathogen

presence. Using the IAT methodology, one study reported in this chapter tested the possibility that emaciation is a cue which connotes pathogen presence. Further studies investigated the automaticity of responses to both obesity and emaciation by providing participants with conflicting heuristic and objective information pertaining to two targets (i.e., an objectively healthy but obese target and an objectively contagious but normal weight target) and testing which target was more strongly associated with 'disease' and 'unpleasant' concepts. The relative strength of obesity and emaciation as pathogen connoting cues was also tested.

The study reported in Chapter 6 addresses the possibility that psychological disease avoidance processes contribute to negative stereotypes of the elderly. The hypothesis that physical features typical of aging are implicitly associated with aversive concepts was tested. Using an IAT methodology, the extent to which old targets, relative to young targets, were associated with the concepts 'disease' and 'unpleasant' was investigated. Cultural differences in antipathy towards elderly targets were also investigated.

A different kind of conceptual question was addressed in Chapter 7. This chapter focused on a specific aspect of the processes involved in learning the cues associated with pathogen presence. Although it is likely that any deviation from the norm has the potential to activate the behavioral immune system, it is likely that we rely on information from others to indicate those deviations that are especially likely to pose a threat. The two studies in this chapter investigated the extent to which sensitivity to facial expressions of disgust were influenced by temporary or chronic concerns with communicable threat. Finally, Chapter 8 provides a summary of the findings. This is followed by a comparison of domain specific and domain general processes, and the likelihood that the findings reported here result from pathogen avoidance, versus more general avoidance mechanisms. It concludes by discussing the implications of the current findings and suggesting directions for future research.

# CHAPTER 3: PERCEIVED VULNERABILITY TO DISEASE: DEVELOPMENT AND VALIDATION OF A 15-ITEM SELF-REPORT INSTRUMENT

Infectious diseases have imposed a threat to human well-being for a long time. In contemporary contexts, both objective and subjective vulnerability to disease has implications for a wide range of outcomes (Ackerman, Becker, Mortensen, Sasaki, Neuberg, & Kenrick, 2009; Curtis, Aunger & Rabie, 2004; Fessler, Eng, & Navarrete, 2005; Fincher, Thornhill, Murray, & Schaller, 2008; Schaller & Murray, 2008). Many phenomena in the realm of social cognition are influenced by the temporary salience of disease and by individual differences in chronic concerns about disease transmission (Schaller & Duncan, 2007). These individual differences predict ethnocentric attitudes, antipathy toward individuals who are obese or physically disabled, and preferences for facial characteristics associated with good health (Faulkner, Schaller, Park, & Duncan, 2004; Navarrete & Fessler, 2006; Park, Faulkner, & Schaller, 2003; Park, Schaller, & Crandall, 2007; Welling, Conway, DeBruine, & Jones, 2007). The emerging implication is that different psychological phenomena (many of which may not be overtly diseaserelevant) may be uniquely predicted by individual differences in perceived vulnerability to infectious disease.

Three different kinds of self-report instruments might be used to assess perceived vulnerability to infectious disease. Each has its limitations.

First, given that the emotion of disgust is elicited by disease-connoting cues (Curtis et al., 2004), one might use measures of disgust sensitivity as an affective indicator of perceived vulnerability to disease (e.g., Navarrete & Fessler, 2006). This empirical approach is less than ideal given that disgust-sensitivity measures (Haidt, McCauley, & Rozin, 1994; Olatunji et al., 2007) assess reactions to a broad range of stimuli, only a subset of which are directly relevant to disease transmission. Also, these measures are designed to assess affective responses, but are not suited to pick up on less emotion-laden beliefs or perceptions pertaining to one's susceptibility to disease transmission.

A second set of measures comprises instruments designed to assess hypochondria and other health-relevant anxieties (e.g., Kellner, 1986; Pilowsky, 1967). These measures do assess beliefs about one's susceptibility to disease, but they tend to focus on a very broad range of potential health problems (e.g., heart disease, cancer), rather than on infectious diseases in particular. These scales are typically designed for clinical diagnostic purposes, lessening their suitability for non-clinical research.

Given the limited utility of existing self-report instruments, a new measure was designed to assess perceived vulnerability to disease (PVD). This measure assesses beliefs about personal susceptibility to the transmission of infectious diseases and emotional discomfort in the presence of potential disease transmission, and has been included in several recent investigations (Faulkner et al., 2004; Hodson & Costello, 2007; Navarette & Fessler, 2006; Park et al., 2003; 2007; Welling et al., 2007). This research attests to the empirical utility of this self-report questionnaire. It also reveals a set of methodological inconsistencies and shortcomings. Different versions of the questionnaire have been employed (ranging from 14 to 19 items). Scoring of the questionnaire has been inconsistent. In some investigations, responses were compiled to produce a single overall PVD score (e.g., Faulkner, et al., 2004); in other investigations, subscale scores were computed (e.g., Park et al., 2003). The PVD questionnaire has not undergone

psychometric validation. Consequently, no version of the PVD questionnaire has been published in the scientific literature.

This article is designed to overcome those limitations. We provide a psychometric assessment of 19 items that comprise the longest regularly used version of the PVD questionnaire.

# **Methods and Results**

#### Item Development

Nineteen items were designed to assess either general beliefs about personal susceptibility to infectious diseases or discomfort in situations in which the possibility of disease transmission was salient. These items were constructed by the first author, who solicited input and item nominations from colleagues familiar with research on disgust and infectious diseases. Approximately half the items were reverse scored. Participants responded to each item on a 7-point scale (with endpoints labelled "Strongly disagree" and "Strongly agree").

#### Item Reduction and Factor Analysis

### Participants and Dataset

There were 1539 participants across 22 different studies. In each study, participants completed the 19-item version of the PVD questionnaire among other questionnaires and tasks. For 4 studies, participants were undergraduate students at the University of Groningen, in the Netherlands (n = 424; 291 female, 133 male; mean age = 20.8). For the remaining studies, participants were undergraduate students at the University of British Columbia, in Canada (n = 1117; 843 female, 272 male; mean age = 20.1). The UBC sample was ethnically diverse, including 595 participants of East Asian heritage, 353 participants of European heritage, and 167 participants from a variety of other ethnic backgrounds.

# Inter-Item Correlations

Inter-item correlations for all 19 items were computed for the 1508 participants who answered every item. Results revealed that 4 items had unacceptably weak inter-item relationships (|r|s < .3; Tabachnick & Fidell, 2001). These items were removed, leaving 15 items (that all 1539 participants had completed) for further analysis.

#### Factor Analyses

The 15 remaining items were subjected to parallel analysis with principal axis factoring. Results indicated that two factors should be retained based on 95-percentile of random eigenvalues. A two-factor solution (with Direct Oblimin rotation) was forced. This solution accounted for 46.3% of the variance among the 15 items after extraction, with each of the 15 items loading .4 or higher on either Factor 1 or Factor 2; no items cross-loaded. Factor 1 comprised 7 items that assess beliefs about immunological functioning and personal susceptibility to infectious diseases (*Perceived Infectability*). Factor 2 included 8 items that assess aversive affective responses to situations that connote a relatively high likelihood of pathogen transmission (*Germ Aversion*). Table 3.1 lists each of the 15 items, along with factor loadings on each factor.

The factor structure was also tested using a polychoric correlation matrix. The same items loaded with similar strength on each factor (differences in factor loadings ranged from .042 - .115). Additional factor analyses were run separately on male, female, Dutch, Canadian, East Asian Canadian, and European Canadian participants. The items loading on each factor are identical, and the strengths of the loadings are highly similar

across groups, suggesting a factor structure consistent across these demographic categories.

# Table 3.1

# Factor Loadings of 15 Items on the Perceived Vulnerability to Disease (PVD) Questionnaire.

	Perceived	Germ
	Infectability	Aversion
	(Factor 1)	(Factor 2)
In general, I am very susceptible to colds, flu and other	.812	.009
infectious diseases. (Item 8)		
I am unlikely to catch a cold, flu or other illness, even if it is	742	031
'going around'. (Item 12; Reverse-scored)		
If an illness is 'going around', I will get it. (Item 2)	.724	.115
My immune system protects me from most illnesses that	713	073
other people get. (Item 14; Reverse-scored)		
I am more likely than the people around me to catch an	.685	.080
infectious disease. (Item 10)		
My past experiences make me believe I am not likely to get	645	001
sick even when my friends are sick. (Item 5; Reverse-		
scored)		
I have a history of susceptibility to infectious disease. (Item	.573	.037
6)		

	Perceived	Germ
	Infectability	Aversion
	(Factor 1)	(Factor 2)
I prefer to wash my hands pretty soon after shaking	.060	.629
someone's hand. (Item 7)		
I avoid using public telephones because of the risk that I may	.018	.578
catch something from the previous user. (Item 15)		
I don't like to write with a pencil someone else has obviously	.006	.551
chewed on. (Item 4)		
I dislike wearing used clothes because you don't know what	.063	.511
the last person who wore it was like. (Item 9)		
I am comfortable sharing a water bottle with a friend. (Item	008	509
3; Reverse-scored)		
It really bothers me when people sneeze without covering	.037	.470
their mouths. (Item 1)		
It does not make me anxious to be around sick people. (Item	207	450
13; Reverse-scored)		
My hands do not feel dirty after touching money. (Item 11:	024	438
Reverse-scored)	-	

*Note*. Items corresponding to each of the two factors (subscales) are listed according to the strength of their factor loading. Following each item, in parentheses, are suggestions for item order when constructing a 15-item self-report questionnaire.

# Internal Consistency

The 15 items showed an acceptable level of internal consistency (after reversescoring of items indicated in Table 3.1): Cronbach's alpha = .82. However, given evidence for two underlying factors, it seems appropriate to compute scores on separate subscales corresponding to the two factors. For the 7 items on the Perceived Infectability factor, Cronbach's alpha = .87. For the 8 items on the Germ Aversion factor, Cronbach's alpha = .74. Subscale scores are computed as the mean of all items within a factor (after reverse-scoring of indicated items). The subscale scores were only modestly correlated (r= .30), indicating the utility of computing subscale scores for purposes of prediction.

# **Construct Validity and Correlates**

Subscale scores were computed as described above. Higher scores indicate greater perceived vulnerability to disease.

#### Participants and Dataset

An additional 215 participants completed the 15-item version of the questionnaire. Perceived Infectability and Germ Aversion subscale scores were thus computed for a total of 1757 participants. These included 425 students from the University of Groningen (291 female, 134 male; mean age = 20.8) and 1332 from the University of British Columbia (1007 female, 325 male; mean age = 20.2). Further breakdown of the UBC sample revealed 686 participants of East Asian heritage, 438 participants of European heritage, and 208 participants from a variety of other ethnic backgrounds.

# Gender Differences

Gender differences emerged on both subscales. Compared to men, women had higher scores on both Perceived Infectability and Germ Aversion (ts = 6.80 and 5.70, respectively; both ps < .001). Means and standard deviations are presented in Table 3.2. *National and Cultural Differences* 

Table 3.2 also summarizes mean differences based on nationality and ethnic background. Compared to Canadian (UBC) participants, Dutch (University of Groningen) participants scored lower on both Perceived Infectability and Germ Aversion, (ts = 7.94and 16.63, respectively, both ps <.001). Within the Canadian sample, one-way ANOVA's indicated there were ethnic differences on both PVD subscales (Perceived Infectability, F (3, 1753) = 111.93, p < .001; Germ Aversion, F (3, 1753) = 24.50, p <.001). Post hoc comparisons using Tukey's HSD test revealed that participants of East Asian background had significantly higher Perceived Infectability scores than participants of other (non-European) ethnic backgrounds, and had higher Germ Aversion scores than participants of both European and other ethnic backgrounds (ps < .05).

# Table 3.2

# Mean Scores on PVD Subscales, Illustrating Gender, National, and Cultural

	Ν	Perceived Infectability	Germ Aversion
Men	458	3.08 (0.98)	3.38 (1.04)
Women	1299	3.50 (1.19)	3.70 (1.02)
Dutch sample	425	3.01 (1.15)	3.00 (0.82)
Canadian sample	1332	3.52 (1.12)	3.81 (1.02)
European ethnic heritage	438	3.48 (1.20)	3.55 (1.06)
East Asian ethnic	686	3.59 (1.05)	4.02 (0.95)
heritage			
Other ethnic heritage	208	3.33 (1.12)	3.70 (0.98)

# Differences

Note. Standard deviations are indicated in parentheses.

# Assessment of Convergent and Discriminant Validity

Within the complete set of 1757 responses, smaller subsets of participants completed additional self report individual difference measures bearing on convergent and discriminant validity of the PVD questionnaire. Measures assessing hypochondria and other health-relevant beliefs were expected to correlate positively with PVD subscales. Measures assessing disgust sensitivity were also expected to correlate positively – especially with the Germ Avoidance subscale. In addition, we assessed relations with the Big Five personality traits, and with a wide variety of other measures on which data were available. As we discuss below, there are conceptual and/or empirical precedents to suggest that some of these additional measures may correlate with one or both PVD subscales; nevertheless, because these additional measures are conceptually distinct from both Perceived Infectability and Germ Aversion, these relations were expected to be only modest at best. Finally, we report on dispositional tendencies toward socially desirable responding; ideally, PVD subscales should be uncorrelated with this response bias.

## Correlations with Hypochondria and Health Beliefs

A small subset of participants completed the 14 item Health Anxiety Inventory (Salkovskis et al., 2002), the 14 item Whitely Index (Pilowsky, 1967), and the 27 item Illness Attitude Scale (Kellner, 1986; Ferguson & Daniel, 1995). None of these questionnaires is specific to infectious diseases, although each assesses beliefs bearing on susceptibility to health threats, health anxiety, or hypochondriasis. Correlations between these measures and PVD subscales are presented in Table 3.3. All correlations are positive. All three measures correlated more strongly with the Perceived Infectability subscale than with the Germ Aversion subscale (although not significantly so, given the small sample size associated with these analyses).

# Correlations with Disgust Sensitivity

Subsets of participants completed one of two disgust sensitivity measures: A 32item questionnaire (Disgust Sensitivity; Haidt et al., 1994) and a revised 25-item questionnaire (Disgust Sensitivity – Revised; Olatunji et al., 2007). Both assess emotional responses to specific elicitors. Disgust sensitivity was only weakly correlated with the PVD Perceived Infectability subscale, but more strongly correlated with the Germ Aversion subscale (see Table 3.3). The strongest relations were with the disgust sensitivity subscales most directly relevant to the transmission of infectious diseases (the "interpersonal disgust" subscale identified by Haidt et al., 1994, and the "contamination" subscale identified by Olatunji et al., 2007).

#### Correlations with the Big Five Personality Traits

A subset of 661 participants completed a questionnaire assessing the Big Five personality traits (John & Srivastava, 1999). While none of these general personality factors correlated substantially with either PVD subscale, four of the five correlations with Germ Aversion were statistically significant, as were three of the five correlations with Perceived Infectability (see Table 3.3). The negative correlations between Germ Aversion and both extraversion and openness are notable, as they are conceptually consistent with previous research showing lower levels of extraversion and openness among populations with high prevalence of infectious disease (Schaller & Murray, 2008). *Correlations with Other Traits* 

Table 3.3 lists correlations between the PVD subscales and a variety of additional trait measures: the Sociosexual Orientation Inventory, which measures preferences for restricted (e.g. monogamous) versus unrestricted (e.g. promiscuous) relationships (Simpson & Gangestad, 1991), Belief in a Dangerous World (Altemeyer, 1988), Social Dominance Orientation (Pratto, Sidanius, Stallworth, & Malle, 1994), Need for Structure (Neuberg & Newsom, 1993), Need for Cognition (Cacioppo & Petty, 1982), Faith in Intuition (Epstein, Pacini, Denes-Raj, & Heier, 1996), and the Affect Intensity Measure (Larsen & Diener, 1987). Several results are worth noting. First, the negative correlations with the Sociosexual Orientation Inventory are consistent with research showing more restricted sexual behavior among populations with high prevalence of infectious disease (Schaller & Murray, 2008). Second, the relatively weak positive correlations with Belief

in a Dangerous World indicate minimal overlap between PVD and perceived vulnerability to other interpersonal dangers. Third, both Faith in Intuition and Affect Intensity correlated positively with the Germ Aversion subscale, but less so with the Perceived Infectability subscale. These results are consistent with the expectation that Germ Aversion reflects a more intuitive, affect-based appraisal of disease vulnerability than Perceived Infectability.

# Correlations with a Measure of Socially Desirable Responding

A subset of 101 participants completed a measure assessing tendencies to respond in an inauthentic, socially desirable manner on self-report instruments (Crowne & Marlowe, 1964). Results revealed no correlation between social desirable response bias and scores on PVD subscales (see Table 3.3).
### Table 3.3

## Correlations of the PVD Subscales with Other Individual Difference Measures

Individual Difference Measure	Ν	Perceived Infectability	Corre	<i>p</i> -value for	
			Germ	difference	
			Aversion	between <i>r</i> 's	
Health Anxiety Inventory	35	.42*	.32	.62	
Whitely Index	30	.37*	.56**	.28	
Illness Attitudes Scale Total	29	.72**	.57**	.28	
General Hypochondriacal	29	.72**	.60**	.40	
Fears and Beliefs					
Thanaphobia	29	.49*	.38*	.56	
Coronary Heart Disease and	29	.46*	.26	.29	
Associated Health Habits					
Symptom Experience and	29	.39*	.32	.70	
Frequency of Treatment					
Disgust Sensitivity	983	.22**	.55**	<.001	
Core	984	.17**	.41**	<.001	
Interpersonal	984	.16**	.68**	<.001	
Death & Body Envelope	983	.20**	.29**	.02	
Sex	984	.15**	.38**	<.001	
Disgust Sensitivity – Revised	214	.18**	.51**	<.001	
Core	214	.20**	.46**	<.001	

Individual Difference Measure	Ν	Perceived Infectability	Germ	<i>p</i> -value for	
				difference	
			Aversion	between r's	
Animal Reminder	214	.14*	.31**	.04	
Contamination	214	.07	.58**	<.001	
Big Five Inventory					
Agreeableness	661	10**	15**	.35	
Conscientiousness	661	11**	01	.04 .04  .07 .02 <.001	
Extraversion	661	06	16**		
Neuroticism	661	.17**	.17**		
Openness	661	03	12**		
Sociosexual Orientation	453	14**	28**		
Belief in Dangerous World	1315	.13*	.27*		
Social Dominance Orientation	216	07	.28**	.06	
Need for Structure	89	.16	.27**	.36	
Need for Cognition	163	.00	09	.50	
Faith in Intuition	173	02	.20**	.06	
Affect Intensity Measure	47	.11	.34*	.25	
Social Desirability	101	.00	02	.90	

*Note*. \* p < .05, \*\* p < .001. Within each row, the difference in the magnitudes of the two correlations was tested against the null hypothesis (using methods described by Tabachnick & Fidell, 2001); the resulting p-values are tabulated in the rightmost column.

#### Predictive Utility in the Domain of Social Inference

Several published articles report results in which PVD was related to outcomes in the realm of social inference. In each, PVD scores (or PVD subscale scores) were computed somewhat differently (based on a 14-item, 18-item, or 19-item version of the PVD questionnaire). Therefore, we reanalyzed studies for which raw data were available for the 15 items identified in Table 3.1 to assess the differential effects of the Perceived Infectability and Germ Aversion subscales.

#### Friendships with Disabled Individuals

Park et al. (2003) computed two subscale scores based on an 18-item PVD questionnaire and found that both were negatively correlated with the participant-reported number of friends with physical disabilities (rs = -.20 and -.22). Subscale scores based on the 15-item PVD questionnaire produce identical results: Individuals with higher scores on both Perceived Infectability and Germ Aversion report fewer friendships with disabled individuals (rs = -.20 and -.21, both ps < .05).

#### Explicit Anti-Fat Attitudes

Park et al. (2007) found that dislike of fat people (a subscale of the Anti-Fat Attitudes questionnaire; Crandall, 1994) was positively correlated with a 10-item germ aversion subscale (r = .25). This relationship remained essentially unchanged when employing the 8-item Germ Aversion subscale (r = .24, p = .001). We also found that the 8-item Germ Aversion subscale is positively correlated with another subscale of the Anti-Fat Attitudes questionnaire – fear of becoming fat oneself (r = .26, p < .000). The Perceived Infectability subscale showed no meaningful relationship with these anti-fat attitudes (rs = .05 and .08,  $ps \ge .14$ ).

#### Explicit Attitudes Toward Immigrants

Faulkner et al. (2004) reported four studies documenting a relationship between PVD and xenophobic responses to subjectively foreign outgroups. The overall PVD score was computed from 14 self-report items. For one study (Study 4), participants actually completed a longer questionnaire that included all 15 items in Table 3.1. Our reanalysis revealed that the reported relationship between PVD and pro-immigrant attitudes (r = -.40) was due entirely to the strong negative relationship between the 8-item Germ Aversion subscale and pro-immigration attitudes (r = -.48, p = .001); the 7-item Perceived Infectability subscale was not related to pro-immigration attitudes (r = .03, p = .84). *Implicit Negative Associations with Physical Disability* 

Park et al. (2003) employed a computer-based reaction-time task to assess the extent to which physically disabled individuals were implicitly associated with aversive semantic concepts. Among European participants (but not among East Asian participants), scores on a 10-item germ aversion subscale were related to a tendency to implicitly associate physical disability with negative semantic concepts (r = .38). Our reanalysis using the 8-item Germ Aversion subscale produced the same result (r = .35, p = .06). In contrast, the Perceived Infectability subscale showed no relation to implicit negative associations with physical disability (r = .08, p = .68)

#### Implicit Ageism

One additional result reveals an outcome in which Perceived Infectability is uniquely predictive. Employing methods modeled after those of Park et al. (2003), Duncan and Schaller (in press) employed a computer-based reaction-time task to assess implicit ageism – the extent to which elderly adults are implicitly associated with negative semantic concepts. Results revealed that, among European participants for whom pathogen transmission was made temporarily salient by a slide show manipulation (but not among East Asian participants who watched the same slide show), the Perceived Infectability subscale strongly predicted implicit ageism (r = .56, p < .05). In contrast, there was no meaningful effect of Germ Aversion (r = -.26, p = .35).

#### Discussion

These analyses represent the first psychometric evaluation of an instrument that has been used across a variety of recent investigations in different research labs (e.g., Faulkner et al., 2004; Hodson & Costello, 2007; Navarrete & Fessler, 2006; Park et al., 2007; Welling et al., 2007). The results reveal two conceptually distinct factors measured reliably by 15 items. One factor (measured by 7 items) assesses individuals' beliefs pertaining to their susceptibility to infectious diseases. The corresponding subscale (Perceived Infectability) correlates relatively highly with measures of hypochondria and health anxiety, but is distinct in two important ways. First, whereas other health anxiety measures assess beliefs about existing health status, Perceived Infectability assesses beliefs about vulnerability to future health problems. Second, whereas other health anxiety measures assess beliefs about diverse health problems, Perceived Infectability is specific to infectious diseases. The second factor (measured by 8 items) assesses individuals' discomfort in situations that connote an increased likelihood for the transmission of pathogens. The corresponding subscale (Germ Aversion) is moderately correlated with measures assessing intuitive appraisal and emotional reactivity, and correlates relatively highly with measures that assess sensitivity to disgust – the emotional response that is linked to infectious disease avoidance (Curtis et al., 2004).

Germ Aversion isn't isomorphic with disgust sensitivity. Whereas disgust sensitivity measures assess emotional responses to a broad range of potentially disgust-arousing circumstances, Germ Aversion is specific to situations connoting the potential transmission of infectious diseases.

Given the conceptual distinction between the subscales, it's not surprising that they are only modestly intercorrelated. While one could compute an overall index of Perceived Vulnerability to Disease (PVD), more nuanced predictions may be attained by computing the separate subscale scores. As summarized above, many phenomena tend to be predicted by one or the other, but not both. Within the domain of social inference, Germ Aversion predicts responses rooted in intuitive appraisals of disease transmission risk, whereas Perceived Infectability predicts responses informed by more rational appraisals. This distinction is consistent with evidence that Germ Aversion more strongly predicts implicit negative associations with individuals characterized by morphological anomalies (e.g., Park et al., 2003), whereas Perceived Infectability more strongly predicts implicit negative associations with individuals who tend to be characterized by diminished immunocompetence (e.g., the elderly; Duncan & Schaller, in press).

Additional questions and issues remain. It is not yet clear how best to interpret gender, national, and cultural differences on the PVD subscales. Although the gender differences are broadly consistent with gender differences in disgust sensitivity, and the cultural differences are broadly consistent with geographical differences in the prevalence of infectious diseases, the meanings of these differences, and their implications, remain to be explored. Additional research must be done to further explore the range of phenomena that might be predicted by the constructs assessed by the PVD scale.

#### **Conclusions**

A surge of empirical research indicates that the threat posed by infectious diseases has implications for psychological outcomes. This research highlights the scientific value offered by an instrument that can specifically and reliably assess individual differences in perceived vulnerability to infectious disease. The Perceived Vulnerability to Disease (PVD) questionnaire attempts to provide such an instrument. The empirical merit of the PVD questionnaire is suggested by its recent employment in multiple research labs. The PVD questionnaire had its utility constrained by the fact that the questionnaire had never previously been subjected to careful psychometric scrutiny, and that no version of the questionnaire had ever been archived in the scientific literature. We hope that this article helps to address those issues.

# CHAPTER 4: AUTOMATIC AVERSIVE RESPONSE TO FACIAL DISFIGUREMENT

In our everyday social interactions we receive innumerable social cues from others around us. Some of these we interpret in such a way that they inform the decisions we make about the health status of those around us. This type of assessment happens so frequently that we are rarely aware that we are doing it. However, this type of evaluation is an adaptive part of social cognition – by attending to cues that potentially connote illness we are better able to match our behaviour to our social and physical environment.

The cues to which we attend when making these decisions about the health status of others are not necessarily honest indicators of pathogen presence. The microscopic size of most pathogens results in the near impossibility of direct detection of the majority of communicable threats. As a result of relying on a wide range of indirect, and therefore fallible, cues of pathogen presence (some of which may be only weakly correlated with the presence of actual disease) we face a signal detection dilemma regarding cues of health status (Nesse, 2005; Haselton & Nettle, 2006). We must balance two kinds of signal detection errors, which can lead to two different types of inference bias. The first, a bias toward false positives, results in assuming that a healthy person displaying a cue associated with pathogen presence is sick, which results in unnecessary avoidance of individuals bearing disease cues. The second, a bias toward false negatives, results in assuming a sick person who displays no outward cues of pathogen presence is actually healthy, which increases the chances that we will contact and contract pathogens. The adaptive solution is the avoidance of potential pathogen carriers. The behavioral immune system evolved to minimize false negatives, therefore we are sensitive to an over-general

set of cues which connote pathogen presence (see Chapter 2). We will therefore err on the side of false positive decisions where disease connoting cues are concerned (Schaller & Duncan, 2007).

The implication of this default setting is that we may respond automatically and aversively to superficial cues that heuristically connote the presence of disease, even when those cues are wrong. There are a wide range of cues that are associated with the presence of communicable disease, but are not necessarily indicative of contagious threat. For example, sneezing, coughing, rashes and vomiting are frequently honest indicators of the presence of infectious agents (e.g., colds, flu, and chicken pox). However, each of these symptoms also occurs as a result of non-infectious causes (e.g., allergies, asthma, and ingestion of toxins). Physical features, and especially facial features, also frequently display honest information about an individual's health status. Most of the facial features and traits that are considered attractive, including skin texture and color, symmetry, and averageness, are in some way linked to, or indicative of, health status (Roujeau, 2001; Rhodes, Zebrowitz, Clark, Kalick, Hightower, & McKay, 2001; Jones, Little, Penton-Voak, Tiddeman, Burt, & Perrett,. Individuals who are considered unattractive have faces that deviate (usually fairly subtly) from these norms. It is therefore not surprising that unattractive individuals are also generally considered less healthy than their more attractive counterparts (Zebrowitz & Rhodes, 2004).

These findings demonstrate that our perceptions of the health status of others are influenced by a range of heuristic cues. These heuristics are, by their very nature, not as fine-tuned as we might 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, especially if they are the only available sources of information pertaining to health status.

Although important, the information we glean from heuristic cues of health status is not our only source of health-relevant information in contemporary society. We also frequently have available to us objective health information, such as verbal labels (e.g., Tuberculosis), which provide information which is processed at a higher cognitive 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 pertaining to the health status of others. For example, one factor that predicts social rejection of unhealthy others is the perceived severity of their condition. Non-treatable diseases such as AIDS are considered more severe than illnesses like the flu, and predict higher levels of 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.

In sum, there is evidence that we rely on a wide range of crude visual heuristics as cues to indicate the health of others when objective knowledge is not available. There is also evidence that we actively process the accurate information provided in formal diagnosis of health conditions when it is available. However, what remains to be known is the way each type of information is used when they provide conflicting information regarding the health status of a novel person.

There are two possibilities to consider. The first is that perceivers will ignore more heuristic information (e.g. facial disfigurement) when they have access to more reliable, objective knowledge. Specifically, it may be the case that as the costs of making a wrong decision (in this case, deciding a person is healthy when they are not) increase, we become less likely to rely on the information provided by fallible heuristic cues, and more likely to seek out and use objective knowledge as a basis for decisions (Langer, Blank and Chanowitz, 1978). As successful disease avoidance is an important aspect of human survival, and missing relevant information has severe negative consequences, it is possible that we make an active effort to make a correct decision, placing higher value on any objective (truthful and certain) information that is available to us (Langer & Moldoveanu, 2000).

The second possibility is that in situations of conflicting information, heuristic cues automatically activate an initial assessment of health status which may then be tempered or overridden by objective knowledge (although the second stage incorporation of objective knowledge will not necessarily occur in all situations involving conflicting information). The first stage of this result would be consistent with three of the criteria required for automaticity (i.e. unintentional, autonomous and involuntary). 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 are modified by slower rule-based or deliberate processes.

#### **Previous Test of Automatic Reactions to a Healthy but Facially Disfigured Target**

To date, only one study has investigated the way conflicting heuristic and objective information is implicitly processed. Duncan (2005) conducted a test of the alleged automaticity of the aversive cognitive response. Participants completed individual difference measures of chronic concerns with communicable threat. They were then provided with brief biographical sketches of two men containing, among other information, objective health status information. Each biographical sketch was accompanied by a facial photograph of the man, which contained health relevant heuristic information. One man, Bob, had a very noticeable port wine stain birthmark on his face, but this birthmark was explicitly described as superficial and the man himself was described as strong and healthy. The other man, Jake, looked just fine, but was described as suffering from a strain of communicable drug-resistant tuberculosis. After reading the biographies, participants watched a slide show designed to make either contagious physical threats (i.e., infectious disease) or non-contagious physical threats (i.e., accidents) temporarily salient. Participants then completed a computer-based reaction time task, designed to assess which of the two men was more strongly associated with the semantic concept "disease". (This task was a variant of the implicit association test; Greenwald, Nosek & Banaji, 2003). Results showed that, across all participants, there was a general tendency to associate disease concepts more strongly with the faciallydisfigured man (who was known to be healthy) than the man who was actually known to suffer from a contagious disease (but who looked normal). This tendency was not influenced by either temporary or chronic concerns with communicable disease. This finding is consistent with a highly-automatized response generated by the visual observation of morphologically anomalous features resulting in disease-connoting inferences. Even when processes of rational appraisal explicitly indicate otherwise, anomalous features such as facial disfigurements implicitly imply the threat of contagious disease.

Although a compelling test of the strength and automaticity of heuristic information, this initial investigation of the automaticity of the disease avoidance system has obvious limitations. First, this study used only one target individual and one morphological anomaly. This prevents the generalizability of this finding to other types of facial disfigurement.

Second, the initial study tested only the activation of "disease" specific cognitions. While disease specific implicit associations are directly relevant to the area of interest, the use of a single semantic concept makes it impossible to know if the cognitions that were activated were more generally unpleasant and registered as "disease" because it was the negative option, or if the cognitions are actually specific to "disease". Although neither option is inconsistent with an automatic disease avoidance response (either would initiate an avoidance response), our understanding of the cognitive processes involved in the behavioral immune system will be enhanced by a more finely grained measurement of the implicit associations heuristic and objective information relevant to communicable threat.

Third, this study did not show evidence of functional flexibility in response to either temporary or chronic concerns with disease. If the association between facial disfigurement and disease concepts are the result of pathogen avoidance processes, sensitivity to perceived levels of infectious threat and adjustment of responses in accordance to threat are expected to occur. However, it may be the case that facial disfigurement is an especially strong cue connoting pathogen presence that it activates the behavioral immune system regardless of chronic or temporary salience of communicable threat. Further investigation of the effects is warranted. The following study was

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designed to conceptually replicate and extend the findings of the first study by addressing these concerns.

The study reported here both conceptually replicates and improves the initial investigation into the way in which we processes conflicting heuristic and objective health information. First, it increases the ability to generalize these findings by using (a) a novel type of morphologically anomalous facial feature and (b) completely different target individuals. To increase the generalizability of the finding beyond implicit associations with facial birthmarks, new target people were selected for both the 'looks sick but is healthy' target and the 'looks healthy but is sick' target. The morphologically deviant individual in this study had facial tumors which distorted his facial appearance from the prototypical face. (He was also of East Asian descent, which differs from the Caucasian target used in the first study. The objectively sick individual was also East Asian, to keep ethnicity consistent across targets.)

Second, the specificity of the cognitions that were activated was teased apart in 2 separate tests of implicit associations. This study measured implicit associations of the target individuals with semantic concepts that were more specific to the means of communicable disease threat (i.e., 'contagious') and more generally negative (i.e., 'unpleasant'). This allowed for a better understanding of the cognitive processes activated by heuristic and objective health information.

Third, the role of functional flexibility in cognitive activations resulting from both objective and heuristic health information was examined in two ways: Temporary salience of disease threat was manipulated using a slide show designed to make specific physical threats salient, while chronic salience of vulnerability to disease threat was measured using the Perceived Vulnerability to Disease scale and a measure of Disgust Sensitivity.

To 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 together than objects and concepts that are weakly associated (i.e. insect and pleasant). Previous research has demonstrated that the IAT is sensitive to changes in association strength due to individual differences, and to contextual manipulation, 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 (as in Duncan, 2005), participants received conflicting heuristic cues and objective health knowledge about two individuals via photos and biographical information. By measuring the relative strength of the associations between each target and the semantic concepts of interest (i.e. contagious and unpleasant), it was possible to identify which type of information was more influential in determining implicit perceptions of health status.

#### Method

#### **Participants**

One hundred and three individuals participated in the study. Four participants did not complete the IATs and were excluded from the analysis. An additional 6 participants were excluded because they were unable to correctly identify which of the targets was contagious and which was not in a brief questionnaire filled out after completing the IATs. As a result, 93 participants (68 female, 25 male; mean age 20.4) are included in the analyses. The sample was ethnically diverse, including 57 participants of East Asian heritage, 19 participants of European heritage and 17 participants from a variety of other ethnic backgrounds.

#### Procedure

Participants were told the purpose of the study was to investigate various aspects of person perception. They were informed they would be filling out questionnaires, reading information about 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. Two of these questionnaires were relevant to disease. The Perceived Vulnerability to Disease scale (Duncan, Schaller & Park, 2009; see Chapter 3) is a 15-item scale that measures individual differences in chronic perceptions of vulnerability to disease. The Revised Disgust Sensitivity Scale (Olatunji, Williams, Tolin, Abramowitz, Sawchuk, Lohr, & Elwood, 2007) is a 25-item scale that assesses individual differences in sensitivity to domain specific disgusts, which are combined to obtain an overall disgust score.

One individual difference measure, the 12-item Belief in a Dangerous World scale (BDW; Altemeyer, 1988) was included to assess the extent to which people are chronically pessimistic concerning the intentions of others.

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

#### Practice IAT

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 *Implicit Association Tasks*). 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 presented simultaneously with photographs and biographical information about two men ("Ken" and "Alex") and told to carefully read the biographies as they would be required to answer questions regarding the two men at a later point. The photograph of Ken showed a dark haired Asian man with no obvious facial blemishes. The biographical information about Ken, however, made it clear that he suffered from a contagious disease:

Ken is a 35-year-old web designer. Ken suffers from an incurable infectious disease called Multi-Drug Resistant Tuberculosis (MDR-TB). This form of tuberculosis is extremely contagious. It affects the respiratory system and spreads easily through everyday actions such as coughing and sneezing. As a result of his illness, Ken experiences constant fatigue, loss of appetite, and breathing problems. Since contracting MDR-TB, Ken's lifestyle includes more activities that are not physically demanding such as online poker, reading, and writing book reviews for local newspapers. Recently, Ken published an article in a local newsletter about proper precautions individuals with this form of Tuberculosis must take to avoid spreading the disease to others.

In contrast, the photograph of Alex depicted an Asian man with severe facial

disfiguration. The biographical information about Alex made it clear that the facial

disfigurement was not contagious and had no consequences on Alex's active lifestyle:

Alex is a 37-year-old artist. Even though Alex has obvious facial abnormalities caused by a non-contagious condition called Neurofibromatosisa, he is an optimist and doesn't let this genetic mutation prevent him from participating in a diverse variety of activities. He enjoys exploring new cities while traveling, photography, and spending time with friends. Alex is an active, outgoing individual with a great sense of humor. He is happy to explain his condition to those he meets, and titled a series of self portraits "I'm Alex, Don't Worry - You Can't Catch It!"

#### Disease Salience Manipulation

Participants were told that experimental protocol required them to wait a specific amount of time between the practice computer task and the next computer task and that in this time each participant would watch the same slide show, to ensure that random thoughts do not influence the outcome of the second set of computer tasks. Participants were asked to pay attention to the slide show as they would be asked questions about the content at a later time. This slide show manipulation has been used successfully in previous investigations of context on health relevant stimuli (Faulkner et al, 2004).

In reality, participants were randomly assigned to one of two slide show conditions: Pathogen 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 to avoid these dangers.

In the Pathogen salient condition (n = 46), the slide content was constructed to increase the salience of the plethora of possible health threats attributable to communicable disease, germs and bacteria. 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 = 47), 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 his finger with dangerously hot tap water.

After watching the slide show, participants were asked to identify the theme of the slide show, and rate the effectiveness of the slide show in communicating this theme on a 7 point scale with endpoints labeled "not effective" and "very effective". The effectiveness ratings did not differ significantly by slide show content (pathogen = 3.7,

accident = 3.3, t (91) = 1.27, p = .21), suggesting the manipulations were equally effective.

#### Implicit Association Tasks

Upon completion of the effectiveness rating scales, participants commenced the IAT tasks. The purpose of the IATs was to measure the extent to which the semantic concepts of interest were relatively more likely to be associated with "Alex" or with "Ken". That is, the IATs measured the extent to which "contagious" (in one task) and "unpleasant" (in a separate task) are more likely to be automatically linked to a person who is known to be infected with a contagious disease but looks just fine (Ken), or to a person with a facial disfigurement who is known to be healthy (Alex).

The IAT tasks consisted of 140 trials split into five blocks. In each trial a word or photograph was to be categorized. For the Contagious IAT, the words (contagious, illness, infectious, sickness, epidemic, healthy, nutritious, strong, hygienic, well) were categorized as either "contagious" or "not contagious". For the Unpleasant IAT, the words (ugly, failure, hostile, evil, nasty, trust, smart, gift, gentle, rainbow) were categorized as either "unpleasant" or "pleasant". In both the Contagious IAT and the Unpleasant IAT the photographs of Ken and Alex were categorized as either "Ken" or "Alex". The IAT tasks were programmed to control for order effects present in the methodology.<sup>2</sup>

The words were presented one at a time in random order determined by the IAT software. The stimulus pictures of "Ken" and "Alex" had been matched for size (2 inches by 3 inches) and approximate proportion of subject to background in composition. Three

<sup>&</sup>lt;sup>2</sup> Pre-rating of all target words was done by an independent sample of participants. The words were rated as clearly relevant to the categories they represented (Park, 2005).

pictures of "Ken" and three pictures of "Alex" were used in the IAT task. The pictures were presented in random order. Both words and pictures were categorized by pressing one of two keys on the keyboard that corresponded to the appropriate category for the target word or picture.

For one task (Contagious IAT), participants judged whether the stimulus photos depicted "Ken" or "Alex", and also categorized words as connoting either "contagious" or "not contagious". The IAT was 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 would have found the categorical arrangement in one of the critical blocks easier than the other, depending on which man they implicitly associated with disease. Of interest, then, were responses to two critical blocks of trials which consisted of 40 trials in which both words and pictures were categorized. In one block, responses to the categories "Alex" and "contagious" shared one response key on the keyboard, whereas "Ken" and "not contagious" shared another response key. If the morphologically deviant individual (Alex) was associated with "contagious" concepts then this pairing of person and concept would be consistent with implicit associations, resulting in relatively short reaction times. In the other critical block of trials, "Alex" and "not contagious" shared one response key, whereas "Ken" and "contagious" shared a response key. If the morphologically deviant individual (Alex) was associated with contagious (rather than non contagious) concepts, then this reversed arrangement would conflict with existing implicit associations, resulting in relatively longer response times. To the extent that one of the target men was relatively more strongly implicitly associated with the semantic concept *contagious* than the other, the

reaction times on the critical blocks would be more divergent. The difference of the average reaction times in each critical block provided a measure of the relative strength of the implicit association each target had with each concept.

For another task (Unpleasant IAT), participants categorized pictures as being either "Alex" or "Ken" and words as connoting either "unpleasant" or "pleasant" semantic concepts. Other than substituting contagious and non contagious words for unpleasant and pleasant words, this task was identical to the Contagious IAT. To the extent that one of the target men was relatively more strongly implicitly associated with the semantic concept "unpleasant" than the other, the reaction times on the critical blocks were expected to be more divergent. The difference of the average reaction times in each critical block provided a measure of the relative strength of the implicit associations of "Alex" and "Ken" with "unpleasant" and "pleasant", respectively.

The order in which the participants completed the IATs was counterbalanced across participants. Within each IAT the order in which participants completed these critical blocks was also counterbalanced to control for order effects on reaction time. An overall IAT index was computed (in the manner prescribed by Greenwald et al., 2003) by 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. The direction (and magnitude) of this difference offered an indicator of the extent to which participants implicitly associated "contagious" or "unpleasant" with either "Alex" (the disfigured target) or "Ken" (the contagious target). Positive values on the Contagious IAT index indicate an implicit association linking "contagious" with "Alex" (and "not

contagious" with "Ken"); negative values indicated an association linking "contagious" with "Ken" (and "not contagious" with "Alex"). Similarly, a positive score on the Unpleasant IAT indicates that participants implicitly associated "unpleasant" with "Alex" (and "pleasant" with "Ken"); negative values indicate an implicit association between "unpleasant" and "Ken" (and "pleasant" and "Alex").

#### Target Recall and Rating

After completing the two IATs, participants filled out a questionnaire which assessed their ability to recall the information provided for each of the targets at the start of the study. For each of the targets, participants were asked to recall 3 pieces of information presented in the biographical information. They then reported if the targets were familiar (yes/no), contagious (yes/no) and the extent to which they found each target attractive, and real (1 - 7 point Likert-type scale, endpoints Very and Not at All).

#### Results

Preliminary analyses were carried out to determine the effects of gender and ethnic background on responses to the targets. Results indicate that scores on the Unpleasant IAT and the Contagious IAT did not differ significantly by gender or ethnicity (all ps > .18). The Contagious and Unpleasant IATs were significantly correlated to one another (r = .26, p = .013).

Does disfigurement trump actual disease in connoting "Contagious"?

The mean IAT score for the Contagious IAT did not differ significantly from zero (M=.01, t (92) = .274, p = .79). This means that participants were equally likely to implicitly associate Alex (the disfigured but not contagious target) and Ken (the contagious but not disfigured target) with the concept of contagion. These results suggest

that although the information provided by the heuristic cue of facial disfigurement was not strong enough to completely trump the objective information directly related to contagion, it did influence participants to a degree that they relied equally on objective and heuristic cues of health status.

#### Does disfigurement trump actual disease in connoting "Unpleasant"?

The mean IAT score in the Unpleasant IAT was positive and significantly different from zero (M=.12, t (92) = 2.55, p=.012). The direction of the score indicates that participants implicitly associated Alex (the facially disfigured but healthy target) with unpleasant concepts relatively more than Ken (the not disfigured but infectious target). In this IAT we see the heuristic information was the more powerful influence. At an implicit level, participants did find severe facial disfigurement more unpleasant than an actual contagious disease.

Do either of the implicit associations vary according to temporary or chronic activation of disease vulnerability?

The slide show manipulation had no effect on either the Contagious IAT or the Unpleasant IAT results (Contagious IAT: pathogen M = -.06, accident M = .08, t (91) = 1.52, p = .133; Unpleasant IAT: pathogen M = .11, accident M = .13, t (91) = .183, p = .855).

Correlations between IAT results and individual difference measures are presented in Table 4.1. Chronic concerns with disease vulnerability (as measured by the germ aversion and perceived infectability subscales of the PVD and the Disgust Sensitivity scale) were not significantly related to scores on the Contagious IAT. However, higher scores on the Germ Aversion subscale of the PVD and the Disgust Sensitivity scale were related to higher scores on the Unpleasant IAT (r = .23, p = .03 and r = .25, p = .02, respectively). In other words, those participants for whom germ transmission was chronically salient were especially likely to implicitly associate the disfigured target, relative to the infectious target, with unpleasant concepts.

#### Table 4.1

Correlations between Individual Differences and Implicit Associations with Semantic Concepts 'Contagious' and 'Unpleasant'

	Contagious IAT		Unpleasant IAT	
	r	р	r	р
Perceived Vulnerability to Disease				
Germ Aversion	02	.97	.23	.03*
Perceived Infectability	04	.69	.09	.42
Disgust	.13	.22	.25	.02*
Core	.03	.80	.20	.06
Animal Reminder	.18	.08	.22	.04*
Contamination	.13	.21	.27	.01*
Belief in a Dangerous World	.07	.52	.06	.59

*Note.* \* indicates correlation is significant at p < .05 (two tailed).

Does the extent to which the targets are perceived to be 'real' influence implicit associations with contagious or unpleasant concepts?

One additional perceptual difference is noteworthy. As a result of comments from some initial participants concerning the possibility that the photo of Alex (the disfigured target) had been digitally manipulated, an item was added to the post IAT questionnaire.

(The person depicted in the photograph is, in fact, a real individual.) This item required participants to rate the extent to which each target was 'real' on a 7 point scale (with endpoints labeled Very Unrealistic and Very Realistic). Of the total of 59 participants who completed this item, approximately half (n = 31) rated Alex, the facially anomalous but objectively healthy individual, to be unrealistic (3 or lower on the 7 point scale). Only 1 participant rated Ken, the contagious individual, below the midpoint on real. To investigate the possibility that perceived realness might influence implicit associations with the concepts of interest, the IAT results were analyzed separately for the subset of participants whose ratings on the 'real' item was 4 or higher for both targets (n = 27) and those who doubted the authenticity of one of the targets (scores of 3 or lower; n = 32).

The extent to which participants think both the targets are real did influence implicit associations between the targets and the semantic concept "contagious". Those participants who thought both targets were real implicitly associated contagious concepts significantly more with Ken, the contagious individual, than with Alex, the facially disfigured individual (M = -.234, t (26) = -3.08, p =.005). However, perceived realness did not significantly influence associations with general "unpleasant" concepts (real M =.01, not real M = .13, t (57) = .993, p = .325).

#### Discussion

This study was designed to investigate the relative strength of facial disfigurement and objective knowledge of health status as cues of pathogen presence at an implicit level. 'Introducing' participants to two targets, each of which displayed only one of these cues (disfigured but not contagious or contagious but not disfigured) allowed a test of the extent to which each type of cue (relative to the other) connoted contagion specific or generally unpleasant concepts. Specifically, this method tested if a heuristic cue of pathogen presence, represented in this study by facial disfigurement, automatically activated stronger cognitions specific to contagion than objective knowledge of the presence of communicable disease. This study also allowed the test of the strength of these cues as triggers of less specific aversive cognitions by measuring the extent to which the disfigured target, relative to the contagious one, was associated with generally unpleasant cognitions.

Worth noting is the differences in implicit associations for those individuals who thought both targets were real compared to those who did not. Those who thought the targets were real were more likely to associate Ken, the actually contagious target with contagious. Those who thought the targets were not real associated Alex, the disfigured individual with contagious concepts. Both groups found the two targets equally unpleasant. It is premature to interpret either of these results as being correct, as there is no way to determine which group is more representative of what occurs in real life, therefore the discussion will focus on the overall findings. However, these differences demonstrate the need to conduct future research on variables other than differences in concerns with communicable threat that may influence the behavioral immune system.

The results for the Contagious IAT indicated that both targets were equally associated with contagious concepts. This implies that the heuristic cue of facial disfigurement is an equally strong cue of pathogen presence as is the knowledge that an individual has a contagious disease. The results for the Unpleasant IAT indicated that the facially disfigured target was more strongly associated with unpleasant concepts than the contagious one. This suggests that when it comes to generally aversive cognitions, facial disfigurement is a stronger trigger than objective knowledge than an individual is harboring an infectious disease.

Is it possible that these results have nothing to do with the behavioral immune system, and were caused by something other than pathogen avoidance processes? The results from this study do leave this possibility open, especially since the link between disfigurement and contagious concepts was not found. It may be that the disfigured target was simply considered more unattractive than the contagious one, activating cognitive biases (e.g., the halo effect; Bersheid & Walster, 1974) which caused the participants to attend less to the information (pertaining to their health status) contained in the biography. This process would result in participants finding the disfigured target less pleasant than the more normative individual. Alternatively, it is possible that the disfigured individual is implicitly associated with unpleasant concepts that result from intra-personal processes. The novelty of the disfigurement may cause a perceiver to want to stare, which could create a conflict with existing beliefs the perceiver holds about the appropriate way to respond to people who deviate from the physical norm. These opposing desires may activate feelings of discomfort about the self, which make the source of this discomfort aversive (Langer, Fiske, Taylor, & Chanowtiz, 1976). If there were no relationships between chronic concerns with communicable threat and implicit associations between the disfigured target and unpleasant concepts it would be impossible to rule out these alternative explanations.

However, in addition to measuring the implicit associations between facial disfigurement and contagious and unpleasant concepts, the study measured chronic concerns with the threat posed by communicable pathogens (the PVD and Disgust

Sensitivity scales) and manipulated the extent to which pathogen threat was temporarily salient. This allowed a more nuanced understanding of the extent to which individual differences and environmental salience of pathogen threat influence the negative or contagious cognitions activated by each target. If pathogen avoidance motivations contribute to aversive reactions to individuals who deviate from the norm because deviation acts as a cue connoting pathogen presence, individuals who report higher chronic concerns with pathogens, and those for whom pathogens are temporarily salient, should be especially likely to associate the disfigured individual with contagious and unpleasant concepts. This study provided evidence that higher levels of both chronic concerns with situations in which pathogens are especially likely to be salient (measured by the Germ Aversion subscale) and disgust sensitivity were positively related to the likelihood that facial disfigurement acts as a trigger of unpleasant (but not contagious specific) cognitions.

To better understand facial disfigurement as a cue of pathogen presence requires consideration of these findings in relation to the findings from the previous study of facial disfigurement as a cue connoting pathogen presence (Duncan, 2005). This study used the same methodology to test the extent to which a facially disfigured target (who in this study had a large birthmark on one side of his face) was implicitly associated with disease concepts relative to a contagious target (who had tuberculosis). Results indicated the facially disfigured target was more strongly associated with disease concepts (but found no evidence that either chronic or temporary salience of infectious threat influenced this association). Taken together, the semantic concepts used in these studies represent a continuum of cognition specificity going from general aversion (unpleasant concepts), through moderate specificity (disease concepts) to highly specific (contagious concepts). The results indicate that facial disfigurement is a strong enough cue connoting pathogen presence to trump actual contagious threat when it comes to associations with generally unpleasant and disease cognitions, but that it is not a strong cue to override objective knowledge concerning contagious concepts. This implies that morphological deviations from the norm are strong but relatively crude cues, activating cognitions that are likely to motivate behavioral avoidance without requiring that these cognitions be specific to the transmission of infectious threat.

Two key results regarding the relationship between chronic concerns with contagious threat and the use of disfigurement as a heuristic cue of pathogen presence warrant further discussion. First is the finding that high scores on both the Germ Aversion subscale of the PVD and the Disgust Sensitivity scale were related to the extent to which the heuristic information (contained in the facial disfigurement) trumped actual objective information (contained in the diagnosis of tuberculosis). Second is the fact that the relationships mentioned above were found only for the Unpleasant IAT.

The first finding has implications for our understanding of the cue detection mechanisms involved in the behavioral immune system. If chronic concerns with communicable threat are positively related to stronger implicit associations between a facially disfigured target and unpleasant concepts, then it suggests pathogen avoidance processes contribute to these associations. Therefore, the finding that people high in Germ Aversion and/or Disgust Sensitivity have a stronger tendency to associate facial disfigurement with aversive concepts, thus using it as a strong heuristic cue of connoting pathogen presence is consistent with the hypothesis that the behavioral immune system is automatically triggered by perceptual cues connoting pathogen presence. Importantly, it suggests that the sensitivity of the system to these cues varies as a function of an individual's feelings of vulnerability to contagious threats. This result provides evidence for the theorized functional flexibility of the detection mechanisms the behavioral immune system employs.

The second finding has implications for our understanding of the psychological response mechanisms of the behavioral immune system. The heuristic cue of facial disfigurement trumped the objective knowledge of tuberculosis in activating implicit associations with general unpleasant concepts, but not with specific contagious concepts. This indicates that the cognitive response to facial disfigurement as a perceptual trigger is fairly gross, activating cognitions of "bad in general", and not cognitions that are specific to connoting contagion. That it occurred in spite of objective knowledge of contagious threat supports the two stage theory that our initial, automatic reactions to crude, pathogen connoting cues are adjusted by slower, more conscious processes. This finding is consistent with the two process theory of stigma (Pryor, et al., 2004; Reeder & Pryor, 2008).

These findings extend existing evidence supporting the use of facial deviations from the norm as a cue that connotes pathogen presence. They demonstrate that more than one type of facial disfigurement activates negative cognitions, and indicate that the behavioral immune system is functionally flexible in its detection of and response to facial deviations. Additionally, these results suggest the behavioral immune system operates by activating aversive (but not contagion specific) cognitions in response to perceptual cues that connote pathogen presence.

The general nature of the cognitions that are activated by facial disfigurement (unpleasant, not contagious) may be an indication that the behavioral immune system, although a sophisticated set of psychological mechanisms, does not need to (and may be unable to) provide an especially sophisticated cognitive output. It is only in the relatively recent past, with the introduction of germ theory, that we have consciously understood that pathogens cause infectious diseases, and that taking measures to avoid contracting the bacteria, viruses and parasites that others host is an effective means of preventing illness. However, the behavioral immune system is theorized to work by activating affective and cognitive responses that result in behavioral avoidance of potentially infectious individuals and situations- which is one way of preventing the spread of disease causing pathogens. It may also be the case that the cognitive resources required to associate heuristic cues which connote pathogen presence with a concept as specific and complex as 'contagious' do not provide any additional benefits above and beyond the activation of more general, but equally aversive, concepts (e.g., unpleasant, disease) if both processes achieve the same behavioral outcome.

Although these findings are important contributions to our understanding of the behavioral immune system, there are a number of limitations to the current study. The first is that the slide show manipulation of pathogen salience did not affect implicit associations as expected. One possible reason for the lack of findings is that the behavioral immune system is not sensitive to temporary salience of pathogens. However, previous studies have found differences in implicit cognitive activations based on temporary salience of pathogen threat (Park et at., 2007) and self reports of attitudes (Faulkner et al., 2004) suggest this is not likely the case. Another possibility is that the slide show activates conscious awareness of pathogens in the environment (as demonstrated by the manipulation check) but that it is not an effective means of making participants feel that they are especially vulnerable to communicable threat. If this is the case, it suggests a different type of manipulation which focuses on increasing subjective feelings of vulnerability to, not just awareness of, infectious threat may be more effective.

#### **Conclusions**

The current methods, which measure associations with "contagious" and "unpleasant" concepts, do not directly address the criteria set for facial disfigurement to be considered a triggering cue for the behavioral immune system – that the deviation activates "disease" cognitions. However, the fact that facial disfigurement was as related to "contagious" specific concepts as objective knowledge, in combination with the findings from Duncan (2005) which found an association between facial disfigurement and disease, suggests that facial disfigurement is a triggering cue. Additionally, facial disfigurement meets the second, stronger criteria for triggering cues, such that it is especially likely to activate unpleasant cognitions for individuals with chronic concerns with communicable threat and disgust. It does not, however, vary as a result of temporary increases in the salience of communicable threats.

This study also provides evidence which bears on the level of connotative complexity in the cognitions activated by the behavioral immune system. These results suggest that the concepts activated in response to facial disfigurement are generally

aversive, and not specific to contagion, as associations between the disfigured target and the contagious target were only different on the Unpleasant IAT.

Regarding the automaticity of behavioral immune system activation, these tests provide somewhat ambiguous results. In the Contagious IAT, the objectively correct response would have been to associate Ken, the contagious individual with contagious concepts. It was found that both men were equally associated with contagion, suggesting that the behavioral immune system may have been activated (causing the disfigured but healthy individual to be associated with contagious concepts), and that this activation occurred, at the very least unintentionally, autonomously and involuntarily, thus meeting three of the four criteria established for automaticity. The same conclusions regarding automaticity can be made for the Unpleasant IAT, with the addition of one assumption: that an individual who poses an actual communicable threat is objectively more unpleasant than one who deviates from a physical norm. The extent to which these responses were effortless cannot be determined with this methodology.

#### **CHAPTER 5: RESPONSES TO EXTREME WEIGHT DEVIATION**

The behavioral immune system necessarily relies on indirect cues of pathogen presence, due to the microscopic size of most of the communicable threats we face. As such, we will necessarily make mistakes when deciding which individuals and situations honestly pose communicable threats. These mistakes will typically be in the direction of overgeneralizing cues that connote the possibility of pathogen presence (Zebrowitz, 1990, 1997, Zebrowitz, Fellous, Mignault & Andreoletti, 2003). As such, we are more likely to over-apply cues by assuming a healthy individual is sick then under-apply them by assuming a sick individual is healthy, as the cost of the second type of error is, on average, smaller than the cost of the first (Schaller & Duncan, 2007; Haselton & Nettle, 2006).

The previous chapter investigated the possibility that morphological deviations from the prototypical human face may act as a heuristic cue of pathogen presence and activate the behavioral immune system. Although the face is an important source of social information, it is not the sole physical source of social cues. We also use the body as a source of information about an individual. For example, recent research has found that people are able to accurately judge the formidability (upper body strength) of male targets (Sell, Cosmides, Tooby, Sznycer, von Rueden & Gurven, 2009), as well as the symmetry of male targets by watching them dance (Brown, Cronk, Grochow, Jacobson, Liu, Popovic & Trivers, 2005).

Just as bodies that match the prototype provide information (Singh, 2002) so too might bodies which deviate from the norm. Deviations from the prototypical human body may act as cues which connote the possible presence of communicable pathogens and so activate the behavioral immune system.

#### Physical Deviation As a Cue Connoting Pathogen Presence

There are numerous ways in which the body can deviate from the species typical norm. These deviations can occur from the contraction of communicable pathogens (e.g. pox, rashes, muscle atrophy), congenital and therefore non-communicable means (e.g., dwarfism, gigantism, cerebral palsy), and intentional body modification processes (e.g. overdeveloped musculature, neck, lip, and earlobe stretching). It is likely that each of these types of deviation has the potential to act as a heuristic cue of pathogen presence, regardless of the actual source of the morphological anomaly<sup>3</sup>. Viewed through the lens of pathogen avoidance motivations, there are at least two possible reasons these deviations could be perceived as cues indicative of pathogen presence. First, it is unlikely that the cue detection processes of the behavioral immune system are sophisticated enough to differentiate between intentional and unintentional causes of physical deviation, as cultural modifications change more quickly than the system can. Second, and more importantly, the behavioral immune system evolved in such a way that it is necessarily overly-sensitive to an overly-general set of cues which might indicate pathogen presence. It can best fulfill its goal of preventing contact with potentially infected individuals by being sensitive to physical deviations from the prototypical body, regardless of actual cause. The implication is that any type of deviation from a physical

<sup>&</sup>lt;sup>3</sup> However, any culturally sanctioned intentional modification process is not likely act as a pathogen connoting cue for individuals within the culture, as the specific modifications will have been frequently observed and incorporated into the physical prototype.
norm may provide fruitful avenues of investigation to further our understanding of the effects of pathogen avoidance motivations on psychological phenomena.

There is already evidence from a series of studies that physical disability acts as a trigger for the behavioral immune system (Park, Faulkner and Schaller, 2003). One study found that individuals with chronic concerns with communicable disease (as measured by the Germ Aversion subscale of the Perceived Vulnerability to Disease) were negatively related to reported number of friends and family members with physical disabilities. In another study it was found that for European participants, scores on both of the PVD subscales were positively related to implicitly associating disabled targets with both generally unpleasant and disease specific semantic concepts. Additionally, disabled people were especially likely to be associated with disease by those participants for whom disease threat had been made temporarily salient, suggesting disease avoidance mechanisms contribute to aversive reactions to physically disabled individuals. However, among East Asian participants a different pattern of results emerged. The manipulation of the temporary salience of pathogens did not affect implicit associations with either generally unpleasant or disease specific concepts, however participants with higher scores on a measure of Disgust Sensitivity were more likely to implicitly associate physically disabled individuals with both concepts.

#### **Extreme Weight As a Cue Connoting Pathogen Presence**

Another type of deviation from the physical norm that has been investigated is obesity. Recent work has shown that extreme corpulence acts as a trigger to activate the behavioral immune system (Park, Schaller and Crandall, 2007). In one study, it was found that chronic concerns with communicable disease (as measured by the Germ Aversion subscale of the PVD) were positively related to explicit reports of dislike of fat people, especially for those participants who had recently viewed photos of obese individuals. A second study investigated implicit associations between obesity and disease concepts. Results revealed that participants implicitly associated fat people with 'disease' concepts, and that this association was exaggerated when the threat of communicable disease was made temporarily salient. These findings are consistent with the operation of disease avoidance mechanisms and suggest that disease avoidance motivations may contribute to anti-fat prejudice.

Just as it is possible to be overweight, it is also possible to be underweight – and abnormally so. If the behavioral immune system is activated by deviations from the species typical norm, then we should expect extreme skinniness to act as a heuristic cue of pathogen presence in the same manner as deviations in the opposite direction. No previous research has tested the possibility that extreme thinness may also be a trigger and be associated with "disease". The first study described in this chapter was designed to do just that.

Weight is a fairly unique physical dimension because deviation from the norm can occur in two extremes. This property qualifies it as a variable that can be used to improve our understanding of the way the behavioral immune system responds to and uses deviations from the norm as cues of pathogen presence<sup>4</sup>. There are two apparent possibilities. If the system is attuned only to absolute deviation from a norm, it suggests

<sup>&</sup>lt;sup>4</sup> Determining the 'normal' weight is a daunting task in itself, let alone determining what counts as deviation from that norm. The best and most accepted rough estimate of body fat is provided by the Body Mass Index, which is calculated by dividing the weight of an individual in kilograms by the square of their height in meters (kg/m<sup>2</sup>). The Canadian Guidelines for Healthy Weights (1988) determined that a body mass index of between 20 and 27 is a generally acceptable range for most people. For example, consider an individual who is 5'7" tall. At 100 pounds, this individual would be underweight, having a BMI of just 15.7. At 150 pounds, their BMI increases to 23.5. At 200 pounds this individual would be classified as overweight, with a BMI of 31.1.

the system's cue detection mechanisms are highly tuned to the prototypical norm, and treat all deviations from this norm as equally likely to connote pathogen presence. If this is the case, then we should expect to see that both extreme obesity and extreme emaciation activate the behavioral immune system, and that they do so to the same degree. A second possibility is that the cue detection system is sensitive to certain types of deviations from the prototype. Specifically, the system could be especially attuned to deviations that are more likely to be indicative of actual pathogen presence than others. If this is the case, we should expect to see that that the weight extreme which occurs most frequently as a result of pathogen presence should activate a stronger behavioral immune response than the less pathogen related extreme. For example, of the 25 most important diseases (in terms of human cost) identified by Wolfe, Dunavan & Diamond (2007), 5 have weight loss as frequent symptoms, an additional 10 cause nausea and/or vomiting and/or diarrhea, which can lead to decreased caloric intake or loss of metabolic resources resulting in weight loss. In contrast, only one (typhoid) has bloating as a symptom. This suggests that extreme thinness may be an especially honest indicator of pathogen presence, especially when compared with obesity. And, as is the case with the response to any cue which may trigger the behavioral immune system, it is expected that the functional cognitive, affective, and behavioral responses that are activated will be heightened in situations where communicable threat is especially salient, and among individuals who are have higher levels of chronic awareness of communicable threat.

The second set of studies described in this chapter compares the relative strengths of both types of weight extreme as disease connoting cues. While either deviation from the weight norm has the required characteristic to activate the behavioral immune system, emaciation may be especially likely to trigger aversive cognitions. Measuring the independent and relative strength of obesity and emaciation as cues of pathogen presence provides useful, but somewhat limited, descriptive information about the cognitions that are activated in response to these cues. Therefore, to get a more nuanced understanding of the ways in which pathogen avoidance motivations influence reactions to emaciation and obesity requires both the manipulation of the temporary salience of communicable and measures of chronic concerns with pathogen transmission. Thus, all the studies reported in this chapter involve manipulations of pathogen salience and individual difference measures of chronic concerns with communicable threat.

# **Study 5.1: Thin Implicit Association Test**

The purpose of this study is to determine if extreme emaciation is a cue which connotes pathogen presence. Measuring the extent to which emaciated, relative to normal weight targets, are implicitly associated with generally unpleasant and disease specific concepts will provide an answer to this question. In addition to overall levels of association with the target concepts, manipulating temporary and measuring chronic concerns with communicable threat will contribute to the understanding of the role of pathogen avoidance motivations in responses to emaciated individuals.

## Method

#### **Participants**

Fifty-eight participants completed the study. Computer program errors prevented three participants from completing the computer tasks; these individuals were therefore excluded from the analysis. The final sample comprises 55 participants (42 female, 13 male, 3 unreported; mean age 20.2). The sample was ethnically diverse, including 27

participants of East Asian heritage, 17 participants of European heritage and 11 participants from a variety of other ethnic backgrounds.

## Procedure

Participants were told the purpose of the study was to investigate two lines of research, one focusing on the way we process information that relates to people, and the second on public health issues. They were informed they would be filling out questionnaires, 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 three individual difference measures. Two of these questionnaires were relevant to disease. The Perceived Vulnerability to Disease scale (Duncan, Schaller & Park, 2009, see Chapter 3) and the Disgust Sensitivity Scale (Haidt, McCauley, & Rozin, 1994), which is a 32-item scale that assesses individual differences in sensitivity to domain specific disgusts, which are combined to obtain an overall disgust score. The additional individual difference measure was relevant to assessments of the intentions of others, the Belief in a Dangerous World scale (BDW; Altemeyer, 1988). A demographic questionnaire was also included in the questionnaire package. It asked the participant's age, gender and ethnic background.

## Practice IAT

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 is described in more detail below. Participants completed this initial version of the IAT only to familiarize them with the IAT procedures.

#### Disease Salience Manipulation

Participants were told that experimental protocol required them to wait a specific amount of time between the practice computer task and the next computer task to prevent practice effects. Each participant was asked to fill this time by watching and rating a slide show that was ostensibly being used in a future study. Participants were asked to pay attention to the slide show as they would be asked questions about the content at a later time. In reality, participants were randomly assigned to one of two slide show conditions: pathogen salient (n = 29) or accident salient (n = 26). 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 (Faulkner et al, 2004). This manipulation is the same as the one used and described in Chapter 4.

After watching the slide show, participants were asked to identify the theme and rate the effectiveness of the slide show in communicating this theme on a 7 point scale (endpoints labeled "Not effective" and "Very effective"). They were also asked to indicate a time in their past when that type of threat (either pathogen related or accident related) was especially salient. They were then asked to review the slide show a second time and identify the slide they thought most effectively conveyed the theme of the slide show.

#### Implicit Association Tasks

Upon completion of the effectiveness rating scales, participants commenced the IAT tasks. The purpose of the IATs was to measure the extent to which the semantic concepts "disease" (in one task) and "unpleasant" (in a separate task) are more likely to be automatically linked to people who are extremely emaciated or are a more prototypic body weight.

For the Disease IAT, the words were categorized as connoting either "disease" or "health". For the Unpleasant IAT, the words were categorized as either "unpleasant" or "pleasant". All words were the same as those used and described in Chapter 4. In both the disease and the unpleasant IAT, the photographs being categorized were of either normal weight or extremely emaciated individuals. There were 10 photos of thin individuals, each of which showed the face and the majority of the body of an emaciated individual (the majority of which were fashion models). There were also 10 photos of normal weight people, each of which showed the face and all or the majority of the body. Each set of photos had 9 female targets and 1 male. Participants categorized the individuals in the pictures as being either "thin" or "average" weight.

Each of the IAT tasks was run using Inquisit software and consisted of 140 serially presented trials split into five blocks. In each trial a word or photograph was to be assigned to one of two possible categories. Three of these blocks were considered practice blocks, where the participant categorized either words or pictures by pressing one of two designated keys on the keyboard. Two of the blocks were 'critical' blocks, in which participants categorized both words and pictures. In these blocks there were four possible categories (two for pictures, two for words) but only 2 response keys, as each key represented both a word and a picture category. In the Disease IAT participants responded to each stimulus word by categorizing it as relevant to either "disease" or "health"; participants responded to each stimulus photograph as depicting either "thin" or "average". On one critical block of trials, the categories "thin" and "disease" shared the same response key. On the other critical block of trials, "average" and "disease" shared the same response key.

The Unpleasant IAT was completed in an identical manner, except participants associated the photographs of thin or average weight targets with either "unpleasant" or "pleasant" concepts.

The order in which the participants completed the IATs was counterbalanced across participants. Within each IAT the order in which participants completed these critical blocks was also counterbalanced to control for order effects on reaction time.

An overall IAT index was computed (in the manner prescribed by Greenwald et al., 2003) for each test by subtracting mean response times during one critical block of trials from mean response times during the other critical block of trials and dividing the difference by the combined standard deviation of both critical blocks. The direction (and magnitude) of each IAT index offers an indicator of the extent to which participants implicitly associated the semantic concepts of interest with "thin" relative to "average" weight individuals. In the Disease IAT, positive values on this IAT index indicate an implicit association linking "disease" with thin (and "healthy" with average); negative values indicate an association linking "disease" with average (and "healthy" with thin). Similarly, a positive score on the Unpleasant IAT indicates participants implicitly associate "unpleasant" with thin (and "pleasant" with average); negative values indicate an implicit association between "unpleasant" and average (and "pleasant" and thin).

#### Results

Is extreme thinness associated with "disease" concepts?

The mean score in the Disease IAT is positive, and significantly different than zero (M = .35, t (54) = 6.20, p = .000). This result indicates that participants were more likely to associate thin targets, relative to average weight targets, with concepts specific to disease.

## Is extreme thinness associated with "unpleasant" concepts?

The mean score for the Unpleasant IAT is also positive, and significantly different from zero (M = .40, t (54) = 6.31, p <.000). This result indicates that participants were also more likely to associate thin targets, relative to average weight targets, with generally unpleasant concepts.

Do either of the implicit associations vary according to temporary or chronic activation of disease vulnerability?

Analyses of the manipulation of temporary pathogen salience indicate that it had no effect on either the Disease IAT or the Unpleasant IAT results (Disease IAT: pathogen M = .33, accident M = .38, t (53) = -.43, p = .67; Unpleasant IAT: pathogen M = .39, accident M = .43, t (53) = -.35, p = .73).

Chronic concerns with disease vulnerability measured by the PVD subscales and Disgust sensitivity were not related to scores on the Disease IAT (see Table 5.1).

## Table 5.1

# Correlations between Individual Difference Measures and Disease IAT and Unpleasant

## IAT Scores

Individual Difference Measure	п	Disease IAT	Unpleasant IAT
Germ Aversion	55	12	29*
Perceived Infectability	55	.04	.25
Disgust Sensitivity	55	18	26
Belief in a Dangerous World	55	17	05

*Note.* \* indicates correlation is significant at p < .05 (two tailed).

The results for the Unpleasant IAT are less straightforward. Participants with high scores on the Germ Aversion subscale of the PVD, as well as those with high sensitivity to disgust were especially likely to associate thin targets with "pleasant" (not unpleasant) concepts (r = -.29, p = .04 and r = -.26, p = .052, respectively). These relationships between these individual difference measures is somewhat counterintuitive, as the pathogen avoidance model suggests those individuals who are chronically concerned with communicable disease should find deviant individuals especially aversive. In contrast, participants with high scores on the Perceived Infectability subscale of the PVD showed a marginally greater tendency to associate thin targets with "unpleasant"(r = .25, p = .07).

The results from this study show that extreme thinness is associated with both "disease" concepts and "unpleasant" concepts, which suggests extreme thinness meets the triggering cue of the behavioral immune system criteria of implicit associations with "disease" concepts and speaks to the more general nature of the cognitions activated by the system. Additionally, the positive relationship between the Perceived Infectability subscale and implicit associations of thin targets with unpleasant is consistent with these associations being related to pathogen avoidance motivations. However, these associations did not differ depending on the temporary salience of pathogen presence. Further, the negative relationship between scores on the Unpleasant IAT and the Germ Aversion subscale and Disgust Sensitivity is inconsistent with the criteria set for pathogen avoidance motivations. The reasons for these negative relationships are unclear, but may be illuminated by the results of the second and third study on deviant body weight as a disease cue.

#### Fat and Thin Versus Contagious Implicit Association Tests: Studies 5.2a and 5.2b

The results from the previous study indicate that extreme thinness is implicitly associated with disease and unpleasant concepts. Obesity is implicitly associated with disease concepts, especially if pathogens have been made temporarily salient (Park et al., 2007). These results suggest that extreme weight deviation is used as a cue of health status, at least when no other pertinent information is available. However, it remains to be seen if emaciation and obesity are strong enough heuristic cues to activate the behavioral immune system in spite of knowledge of actual health status. This pair of studies was designed to address three research questions: Is emaciation a stronger disease cue than objective knowledge of infection? Is obesity a stronger disease cue than objective knowledge of infection? Are both types of weight deviation are equally strong cues connoting pathogens, or is one stronger than the other?

These questions can be addressed in the same way the question of the strength of facial disfigurement as a cue was addressed in Chapter 4. By providing people with two

types of contradictory health information in the form of photographs containing information about the target's weight (deviant, average) and biographical information about the health status of the target (contagious, not contagious) and measuring the extent to which each target is associated with generally unpleasant or disease specific concepts, we are able to see the extent to which both extremes of deviant weight automatically trigger cognitions consistent with disease avoidance mechanisms.

Beyond trumping objective knowledge, this investigation was designed to illuminate the relative strength of obesity and emaciation as pathogen connoting cues. Our current understanding of the way the behavioral immune system responds to physical cues is crude, such that we assume deviations from the prototypical norm trigger the system (e.g. Park et al, 2003; 2007). There is little, if any, evidence which speaks to the possibility that certain types of deviations are more likely to activate the system or to initiate a stronger response than others. By comparing the implicit associations of both weight extremes, this study provides the first empirical test of the relative strength of two perceptual cues as triggers of the behavioral immune system.

Two conceptually similar studies were run to answer these questions. All procedures were the same, and the dependent measures (Unpleasant and Disease IATs) were identical. Across study 2A and 2B there were only two changes: different target people were used as Fat, Thin and Contagious targets in each study, and a different version of the Disgust Sensitivity Scale was used in each study. Study 5.2a should be considered a pilot study, as the materials chosen left open several alternative explanations for the findings. These issues were addressed in Study 5.2b.

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#### Study 5.2a

## Method

## **Participants**

Fifty three participants completed the study. Two participants did not complete the IAT portion of the study; their data therefore were excluded from the analysis. The final sample comprises 51 participants (34 female, 17 male, mean age 19.6). The sample was ethnically diverse, including 37 participants of East Asian heritage, 13 participants of European heritage and 1 participant from another ethnic background.

## Procedure

Participants were told the purpose of the study was to investigate various aspects of person perception. They were informed they would be filling out questionnaires, reading information about two people, 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 which contained three individual difference measures. Two of these questionnaires were relevant to disease: the Perceived Vulnerability to Disease scale (Duncan, Schaller & Park, 2009, Chapter 3) and the 32 item version of the Disgust Sensitivity Scale (Haidt, McCauley, & Rozin, 1994). One was relevant to interpersonal threat more broadly, the Belief in a Dangerous World scale (BDW; Altemeyer, 1988). A demographic questionnaire was also included in the questionnaire package. It asked the participant's age, gender and ethnic background.

## Practice IAT

Upon completion of the questionnaires, participants completed a practice 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. 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 presented with photographs and biographical information about two men. Participants were randomly assigned to either the "fat" or the "thin" condition. In both conditions they received information about two individuals, one of which was described as having an infectious disease but in the picture provided did not appear differ from the physical norm. The other individual's description made no mention of health status but the picture provided showed the individual deviated from the prototypical weight by being either obese or emaciated. Participants were asked to read the biographies carefully, as they would be required to answer questions regarding the two men at a later point. The only difference between the "fat" and "thin" conditions was that in the "fat" condition the objectively healthy individual pictured was obese, and in the "thin" condition the objectively healthy individual pictured was extremely underweight.

The contagious individual in both the "fat" and "thin" condition was named Steve. His photograph showed that he was a dark haired Caucasian man in a grey long sleeved shirt with no obvious deviations from the physical norm. The picture showed him from just below the waist up. The biographical information about Steve, however, made it clear that he suffered from a contagious disease:

### Biography used for Steve

Steve 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, Steve enjoys video games, reads and writes book reviews for local papers.

In contrast, the photographs of Mike (obese) and Dave (emaciated) depicted Caucasian men with extremely deviant weight. The photograph of Mike showed a man from just below the waist up in a grey short sleeved shirt who was extremely overweight (weight 407, height 6'2, Body Mass Index = 52.3). The photograph of Dave showed a man from just below the waist up who was not wearing a shirt and was extremely emaciated (weight 121 pounds, height 6'0, Body Mass Index 16.4). The biographical information about Mike and Dave made no mention of illness or contagion, and highlighted the fact that their weight had no negative physical or social consequences on the individual's lifestyle.

## Biography used for both Mike and Dave

Mike/Dave is a 27 year old male who lives in the Lower mainland. He works in the construction industry. Mike/Dave is an active, outgoing individual with a great sense of humor. He does public speaking to raise awareness for causes he believes in.

Mike/Dave enjoys spending time with friends going to movies, and has been known to be the life of the party in situations that range from dancing at weddings to spending a night out on the town with the boys.

## Disease Salience Manipulation

After reading the biographical information, participants were told that the experimental protocol required them to wait a specific amount of time between the practice computer task and the next computer task. In order to ensure that random thoughts did not influence the outcome of the second set of computer tasks, each participant was told they would watch the same slide show. Participants were asked to pay attention to the slide show as they would be asked questions about the content at a later time. This slide show manipulation is the same that was used in Chapter 4.

In reality, participants were randomly assigned to one of two slide show conditions designed to make salient one of two threats: Pathogen salient (n = 27) or Accident salient (n = 24). 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.

After watching the slide show, participants were asked to identify the theme and to rate the effectiveness of the slide show in communicating this theme on a 7 point scale, endpoints "not effective" and "very effective". The slide shows were rated as being equally effective (Pathogen M = 3.34, Accident M = 3.67, t (49) = -.70, p = .49).

## Implicit Association Task

Upon completion of the effectiveness rating scales, participants commenced the IAT tasks. The purpose of the IATs was to measure the extent to which the semantic concepts of interest were relatively more likely to be associated with the individual who is actually contagious or the one who displays a heuristic cue that connotes pathogen presence. That is, the IATs measured the extent to which "disease" (in one task) and "unpleasant" (in a separate task) are more likely to be automatically linked to a person who is known to be infected with a contagious disease but looks just fine ("Steve"), or to a person with deviant weight but is known to be healthy ("Mike" in the obese condition; "Dave" in the emaciated condition).

The IAT tasks consisted of 180 trials split into seven blocks. In each trial a word or photograph was categorized. For the Disease IAT, the words were categorized as either "disease" or "healthy" For the Unpleasant IAT, the words were categorized as either "unpleasant" or "pleasant" and the photographs of the target individuals were categorized as "Steve" (tuberculosis), "Dave" (emaciated), or "Mike" (obese).

The "disease" words (contagious, illness, infectious, sickness, epidemic), "health" words (healthy, nutritious, strong, hygienic, well), "unpleasant" words (ugly, failure, hostile, evil, nasty), and "pleasant" (trust, smart, gift, gentle, rainbow) words were the same as those used in Chapter 4. These words were presented one at a time in random order determined by the IAT software. The stimulus pictures of Mike, Dave and Steve had been matched for size (2 inches by 3 inches) and approximate proportion of subject to background in composition. Three pictures of each target were used in the IAT task. The pictures were presented in random order from the set of 6 images. Both words and

pictures were categorized by pressing one of two keys (E and I) on the keyboard that corresponded to the appropriate target category.

For one task (Disease IAT), participants judged whether the stimulus photos depicted either "Dave" (thin) or "Steve" (tuberculosis) in the Thin condition or "Mike" (fat) or "Steve" (tuberculosis) in the Fat condition. They also categorized words as connoting either "disease" or "health". Depending on which man they associate with disease, participants should find the categorical arrangement in one of the critical blocks easier than the other. Of interest, then, are responses to two critical blocks of trials (which consist of 40 trials) in which both words and pictures are categorized. In one block, responses to the categories "Dave" (or "Mike") and "disease" shared one response key on the keyboard, whereas "Steve" and "health" shared another response key. If the morphologically deviant individual ("Dave" or "Mike") is associated with "disease" concepts then this set up is consistent with implicit associations, which may result in relatively short reaction times. In the other critical block of trials, "Dave" (or "Mike") and "health" shared one response key, whereas "Steve" and "disease" shared a response key. If the morphologically deviant individual ("Dave" or "Mike") is associated with "disease" (rather than healthy) concepts, then this reversed arrangement conflicts with existing implicit associations, which could result in relatively longer response times. To the extent that one of the target men is relatively more strongly implicitly associated with the semantic concept "disease" than the other, the reaction times on the critical blocks will be more divergent. The difference of the average reaction times in each critical block divided by the standard deviation of the reaction times for both blocks provides a measure of the relative strength of the implicit association each target has with each

concept. This is referred to as an IAT effect. Larger IAT effects indicate one target is associated more strongly with one semantic concept (either "disease" or "health") concept than the other.

For another task (Unpleasant IAT), participants categorized pictures of "Dave" (or "Mike") and "Steve", although this time they categorized words as connoting either "unpleasant" or "pleasant" semantic concepts. Other than substituting "disease" and "health" words for "unpleasant" and "pleasant" words, this task was identical to the Disease IAT. To the extent that one of the target men is relatively more strongly implicitly associated with the semantic concept "unpleasant" than the other, the reaction times on the critical blocks will be more divergent, the IAT effect will be bigger. As in the Disease IAT, the difference of the average reaction times in each critical block provides a measure of the relative strength of the implicit association of "Dave" (or "Mike") and "Steve" with "unpleasant" and "pleasant" concepts, respectively. The order in which the participants completed the IATs was counterbalanced across participants. Within each IAT the order in which participants completed these critical blocks was also counterbalanced to control for order effects on reaction time.

After completing the two IATs, participants filled out a questionnaire which assessed their ability to recall the information provided for each of the targets at the start of the study. For each of the targets, participants were asked to recall 3 pieces of information presented in the biographical information. They then rated if each target was contagious, (yes/no), familiar (yes/no) and the extent to which they found each target attractive, and real on a 7 point scale with endpoints "Very" and "Not at All". An overall IAT index was computed (in the manner prescribed by Greenwald et al., 2003) by 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 on both critical blocks. The direction (and magnitude) of this difference offers an indicator of the extent to which participants implicitly associated the concepts "disease" or "unpleasant" with either the morphologically deviant target ("Dave" or "Mike") or the actually contagious target ("Steve"). Positive values on the Disease IAT index indicate an implicit association linking "disease" with "Dave" or "Mike" (and "health" with "Steve"); negative values indicated an association linking "disease" with "Steve" (and "health" with "Dave" or "Mike"). Similarly, a positive score on the Unpleasant IAT indicates participants implicitly associate "unpleasant" with "Dave" or "Mike" (and "pleasant" with "Steve"); negative values indicate an implicit association between "unpleasant" and "Steve" (and "pleasant" and "Dave" or "Mike").

#### Results

Preliminary analyses were carried out to determine the effects of gender and ethnic background on responses to the targets. Results indicate that, in both the Fat and Thin conditions, scores on the Unpleasant IAT and the Disease IAT did not differ significantly by gender or ethnicity (all ps > .19). The Disease and Unpleasant IATs were significantly correlated to one another in the Fat condition (r = .45, p = .02), but not in the Thin condition (r = .19, p = .36). Fat Condition: Does obesity trump actual disease in connoting "Disease"?

The mean IAT score for the Disease IAT differed significantly from zero (M = -.17, t(26) = -2.06, p = .049. This means that participants were especially likely to implicitly associate "Steve" (the contagious but not obese target) with the concept of "disease". These results suggest that obesity is not a strong enough cue to override knowledge that an individual has a contagious condition.

## Fat Condition: Does obesity trump actual disease in connoting "Unpleasant"?

The mean IAT score for the Unpleasant IAT did differ significantly from zero (M = -.23, t(26) = -2.89, p = .008. This means that participants were especially likely to implicitly associate "Steve" (the contagious but not obese target) with concepts that are generally "unpleasant". These results suggest that at an implicit level, contagious health conditions are considered more unpleasant than obesity.

*Fat Condition: Do either of the implicit associations vary according to temporary or chronic activation of disease vulnerability?* 

The slide show manipulation had no effect on the results of either the Disease IAT or the Unpleasant IAT results (Disease IAT: pathogen M = -.21, accident M = -.26, t (25) = -.34, p = .74; Unpleasant IAT: pathogen M = -.24, accident M = -.11, t (25) = -.76, p = .45).

Correlations with IAT results and individual differences are presented in Table 5.2. The only significant relationship for the Fat condition was that between the Perceived Infectability subscale of the PVD and the Disease IAT. The nature of the relationship suggests that people who are chronically concerned with contracting

communicable diseases are more likely to associate the obese, rather than the contagious, individual with disease concepts.

# Table 5.2

# Fat Condition: Correlations between Individual Difference Measures and Disease IAT and Unpleasant IAT Scores

	Fat			
	Disease IAT		Unpleasant IAT	
	r	р	r	р
Germ Aversion	.26	.19	.26	.18
Perceived Infectability	.39	.05*	.04	.85
Disgust Sensitivity	.04	.85	.00	.99
Belief in a Dangerous World	.01	.96	.07	.74

*Note.* \* indicates correlation is significant at p < .05 (two tailed).

#### Thin Condition: Does emaciation trump actual disease in connoting "Disease"?

The mean IAT score for the Disease IAT differed significantly from zero (M =.32, t (23) = 3.73, p = .001. This means that participants were especially likely to implicitly associate "Dave" (the emaciated but healthy target) with the concept of "disease". These results suggest that emaciation is such a strong cue connoting pathogen presence that, at an implicit level, it can override knowledge that an individual has a contagious condition. *Thin Condition: Does emaciation trump actual disease in connoting "Unpleasant"*?

The mean IAT score for the Unpleasant IAT did not differ significantly from zero (M = .08, t (23) = .61, p = .55). This means that participants were equally likely to implicitly associate "Steve" (the contagious but not emaciated target) and "Dave" (the

emaciated but not contagious target) with "unpleasant" concepts. This result suggests that although the information provided by the heuristic cue of emaciation was not strong enough to completely trump the objective health information for associations related to "unpleasant" concepts, it did influence participants to a degree that they found both targets equally aversive.

Thin Condition: Do either of the implicit associations vary according to temporary or chronic activation of disease vulnerability?

The slide show manipulation had no effect on the results of either the Disease IAT or the Unpleasant IAT results (Disease IAT: pathogen M = .13, accident M = .03, t (22) = .40, p = .70; Unpleasant IAT: pathogen M = .31, accident M = .33, t (22) = .13, p = .90).

Correlations with IAT results and individual differences are presented in Table 5.3. The only significant relationship for the Thin condition was between the Germ Aversion subscale of the PVD and the Unpleasant IAT. The nature of the relationship suggests that people who are chronically aware of pathogen transmission are more likely to associate the contagious target, rather than the emaciated one, with "unpleasant" concepts.

## Table 5.3

# Thin Condition: Correlations between Individual Difference Measures and Disease

	Thin			
	Disease IAT		Unpleasant IAT	
	r	р	r	р
Germ Aversion	.09	.67	41	.05*
Perceived Infectability	.20	.35	22	.30
Disgust Sensitivity	22	.32	.01	.97
Belief in a Dangerous World	25	.25	12	.58

#### IAT and Unpleasant IAT Scores

*Note.* \* indicates correlation is significant at p < .05 (two tailed).

## Do Fat and Thin targets activate equally strong associations with Disease?

To answer the question of the relative strength of the extremes of deviation from a normal weight as cues connoting pathogen presence, the association strength of Fat with "disease" concepts was compared with that of Thin. Results indicate that the thin target was associated more strongly with "disease" concepts than the fat target, t (49) = -4.12, p < .001.

Do Fat and Thin targets activate equally strong associations with Unpleasant?

A similar test was done comparing the relative associations of Fat and Thin targets with "unpleasant" concepts. This test violated Levene's test of equality of variances, thus the adjusted degrees of freedom are reported. Comparing the Unpleasant IAT scores by target weight, results indicated obese targets were associated more strongly with "pleasant" concepts than were emaciated targets, t (38.7) = -2.037, p = .05.

#### Discussion

Overall, these results suggest that emaciation is a strong enough cue connoting "disease" to override rational knowledge of a communicable infection, but that it is equally as "unpleasant" as communicable infection. Obesity, on the contrary, is not strong a strong enough cue of pathogen presence to trump rational knowledge of a communicable infection in either "disease" or "unpleasant" associations.

However, there are at least two important factors that must be considered before we interpret these findings and what they mean for the relative strength of obesity and emaciation as cues which trigger disease avoidance cognitions. First is the fact that the emaciated target was shirtless, while the contagious and obese targets were both depicted wearing shirts. Thus, it is not possible to determine if emaciation was simply a more apparent deviation from the norm than was obesity in this design, or if emaciation is a stronger cue connoting pathogen presence. To tease these possibilities apart requires a second study in which the physical attributes of all three targets are equally apparent. The second methodological concern is the fact that the postures and facial expressions of the individuals in the photos given with the biographies were not especially well matched between targets. "Steve", the contagious target and "Mike", the obese target, both had photos in which they were depicted looking at the camera and their general posture was upright. The photo of "Dave", the emaciated target that was given with the biographical information showed him in a somewhat contracted posture, not looking at the camera and with a distracted or pained look on his face. These systematic differences may have influenced the impressions that participants formed of the targets, above and beyond the objective and intended heuristic information. Thus, we cannot be sure if the results

reported here are due to perceivers' responses to the targets weight and health status, or due to their perceptions of how happy, friendly or confident the target seemed.

To address these issues, a second study was run. The methodology was identical to that used in Study 5.2a, with the exception of the photos of the target individuals, and the use of a newer version of the Disgust Sensitivity scale.

## Study 5.2b

#### Method

## **Participants**

Sixty-six participants completed the study. One participant did not complete the questionnaire package and therefore was excluded from the analysis. The final sample comprises 65 participants (55 female, 10 male, mean age 20.5). The sample was ethnically diverse, including 34 participants of East Asian heritage, 18 participants of European heritage and 13 participants from other ethnic backgrounds.

#### Procedure

Participants were told the purpose of the study was to investigate various aspects of person perception. They were informed they would be filling out questionnaires, reading information about two people, 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 which contained three individual difference measures: the Perceived Vulnerability to Disease scale (Duncan, Schaller & Park, 2009, Chapter 3), the revised 27 item version of the Disgust Sensitivity Scale (Olatunji et al., 2007), and the Belief in a Dangerous World scale (BDW; Altemeyer,

1988). A demographic questionnaire was also included in the questionnaire package. It asked the participant's age, gender and ethnic background.

#### Practice IAT

Upon completion of the questionnaires, participants completed the same practice Implicit Attitudes Task (IAT) as described in Study 5.2a. 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 presented with photographs and biographical information about two men (see Appendix 2). As in Study 5.2a, participants were randomly assigned to either the "fat" or the "thin" condition. In both conditions they received information about two individuals, one of which was described as having an infectious disease but in the picture provided did not differ from the physical norm. The other individual's description made no mention of health status but the picture provided showed they deviated from the prototypical weight by being either obese or emaciated. Participants were asked to read the biographies carefully, as they would be required to answer questions regarding the two men at a later point. The only difference between the "fat" and "thin" conditions was that in the "fat" condition the objectively healthy individual was obese, and in the "thin" condition the objectively healthy individual was extremely underweight.

The contagious individual in both the "fat" and "thin" condition was named "Will". "Will's" photograph showed that he was a brown haired Caucasian man with no obvious deviations from the physical norm. The picture showed him from just below the waist up. He was not wearing a shirt. The obese target in this study was named "Rick". The photograph of "Rick" showed a shirtless Caucasian man from just below the waist up who was extremely overweight (weight was over 400 pounds, height approximately 5'10, estimated Body Mass Index = 57.4).

The emaciated target in this study was named "Brad". The photograph of "Brad" showed a Caucasian man from just below the waist up who was not wearing a shirt and was extremely emaciated (weight 92 pounds, height 5'7, Body Mass Index 14.4) The biographical information presented with the photographs was the same as that presented in the first study.

## Disease Salience Manipulation

After reading the biographical information, participants watched the same slide show manipulation that was used in Study 5.2a. Participants were randomly assigned to either the Pathogen salient (n = 33) or Accident salient (n = 32) condition. 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.

After watching the slide show, participants were asked to identify the theme and rate the effectiveness of the slide show in communicating this theme on a 7 point scale, endpoints "not effective" and "very effective". The slide shows were rated as being equally effective (Pathogen M = 3.51, Accident M = 3.88, t (63) = .94, p = .35). *Implicit Association Task* 

Upon completion of the effectiveness rating scales, participants commenced the IAT tasks. The purpose of the IATs was to measure the extent to which the semantic concepts of interest were relatively more likely to be associated with the individual who

is actually contagious or the one who displays a heuristic cue that connotes pathogen presence. That is, the IATs measured the extent to which "disease" (in one task) and "unpleasant" (in a separate task) are more likely to be automatically linked to a person who is known to be infected with a contagious disease but looks just fine ("Will"), or to a person with deviant weight but is healthy ("Rick" in the obese condition; "Brad" in the emaciated condition). Apart from the changed names and photos of the target individuals, these tasks were the same as those described for Study 5.2a.

After completing the two IATs, participants filled out a questionnaire which assessed their ability to recall the information provided for each of the targets at the start of the study. For each of the targets, participants were asked to recall 3 pieces of information presented in the biographical information. They then rated if each target was contagious, (yes/no), familiar (yes/no) and the extent to which they found each target attractive, and real on a 7 point scale with endpoints "Very" and "Not at All".

An overall IAT index was computed (in the manner prescribed by Greenwald et al., 2003) by 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 on both critical blocks. The direction (and magnitude) of this difference offers an indicator of the extent to which participants implicitly associated the concepts "disease" or "unpleasant" with either the morphologically deviant "Rick" (or "Brad") or the actually contagious "Will". Positive values on the Disease IAT index indicate an implicit association linking "disease" with "Rick" or "Brad" (and "health" with "Will"); negative values indicated an association linking "disease" with "Will" (and "health" with "Rick" or "Brad"). Similarly, a positive score on the Unpleasant IAT indicates participants implicitly associate "unpleasant" with "Rick" or "Brad" (and "pleasant" with "Will"); negative values indicate an implicit association between "unpleasant" and "Will" (and "pleasant" and "Rick" or "Brad").

#### Results

Preliminary analyses were carried out to determine the effects of gender and ethnic background on responses to the targets. Results indicate that, in both the Fat and Thin conditions, scores on the Unpleasant IAT and the Disease IAT did not differ significantly by gender or ethnicity (all ps > .29). The Disease and Unpleasant IATs were marginally significantly correlated to one another in the Fat condition (r = .32, p = .07), but were not correlated in the Thin condition (r = .09, p = .61).

Fat Condition: Does obesity trump actual disease in connoting "Disease"?

The mean IAT score for the Disease IAT did differ significantly from zero (M = .26, t (33) = 4.00, p < .001. This means that participants were more likely to implicitly associate "Rick" (the obese but not contagious target) than "Will" (the contagious but normal weight target) with the concept of "disease". These results suggest that for these targets, obesity is a strong enough cue connoting pathogen presence to override knowledge that an individual has a contagious condition.

Fat Condition: Does obesity trump actual disease in connoting "Unpleasant"?

The mean IAT score for the Unpleasant IAT was also significantly more positive than zero (M = .24, t (33) = 2.93, p = .006. This finding means participants were especially likely to implicitly associate "Rick" (the obese but not contagious target),

relative to "Will", with concepts that are generally "unpleasant". These results suggest that at an implicit level, obesity is considered more unpleasant than is tuberculosis.

Fat Condition: Do either of the implicit associations vary according to temporary or

chronic activation of disease vulnerability?

The slide show manipulation had no effect on either the Disease IAT or the Unpleasant IAT results (Disease IAT: pathogen M = .19, accident M = .30, t (32) = .68, p = .50; Unpleasant IAT: pathogen M = .20, accident M = .31, t (32) = -.88, p = .39).

Correlations with IAT results and individual differences are presented in Table 5.4. There were no significant relationships between any of the individual differences and scores on either the Unpleasant IAT or the Disease IAT.

# Table 5.4

# Fat Condition: Correlations between Individual Difference Measures and Disease IAT and Unpleasant IAT Scores

	Fat			
	Disease IAT		Unpleasant IAT	
	r	р	r	р
Germ Aversion	.05	.78	.10	.59
Perceived Infectability	.05	.78	.16	.35
Disgust Sensitivity	03	.87	19	.27
Belief in a Dangerous World	05	.77	.26	.14

Thin Condition: Does emaciation trump actual disease in connoting "Disease"?

The mean IAT score for the Disease IAT was significantly more positive than zero (M = .37, t(30) = 4.44, p < .001. This means that participants were especially likely to implicitly associate "Brad" (the emaciated but healthy target) with the concept of "disease" relative to "Will" (the contagious but normal weight target). These results suggest that emaciation is such a strong cue connoting pathogen presence that, at an implicit level, it can override knowledge that an individual has a contagious condition. *Thin Condition: Does emaciation trump actual disease in connoting "Unpleasant"*?

The mean IAT score for the Unpleasant IAT was also significantly more positive than zero (M = .54, t (30) = 7.00, p < .001. Participants were much more likely to implicitly associate "Brad" than "Will" with concepts that are generally "unpleasant". These results suggest that the information provided by the heuristic cue of emaciation was so strong that it trumped the objective information directly relevant to health status. *Thin Condition: Do either of the implicit associations vary according to temporary or chronic activation of disease vulnerability?* 

The slide show manipulation had no effect on either the Disease IAT or the Unpleasant IAT results (Disease IAT: pathogen M = .56, accident M = .53, t (29) = -.20, p = .85; Unpleasant IAT: pathogen M = .30, accident M = .45, t (29) = .91, p = .37).

Correlations between the IAT results and individual difference measures are presented in Table 5.5. The only (marginally) significant relationship for the Thin condition was between Belief in a Dangerous World and the Unpleasant IAT (r = .36, p = .05). The nature of the relationship suggests that people who are chronically concerned that other people have unsavory interpersonal motivations are more likely to associate the emaciated target, rather than the contagious one, with "unpleasant" concepts.

# Table 5.5

## Thin Condition: Correlations between Individual Difference Measures and Disease

## IAT and Unpleasant IAT scores

	Thin			
	Disease IAT		Unpleasant IAT	
	r	р	r	р
Germ Aversion	.14	.45	24	.20
Perceived Infectability	10	.60	.04	.82
Disgust Sensitivity	.01	.98	07	.73
Belief in a Dangerous World	04	.83	.36	.05

#### Do Fat and Thin targets activate equally strong associations with "Disease"?

To answer the question of the relative strength of the extremes of deviation from a normal weight as cues connoting pathogen presence, the association strength with "disease" concepts was compared for the Fat and Thin conditions. Results indicate that the thin target was associated more strongly with "disease" concepts than the fat target (t (63) = -2.60, p = .01).

Do Fat and Thin targets activate equally strong associations with "Unpleasant"?

A similar test was done comparing the relative associations of Fat and Thin targets with "unpleasant" targets. Comparing the Unpleasant IAT scores by target weight, results indicated there was no difference in the extent to which the obese and emaciated targets were implicitly associated with "unpleasant" concepts (t (63) = -1.07, p = .289).

#### Additional Analyses on Study 5.2b Data: Accurate Participants Only

One final set of analyses must be looked at before we can begin to understand what these results imply. The current results include all participants who completed the study, under the assumption that they were exposed to both the objective and heuristic information relevant to each target, and therefore represents how these people would use information and react in the real world. This assumption is made based on the idea that in everyday life, we receive both visual and objective information about people, and we process the information we consider relevant (either consciously or unconsciously), therefore the results presented above represent an understanding of the way each type of information would be used. However, for this methodology to be a strong test of the relative strength of objective and heuristic information connoting pathogen presence, participants must be able to identify which target actually has an infectious disease, and which does not. Two of the questions participants completed after the Disease and Unpleasant IATs had them indicate if each target was contagious. This provided a means of identifying those participants for whom it is certain that they had a conscious awareness of both the weight and the infectious status of the target individuals. The results of the analyses for this subset of participants are reported below.

#### **Participants**

This subset comprises 36 participants (34 female, 2 male, mean age 20.5). The sample was ethnically diverse, including 13 participants of East Asian heritage, 17 participants of European heritage and 6 participants from other ethnic backgrounds. There were 21 correct participants in the Fat condition and 15 in the Thin condition.

## Fat Condition

Considering only those participants who were correct, the Disease IAT score was significantly more positive than zero (M = .29, t(20) = 3.35, p = .003), indicating that despite knowing the infectious status of the targets, "Rick" (the obese but not contagious target) was more strongly implicitly associated with Disease than "Will" (the contagious but normal weight target). Results for the Unpleasant IAT were not significantly different from zero (M = .17, t(20) = 1.6, p = .117). Taken together the results suggest that for this subset of participants obesity is a strong enough cue connoting pathogen presence that it is more strongly implicitly associated with disease than rational knowledge of communicable disease, but that both the obese and the contagious target are equally likely to activate generally aversive cognitions.

## Thin Condition

Considering only those participants who were correct, the Disease IAT score was positive, but did not differ significantly from zero (M = .21, t (14) = 1.6, p = .131), indicating that "Brad" (the emaciated but not contagious target) and "Will" (the contagious but normal weight target) were equally likely to be associated with the concept "disease". Results for the Unpleasant IAT were significantly more positive than zero (M = .44, t (14) = 5.11, p < .001), meaning participants associated the emaciated target with "unpleasant" concepts more than the contagious target. Taken together the results suggest that for this subset of participants, emaciated individuals activate generally aversive cognitions, but that they are as associated with "disease" as individuals who actually have a contagious condition. Thus, emaciation is not a strong enough cue to

override rational knowledge related to contagion, but is a strong enough cue connoting pathogen presence to match the association strength of objective health knowledge. *Do either of the implicit associations vary according to temporary or chronic activation* 

of disease vulnerability?

Although the difference between the Pathogen salient and the Accident salient slide shows did not differ significantly in either the fat (Unpleasant IAT: t (19) = .13, p = .90; Disease IAT: t (19) = -1.23, p = .23) or the thin condition (Unpleasant IAT: t (13) = .55, p = .59; Disease IAT: t (13) = .94, p = .37), an interesting pattern of results emerged across both conditions. For both the Fat and the Thin condition, when pathogens were made temporarily salient, implicit associations with "disease" seemed to deviate from the other implicit associations (see Table 5.6). Thus, for the Fat condition, temporarily increasing the salience of communicable threat made participants especially likely to associate the obese individual, relative to the contagious one, with disease. In the Thin condition, exactly the opposite pattern was seen, such that making pathogens salient made it less likely that a thin target would activate contagious concepts more than a contagious one. This pattern was not seen for the Unpleasant IAT results.
#### Table 5.6

## Means on the Unpleasant IAT and the Disease IAT for Participants Who Correctly Identified the Contagious Status of Both Targets

	n	Unpleasant	Disease		n	Unpleasant	Disease
		IAT	IAT			IAT	IAT
Fat	21			Thin	15		
Accident	9	.19	.17	Accident	8	.49	.32
Pathogen	12	.16	.38	Pathogen	7	.39	.08

In the Fat condition there were no significant relationships with either the Disease or the Unpleasant IAT and any of the individual difference measures (see Table 5.7). In the Thin condition there was one significant relationship, between the Germ Aversion Subscale of the PVD and scores on the Disease IAT, such that people who were chronically concerned with pathogen transmission were also especially likely to associate the emaciated target with "disease" concepts. There was also a marginally significant relationship between Belief in a Dangerous World and the Unpleasant IAT, such that people who reported more concern with others intentions also associated the emaciated target with "unpleasant" concepts.

#### Table 5.7

#### Correlations with Individual Difference Measures for Participants who Correctly

	Fat				Thin				
	Disease IAT		Unpleasant IAT		Disease IAT		Unpleasant IAT		
	r	р	r	р	r	р	r	р	
Germ Aversion	.13	.58	.16	.49	.54	.04	07	.80	
Perceived	.30	.19	.03	.91	08	.77	.18	.53	
Infectability									
Disgust Sensitivity	.01	.96	.14	.54	.18	.52	.08	.77	
Belief in a	.28	.23	.04	.88	.28	.33	.49	.07	
Dangerous World									

#### Identified the Contagious Status of Both Targets

*Note.* \* indicates correlation is significant at p < .05 (two tailed).

# Do Fat and Thin targets activate equally strong associations with Disease and Unpleasant?

Results indicate that the pattern of results found in the entire sample was consistent in this subset. The thin target was associated more strongly with "disease" concepts than the fat target (t (34) = -1.88, p = .07). No such difference was found for the Unpleasant IAT (t (34) = .58, p = .56).

#### Discussion

The studies presented in this chapter were designed to investigate the extent to which bodies that deviate from the prototypical weight act as cues which trigger the behavioral immune system and the extent to which this activation occurs automatically. One previous finding (Park et al., 2007) had found that obesity activated disease cognitions, especially if communicable threat was especially salient, however, no further information in the literature speaks to the role of pathogen avoidance motivations in reactions to individuals who deviate from the physical norm in this domain. These studies are therefore the first to empirically examine the strength of extreme weight as a possible disease-connoting cue relative to objective knowledge that an individual is carrying an infectious disease.

This is also the first investigation of the possibility that extreme emaciation acts as a cue connoting pathogen presence. The results from Study 5.1 indicate that emaciation is a trigger for psychological disease avoidance mechanisms. Results from the IAT show that relative to average weight individuals, emaciated individuals activate disease and unpleasant cognitions. This study follows up previous research indicating obesity is a disease-connoting cue (Park et al., 2007) and demonstrates that deviations on both ends of the weight continuum activate the behavioral immune system.

Studies 5.2a and 5.2b compared the relative strength of emaciation and obesity as heuristic cues of pathogen presence in two ways. First, the methodology provided a means of comparing the associative strength with both "disease" and "unpleasant" for obesity and emaciation relative to objective knowledge of communicable threat. The results indicate that emaciation is an especially strong disease-connoting cue, so strong that it overrides rational knowledge of contagious health status. Considering the results of the more rigorously designed study, obesity is also a strong enough cue of pathogen presence to override objective knowledge to the contrary. Second, by comparing the IAT scores from the obese and emaciated targets we were able to discover the relative strength of each weight extreme as a cue which connotes pathogen presence. Thus we were able to determine that emaciation activates stronger disease related cognitions than obesity, but that there is no difference in the extent to which either deviation activates generally unpleasant concepts. These results suggest that the behavioral immune system is especially sensitive to cues that are especially likely to be honest indicators of pathogen presence, which is likely the case with emaciation as compared to obesity (see Wolfe, Dunavan & Diamond, 2007 for important infectious diseases).

The results for each type of deviation provide new information about the way the behavioral immune system is activated, and the cognitive processes that occur. Based on the prevalence of weight loss as a symptom of many communicable conditions, it should not be surprising that extreme thinness is strongly implicitly associated with disease concepts, so much so that it automatically activates disease related and unpleasant cognitions more strongly than the knowledge that an individual currently has a communicable illness. However, this association may be somewhat counterintuitive considering the current cultural values in most western societies (Eisenberg, Neumark-Sztainer, Story, & Perry, 2005), where "you can never be to rich or too thin".

The positive value placed on thinness is generally emphasized in females, suggesting the pathogen avoidance cognitions activated by the physical cue of emaciation were strong enough to override the cultural value placed on thinness that could have been present in Study 5.1. To remove this potential confound from the later studies, male targets were used in Study 5.2a and 5.2b. Across all studies, similar associations of emaciated targets with both disease specific and generally unpleasant concepts were found, suggesting emaciation triggers negative cognitive processes regardless of the gender of the individual and the cultural value than may be placed on thinness.

At a superficial level, the results of the Disease and Unpleasant IATs in the Fat condition of study 5.2a might appear as though they contradict previous findings by Park et al. (2007) that obesity is associated with disease concepts. However, this interpretation does not consider the relative nature of this task. This test pits rational knowledge of pathogen presence against heuristic cues connoting pathogen presence. In this case, we see only that participants associate contagious individuals with "disease" and "unpleasant" concepts more than they associate obese individuals with these same concepts. However, it is entirely possible that participants did associate obese targets with these concepts, but that in this study these associations were stronger for the contagious target than the obese target.

Study 5.2b provided a better test of the strength of weight deviation as a disease cue as the targets were matched on more dimensions than was the case in Study 5.2a. The results of this study suggest that obesity automatically activates more unpleasant cognitions than does a contagious threat, but the associations between obese and disease concepts are similar to those between a contagious individual and disease concepts. Thus, this pattern of results suggests that obesity activates negative and disease relevant cognitions when it is the only source of health relevant information available (see Park et al., 2007), but that when more accurate sources of health information are available, the rational information is considered in addition to the visual cue of obesity.

Overall, these results are consistent with the hypothesis that extreme deviations in body weight act as cues connoting pathogen presence and activate the behavioral immune system, causing both emaciation and obesity to be implicitly associated with generally aversive and disease specific cognitions. There are, however, limitations which should be considered prior to accepting these results at face value.

There is a third variable which may influence the extent to which the obese targets are associated with the concept of disease. While the results of Study 5.2b are consistent with obesity acting as a cue of communicable pathogen presence, it is also possible that the disease concepts that are activated by the obese target are in fact non-contagious health threats known to be associated with carrying excess weight, including diabetes (Ford, Williamson & Liu, 1997), heart disease (Rimm, Stampfer, Giovannucci, Ascherio, Spiegelman, Colditz & Willett, 1995), and stroke (Kurth, Gaziano, Rexrode, Kase, Cook, Manson & Buring, 2005). That obesity is a risk factor in the development of chronic health conditions is well known. It is unclear, at this point, which type of 'disease' concepts (contagious or non-contagious) are being activated by the current methodology. Therefore, it may be prudent in future studies using obese targets to include a condition which could tease apart these two different 'disease' domains.

It is also possible that the methodology employed in Study 5.2a and 5.2b (as well as in Chapter 4) influenced the person perception processes. Recall that when being 'introduced' to the targets, participants received both the photograph of the target and the biographical information at the same time. The heuristic information in the photograph was likely processed before the objective content contained in the text. There could be an order effect influencing the extent to which deviant targets are associated with disease, because participants see the visual cue which activates the behavioral immune system before receiving the objective information. This potential effect may have caused the initial impression to be set, and therefore especially difficult to override. In the real world we frequently encounter individuals who deviate from a norm prior to obtaining knowledge about the source of their deviation. Therefore, having an understanding of our responses when information is presented in the visual/objective order is in itself valuable.

Expanding our understanding of the way the behavioral immune system uses information could provide means of preventing negative responses to deviant individuals. If it is the case that an order effect does occur such that aversive responses to deviant individuals are dampened by providing objective information prior to actually encountering the individual, this information could be incorporated into interventions to reduce stereotypes and prejudice. Future studies could address this issue by repeating the procedures described here with the small but important modification of presenting the objective biographical information before the photograph, then having participants complete the IATs. Although further investigations of the potential of an order effect are worthwhile to improve our understanding of the cognitive processes involved in the behavioral immune system, this issue does not undermine the value of the studies reported here.

Once again, there was no evidence that the pathogen salience manipulation had any effect on the associations between the physically deviant individuals and "disease" or "unpleasant" concepts. This finding is consistent with the results of Chapter 4, providing more support for the lack of effectiveness of this methodology in activating feelings of subjective vulnerability to communicable threat despite indications from the manipulation check that the slide shows are equally (but not highly) effective at portraying the intended theme. There is some evidence (from the subset of participants who were correct) that the pathogen slide show does influence the implicit associations participants have with both the obese and emaciated targets, relative to the contagious target.

It is also well documented that weighing more than the prototypical (or ideal) body weight is a cause of stigmatization (Puhl &Brownell, 2001; Schwartz, Chambliss, Brownell, Blair & Billington, 2003; Latner & Stukard, 2002), and that obese individuals are targets of negative stereotypes (Allison, Basile & Yuker, 1991; Park et al., 2007; Wang, Brownell & Wadden, 2004). The same cannot be said of weighing less than the prototype, although there are gender differences in the extent to which thinness is valued (such that it is more highly valued and studied in women). Thus, it may be the case that the generally aversive response to the obese target is a result of these general stigmatizing processes. However, it has also been proposed that the disease avoidance processes of interest contribute to this widespread aversive response to obese individuals (see Kurzban & Leary, 2000), which may have contributed towards aversive cognitions, independent of pathogen driven motivations. Additionally, the findings from all three studies show that emaciated individuals were associated with unpleasant concepts suggesting negative stereotypes are not the only contributing factor to the unpleasant-obese associations.

#### **Conclusions**

The current findings demonstrate that emaciation activates disease cognitions, thus meeting the basic criteria for being a trigger of the behavioral immune system. Additionally, the extent to which emaciation activated disease cognitions was positively related to Perceived Infectability, (although also negatively related to Germ Aversion) suggesting the salience of communicable threat influences the extent to which the system responds to emaciation as a cue. However, there was no evidence that responses to emaciation vary as a result of changes in temporary salience of communicable threat.

Both emaciation and obesity were not limited to implicit associations with disease concepts, but instead showed associations with a broader range of unpleasant concepts, suggesting weight deviations activate a broad range of aversive connotations that are not specific to disease.

Finally, the studies reported in this chapter provide information about the automaticity of the activation of the behavioral immune system. As in Chapter 4, the results from Study 5.2b demonstrate that both emaciation and obesity were strong enough to override objective health information at an implicit level. In the Disease IAT, the objectively correct response would have been to associate the contagious individual with disease concepts. However, in both the Fat and Thin IATs the physically deviant individuals were associated with disease, suggesting that the behavioral immune system was activated in response to the heuristic cues. That this activation occurred despite the objective knowledge about the health status of the targets suggests the associations occurred unintentionally, autonomously and involuntarily, again meeting three of the five criteria for automaticity. As in Chapter 4, the same conclusions regarding automaticity can be made for the Unpleasant IAT, with the addition of one assumption: that an individual who poses an actual communicable threat is objectively more unpleasant than one who deviates from a physical norm. The extent to which these responses were unconscious and effortless cannot be determined with this methodology.

This study also provided evidence that thinness is an especially strong cue of pathogen presence, relative to obesity. This result indicates that all deviations from a physical norm are not equal in their tendency to connote communicable threat.

# CHAPTER 6: PREJUDICIAL ATTITUDES TOWARD OLDER ADULTS MAY BE EXAGGERATED WHEN PEOPLE FEEL VULNERABLE TO INFECTIOUS DISEASE: EVIDENCE AND IMPLICATIONS

The human population is aging. In 2001, 795,000 people per month entered the "over 65" age category (a number expected to increase to 847,000 per month by 2010); and, in many countries, the oldest old (80 and above) are the fastest-growing component of the population (Kinsella & Velkoff, 2001). This aging population produces many challenges, some of the most obvious of which lie in the realms of health care and economics. Perhaps less obviously, the aging population produces a larger pool of people who are the target of age-based prejudices and acts of discrimination (or "ageism" for short). Ageism manifests in many forms, and has many implications for the well-being of older adults and for public policy (see Bugental & Hehman, 2007 for a review). To effectively combat ageism, one must understand its psychological causes. By doing so, one can identify circumstances that are especially likely to trigger ageist responses, and also specify interventions and policy initiatives that may inhibit age-based discrimination. Multiple, conceptually independent psychological processes contribute to ageism (Bugental & Hehman, 2007). Here we identify an additional psychological mechanism that may play a role in ageism - a mechanism that produces highly automatized (and often erroneous) cue-based inferences about infectious disease. This mechanism implies specific circumstances under which ageist responses to older adults may be especially pronounced. In this chapter, I report the first empirical evidence linking this mechanism to ageist attitudes, and discuss implications for public policy.

#### **Background: Antecedents of Ageism**

Prejudice and discrimination against older adults takes many forms, across many different domains of social life. In the workplace, for example, older adults are often less likely than younger applicants to secure interviews (Finkelstein & Burke, 1998; McMullin & Marshall, 2001). In the home, elderly people are in the highest risk category to suffer from abuse and neglect from caregivers (Choi & Mayer, 2000; Lachs, Williams, O'Brien, Hurst & Horowitz, 1997; O'Keefe et al., 2007). Older adults also suffer from a variety of forms of segregation and social exclusion (Bugental & Hehman, 2007; Hagestad & Uhlenberg, 2005).

These negative responses occur despite the fact that beliefs about older adults are often substantially positive. While common stereotypes of older adults include negative traits such as *incompetent*, *dependent*, and *sickly*, they also contain positive traits as well, such *warm*, *nurturing* and *wise* (Cuddy & Fiske, 2002; Cuddy, Norton & Fiske, 2005; Kite & Wagner, 2002; Levy & Langer, 1994). Negative attitudes toward the elderly co-exist with a variety of positive attitudes and values, such as those promoting filial piety (e.g., McCann, Ota, Giles, & Caraker, 2003). Indeed, cross-cultural evidence reveals that negative attitudes toward the elderly are, if anything, especially pronounced within countries (such those in eastern and southeastern Asia) that have strong traditions of filial piety (McCann et al., 2003; Sharps, Price-Sharps, & Hanson, 1998).

These apparent contradictions can be understood within the context of a dualprocess model of stigma and prejudice (Pryor, Reeder, Yeadon & Hesson-McInnis, 2004; Reeder & Pryor, 2008). According to this model, responses to stigmatized individuals include an immediate reflexive response (based on highly automatized associative mechanisms) to perceptual cues displayed by those individuals, as well as a more deliberative (and slower) response that incorporates additional, rule-based considerations. Whereas positive attitudes toward older adults may result from the deliberative rule-based process, aversive reactions are likely to result from the highly automatized cue-based associative process. Consistent with this analysis is evidence from studies that have used reaction-time methodologies to assess the extent to which older adults (compared to younger adults) are implicitly associated with negative (versus positive) semantic information. The results are clear: At an implicit level of analysis, older adults are associated with negative concepts (Dasgutpa & Greenwald, 2001; Karpinski & Hilton, 2001; Nosek, Banaji & Greenwald, 2002). Implicit cognitive associations of this sort can have powerful effects on actual behavior (e.g., Bargh, Chen, & Burrows, 1996; McConnell & Leibold, 2001). Therefore, despite the presence of explicit attitudes that imply more positive responses, deleterious acts of prejudice and discrimination against older adults may result substantially from the automatic activation of aversive affective and cognitive responses.

What exactly are the psychological mechanisms that might produce such aversive responses? Multiple mechanisms have been identified (Bugental & Hehman, 2007), and there is some empirical evidence bearing on each. One explanatory perspective focuses on the fact that, compared to younger adults, older adults are characterized by decreased levels of cognitive flexibility and physical ability (Kite & Wagner, 2002; Langer, 1982; Levy & Langer, 1994), potentially causing them to be implicitly perceived as suffering from deficits in valued characteristics (Butler, 1989). Ageist attitudes may result from a process in which elderly people are judged to have limited potential in the important

realm of social exchange relationships (Kurzban & Leary, 2001; Cosmides & Tooby, 2005). Also, it has been suggested that older adults remind perceivers of their own mortality – an affectively aversive experience with implications for prejudice (Greenberg, Schimel & Martens, 2002; Martens, Goldenberg & Greenberg, 2005).

It is clear, then, that multiple mechanisms may contribute to implicit aversive responses to older adults. In addition, there is reason to speculate that implicit ageism might occur as a result of the operation of cue-based stimulus-responses mechanisms designed to inhibit contact with infectious diseases.

#### Disease Avoidance Mechanisms and Their Implications for Ageism

Infectious diseases have long posed to a threat to human life. The immune system provides one sophisticated means of defending against this threat. In addition, there appears to be a sort of "behavioral immune system" too – a suite of psychological mechanisms that facilitates the detection and behavioral avoidance of other individuals who might be infected with disease-causing pathogens (Schaller & Duncan, 2007).

Because most pathogens are microscopic and not directly perceptible, people must typically rely on superficial morphological or behavioral cues (e.g., skin lesions, coughing spasms) to detect their presence. The perception of disease-connoting cues typically triggers disgust (Curtis, Aunger, & Rabie, 2004) and also triggers the activation of aversive cognitions into working memory, both of which have the functional consequence of motivating behavioral avoidance (Kurzban & Leary, 2001; Schaller & Duncan, 2007).

The correspondence between superficial cues and the presence of pathogens is imperfect, and this gives rise to a signal-detection problem. Because the costs of a false negative error (failing to avoid a truly infectious individual) are typically much graver than the costs of a false positive error (avoidance of an individual who is actually healthy), the behavioral immune system – like other psychological defense systems (Nesse, 2005; Haselton & Nettle, 2006) – is predictably biased toward minimizing false negatives. Perceivers therefore tend to be biased toward inferring that healthy people are diseased, rather than the reverse. This inferential bias manifests in a tendency to implicitly associate risk of infection with a broad range of superficial cues: Any gross deviation from species-typical morphological norms may be implicitly interpreted as evidence of possible parasitic infection, and thus may trigger an aversive response (Kurzban & Leary, 2001). Consistent with this analysis, people respond aversively not only to individuals who truly are diseased, but also to healthy individuals who are morphologically anomalous is some way – including individuals who are disfigured, disabled, or obese (Park, Schaller, & Faulkner, 2003; Park, Schaller, & Crandall, 2007; Schaller & Duncan, 2007).

Hyper-vigilant and over-inclusive disease-avoidance mechanisms provide some functional benefits (reduced contact with infectious pathogens), but they involve some costs as well (e.g., reduced contact with entirely healthy individuals who might be potential friends and benefactors). As a means of maximizing the benefits, while minimizing the costs, it appears that these mechanisms are engaged somewhat flexibly, contingent upon the presence of additional information indicating the extent to which infectious diseases should be considered a cause for concern. Perceivers respond especially aversively to morphologically anomalous individuals under circumstances in which they (the perceivers) feel especially vulnerable to infectious disease. For instance, while people in general respond aversively to the perception of physically disabled individuals, this aversive response is exaggerated among perceivers who generally feel vulnerable to disease transmission, or who are especially prone to experience disgust (Park et al., 2003). Similarly, while people respond negatively to the sight of obese individuals, this aversive response is especially pronounced among individuals who perceive themselves to be especially vulnerable to disease transmission, or for whom the threat posed by disease-causing pathogens has been made temporarily salient (Park et al., 2007).

Cultural background may also have an influence on the operation of these mechanisms. Infectious diseases have historically been more prevalent in some geographical regions than others, an ecological difference that has both cultural and psychological implications (e.g., Schaller & Murray, 2008). In addition, there exist cultural differences in lay theories of epidemiology and disease transmission (Pachuta, 1996), with the implication that contextual cues connoting vulnerability in one culture (e.g., Western European) may be interpreted somewhat differently within another (e.g., East Asian). Indeed, some differences between Europeans and East Asians have appeared in previous research linking disease-avoidance mechanisms to implicit prejudices against the physically disabled (Park et al., 2003).

Just as disease-avoidance mechanisms are one cause of prejudices against the physically disabled and obese, so too they seem likely to contribute to ageism. There are two reasons this could be the case. The first is that elderly people have less able immune systems than their younger counterparts, and are therefore more likely to host a larger number of pathogens than younger individuals. The second is that the physical process of aging is associated with many different changes in facial appearance, including a loss of fat tissue, qualitative and quantitative increases in wrinkles and bags, and changes in hair distribution and color (Gonzalez-Ulloa & Flores, 1965; Guthrie, 1976). Facial proportions also change as a result of the growth of ear and nose cartilage throughout life, such that in advanced age the nose becomes longer and broader, and the ears increase in length (Smith, 1978). Older adults are also more likely to display skin discoloration (Gilchrest, 1996). Thus, as people age, their physical appearance increasingly deviates from the species-typical prototype. Consequently, given the manner in which the behavioral immune system operates, the mere visual perception of older adults may trigger an implicit aversive response.

Importantly, however, the magnitude of this implicit aversive response to older adults is expected to vary depending upon the extent to which perceivers are worried about the threat posed by infectious diseases. Implicit ageism is likely to be greatest among those who feel especially vulnerable to disease transmission; ageism may be attenuated among perceivers who feel less vulnerable. This logical deduction not only provides a means of empirically testing the disease-avoidance perspective on ageism, it also has additional implications for policies and other interventions that that might be used to combat ageism.

In addition, it is important to consider the possibility that these hypothesized effects may vary depending on individuals' cultural background. If cultural differences emerge, this too has implications for the implementation of any intervention employed to combat ageism.

#### **Empirical Evidence**

Although previous authors have speculated about a possible link between diseaseavoidance mechanisms and ageism (Bugental & Hehman, 2007), no prior research has empirically tested this proposed link. The present study provides the first empirical test. The central hypothesis is that implicit ageist attitudes are amplified among individuals who are especially worried about disease transmission, and attenuated among those who are not. Therefore, we assessed individual differences in perceived vulnerability to disease, and also introduced an experimental manipulation designed to make diseasecausing pathogens especially salient to a subset of participants. Following the manipulation, participants completed two computer-based reaction time tasks. The design of these tasks allowed the assessment of the extent to which participants were especially likely to implicitly associate older adults – relative to younger adults – with aversive semantic concepts.

Our participant sample was drawn from a multi-ethnic University population that included substantial numbers of individuals with East Asian (primarily Chinese) cultural backgrounds, as well as substantial numbers with European cultural backgrounds. Thus, in analyzing results, we were sensitive to the possibility that cultural background might directly influence implicit ageism, and also the possibility that cultural background might moderate effects of the primary variables (perceived vulnerability to disease and temporary pathogen salience) on implicit ageism.

#### Method

#### **Participants**

Participants were 88 undergraduate students at the University of British Columbia. Within the sample, 55 participants reported an East Asian ethnic heritage, and 33 reported a European heritage. (Seven additional participants reported neither East Asian nor European heritage; their data were not included in analyses.)

#### Individual Differences in Perceived Vulnerability to Disease

Participants completed several questionnaires at the outset of the study, one of which was designed explicitly to assess individual differences in perceived vulnerability to disease. This 15-item Perceived Vulnerability to Disease (PVD) questionnaire has two subscales (Duncan & Schaller, 2009). An 8-item "Germ Aversion" subscale (Chronbach's  $\alpha = .61$ ) measures the extent to which individuals experience discomfort in situations that imply a high likelihood of pathogen transmission (e.g. "I don't like to write with a pencil someone else has obviously chewed on"). A 7-item "Perceived Infectability" subscale (Chronbach's  $\alpha = .85$ ) measures the extent to which individuals subjectively believe that they are susceptible to contracting infectious diseases (e.g. "I am more likely than the people around me to catch an infectious disease"). These subscales were moderately correlated (in the present sample, r (86) = .21, p = .049), and previous research reveals that they may predict different outcomes (Park et al., 2003, 2007). *Experimental Manipulation of Pathogen Salience* 

Participants were randomly assigned to view one of two slide show presentations, each containing 10 slides. In one experimental condition ("Pathogens Salient"), each of the 10 slides was designed to temporarily heighten the salience of pathogens and/or the infectious diseases they cause (e.g. one slide depicted germs and bacteria lurking on kitchen sponges and countertops). In the other experimental condition ("Accidents Salient" – a control condition), each of the 10 slides was designed to temporarily heighten the salience of other, equally dangerous but disease-irrelevant threats to physical well-being (e.g. one slide depicted the risk of electrocution from home appliances).

#### Manipulation Check

After viewing the slide show, participants rated how effective the slide show was in raising awareness of the pertinent threat. Responses were recorded on a 7-point scale (1 = not at all effective; 7 = very effective). In both experimental conditions, the slide show was rated as reasonably effective, and effectiveness ratings did not differ between experimental conditions (*M*'s = 4.60 and 4.80 in the Pathogens Salient and Accidents Salient conditions, respectively; *p* = .44).

#### Reaction-Time Measures of Implicit Ageism

Participants then performed two variations of a computer-based reaction-time task designed to assess the extent to which older adults (relative to younger adults) were especially likely to be implicitly associated with aversive semantic information. One task assessed associations with negative semantic concepts in general. The other assessed associations specifically with concepts connoting disease. (The order in which participants completed these two tasks was counterbalanced.) Both tasks were versions of the Implicit Association Test (IAT; Greenwald, Nosek, & Banaji, 2003), which has been used successfully in previous research assessing implicit ageism (Dasgupta & Greenwald, 2001; Nosek, Banaji, & Greenwald, 2002), and also previous research assessing the effects of temporary threats on implicit social cognition (Park et al., 2003; 2007; Schaller, Park, & Mueller, 2003). For one IAT task, participants categorized positively- or negatively-valued stimulus words (e.g., smart, nasty) as either "Pleasant" or "Unpleasant" by pressing specified response keys on a computer keyboard; they also categorized a set of target faces as either "Young" or "Old," using the same set of response keys. Target faces were photos of 6 young men and women, and of 6 elderly men and women.<sup>5</sup> Within the task, there were two critical blocks of trials (the order of these critical blocks was counterbalanced across participants). For one critical block of trials, the response categories "Old" and "Unpleasant" shared a response key; for the other critical block, "Old" and "Pleasant" shared a response key. The difference in mean reaction times across these two blocks of trials indicates an implicit cognitive association: Relatively shorter reaction times on trials in which "Old" and "Unpleasant" share a response key indicates an implicit cognitive association linking older adults (compared to younger adults) with unpleasant semantic concepts. The other IAT task followed an identical template, except that on the word-categorization trials, participants categorized health- or disease-relevant words (e.g., *strong*, *contagious*) as connoting either "Health" or "Disease." For this IAT task, relatively shorter reaction times on trials in which "Old" and "Disease" share a response key indicates an implicit cognitive association linking older adults (compared to younger adults) with the semantic concept of disease. For each IAT task, an IAT effect size score (analogous to Cohen's d) was computed for each participant, following computational guidelines described by Greenwald et al., 2003. These scores were computed such that positive values indicated implicit ageism (i.e.,

<sup>&</sup>lt;sup>5</sup>Target faces were identical to those used in previous work on implicit ageism (Nosek et al., 2002). To assess the perceived age of these faces, we asked a separate sample of 21 participants to estimate the age of the target individuals. The mean perceived age of the 6 young faces was 23.8 years (SD = 4.23). The mean perceived age of the 6 elderly faces was 66.3 years (SD = 13.53).

implicit cognitive associations linking "Old" people with "Unpleasant" and with "Disease"); more strongly positive values indicated more extreme levels of implicit ageism.

#### Results

Preliminary analyses revealed that, compared to European participants, East Asians scored more highly on the Germ Aversion subscale of Perceived Vulnerability to Disease questionnaire (East Asian M = 4.17, European M = 3.70, t (86) = 2.45, p = .01). There was a similar mean difference on the Perceived Infectability (PVD) subscale, but this difference was nonsignificant (East Asian M = 3.70, European M = 3.42; t (86) = 1.16, p = .25). There were no statistically significant gender differences on either PVD subscale.

On both the Unpleasant and Disease IATs, the mean effect size score was significantly more positive than zero: Unpleasant IAT mean = 0.46, t (87) = 11.10, p < .001; Disease IAT mean = 0.43, t (87) = 11.58, p < .001. These results reveal that, relative to younger adults, elderly individuals were especially likely to be implicitly associated with negative semantic concepts in general, and with disease-connoting concepts in particular.

Mean scores on the Unpleasant IAT were greater among East Asians (M = 0.54) than among Europeans (M = 0.31), t (68) = 2.85, p = .005. No such difference was found on Disease IAT scores (East Asian M = 0.40, European M = 0.47; t (86) = 0.92, p = .36). There were no statistically significant gender differences on either IAT.

These findings are consistent with previous work showing that elderly targets are implicitly associated with more aversive concepts than younger targets, and also indicate some cultural differences in these implicit associations; but these preliminary analyses do not address whether implicit ageism varied depending upon the extent to which perceivers were worried about the threat posed by infectious diseases. Three variables were particularly pertinent to the perception of disease threat: Chronic concerns with infectious diseases as measured by the Germ Aversion and Perceived Infectability subscales of the PVD questionnaire; and temporary salience of infectious diseases as created by the Slide Show manipulation (Pathogens Salient versus Accidents Salient). To assess the impact of these variables, we conducted two separate regression analyses (one with the Unpleasant IAT score as the dependent variable, and the other with the Disease IAT score as the dependent variable) to assess the main and interactive effects of these key predictor variables, along with ethnicity (European, East Asian) as an additional predictor variable. (Continuous predictor variables were centered prior to computing interaction terms.)

The regression analysis of Unpleasant IAT scores produced two statistically significant effects. There was a main effect of ethnicity,  $\beta = -.29$ , t(75) = 2.57, p = .01, such that East Asian participants associated elderly targets more strongly with unpleasant concepts. This effect was qualified by a 3-way interaction between ethnicity, Perceived Infectability, and the Slide Show manipulation,  $\beta = .30$ , t(75) = 2.44, p = .02.

The analysis of Disease IAT scores also produced two statistically significant effects. One was a 2-way interaction between ethnicity and the slide show manipulation,  $\beta = .27$ , t (75) = 2.27, p = .03. The other (just as with Unpleasant IAT scores) was a 3-way interaction between ethnicity, Perceived Infectability, and the Slide Show manipulation,  $\beta = .24$ , t (75) = 1.99, p = .05.

To better illuminate the nature of these 3-way interactions, we conducted additional regression analyses on both the Unpleasant and Disease IAT scores, separately for Europeans and East Asians. Each analysis included the Perceived Infectability subscale and Slide Show manipulation as predictor variables, along with the interaction of Perceived Infectability with the slide show manipulation. Of particular interest was the 2-way interaction between Perceived Infectability and the Slide Show manipulation. Among European participants, this 2-way interaction emerged both on Unpleasant IAT scores and on Disease IAT scores (Unpleasant IAT:  $\beta = .34$ , t (29) = 1.94, p = .06; Disease IAT:  $\beta = .37$ , t (29) = 2.27, p = .03). No such effects emerged among East Asian participants (Unpleasant IAT:  $\beta = .13$ , t (51) = 0.93, p = .36; Disease IAT:  $\beta = ..14$ , t (51) = 1.05, p = .30). Thus, among perceivers of European cultural background (but not among perceivers of East Asian background), implicit ageism was an interactive product of both chronic concern with disease transmission and the temporary salience of infectious pathogens.

Additional regression analyses (following methods prescribed by Baron & Kenny, 1986) were conducted to investigate the possibility that, among European participants, the effect of the 2-way interaction on Unpleasant IAT scores was mediated by its effect on Disease IAT scores. Results indicated no compelling evidence of any such mediation.

Given that this pattern of findings was essentially identical across both IAT tasks, the graphical representation (and interpretation) of these effects can be simplified by combining scores on both IATs into a single index of implicit ageism. Therefore, for each participant, we computed the mean of the two IAT scores to create a composite score. Using this composite IAT index as the criterion, we conducted separate regression analyses (identical to those described above) on the implicit ageism scores of European and East Asian participants. Among participants of European heritage, the Perceived Infectability by Slide Show interaction was significant,  $\beta = .43$ , t (29) = 2.69, p = .01. No such effect emerged among participants of East Asian heritage,  $\beta = -.165$ , t (51) = 1.20, p= .23. The results are depicted graphically in Figure 6.1 (following methods prescribed by Aiken & West, 1991). Further tests indicated that the Slide Show manipulation produced significant differences in implicit ageism among participants with chronically high levels of Perceived Infectability (1 SD above the mean;  $\beta = .68$ , t (29) = 2.95, p = .006) but not among those with low levels of Perceived Infectability (1 SD below the mean;  $\beta = .21$ , t (29) = 0.91, p = .37).

Among participants of European heritage, implicit ageism was predicted by the interactive effect of individual differences in Perceived Infectability and the temporary salience of pathogens (see Figure 6.1, upper panel). This interaction did not emerge among participants of East Asian heritage (see Figure 6.1, lower panel).

Interactive Effects of Perceived Infectability and Temporary Pathogen Salience on Implicit Ageism for People of European and East Asian Cultural Heritage



**European Cultural Heritage** 



In sum, among European participants, the highest levels of implicit ageism were found among individuals who were dispositionally inclined to worry about their own vulnerability to infectious diseases and for whom the threat of pathogens was also temporarily salient. In contrast, the effects of Perceived Infectability and the Slide Show manipulation were negligible among participants of East Asian heritage.

#### Discussion

These results provide the first evidence indicating that (at least among some populations) implicit prejudices against older adults may result, in part, from the operation of highly automatized disease-avoidance mechanisms. Because these mechanisms are sensitive to perceptually non-normative morphological features, they may trigger aversive responses to any individual whose physical features deviate from a subjectively prototypical human appearance. Moreover, because these mechanisms are engaged flexibly, these aversive responses tend to be predictably amplified in contexts connoting high levels of vulnerability. This is exactly the pattern observed here within the sample of participants with a European cultural heritage. Compared to circumstances in which disease-irrelevant threats were salient, implicit ageism was greater under circumstances in which the threat of pathogen transmission was temporarily salient, and this effect occurred primarily among perceivers who chronically perceived themselves to be vulnerable to pathogenic infection.

This pattern of results is conceptually similar to previous findings documenting the role of disease-avoidance mechanisms as contributors to other forms of prejudice based on other kinds of morphological anomalies (Park et al., 2003, 2007; Schaller & Duncan, 2007). More broadly, these findings are conceptually analogous to other findings in the psychological literature on perceived threats and prejudices. In several studies it has been found that danger-relevant stereotypes of African Americans (i.e., the stereotypical tendency to associate African Americans with aggression, criminality, and other danger-connoting traits) are most strongly activated into working memory when perceivers find themselves in contexts that imply vulnerability to harm (e.g., in the dark), and this activation occurs primarily among individuals who chronically perceive the world to be a dangerous place (Schaller, Park, & Meuller, 2003). Findings such as these have useful implications for the development of interventions aimed at ameliorating racial and ethnic prejudices (e.g., Neuberg & Cottrell, 2006; Schaller & Abeysinthe, 2006; Schaller & Neuberg, 2008). Similarly, the present findings have implications for the development of interventions for the development of interventions for the development of states in the implications for the development of states age-based discrimination. We discuss these possibilities more fully below.

Before doing so, however, we must raise two points that are worthy of note. First, the possibility that the implicit associations reported here were influenced, in part, by existing associations between advanced age and vulnerability to disease. The methods used in this study do not allow a means of distinguishing whether the implicit associations with both disease and aversive concepts were the sole result of responses to the deviations of facial characteristics from the prototype, of perceivers' beliefs about the decreased immunocompetence of elderly people, or a combination of these two factors. Although both are consistent with pathogen avoidance motivations, our understanding of the behavioral immune system and ageism would benefit from clarifying the extent to which each contributes to aversive associations.

The second point is that, whereas there was evidence of a relation between disease-threat and implicit ageism among participants of European heritage, no such relation emerged among participants of East Asian heritage. What might account for this cultural difference? One possibility is that the apparent cultural difference resulted in some way from the fact that all the target faces were of European background. European participants were therefore responding to members of a cultural ingroup, whereas East Asian participants were responding to members of a cultural outgroup. Consequently, among East Asian participants, additional psychological processes (activated by the implied inter-group context) may have compounded the psychological experience such that the distinction between young and old target faces was less immediately relevant. It is worth noting, though, that East Asian participants generally showed high levels of implicit ageism, indicating that the young / old distinction was not diluted in any substantial way. In fact, given that implicit ageism was generally higher among East Asians than among Europeans, and East Asians also generally score higher on the PVD scales, another possibility is that there was something of a threshold effect among East Asians: Once the perceived threat of disease transmission meets a certain threshold, and activates ageist attitudes, additional variation in perceived threat may have no discernable additional impact on ageism. A third possible explanation lies in the fact that pathogen transmission may be differentially emphasized in the epidemiological beliefs systems associated with different cultural populations. The traditional tenets of Chinese medicine, for instance, emphasize internal rather than external factors in the etiology of disease (Ohnuki-Tierney, 1984; Pachuta, 1996; Wang, 1991; Wilson & Ryan, 1990). Consequently, in terms of actually creating a psychologically meaningful sense of

vulnerability, the pathogen salience manipulation may simply have had less impact on East Asians than on Europeans. In any case, these are not the first results to show cultural differences in the relation between disease threat and implicit prejudice (conceptually similar results were reported by Park et al., 2003). A full understanding of these cultural differences awaits further research.

Overall, then, these results make two important conceptual contributions. They provide the first empirical evidence indicating that, consistent with previous speculations (Bugental & Hehman, 2007), ageist attitudes may result in part from the operation of disease-avoidance mechanisms – and thus may be moderated by the extent to which perceivers feel themselves to be vulnerable to disease. They also indicate that these interesting effects may themselves vary depending on the perceiver's cultural context.

#### Implications for Public Life and Public Policy

Although often non-conscious, implicit forms of prejudice can have substantial effects on behavioral interactions with the targets of those prejudices (McConnell & Leibold, 2001). This is troubling, especially given that implicit attitudes are often resistant to the variables and interventions that affect more conscious and deliberative beliefs (McConnell, Rydell, Strain, & Mackie, 2008). But this does not mean that implicit prejudices – such as implicit ageism – are inevitable and unchangeable. It simply means that we must often look in different (and sometimes nonobvious) places to find the variables that do moderate these implicit prejudices. Along with many other results bearing on the relation between threats and prejudices (e.g., Schaller & Neuberg, 2008), the results reported above suggest that when a specific implicit prejudice results, in part, from some specific form of threat, the magnitude of that implicit prejudice may be

moderated by any variable that influences the extent to which people are (or merely perceive themselves to be) vulnerable to that particular threat. This insight has implications for identifying many real-life variables that may affect the degree to which older adults are the target of prejudice and discrimination.

For instance, given that infectious pathogens are more prevalent in some geographical regions than in others, ageism might also be expected to vary geographically. Observed cultural differences in ageism (e.g., higher levels of ageism in Southeast Asia compared to North America; McCann et al., 2003; Sharps et al., 1998) correspond to well-documented regional differences in pathogen prevalence (Epstein, 1999; Guernier, Hochberg, & Guégan, 2004). In addition, travelers (who may have a heightened susceptibility to infectious diseases in the first place) may feel especially susceptible, and therefore may be especially prone to implicit ageism, when traveling to parts of the planet with especially high prevalence of pathogens.

Other forms of naturally occurring susceptibility may also temporarily dispose individuals toward ageist attitudes. One intriguing example emerges from recent research on pregnancy. Neurochemical changes occurring in the first trimester of pregnancy suppress of the body's immune response, with the implication that women in the early stages of pregnancy have a temporarily heightened vulnerability to infectious diseases. This has important psychological consequences, including a heightened sensitivity to disgust and increased ethnocentrism (Fessler, Eng, & Navarrete, 2005; Navarrete, Fessler, & Eng, 2007). It follows that women in the first trimester of pregnancy may also be more prone to implicit ageism. Other immunosuppressing events or circumstances might exert similar effects on ageism.

Other potentially-relevant contextual variables pertain to the different social or institutional environments within which individuals might find themselves in the course of ordinary life. Consider the fact that workplaces may vary profoundly in the extent to which they inspire sensitivity to infectious diseases. In some workplace settings (e.g., banks and financial offices), the threat of disease is unlikely to be salient. In other settings, the salience of this threat is much higher. These include hospitals, doctors' offices and other workplaces within the health care industry. Thus, ironically, it is in exactly those situations where older adults might logically be expected to be treated with the greatest courtesy, that they might also be especially prone to suffer the discriminatory consequences – aversion, avoidance, exclusion – of ageism. There is abundant evidence of age-based discrimination within the health care system (Ward, 2000; Robb, Chen & Haley, 2002) and numerous studies have found that medical, dental and nursing students show little desire to actually work with elderly patients (see Weir, 2004 for a review). Moreover, evidence of actual physical illness dramatically increases elder neglect (Lachs, Williams, O'Brien, Hurst & Horowitz, 1997; Choi & Mayer, 2000).

Contexts involving the preparation and ingestion of food are also likely to trigger a heightened sensitivity to the potential threat of infectious diseases. Consequently, one might expect age-based prejudices and acts of discrimination (e.g., employment discrimination) to be especially pronounced within the food service industry. More broadly, just as other prejudices vary across different workplace settings (see Neuberg, Smith, & Asher, 2000, for an analogous example involving anti-gay employment discrimination), ageism is likely to vary depending on the extent to which the specific setting implies vulnerability to infectious diseases. Perceived vulnerability is not only influenced by actual vulnerability; it may also be influenced by anything that makes disease perceptually salient. Media coverage of health-relevant news can have a substantial impact on the extent to which people worry about disease transmission and, as a consequence, may have an impact on diseaserelevant prejudices such as ageism. Thus, to the extent that news media creates an exaggerated perception of the threat posed by infectious diseases (e.g., coverage of the SARS outbreak in 2003), there may be obvious consequences on health-relevant behaviors as well as more subtle, but no less pernicious, consequences for ageism and other related prejudices.

Of course, news media outlets rarely act alone in exaggerating public fears of infectious diseases. Governments, non-governmental organizations, and other watchdogs of public health can also have a substantial impact on the extent to which people feel fearful of infectious diseases (Glassner, 1999). As a consequence, they may have an unintended impact on ageism (and related prejudices) as well. This impact may be deleterious (caused, for example, by hyperbolic political pronouncements about the threat of bioterrorism, or by incautiously-worded warnings about diseases that pose, in reality, only a very limited threat). But the impact these groups have may be positive as well. Governments and other organizations are in a position to enact health care policies that actually erect buffers against the spread of infectious diseases.

The useful implication is that legislation and public policy in the domain of health care may not only have the intended benefits for health care; they may also have the additional benefit of ameliorating ageism and related prejudices. Indeed, because implicit prejudices (such as ageism) may be relatively resistant to interventions based on overt rule-based injunctions, non-obvious forms of intervention (which address the actual psychological roots of these prejudices) may be more effective. Ageism might ultimately be reduced by policies that promote hygiene and thus inhibit the actual transmission of infectious diseases. Ageism might also be reduced by interventions that either increase public access to health care or increase the caliber of that health care. Access to high-quality health care not only has salutary epidemiological benefits (e.g., epidemic outbreaks of infectious diseases are less likely to occur), it also has the important psychological benefit that individuals are less likely to be fearful of infectious diseases. And, as our findings suggest, this perception (at least among people of European cultural heritage) has implications for ageism.

In a world in which age-based prejudices pose substantial problems to an evergrowing number of older adults, it is increasingly important to uncover the subtle causes of ageist attitudes, so as to design interventions accordingly. These findings offer the first empirical evidence that the implicit psychology of disease-avoidance may be one causal agent. And because of this, ageism may be influenced by variables affecting the extent to which individuals worry about the threat posed by disease transmission. This new empirical knowledge is potentially very useful. As Robert Butler (1989, p. 138) wrote, "Concerning the treatment of ageism as a disease, I find that knowledge is the most basic intervention, serving as antidote to numerous erroneous but widely held beliefs."

#### **Conclusions**

This study was designed to investigate the possibility that facial characteristics of advanced age act as triggering cues for the behavioral immune system. Consistent with the criteria established for a deviation to be considered a cue, elderly faces, relative to young faces, do activate disease cognitions. Additionally, for participants of European heritage, there is evidence that both chronic and temporary salience of communicable threat interact to influence the extent to which elderly faces activate disease cognitions, consistent with the more stringent criteria.

These results also speak to the specificity of the cognitions that are activated in response to cues connoting pathogen presence. The findings revealed that the patterns of implicit associations were the same for both the Disease IAT and the Unpleasant IAT. This suggests that the cognitions activated by elderly facial features are not specific to disease, but include a wider range of unpleasant concepts as well.

### CHAPTER 7: DISEASE AVOIDANCE RELATED LEARNING AND EMOTION DETECTION

The previous three chapters investigated the effects of disease avoidance mechanisms on perceptions of individuals who deviate from the physical norm. In effect, they tested the cognitive associations between morphological deviations from a healthy prototype and 'disease' concepts. The premise of these tests is that morphological deviations from a healthy prototype are interpreted as cues connoting pathogen presence, and the results are generally consistent with this assumption. These studies take for granted that we are able to learn which cues to associate with pathogen presence. Although a relatively safe assumption to make, to date there have been no investigations of the extent to which evolved pathogen avoidance goals may have influenced learning or associative processes.

This chapter proposes that humans are prepared to associate certain types of cues with cognitive and affective responses which increase the chances of avoiding contact with communicable pathogens. More specifically, it tests the extent to which sensitivity to facial expressions of disgust expressions is influenced by temporary or chronic salience of communicable threats. However, to fully appreciate how the results of these very specific tests provide a preliminary understanding of adaptive influences on learning, the following few sections of the introduction are dedicated to an overview of general learning principles, prepared and observational learning. Although not directly relevant to the present research, they provide a necessary foundation for understanding the unique characteristics of the type of learning that is hypothesized to be responsible for creating
associations between the cues that connote pathogen presence and the cognitive and affective responses they generate: emotion specific social learning.

## **Associative Learning**

Associative learning includes both classical and operant conditioning. Classical conditioning involves learning that one event follows another (i.e., the unconditioned stimulus (US) follows the conditioned stimulus (CS)), while in operant conditioning, the organism learns that a specific behavior (Conditioned Response or CR) will be followed by a particular consequence (positive or negative reinforcement or punishment). Learning is indexed by the development of Conditioned Responses (CRs) to the CS that are the same as, or similar to, the Unconditioned Responses (URs), which are the responses elicited by the US. The method most commonly used in learning studies is the differential conditioning design, which involves paring one CS (the CS+) with the US and a second CS (the CS-) with the absence of the US in order to control for non-associative influences on responding (Lovibond, 2004).

The rule of equipontentiallity in associative learning states that any stimulus should be able to serve as the CS if the association between the CS and US is contiguous and reliable – it is the association that is the important factor, not the stimulus itself (Pavlov, 1927). The rule of contiguity in associative learning states that for an organism to acquire an association between the CS and the US, the CS must immediately precede the UCS in time. Above and beyond these requirements, the CS must reliably predict the occurrence of the US for an association between the two to be learned.

There are, however, examples of learning which defy the generalized laws of associative learning (e.g., Little Albert and his fear of white rats, Watson & Rayner, 1920;

Bregman, 1934). These findings, and many other apparent violations of the generalized laws of associative learning, led to the development of an alternative learning theory to account for some of these apparent deviations from the established learning norms.

## **Prepared Learning**

Within the paradigm of prepared learning, the ability to associate stimulusoutcome pairings is influenced by the extent to which the pairings are evolutionarily relevant (as is the case with infectious threats). Organisms are either prepared, unprepared or contraprepared to learn associations that are adaptive, functionally neutral, or maladaptive, respectively (see Seligman, 1970). Concerning prepared learning, the associations between limited sets of stimuli and specific, adaptive responses are theorized to be learned faster, to be harder to unlearn, and to be limited to the range of stimuli for which the system was designed than is the case for unprepared pairings (Seligman, 1970; 1971).

One of the earliest lines of research on prepared learning is the phenomenon of Taste Aversion learning in rats (Garcia, Kimeldorf & Koelling, 1955). After a single pairing of a novel food and subsequent illness, rats will avoid ingesting the novel food. It was presumed, and later demonstrated, that the association of the salient feature of the food (the taste) followed by a visceral response is necessary for this type of learning (Garcia, Hankins & Rusiniak, 1974).

Interestingly, studies have shown that one trial learning of inappropriate food avoidance is not limited to a taste-malaise relationship across species. In species who rely on visual cues in feeding behavior relatively more than rats, such as quail, aversion to a food is learned more quickly to a visual cue (solution color) that precedes physical illness than a taste cue (novel flavor) (Wilcoxon, Dragoin & Kral, 1971). Similar results have been found with monkeys (Johnson, Beaton & Hall, 1975). This evidence suggests that there is, in many species, a prepared, balanced, sophisticated system for monitoring the external and internal environment, detecting and learning the associations between novel food-related stimuli and the physiological outcomes that follow their ingestion.

## **Pathogen Avoidance Learning**

It is possible that the behavioral immune system co-opted this existing prepared 'illness avoidance system' to facilitate the avoidance of other, communicable sources of illness. One problem which becomes immediately apparent with this suggestion is that the cues indicative of communicable threat vary across time, geographic location and type of pathogen. As such, being prepared to learn one particular type of cue (e.g. visually apparent lesions) may be insufficient to prevent contact with the many possible sources of infection (which are also indicated by coughing, emaciation, etc.). However, if the system was set up to provide an efficient means of associating a slightly broader range of cues indicative of potential pathogen presence with an aversive response, it would have been especially advantageous. Those individuals who associated symptomatic cues of pathogen presence and avoidance behaviors would have an adaptive edge in avoiding pathogens. So too would those individuals who could efficiently learn successful cueavoidance associations from others.

An individual cannot afford to be naïve regarding cues indicative of pathogen presence and risk becoming infected. Therefore, the psychological processes required to associate cues connoting pathogen presence and the appropriate affective or behavioral response must be extremely efficient. This necessary efficiency is due to the high fitness costs the individual would incur if less capable mechanisms were in place (Haselton & Nettle, 2006; Nesse 2001; 2005). Social or observational learning would allow the individual the advantage of learning the association between an important pathogen-related cue and the appropriate behavioral response, without direct exposure to infectious threat. Thus, the learning mechanism proposed here is a predisposition, or preparedness, to learn infectious threat related associations modeled by others. However, for it to function properly requires the observer be aware of both the eliciting cue and the adaptive associated response.

#### **Disgust Expressions As Prepared Cues of Pathogen Presence**

Specific to pathogen avoidance prepared learning, the response to which people are proposed to attend to during social learning is theorized to be the facial expression of disgust. Disgust is one of the basic emotions (Darwin, 1872), which some have suggested "evolved to detect reliable signals co-occurring with disease-causing infectious agents, which stimulates avoidance responses and/or other behaviours that tend to decrease the risk of disease." (Rubio-Godoy, Aunger and Curtis, 2007). Disgust can be elicited by taste, olfactory, auditory, tactile and visual cues (Curtis & Biran, 2001; Curtis et al., 2004), any of which may be useful modalities for detecting cues of pathogen presence (e.g., hearing coughing, seeing lesions, smelling vomit). Recognition of the disgust expressions is universal, and it has recently been shown that recognition occurs automatically and at rates comparable to the other basic emotion expressions (Tracy & Robbins, 2008). The expression includes wrinkling of the nose, pulling down at the corners of the mouth, and sometimes includes a gaping mouth and protrusion of the tongue (Ekman, 1992; Rozin et al., 1993). The general premise of social learning is the ability to observe associations others make and integrate the model's response into our own understanding and behavior. Much of the work on social learning of evolutionarily relevant associations starts where Seligman's prepared learning theory leaves off, with the goal of further expanding the single dimension of prepared-unprepared associations to incorporate greater complexity and nuance. This logic is particularly well stated by Source et al (1985):

If the observer can identify emotional expressions and can assume that the expressing person is reacting to relevant environmental circumstances, then it seems quite likely that the attitude and/or behavior of that observing person will be influenced by noting the other's emotional expressions (i.e., a communicative function). Beyond this, to the extent that emotional expressions influence the behavior of the observer, they can be said to be serving a social regulatory function (p 196).

Social learning is generally thought to be most likely to occur in ambiguous situations in which the observer is unsure of the proper response. The indirect and therefore fallible cues indicative of pathogen presence suggest pathogen avoidance is a domain in which social learning may be especially applicable.

# **Evidence for Emotion Specific Social Learning**

The most comprehensive evidence supporting a system of prepared social learning pertains to an evolved module of fear and fear learning of snakes (for a review see Ohman & Mineka, 2001). This line of research provides support for prepared learning by demonstrating the efficient acquisition of associations between certain cues (snakes and reptiles) and the activation of a specific emotion (fear) by individuals who have only observed the reactions and behavior of others in response to the cues. Although this module deals with fear as an adaptive response (and not disgust as an adaptive response) it parallels both the activation pattern and the type of learning that has been proposed for the behavioral immune system and thus provides a well researched starting point for understanding and investigating a possible prepared learning mechanism for disease avoidance. Importantly, both use observational or social learning to activate associations between specific cues and the appropriate emotional and behavioral responses.

Much research has been conducted with both wild and lab reared rhesus monkeys investigating the existence of a prepared system for rapidly associating snakes or other reptilian stimuli with fear, and that this association can be learned by exposure to a conspecific modeling fearful behavior to the target stimulus. Prepared associations are predicted to be easier to learn, harder to extinguish, and faster to rebound than other types of associations. The findings pertaining to the fear module support these assumptions (Mineka, Davidson Cook & Keir, 1984; Mineka & Cook, 1993, 1986; Cook, Mineka, Wolkenstein, & Laitsch, 1985; Cook & Mineka, 1989, 1990; Mineka, 1987; Mineka & Keir, 1983). It is worth noting that the fear module appears to be sophisticated and attuned to experience beyond an 'if see fearful behavior around a snake, then act fearfully' level. A particularly elegant example of the effect of social learning on behavior mediated by the fear module is demonstrated in a study by Mineka and Cook (1986). Lab reared monkeys (who were unexposed to, and therefore unafraid of, snakes) were put in one of three conditions: observing a model behaving non-fearfully to a snake stimulus, observing a model behaving non-fearfully to a neutral stimulus or spending time with a realistic toy snake. All three groups were then exposed to a monkey acting fearfully toward a snake stimulus. Six of the 8 members of the group that were inoculated to snake fear by being exposed to a model acting non-fearfully around snakes did not

display fear on subsequent exposures to snake. In both of the other conditions all individuals displayed fear. These results demonstrate both the power of the modeling on the observer's behavior, and, importantly, that the associations between the cue and the emotional response are not hardwired, but are easily learned when demonstrated (and presumably only demonstrated when functionally relevant, in other words, when the particular cue poses a threat).

Research with humans has demonstrated that the ancient threat posed by snakes (which we share with our primate ancestors) likewise affects our cognitive processes. For example, a snake/shock pairing activated fear (Tomarken, Sutton, & Mineka, 1995), was learned more quickly (after even one trial), and was more resistant to extinction, than a neutral stimulus/shock pairing (Ohman, Eriksson & Olofsson, 1975). Human studies also speak to the possibility that there may be individual differences in the motivation or ability to make certain prepared associations. Individuals with chronic snake phobia are more likely than their non-fearful counterparts to have emotional interference on an executive function task when shown a fear related stimulus (Constantine, McNally & Hornig, 2001). Sensitivity to environmental shifts in threat level has also been demonstrated (Tomarken, Mineka & Cook, 1989). Of particular relevance are studies with humans which show individual differences in fear levels predict vigilance to visual cues associated with the fear for both snake and spider stimulus (Ohman, Flykt & Esteves 2001).

Taken together, this program of research supports the idea of prepared associations, required social learning of these associations, functional flexibility and effects of individual differences. Although this research has focused on the association of snakes and fear, it provides a framework which can be applied to the avoidance of communicable threat through prepared associations between cues of pathogen presence and disgust.

# Developmental Evidence for Social Learning of Negative Emotion Associations in Humans

From a young age we rely on our perceptions and interpretations of the reactions of those around us for information when encountering new or ambiguous objects or situations (Campos & Stenberg, 1981; Feinman, 1982). The act of using others as sources of information is called social referencing, and is predicated on the ability to intentionally attend to an object to which another agent is attending (Scaife & Bruner, 1975). This ability to coordinate attention with a social partner is a critical skill for social learning, as we can only learn associations from others if we can attend to both the teacher and the object to which they are reacting (see Mundy & Newell, 2007 for a review). Relevant to pathogen avoidance, social referencing is required to facilitate the acquisition of associations between cues connoting communicable threat and the functionally appropriate emotional response of disgust. In a recent study of infant brain activity in social referencing, infants watched as their mother displayed positive, neutral or disgust expressions in response to a variety of novel toys (Carver & Vaccaro, 2007). The infants were then shown videos of the toys. The infants' brain activity was highest when watching the toys their mothers had responded to with disgust. Further, the infants' attended more to toys that elicited disgust in the mother than to the toys paired with positive or neutral affective responses. Thus, we know that from an early age that infants have the basic skills required to learn associations between specific objects and disgust.

Children are also able understand that the association between disgust and a novel object is specific to the object that elicited the disgust expression, and are able to use this knowledge to guide future interactions with objects in their environments. A study by Hornick, Risenhoover, & Gunnar (1987) provided clear evidence of children's ability to learn associations between their mother's disgust response and the novel toy that elicited the response. Twelve month old children observed their mothers' react to novel toys with either disgust, happy or affectively neutral responses. Children were less likely to play with the 'disgusting' toy at a later time, although they did not transfer their avoidance to any of the other novel toys. Taken together, the findings from these two studies demonstrate that even very young children are sensitive to disgust expressions of others, attend to and are able to understand the association between the expression and the eliciting object, and use the associations modeled for them to guide future behaviors.

#### **The Present Studies**

There is sufficient evidence in the literature to support that prepared learning of associations between cues signaling pathogen presence and a disgust response is plausible. The fast and specific learning of associations between novel objects and disgust responses, paired with later behavioral avoidance suggest these learning processes could have been shaped by adaptive pathogen avoidance motivations. The studies in this chapter investigate the extent to which disease avoidance motivations influence a particular component of the process required for social learning of pathogen relevant cues. The focus is on the possibility that we are attuned to facial expressions of disgust as social cues connoting the presence of a pathogen relevant threat in the immediate environment. Beyond the simple question of absolute attention to disgust expressions, the extent to which attention to this social cue varies as a result of the salience of communicable threat also needs to be investigated.

The studies reported in this chapter also used a new methodology to temporarily increase the salience of communicable threat. This approach was guided by the findings from the investigation of chronic individual differences in perceived vulnerability to disease reported in Chapter 3 that there are two conceptually independent factors which contribute to chronic concerns with communicable threat. It therefore seems plausible that just as there are conceptually distinct effects and relationships for emotional and cognitive domains in chronic concerns with communicable threat, there may conceptually distinct domains of temporary salience of communicable threat. In other words, it is possible, but remains to be investigated, that specific types of cues activate conceptually distinct concerns with communicable threat, each of which is sensitive to different types of cues in the environment, and temporarily modifies responses to these cues in a specific, functionally appropriate manner. To investigate this possibility, the manipulations used to increase the salience of communicable threat in the studies reported in this chapter were designed to do one of three things. The affective manipulation was designed to elicit the affective response experienced when communicable threat is present, disgust, without activating disease specific cognitions. The cognitive manipulation was designed to increase the awareness of the ease of interpersonal pathogen transmission, without eliciting an affective response. A third manipulation was designed to activate both the cognitive and affective components theorized to be involved in vulnerability to communicable threat.

Together, these studies represent a first step in investigating the extent to which the disgust expression is a social cue indicative of potential pathogen presence, and the extent to which sensitivity to this cue is modified by pathogen avoidance processes. There are three conceptual questions that will be addressed in this chapter. First, are we especially likely to be attentive to detecting disgust in others' faces when communicable threat is made temporarily salient? Second, if attention to disgust expressions is related to disease avoidance motivations, are we especially attentive to seeing disgust expressions in others faces if we are especially concerned about disease transmission? Third, are we especially likely to falsely identify ambiguous facial expressions or expressions of other emotions as disgust when communicable threat is temporarily or chronically salient? To date, no direct test of these questions has been carried out.

#### **Study 7.1: Primed Emotion Recognition**

Study 7.1 was designed to test two hypotheses derived from implications of disease avoidance motivations on the sensitivity of emotion expression recognition. Specifically, if we are prepared to learn associations between cues that connote possible pathogen presence and the emotion of disgust, then it is possible that when we are feeling especially vulnerable to disease, we are especially sensitive to cues that connote infectious threats. One such indicator may be other individuals in our immediate environment who are experiencing disgust, as their disgust would indicate the presence of a potentially relevant elicitor. Thus, we should attend to the expression (and the elicitor), in order to learn the association which will facilitate the appropriate avoidance response in future encounters. The first hypothesis is that recognition rates of disgust expressions (the emotion relevant to communicable threat) will be higher when the temporary and/or

chronic salience of communicable threat is increased. The second is that when communicable threat is salient, there will be a greater likelihood of falsely identifying facial expressions of other emotions as expressions of disgust.

This study used a methodology developed by Tracy and Robins (2008) to test the automaticity of emotion expression recognition. In this methodology, participants completed a series of trials in which they were briefly shown a photograph of a person displaying the facial expression of a specific emotion, and then asked to identify if the emotion depicted in the photograph was a specific target emotion. Participants completed these trials in the presence or absence of a cognitive load. The original study found that participants were able to identify disgust expressions at the same rate as other emotion expressions, and that the addition of cognitive load did not significantly influence expression recognition, suggesting emotion recognition occurs relatively automatically (Tracy and Robins, 2008). This methodology therefore allows the testing of an aspect of automaticity that the IAT was unable to address – the extent to which pathogen avoidance processes are effortless, or require minimal cognitive resources. If the addition of a cognitive load changes the recognition rates of disgust faces, then this criteria will not be met, suggesting that detection of social cues indicative of pathogen threat is not entirely automatized.

To test the influence of communicable threat on both the ability to recognize disgust expressions and the tendency to misidentify other emotion expressions as disgust, movie primes were added. The movie primes were designed to allow for a test of the influence of priming only emotional cues consistent with communicable threat (e.g. eliciting disgust) versus priming only cognitive cues of communicable threat (e.g. demonstrating ease of pathogen transmission) versus priming a combination of cognitive and emotional cues (e.g., demonstrating pathogen transmission and eliciting disgust). In addition, there were two control movies, one of which made a non-communicable threat salient, and another which was unrelated to disgust or any type of threat. Showing these movies prior to the emotion recognition task allowed for the comparison of emotion recognition rates when affective, cognitive or a combination of pathogen relevant threats were made salient. The use of cognitive load allowed for a test of the relative automaticity of disgust expression recognition and misidentification in each of the movie prime conditions. Finally, individual difference measures were included to measure the influence of chronic concerns with pathogen presence on this task.

#### Method

## **Participants**

Seventy four individuals participated in the study (57 female, 17 male; mean age 20.1). The sample was ethnically diverse, and comprised 37 participants with East Asian cultural heritage, 24 with European heritage, and 13 from a variety of other cultural backgrounds.

#### Movie Primes

Five different movie clips were used as primes: Three were relevant to communicable threat, and the remaining two were different types of non-infectious controls. To prime disgust, participants watched scenes from the movie *Trainspotting* (Macdonald & Boyle, 1996), in which an individual loses his suppositories in a grossly overused and under-maintained public toilet, prompting him to eventually reach into a full bowl of fecal matter in an effort to retrieve them. This clip has been shown to induce high levels of disgust (Lerner, Small, & Lowenstein, 2004). To prime cognitive awareness of communicable threats without eliciting disgust, participants watched portions of the short film Sniffles and Sneezes (McGraw-Hill Book Company, 1955), an educational video intended for school children which highlights how careless hygiene practices increase the spread of the common cold, but is affectively unremarkable. To both prime cognitive awareness of communicable threat and elicit disgust, participants watched portions of the movie *Outbreak* (Henderson, Kopelson, Katz & Peterson, 1995), which shows the progression a fictional Ebola-like virus from its inception in Africa to an eventual epidemic in a small American town, including graphic depictions of physical symptoms. The first control clip primed non-contagious physical threat. Participants watched scenes from Silence of the Lambs (Bozman, Saxon, Utt, & Demme, 1991) in which a male serial killer stalks a female FBI agent through a dark basement. This clip has been shown to elicit high levels of fear (Gross & Levenson, 1995; Maner et al., 2005). The second control clip was composed of scenes from the film *Koyaanisqatsi* (Reggio & Coppola, 1983) which features time lapse footage of urban activities and has unique musical accompaniment. The movie clips ranged from approximately 7.0 to 10.8 minutes in length.

# Stimuli

The emotion expression recognition task used a total of 42 photographs of 1 Caucasian male target (21 pictures) and 1 Caucasian female target (21 photos) from the University of California, Davis Set of Emotion Expressions (UCDSEE; Tracy, Robins & Schriber, in press). In all photos the targets are wearing white t-shirts and posed standing in front of a blue background. All photos show the target from the waist up. For each of the emotion expressions targets had been posed following either the directed facial affect task (DFA, Ekman, Levenson, & Friesen, 1983) or, for the self conscious emotions, on guidelines found in the literature. All photos were verified by a certified coder and leading expert in the Facial Action Coding System (Ekman & Friesen, 1978) to ensure the correct display of action units relevant to each expression. The UCDEE has verified photographs for 10 emotion expressions, specifically disgust, anger, fear, joy, sadness, surprise, contempt, shame, embarrassment and pride (Tracy, Robins & Schriber, in press). *Individual Difference Measures* 

Participants completed a questionnaire package containing five individual difference measures. Two of these questionnaires were relevant to disease. The Perceived Vulnerability to Disease scale (Duncan, Schaller & Park, 2009; see Chapter 3) is a 15-item scale that measures individual differences in chronic perceptions of vulnerability to disease. The Revised Disgust Sensitivity Scale (Olatunji, Williams, Tolin, Abramowitz, Sawchuk, Lohr, & Elwood, 2007) is a 25-item scale that assesses individual differences in sensitivity to domain specific disgusts, which are combined to obtain an overall disgust score. The 12-item Belief in a Dangerous World scale (BDW; Altemeyer, 1988) was included to assess the extent to which people are chronically pessimistic concerning the intentions of others. The 12-item Faith in Intuition measure (Epstein et al., 1996) was included to assess the extent to which people rely on their gut reactions. The Interpersonal Reactivity Index is a 28 item measure of four facets of empathy (Davis 1980). It was included for the Fantasy scale, which measures individual differences in the tendency to imagine how characters in books and movies feel. The Affect Intensity Measure is a 40 item self report measure of designed to measure the

intensity with which individuals experience positive and negative emotions (Larsen, 1984). A demographic questionnaire was also included in the questionnaire package. It asked the participant's age, gender and ethnic background.

# Procedure

Participants were told the purpose of the study was to better understand how we perceive other people's facial expressions. They were told they would be watching a movie clip, identifying emotion expressions from photographs presented on the computer, and completing some questionnaires. Informed consent was obtained, and the study began.

Participants were randomly assigned to one of the five video prime conditions (Trainspotting, n = 13; Outbreak, n = 17; Sniffles and Sneezes, n = 15; Silence of the Lambs, n = 14; Koyaanisqatsi, n = 15). Prior to starting the video, the experimenter asked participants to feel, to the best of their ability, what the characters in the film were experiencing. They then watched the clip on a 17 inch computer screen (at 640 pixels wide by 480 pixels high), with headphones supplied for the audio component of the movie.

When the movie was finished, the computer prompted the participants to rate the extent to which they were currently experiencing each of 18 emotions (Anger, Annoyance, Excitement, Guilt, Pride, Anxiety, Fear, Hope, Relief, Arrogant, Frustration, Hostile, Sadness, Disgust, Gratitude, Joy, Shame, and Embarrassment) on a 7-point scale with endpoints labeled "Not At All" and "Extreme". These ratings were made directly on the computer. Upon completion of the ratings, instructions for the emotion recognition task were presented on the computer screen. After reading the instructions, participants started the emotion recognition task.

# Emotion Recognition Task

The procedure used in this study is similar to that used in Tracy and Robins (2008). Participants were told they would view several sets of briefly presented photos of people expressing different emotions, and that their task was to identify if the person in the photograph is expressing a particular emotion. They responded by pressing one of two keys on the keyboard ("J" represented YES, and "F" represented NO). Participants were instructed to place their index fingers on each key before starting the task, and to keep them there until the end of the task, as the protocol required them to respond quickly to each photo. (The two keys were also marked by green and red stickers respectively, so participants would know where to replace their fingers if they moved them at any point during the task).

The emotion recognition task consisted of 10 blocks, each of which focused on a different target emotion (Anger, Fear, Contempt, Disgust, Sadness, Shame, Embarrassment, Surprise, Pride and Happiness). For each block, 8 of the stimulus photos depicted the target emotion (e.g. disgust in the disgust block), while each of the nine remaining emotions were depicted two times. Each block therefore consisted of a total of 26 trials in which the stimulus photograph was presented for 1000 ms. The order of presentation was randomized within each block, and the order of blocks was randomized between participants.

Prior to starting each block, an instruction screen on the computer informed participants of the target emotion for the block. In each block the participants were instructed to identify if the target in each photo was expressing the target emotion (e.g. disgust, in the disgust block). In each trial, the screen showed one stimulus photo and the question "Is this disgust [contempt, anger, fear, happiness, pride, sadness, surprise, embarrassment, shame]?" in 24 pt font (to remind participants of the target emotion for that block).

Participants were instructed to respond as quickly as possible, and go with their gut feelings. Each photo appeared on screen for a maximum of 1000 ms; it disappeared as soon as participants responded, and was replaced by the next photo. If participants did not respond within 1000ms, no response was recorded and a message appeared on-screen telling participants to respond more quickly. The 1000ms duration was chosen because previous research has shown that it prompted participants to respond as fast as possible without conscious deliberation, but did not make the task so difficult that participants became frustrated (Tracy & Robins, 2008).

Participants were randomly assigned to either the cognitive load condition or the no cognitive load condition. Those in the no cognitive load condition completed the task as described above. If the participant was assigned to the cognitive load condition, the procedure differed in only one regard: prior to each target emotion block, he or she was shown a 7-digit number for 10s, instructed to repeat it twice aloud, and then asked to remember the number for the duration of the target block. After the completion of each block, the participant was prompted to recall the number and enter it into the computer. "Dual task" cognitive load manipulation has shown to be effective in diverting people's cognitive resources (Tracy & Robins, 2008).

After participants completed the timed computer-based emotion expression recognition task they filled out the questionnaire package. They were then debriefed, thanked and compensated for their participation.

# Results

#### Did the movie primes elicit the expected emotions?

The mean ratings for key emotions are reported in Table 7.1. The post-movie emotion ratings show that the levels of disgust, F(4, 69) = 20.76, p < .001, anxiety, F(4, 69) = 5.30, p = .001), fear, F(4, 69) = 12.92, p < .001), and sadness, F(4, 69) = 5.97, p < .001, varied significantly by movie condition. Particularly notable is that Trainspotting elicited significantly more disgust than any of the other movies, and that Outbreak and Silence of the Lambs elicited more disgust than Sniffles and Sneezes and Koyaaniqatsi, suggesting the movies chosen as disgust primes were effective at eliciting the desired emotion and that simply making communicable pathogens salient does not necessarily activate disgust. These results do not, however, explicitly address the extent to which the movies elicited pathogen salient cognitions or pathogen avoidance motivations.

# Table 7.1

	Trainspotting	Outbreak	Sniffles and	Silence of	Koyaanisqatsi
			Sneezes	the Lambs	
n	13	17	15	14	15
Disgust	6.69 <sub>c</sub>	4.53 <sub>b</sub>	2.80 <sub>a</sub>	4.64 <sub>b</sub>	2.00 <sub>a</sub>
Anger	2.92	3.06	1.67	2.86	1.93
Anxiety	4.31 <sub>a, b, c</sub>	4.88 <sub>b, c</sub>	3.00 <sub>a</sub>	5.29 <sub>c</sub>	3.33 <sub>a, b</sub>
Fear	2.92 <sub>a, b</sub>	4.47 <sub>b, c</sub>	2.60 <sub>a</sub>	5.21 <sub>c</sub>	1.47 <sub>a</sub>
Joy	2.08	1.65	2.47	1.36	2.27
Sad	3.31 <sub>b, c</sub>	4.18 <sub>c</sub>	1.53 <sub>a</sub>	3.14 <sub>a, b, c</sub>	2.40 <sub>a, b</sub>

# Mean Ratings of Post-Movie Emotion by Movie Condition

*Note*: Subscript letters by row indicate homogeneous subsets with Tukey's HSD, p < .05. *Preliminary Analysis* 

Due to the nature of the methods used and the hypothesis being tested, a signal detection theory approach was used in the analysis of the data. In this framework, recognition accuracy is referred to as *sensitivity*, which reflects the extent to which participants are able to differentiate expressions of disgust from other emotion expressions. Rate of recognition of a disgust expression (Hit; H) was assessed by the proportion of trials on which a participant responded 'yes' to a disgust expression. A nonparametric signal detection measure of sensitivity (A') was computed using the following formula: A' = 1/2 + [(H - FAX1 + H - FA)]/[4H(1 - FA)]. The rate of misidentification of other expressions as disgust (False Alarm; FA) was assessed by the proportion of trials on which a participant responded 'yes' to a non-disgust expression.

The general threshold of responding 'yes, is disgust' versus 'no, is not disgust' is referred to as response bias. A nonparametric measure of response bias (B''d) was computed using the following formula: B''d = [(1 - H)(1 - FA) - HFA]/[(1 - H)(1 - FA) + HFA] (see Stanislaw & Todorov, 1999 and Donaldson, 1992, for details on computations).

Table 7.2 summarizes the hit rate, false alarm rate, sensitivity, and response bias across all conditions, as well as separately by movie condition and cognitive load condition.

# **Table 7.2**

#### **Recognition of Disgust Expressions by Movie Prime and Cognitive Load Condition**

Hit rate	False alarm rate	A'	B"d
.828 (.17)	.137 (.11)	.598 (.04)	.009 (.74)
.731 (.20)	.120 (.11)	.605 (.05)	.340 (.66)
.892 (.12)	.130 (.10)	.597 (.02)	218 (.73)
.809 (.20)	.180 (.10)	.595 (.05)	089 (.75)
.875 (.13)	.091 (.10)	.600 (.02)	.070 (.64)
.825 (.15)	.152 (.11)	.594 (.02)	.005 (.85)
.807 (.16)	.144 (.11)	.592 (.04)	.055 (.66)
.846 (.18)	.130 (.12)	.603 (.03)	032 (.78)
	Hit rate .828 (.17) .731 (.20) .892 (.12) .809 (.20) .875 (.13) .825 (.15) .807 (.16) .846 (.18)	Hit rate False alarm rate   .828 (.17) .137 (.11)   .731 (.20) .120 (.11)   .892 (.12) .130 (.10)   .809 (.20) .180 (.10)   .875 (.13) .091 (.10)   .825 (.15) .152 (.11)   .807 (.16) .144 (.11)   .846 (.18) .130 (.12)	Hit rate False alarm rate A'   .828 (.17) .137 (.11) .598 (.04)   .731 (.20) .120 (.11) .605 (.05)   .892 (.12) .130 (.10) .597 (.02)   .809 (.20) .180 (.10) .595 (.05)   .875 (.13) .091 (.10) .600 (.02)   .825 (.15) .152 (.11) .594 (.02)   .807 (.16) .144 (.11) .592 (.04)   .846 (.18) .130 (.12) .603 (.03)

*Note:* A' = sensitivity (recognition accuracy); B''d = response bias. A' ranges from .5 to 1 where .5 equals chance levels and 1 equals perfect accuracy. B''d values are reported from -1 (liberal bias) to 1 (conservative bias). Standard deviations are reported in parentheses.

Do temporary concerns with communicable threat influence sensitivity to disgust expressions? Does this vary as a result of cognitive load?

The effects of both the movie prime and cognitive load conditions on the sensitivity were tested with a 5 (movie condition) X 2 (cognitive load condition) ANOVA on A'. The results of this omnibus test revealed no significant main effects of movie, F (4, 64) = .25, p = .91, or cognitive load F (1, 64) = 2.27, p = .14, and no significant interaction of cognitive load and movie condition, F (4, 64) = .80, p = .53. Correct recognition of pathogen presence does not appear to be influenced by either the movie primes or cognitive load.

# Do chronic concerns with communicable threat affect sensitivity to disgust expressions?

The sample was initially analyzed as a whole to investigate the possibility that relationships between chronic concerns with communicable threat and emotion recognition transcended temporary primes. There were no significant relationships between Germ Aversion, Perceived Infectability and Disgust Sensitivity and sensitivity to disgust expressions (all ps > .21). However, it is possible that chronic concerns with pathogen presence may be heightened when people already feel disgust, or when pathogen salience is temporarily increased (as seen in Chapter 6) or that chronic concerns may influence the way in which the content in the movies was interpreted. Therefore, the relationships between chronic concerns and emotion recognition were also considered separately by movie condition. The results indicate that only for participants who watched Trainspotting, there were marginally significant positive relationships between sensitivity to disgust expressions and both Germ Aversion (r = .54, p = .06) and Disgust Sensitivity (r = .48, p = .09). This suggests that although there was relatively little

difference across conditions in sensitivity to disgust expressions, chronic concerns with pathogen transmission are more strongly related to disgust expression detection when feelings of disgust have been elicited, but not when cognitive awareness of pathogen transmission is salient.

Do temporary concerns with communicable threat affect response bias? Does this vary as a result of cognitive load?

A preliminary test of the overall effects of both the movie prime and cognitive load conditions on response bias was performed using a 5 (movie condition) X 2 (cognitive load condition) ANOVA on B''d. Results revealed no significant main effects of movie, F(4, 59) = 1.16, p = .34, or cognitive load F(1, 59) = .71, p = .40, and no significant interaction of cognitive load and movie condition, F(4, 59) = .51, p = .73. At this broad level of analysis, neither the primes nor the addition of cognitive load appear to influence response bias in identifying non-disgust expressions as disgust. *What are the independent effects of disgust and salience of pathogen transmission on response bias*?

Focused analyses further investigated the specific effects of cognitive and affective components of the hypothesized behavioral immune processes on the extent to which the cue detector is conservatively (less likely to misidentify a non disgust expression as disgust) or liberally (more likely to misidentify a non disgust expression as disgust) biased.

To investigate potential independent and interactive effects of the cognitive and affective components of the behavioral immune processes, the non-communicable control primes (Koyannasqatsi and Silence of the Lambs) were combined into a single control group. Tukey and LSD tests were done to test the differences in response bias between Trainspotting, Sniffles, Outbreak and the control. Using LSD comparisons, a significant difference in response bias was found between those participants who watched Sniffles and Sneezes and those who watched Trainspotting, p = .045.<sup>6</sup> This suggests that eliciting disgust results in a conservative bias, while making pathogen transmission temporarily salient results in a more liberal response bias.

# Do chronic concerns with communicable threat affect response bias?

Once again, the sample was initially analyzed as a whole to investigate the possibility that relationships between chronic concerns with communicable threat and response bias transcended temporary primes. The relationship between Germ Aversion and response bias was significant (r = -.23, p = .05), suggesting an overall tendency for people who feel chronically concerned with pathogen transmission to demonstrate a liberal bias and misidentify other emotion expressions as disgust. The relationships between response bias and both Perceived Infectability and Disgust Sensitivity were not significant (ps = .11 and .24, respectively). The relationships between chronic concerns with communicable threat and response bias were also analyzed separately by movie condition to investigate the relationships between disgust and pathogen salience and chronic concerns with communicable threats. Results are summarized in Table 7.3. There was no consistent pattern of relationships for those participants for whom disgust was elicited (Trainspotting). Among participants for whom pathogen transmission was made salient, although only the relationship with Disgust Sensitivity was statistically significant, the individual difference variables were all moderately related to response bias and marginally significant. No consistent pattern of relationships was found in the

<sup>&</sup>lt;sup>6</sup> This difference did not reach significance when using Tukey comparison, p = .182.

remaining two conditions. Taken together, these findings suggest that the tendency to misidentify non-disgust expressions as disgust is increased among individuals who have chronic concerns with communicable threat, but only when the cognitive awareness of pathogen transmission is salient.

# Table 7.3

# Correlations between Response Bias and Chronic Concerns with Communicable

## **Threat**

		Trainspotting	Sniffles	Outbreak	Control
	n	13	15	17	29
Germ	r	0.26	-0.50	-0.09	-0.26
Aversion	р	0.40	0.06	0.73	0.17
Perceived	r	-0.10	-0.41	-0.34	0.05
Infectability	р	0.76	0.13	0.18	0.78
Disgust Sensitivity	r	-0.07	-0.55	0.09	-0.16
	р	0.81	0.03*	0.74	0.40

*Note.* \* indicates correlation significant at p < .05.

One final possibility that will be investigated is the effect of cognitive load on the relationship between chronic and temporary salience of communicable threat and the resultant effects on response bias. The correlations between response bias and each of the three individual difference measures relevant to communicable threat (Germ Aversion, Perceived Infectability, and Disgust Sensitivity) are shown in Table 7.4, broken down by movie prime and cognitive load condition. The results indicate the relationship between chronic concerns with communicable threat and the tendency to demonstrate a liberal response bias are much stronger when there is no cognitive load than when there is a

cognitive load and when cognitive awareness of pathogen transmission is temporarily salient. Although the sample sizes are too small to run a reliable comparison of correlation strengths across cognitive load conditions for those participants who watched Sniffles and Sneezes, a preliminary test reveals the difference in the relationship between Disgust Sensitivity and response bias is marginally significant (p = .09). The relationships between chronic and temporary concerns do not differ with the addition of cognitive load in the disgust eliciting condition (Trainspotting).

# Table 7.4

# Correlations between Response Bias and Chronic Concerns with Communicable

		Trainspotting	Sniffles	Outbreak	Control
No Cognitive Load	n	7	7	10	15
Germ Aversion	r	0.69	-0.68	-0.11	-0.25
Gerni Aversion	р	0.09	0.09	0.76	0.37
Perceived Infectability	r	0.02	-0.66	-0.50	0.06
r ercerved infectability	р	0.96	0.09	0.14	0.83
Disquet Sensitivity	r	0.08	-0.86	0.21	0.07
Disgust Sensitivity	р	0.87	0.01	0.56	0.81
Cognitive Load	n	6	8	7	14
Corm Aversion	r	-0.20	-0.28	-0.14	-0.21
Genn Aversion	р	0.70	0.52	0.77	0.46
Deresived Infactability	r	-0.20	-0.27	-0.48	-0.02
received infectability	р	0.70	0.51	0.28	0.96
Disquet Sonsitivity	r	-0.49	-0.17	-0.17	-0.20
Disgust Sensitivity	р	0.32	0.68	0.72	0.48

# Summary

This study was the first use of the film clip, Sniffles and Sneezes, designed to activate pathogen relevant cognitions without activating an affective response. Results indicated it did not elicit disgust relative to the other movie conditions. This suggests that any effect of the movie clip were the result of the cognitions activated by the film (e.g., pathogen salience, ease of transmission of pathogens).

This study measured the extent to which the salience of communicable threat, either due to a temporary manipulation or chronic levels of awareness, influenced the recognition of facial expressions of disgust. Of primary interest was the extent to which these variables influenced the misidentification of expressions of other emotions as disgust. Results indicate that chronic or temporary salience of communicable threat did not influence sensitivity to (recognition of) disgust expressions, but that there were changes in response bias. Specifically, increasing the level of disgust resulted in a conservative bias while increasing the awareness of the potential ease of pathogen transmission resulted in a liberal bias, especially when sufficient cognitive resources were available.

#### **Study 7.2: Primed Emotion Projection**

This study takes a different empirical approach to investigate the extent to which awareness of contagious threat is related to sensitivity to social cues indicative of potential pathogen presence. Study 7.1 measured the relationship between chronic and temporary salience of specific threats and the detection or misidentification of functionally related facial expressions present in the social environment. This study investigates the extent to which perception or interpretation of ambiguous social cues may be influenced by the salience of a specific threat. It was designed to test a hypothesis derived from implications of disease avoidance motivations on the sensitivity of emotion expression recognition.

The behavioral immune system is theorized to be biased towards assuming cues that could indicate pathogen presence do indicate pathogen presence. Previous work has shown that when functionally relevant threats, such as self protection from a physical threat, are made salient, ambiguous facial stimuli are interpreted as being consistent with the threat (Maner et al., 2005). It is therefore possible that when a communicable threat is salient, ambiguous facial stimuli will be more likely to be interpreted as conveying a disgust expression than if communicable threat is not salient. This study provided a test of this relationship between awareness of communicable threat and perception of ambiguous facial expressions. This investigation used a methodology developed by Maner et al. (2005) to test the influence of temporary and chronic awareness of mate search and self-protective motives on the perception of the functionally relevant emotion expression onto emotionally ambiguous target faces. In this methodology participants watch a movie prime, and are then shown photographs of targets displaying neutral facial expressions. They are asked to identify if the target in the photograph is displaying any of 5 target emotions (Disgust, Anger, Fear, Happiness, and Sadness).

## Method

#### **Participants**

One hundred and five individuals participated in the study. Data from 8 participants was excluded from analyses (6 participants guessed the hypothesis, 2 did not follow instructions). There are therefore a total of 97 participants in the data set (65 female, 35 male; mean age 20.7). The sample was ethnically diverse, and comprised 54 participants with East Asian cultural heritage, 26 with European heritage and 17 from a variety of other cultural backgrounds.

# Movie Primes

This study used the same 5 film clips described in Study 7.1. *Stimuli* 

Sixteen photographs showing the head and shoulders of each target were used. Eight were of young adults from a European background (4 female, 4 male) and 8 were of young adults from East Asian backgrounds (4 female, 4 male). An independent sample of 37 participants (23 female, 14 male; 20 East Asian, 17 European) rated the photographs to establish the level of emotion expression each individual was expressing. Ratings were done on a 9 point scale (endpoints "Not at all" and "Very much"). The photographs included in the study were chosen from a larger set of 27 photographs because they were rated as the closest to neutral expressions. Table 7.5 shows the average scores for attractiveness, threat and each of the 5 emotions across all 16 stimulus photographs.

# Table 7.5

#### **Ratings of Stimulus Photographs**

	Attractive	Threatening	Angry	Afraid	Disgusted	Нарру	Sad
Means	3.55	3.06	3.04	2.38	2.68	2.54	3.03

# Procedure

Participants were told we were interested in how people are able to perceive subtle emotional microexpressions in other people's faces, even when the target is trying to hide their emotional expression. Informed consent was obtained.

Participants were randomly assigned to 1 of the 5 movie prime conditions. Prior to viewing the movie, participants were instructed to imagine, to the best of their ability,

what the characters in the clip are feeling. They then watched the clip on a computer monitor with headphones on for the sound. After watching the movie, participants rated the extent to which they were experiencing each of 18 emotions (Anger, Annoyance, Excitement, Guilt, Pride, Anxiety, Fear, Hope, Relief, Arrogant, Frustration, Hostile, Sadness, Disgust, Gratitude, Joy, Shame, and Embarrassment) on a 7-point scale with endpoints labeled "Not At All" and "Extreme".

Upon completing the ratings, participants were told they would be viewing a series of photographs. Due to the fact that the research question involves the perception of ambiguous social stimuli, we wanted to bias the participants towards responding if they had even the slightest feeling that the face in the picture was expressing an emotion. To achieve this end, the following explanation and instruction was given:

Each person you will see was instructed to relive in their mind some very emotionally arousing event in their life, a time in their life that caused a strong emotional reaction. Once they were really feeling the emotions of that event again, we asked that they cover up their emotions by putting on a neutral facial expression. Then we took their picture. Remember though, that research has shown that emotions, in general, can still be detected because people can subconsciously notice subtle microexpressions on people's faces. People are especially accurate when they make their judgments based on their immediate gut reaction about what the emotion is, so you should try to go with your gut reactions to the people in the photos.

The participants then viewed the first photograph. It was presented on a computer screen for 1000 ms. The order in which the photographs were presented was random. Participants reported the extent to which they believed the target was (a) disgusted, (b) angry, (c) frightened and (d) happy using a 9-point scale with endpoints "Not at all" and "very much". The order in which the emotions were presented for each photograph was random. All measures were presented on the computer, and served as the primary

dependent variables. Participants then answered the question "If you had to use only one emotion to describe the emotion you saw on this individual's face which emotion would it be?" This procedure was repeated for each of the 16 target faces.

Upon completion of the emotion identification task, the participant completed a questionnaire package. The package contained 2 measures relevant to chronic concerns with pathogens: the 15-item Perceived Vulnerability to Disease scale (Duncan & Schaller, 2009; Chapter 3) and the 27 item Disgust Sensitivity Revised scale (Olatunji et al. 2007). One measure was relevant to concerns with others' intentions (Belief in a Dangerous World; Altemeyer, 1989). The remaining three measures were included to investigate the possibility that individual differences in empathy, automatic processing and affect intensity influence the effectiveness of the movie prime or chronic sensitivities to emotional cues in others (Empathy; Davis, 1980), Faith in Intuition (Epstein et al., 1996), and the Affect Intensity Measure (Larsen, 1984), respectively).

#### Results

## Did the movie primes elicit the expected emotions?

The means of the key emotions are reported in Table 7.6. The movie condition significantly influenced the extent to which people reported feeling disgust, F(4, 92) = 25.57, p < .001, anxious, F(4, 92) = 8.69, p < .001, fear, F(4, 92) = 38.27, p < .001, joy, F(4, 92) = 2.69, p = .04, and sad, F(4, 92) = 7.72, p < .001. Post hoc tests using Tukey's HSD were done on the ratings of disgust. These results show that Trainspotting elicited significantly more disgust than Outbreak and Silence of the Lambs, which elicited equal amounts of disgust. Koyaanisqatsi and Sniffles and Sneezes elicited significantly less disgust than Trainspotting, Outbreak, Silence of the Lambs and did not differ

significantly from one another. The movie primes were effective in activating the desired disgust response. These results do not, however, explicitly address the extent to which the movies elicited pathogen salient cognitions or pathogen avoidance motivations.

# Table 7.6

	Trainspotting	Outbreak	Sniffles and	Silence of	Koyaanisqatsi
			Sneezes	the Lambs	
n	19	18	20	21	19
Disgust	4.78 <sub>c</sub>	3.31 <sub>b</sub>	1.70 <sub>a</sub>	2.90 <sub>b</sub>	1.74 <sub>a</sub>
Anger	1.72 <sub>a</sub>	2.16 <sub>a</sub>	1.45 <sub>a</sub>	2.00 <sub>a</sub>	2.11 <sub>a</sub>
Anxiety	2.56 <sub>a,b</sub>	3.47 <sub>b</sub>	1.65 <sub>a</sub>	3.43 <sub>b</sub>	2.16 <sub>a</sub>
Fear	1.72 <sub>a</sub>	3.47 <sub>b</sub>	1.25 <sub>a</sub>	3.81 <sub>b</sub>	1.42 <sub>a</sub>
Joy	1.89 <sub>a</sub>	1.26 <sub>a</sub>	1.90 <sub>a</sub>	1.29 <sub>a</sub>	1.68 <sub>a</sub>
Sad	2.00 <sub>a</sub>	3.21 <sub>b</sub>	1.50 <sub>a</sub>	2.19 <sub>a</sub>	2.05 <sub>a</sub>

Average Ratings of Post Movie Emotion by Movie Condition

Note: Subscript letters indicate homogeneous subsets.

Does the tendency to interpret neutral expressions as disgust expressions vary according to temporary activation of disease vulnerability?

A composite score for each emotion was made by averaging the number of times each participant identified a facial expression as that emotion. Table 7.7 shows the mean number of expressions identified as disgust for each movie prime. Using this score, a one-way ANOVA was run using movie condition as the between subjects variable. There was no significant difference in the tendency to see disgust faces across movie condition, F(4,92) = .34, p = .85.

# Table 7.7

	Trainspotting	Outbreak	Sniffles and	Silence of	Koyaanisqatsi
			Sneezes	the Lambs	
Disgust	.23	.27	.28	.27	.23

Mean Frequency of Reporting Seeing Emotion Expression by Movie Condition

What are the independent effects of disgust and salience of pathogen transmission on the tendency to interpret neutral expressions as disgust?

To investigate potential independent and interactive effects of the cognitive and affective components of the behavioral immune processes, the non-communicable control primes (Koyannasqatsi and Silence of the Lambs) were once again combined into a single control group. Tukey tests were done to test the differences in response bias between Trainspotting, Sniffles, Outbreak and the control. No significant differences were found (all  $p_{\rm S} > .78$ )

Does our tendency to interpret neutral expressions as 'disgust' vary according to chronic activation of disease vulnerability?

To answer this question, the total disgust expression frequency was correlated with scores on the Germ Aversion and Perceived Infectability subscales of the PVD, as well as the Disgust Sensitivity scale. There were no significant relationships between these measures and tendencies to see disgust expressions in ambiguous facial expressions (*rs* .00, .02 and .03, respectively). Additional analyses were conducted to investigate the relationships between affect intensity, perspective taking and faith in intuition and tendency to see disgust expressions.

Individual differences in affect intensity and empathy did not correlate significantly with the extent to which participants reported seeing disgust expressions in faces overall (rs -.03 to .14, ps >.17). Faith in intuition was marginally related to the overall tendency to report seeing disgust expressions (r = .19, p = .06).

It is possible that relationships between chronic concerns with pathogen presence and the tendency to see disgust expressions exist but differ depending on the temporary salience of either disgust or awareness of contagious threat. They could therefore be obscured when combined across all conditions. To test this possibility, the correlations between chronic concerns with communicable threat and the tendency to identify facial expressions as disgust were calculated separately for Outbreak, Trainspotting, Sniffles and Sneezes and the combined control condition. Results indicate Germ Aversion is negatively related to identifying neutral expressions as disgust when awareness of pathogen transmission is made temporarily salient (Sniffles and Sneezes; r = -.52, p =.02). No other relationships were significant (rs -.23 to .19, ps > .23).

The relationships between the non-disease relevant individual differences and tendency to see disgust expressions were also considered separately for each movie and the combined controls. Results indicate that in both Trainspotting and Sniffles and Sneezes, Faith in Intuition was positively related to reported disgust expressions (r = .58, p = .006 and r = .43, p = .05, respectively). The only other significant relation was in the control condition, such that scores on the Fantasy subscale of the Empathy measure were positively related to reporting disgust expressions (r = .40, p = .01).

#### **Summary**

Study 7.2 was designed to test the extent to which the salience of communicable threats influenced the perception of ambiguous social stimuli – in this case, neutral facial expressions. The results indicate that disgust, the emotion associated with avoiding communicable threat, was made salient by intended movie primes. However, the movie primes did not influence the extent to which photographs of faces were perceived to be showing disgust expressions, suggesting neither experiencing disgust nor increasing the temporary salience of communicable threat directly influence this aspect of emotion perception.

Chronic concerns with communicable threat were also not related to the perception of disgust expressions overall. When considered by movie prime, one relationship was found. For those participants who watched Sniffles and Sneezes conditions, Germ Aversion was negatively related to the number of disgust expression seen in the targets.

## Discussion

The studies reported in this chapter provide the first empirical investigation of the influence of contextual variables and motivations on the recognition of emotion expressions. They directly tested the influence of disease avoidance mechanisms on the processing of facial expressions of disgust.

The results from Study 7.1 indicated that three variables – temporary salience of pathogen transmission, chronic concerns with communicable threat, and availability of cognitive resources - influenced the extent to which participants demonstrated a conservative or liberal bias in reporting disgust expressions. The results from Study 7.2
showed no effect of temporary or chronic salience of communicable influenced the extent to which ambiguous facial expressions were identified as disgust.

One implication of Study 7.1 is that the results were not simply due to priming disgust. If this were a priming effect, the participants who watched the clip that elicited the most disgust (Trainspotting) would be especially sensitive to disgust expressions and have the most liberal response bias.

The second implication comes from the fact that the difference in response bias by movie condition was only significant in the 'No Cognitive Load' condition. This suggests that when the awareness of communicable threat is increased, the behavioral immune system responds by activating cognitions (which require a certain level of cognitive resources are available) to respond with greater level of sensitivity to cues which could connote communicable threat. The finding that this process is not entirely automatic and requires cognitive resources is consistent with the behavioral immune system regulating a complex set of cognitive and affective processes.

The signal detection framework provides a clear way to approach what might be occurring when the level of environmental threat is increased. Assume that each participant has a threshold criterion for identifying an expression as disgust. This stable criterion level is likely determined, in part, by their chronic level of concerns with communicable pathogens, such that a greater concern would indicate a more liberally biased setpoint (greater likelihood of false positives and lower likelihood of misses). It is then likely that this criterion is adjusted according to information in the immediate environment relevant to communicable threat. Increasing the salience of communicable threat activates cognitive processes which calibrate the criterion level to match the perceived level of immediate threat. The relationship between chronic level of concern with communicable pathogens and the degree of bias suggests individuals who are more concerned with communicable threat are especially sensitive to external cues, and show a larger shift in the criterion to prevent missing potentially relevant cues of pathogen presence, such that they are even more likely err on the side of making more false positives.

However, this re-calibration of the criterion does not occur simply as a result of eliciting disgust. It may be the case that when disgust has already been elicited (as was the case in the Trainspotting condition), allocating attention to the emotion expressions of those around us provides less benefit (i.e. less novel or useful information) than attending to the aspects of our surroundings that may be eliciting the emotion (e.g. inappropriate food, morphologically deviant individuals, feces). This may occur because disgust is already activated, initiating the avoidance of a broad range of elicitors. However, when we are simply sensitized to a heightened possibility of communicable threat (as was the case in the Sniffles and Sneezes condition), but the behavioral immune system has not yet been activated, we may be especially attentive to cues indicating potential sources of infectious threat. In this situation, the emotional responses of other people may be a reliable source of information about the source of infectious threats, and therefore warrant attention.

A finding from Study 7.2 which warrants further discussion is the relationship between the recognition of disgust expressions and Germ Aversion. Specifically, the fact that, for those participants who watched Sniffles and Sneezes, Germ Aversion was negatively related to seeing disgust expressions. It may be the case that people who are high in Germ Aversion are chronically aware of the presence of communicable pathogens because they are unable to automatically detect social cues indicating the presence of communicable threat, requiring them to make conscious decisions about situations in which transmission is especially likely. Thus, they may be highly attuned to contexts were germs are especially likely to be present (which is what the Germ Aversion subscale is picking up on) because they are less able to rely on their own implicit interpretation and application of social cues pertaining to contagious threats. This interpretation is consistent with evidence suggesting that individuals with certain forms of obsessive compulsive disorder are less able to detect disgust expressions (Sprengelmeyer et al., 1997).

One limitation of these studies is that in neither Study 7.1 nor Study 7.2 were the participants' subjective feelings of vulnerability to infectious threats, or the salience of infectious threats, directly measured. Thus, it is not possible to directly measure the effectiveness of the movie primes designed to activate the cognitive awareness of the ease of pathogen transmission (Sniffles and Sneezes for cognition only, Outbreak for cognitive and affective). A check of this manipulation was not included in the methods in an attempt to keep the participant unaware of the objectives of the study prior to completing the dependent measures. The self-report measure of disgust was used to confirm the desired affective in that it did not elicit disgust. However, the extent to which each movie prime activated cognitive awareness of vulnerability to both contagious (in Outbreak, Trainspotting and Sniffles and Sneezes) and non-contagious (Silence of the Lambs) threat should be investigated in future studies. It may be the case that the lack of

differences by movie condition in Study7.2 is actually a product of insufficiently activated feelings of vulnerability to contagious threat, and not reflective of the behavioral immune system's lack of bias in the perception of ambiguous social cues as pathogen avoidance relevant.

A second limitation is the relatively small sample sizes in both Study 7.1 and Study 7.2. Assuming a moderate effect size and power of .8, 50 participants per condition would be required to achieve enough power to be confident in a comparison between just two movie conditions. However, the overall sample sizes of 74 and 97 (separated into 5 movie conditions) are well below this guideline. These studies are therefore underpowered, and consequently are subject to and increased possibility of type II error. The results reported here should be considered in light of this limitation. However, in spite of this, they provide an important initial investigation of attention to functionally relevant social cues, and suggest avenues for future work.

#### *Conclusions*

The studies in this chapter tested a specific implication of a proposed prepared association between the emotion of disgust and cues connoting possible pathogen presence. In Chapter 2 it was established that the recognition of facial expressions of disgust should increase when communicable threat is either chronically or temporarily salient to be consistent with this hypothesis. Results from Study 7.1 suggest that when the awareness of communicable threat is temporarily increased, people become more biased towards interpreting other emotion expressions as disgust, and that levels of chronic concern with communicable threat influence response bias in the expected direction. The results of Study 7.2 did not meet the criteria, with one exception – when

cognitive awareness of communicable threat was made salient for individuals who are chronically concerned with pathogen transmission. Thus, these studies indicate that temporary and chronic salience of communicable threats, in addition to the availability of cognitive resources, influence the way in which actual facial expressions of emotion are interpreted. However, there is little influence of concerns with communicable threat on the interpretation of neutral expressions.

# **CHAPTER 8: GENERAL DISCUSSION**

The goal of this research was to further the current understanding of the way in which evolved pathogen avoidance motivations influence contemporary social cognitive processes. This goal has been achieved using methodologies which tested different facets of social perception. Each study provided an answer to a different, yet related, conceptual question relevant to disease avoidance mechanisms and their implications for the way we perceive our social environment. The findings illustrate individual differences in perceived vulnerability to disease, the effects of pathogen avoidance motivations on the implicit associations of facially disfigured, obese, emaciated and geriatric individuals. Furthermore, they are the first investigations of the way in which attention to facial expressions of a specific emotion may be influenced by disease related stimuli. This chapter provides a summary of the results from each chapter, addresses the implications of these results for the behavioral immune system, and concludes with future directions which could increase the understanding of both the operation of the behavioral immune system and the influence of pathogen avoidance motivations on psychological and behavioral processes.

# **Summary of Findings**

The first empirical chapter in the thesis, Chapter 3, reported the psychometric evaluation of the 15-item Perceived Vulnerability to Disease scale. Many phenomena in the realm of social cognition and behavior are influenced by the extent to which individuals perceive themselves to be vulnerable to infectious diseases; however, the investigation of the role played by chronic concerns with communicable threat was hindered by the lack of a specific, psychometrically validated measure. The results reveal two conceptually distinct factors which are reliably measured and reported as separate subscales. The 7-item Perceived Infectability subscale assesses beliefs about one's own susceptibility to infectious diseases. This cognitively-oriented subscale is related to measures of health anxiety and predicts negative implicit associations with individuals who may have decreased immune function. The 8-item Germ Aversion subscale assesses emotional discomfort in contexts that connote an especially high potential for pathogen transmission. It is related to measures of emotional reactivity and disgust, and strongly predicts negative implicit associations with individuals displaying morphological anomalies.

The findings from Chapter 4 revealed that unpleasant responses to facial disfigurement are automatic, and occur despite objective knowledge that the disfigured individual poses no infectious threat (see Table 8.1). Additionally, this study provided evidence that the cognitions activated by facial disfigurement are not specifically associated with contagion; rather, they appear to relate to semantic concepts invoking general unpleasantness. The extent to which disfigurement, relative to infectious disease, is more strongly associated with unpleasant concepts is positively related to scores on the Germ Aversion subscale of the PVD. The manipulation of temporary salience did not influence these results.

The studies in Chapter 5 investigated the relationship between deviation from a prototypical weight and the behavioral immune processes (see Table 8.1). The first study tested the possibility that extreme emaciation acts as a cue that triggers pathogen relevant cognitions. Emaciation is strongly implicitly associated with both disease specific and generally unpleasant concepts. The second and third studies in this chapter extended this

result by testing the hypothesis that emaciation and obesity act as automatic, heuristic cues of pathogen presence. This was achieved by assessing the extent to which obese and emaciated targets were implicitly associated with disease and unpleasant concepts relative to an objectively contagious target. The results of the strongest test confirmed this hypothesis, indicating that both weight extremes act as automatic cues of pathogen presence. There was no influence of the manipulation of pathogen salience on any of these studies. Comparisons of the relative strength of each morphological deviation as cues indicated that emaciation is a stronger cue of pathogen presence than obesity.

The investigation reported in Chapter 6 provides the first evidence that physical features characteristic of advanced age are implicitly associated with both disease specific and generally unpleasant concepts (see Table 8.1). Further, it appears that culture influences the types of negative cognitions that are activated by these features. Specifically, it was found that for all participants, elderly faces were more strongly associated with unpleasant and disease concepts than young faces. However, cultural differences were found for these associations, such that participants of East Asian heritage showed stronger associations between elderly faces and aversive concepts relative to participants of European heritage. Additionally, among the European heritage participants, implicit aversion to the elderly was especially likely to occur for those individuals who reported chronic feelings of vulnerability to communicable threat (had high scores on the Perceived Infectability subscale of the PVD) when the salience of communicable threat was temporarily increased.

# Table 8.1

Study: Physical	Evidence of		Disease	Unpleasant
Deviation	Automaticity	Manipulation	IAT score	IAT score
4.0: Facial	Yes	No	.01	.12**
Disfigurement				
5.1: Emaciation	N/A	No	.35**	.40**
5.2a: Obese	No	No	17*	23**
5.2a: Emaciated	Yes	No	.32**	.08
5.2b: Obese	Yes	No	.26**	.24**
5.2b: Emaciated	Yes	No	.37**	.54**
6.0: Old Age	N/A	Yes	.43*	.46**

# Summary of IAT results from Chapters 4, 5 and 6.

*Note.* \* indicates IAT score differs from zero at p < .05; \*\* indicates IAT score differs from zero at p < .01. Positive IAT scores indicate the physically deviant target was more strongly associated with the relevant semantic concept.

Chapter 7 provides a preliminary understanding of the processes we use to learn the cues associated with pathogen presence and the role observational social learning plays in this process. This is the first empirical investigation of the extent to which both chronic and temporary salience of pathogen presence and communicable threat influence attention to and processing of facial expressions of disgust. Results of the first study indicated that temporarily increasing the awareness of communicable threat (without intentionally eliciting disgust) increases the tendency to misidentify facial expressions of other emotions as disgust, but does not affect sensitivity to disgust expressions. A positive relationship was found between Germ Aversion subscale scores and this liberal response bias. The second study in this chapter investigated the extent to which this liberal bias would extend to identifying disgust expressions in affectively neutral facial expressions. Chronic concerns with communicable threat were negatively related to the perception of neutral faces as expressing disgust when communicable threat was temporarily salient.

# **Implications for the Behavioral Immune System**

Overall, this body of work provides a more nuanced picture of the ways in which ancient adaptive threats have shaped contemporary social cognition. In the introduction of the thesis, four specific areas of interest regarding the behavioral immune system were described, as were criteria that could be used to judge the extent to which the results of the studies described here could be considered supporting evidence. These results are presented below.

# **Potential Triggering Cues**

Two types of deviation from the physical prototype were selected as potential cues that could activate the behavioral immune system. These were emaciation and facial characteristics of advanced age. No prior work had investigated this possibility. Two criteria were established for emaciation and elderly features to qualify as cues connoting pathogen presence. First, the cue had to activate semantic concepts connoting pathogen presence. Specific to the IAT methodology used to test the cues, the deviations had to be associated with "disease" concepts (relative to non-deviation bearing individuals). The second criteria required aversive responses to the potential triggering cues be amplified

when perceivers felt especially vulnerable to the potential spread of infectious disease (either chronically or temporarily).

Both cues met the first criteria handily. Evidence for the second criteria was less straightforward. Emaciation did not meet this criteria, and was, in fact, less likely to be associated with disease concepts for individuals who had chronic concerns with pathogen transmission. There was a complex relationship for elderly features. Only European participants who felt chronically vulnerable to infectious threat demonstrated increased associations between elderly targets and disease concepts when the salience of communicable threat was made temporarily salient. Taken together, these cues do seem to connote pathogen presence, but their relationships with pathogen salience require further research, as they are less straightforward than initially hypothesized.

## Cognitive Processes: Automaticity

A second research question focused on the extent to which the activation of the behavioral immune system in response to cues connoting pathogen presence is automatic. The relative strength and influence of objective information versus the heuristic information contained in triggering cues on the activation of the behavioral immune system, and the extent to which the automatic response to the heuristic cues connoting potential contagious threat could be moderated was therefore tested. Additionally, the use of cognitive load in Study 7.1 also allowed a further test of automaticity. The criteria established for automatic processing required responses to the heuristic cues (1) be unintentional, (2) be autonomous or capable of running to completion without conscious intervention, (3) be involuntary or not initiated by the conscious choice or will of the agent, and (4) be effortless or not consumptive of limited processing capacity.

Automaticity was assessed in the IAT studies which pitted the heuristic information contained in facial disfigurement, emaciation and obesity against an objectively contagious condition. With this methodology automaticity was considered to have occurred if the physically deviant target, not the contagious target was more strongly implicitly associated with disease and aversive concepts. This is because the correct association is between the contagious individual and disease and unpleasant concepts (although this latter association makes the assumption that an actual communicable threat is more aversive than a non-prototypical individual). Each of the three deviant targets were more likely to be associated with unpleasant concepts than contagious targets. The targets displaying weight deviations were also more likely to be associated with disease than the contagious targets. These results provide strong support that the activation of disease cognitions in response to triggering cues happens automatically.

The emotion recognition/misidentification study (Study 7.1), provided a preliminary test of the extent to which cognitive resources required for the behavioral immune system to react to temporary changes in the salience of communicable threats. Participants who did not have a cognitive load showed greater response bias to when pathogen transmission was made temporarily salient. These findings indicate that activation of the behavioral immune system occurs automatically in response to cues connoting potential pathogen presence, but suggests adjustments to the sensitivity and response of the system do not.

#### Connotative Specificity of the Cognitive Response

Another domain which was addressed in this thesis is the specificity of the disease concepts that are activated by cues which connote communicable threat. It was not

previously known if the cognitions activated by triggering cues were disease-specific or more generally unpleasant. Either outcome was considered plausible. For cognitions to be considered disease-specific, the activation of disease specific concepts, without the activation of more generally unpleasant concepts, was required. Alternatively, the activation of generally unpleasant concepts (with or without the activation of diseasespecific cognitions, as disease is necessarily a negative concept) indicated the behavioral immune system relies on a more general cognitive response.

The results from the IAT studies (see Table 8.1) were used to address this issue. In five of the seven tests, the cues connoting potential pathogen presence were implicitly associated with both disease specific and generally unpleasant cognitions. Thus, these results suggest that the cognitions activated in response to triggering cues are not specific to disease (or contagious concepts) but are more broadly unpleasant.

### The Role of Learning and Development

The final issue raised in the introduction was the possibility that there may exist adaptations that promote especially efficient social learning of certain kinds of parasiteconnoting cues. This was done by investigating the extent to which we are attuned to cues in our social environment indicative of communicable threat. The criteria established was that emotion expressions of disgust were more readily identified (either accurately or falsely) when pathogens are chronically and/or temporarily salient.

The results of Study 7.1 show that response bias is consistent with these criteria, such that participants who reported greater chronic concerns with communicable threats were more likely to show a liberal bias (interpreting other emotion expressions as disgust). Additionally, when pathogen transmission was salient, participants were more

likely to show a liberal bias. Sensitivity to disgust expressions was also positively related to chronic concerns with pathogen transmission and disgust sensitivity, but only when the ease of pathogen transmission was made salient. In Study 7.2, results indicate the interpretation of neutral expressions as disgust was negatively related to chronic concerns with pathogen transmission, and did not vary as a result of temporary salience of communicable threat. Thus, although the results of the first study are promising, more research should be done before a conclusion is reached on the extent to which attention to facial expressions of disgust are influenced by pathogen avoidance motivations.

# Limitations

The studies reported in Chapters 4, 5, and 6 all used the Implicit Association Task as the dependent measure. This well known reaction time task allows for the measurement of associations between targets and semantic concepts that may otherwise be influenced by socially desirable response patterns, which made it a good choice for this type of research. However, the IAT methodology does not come without certain shortcomings. First, it is, by design, a relative test. The implication for these studies is that it can only provide information about the extent to which one target, relative to another target, is associated with specific semantic concepts. This result, while useful, if the comparison target is well chosen, does not tell us anything about absolute associations between any one target and any one semantic concept. This leads to a second potential issue with this task, specifically, the subjectivity of the interpretation of the results. Throughout the thesis I have interpreted the positive IAT scores as indications of associations between deviant targets and disease. However, these same numbers could, just as correctly, be interpreted as indicating a strong association between contagious targets and health. Finally, it has been proposed that the associations this task measures are actually cultural-level associations that are present in society, and do not actually represent what individual participants actually think or feel (Karpinski and Hilton, 2001; Olson and Fazio, 2004; Arkes and Tetlock, 2004). While I cannot rule this out as a possibility, the fact that we found differences in some of these tests in response to individual difference in chronic concerns with communicable threat and/or the manipulation of the salience of communicable threat suggests at least some portion of the associations measured were influenced by the individual's concerns with infectious disease. To overcome these limitations, future research should seek to conceptually replicate the studies presented here using different methodologies which do not suffer these same weaknesses.

A second issue which should be raised is the potential for both Type I and Type II error to have influenced the results reported here. Type I error, a false rejection of the null hypothesis, could potentially have occurred. Although the standard alpha level (.05) was used in each analysis, there were more than 20 individual analyses run, meaning any single significant result may be a false positive. Therefore, although each study and result should be considered on its own methodological strengths and weaknesses, the reader should be most confident in the results which occur consistently across studies, such as the lack of specificity in the cognitive responses to triggering cues.

It is also possible that Type II errors, falsely accepting the null hypothesis, may have also been reported here, given the lack of power in the studies in Chapter 7 which result from small sample sizes. Unfortunately, the small sample sizes are the result of pragmatic time concerns that are somewhat unavoidable in research being conducted with a deadline. This possibility need not discount the value of the results. However, readers would be wise to treat the results of these studies as promising preliminary studies that warrant follow up.

## **Domain Specificity of Findings**

The results reviewed above are generally consistent with predictions derived from an understanding of the domain specific behavioral immune system. However, it is worth considering whether they might also be consistent with a domain general process. In particular, the negativity bias suggests that we attend to negative aspects of our environment more than positive ones (for thorough reviews, see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001; Vaish, Grossmann, & Woodward, 2007).

It has been suggested that there is adaptive value in reacting to the negative cues in our environment more strongly and persistently than to the comparably positive cues (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). This is because cues that elicit negative emotions or cognitions are likely to signal a threat that requires an appropriate response (avoid, aggress) to avoid incurring a negative consequence, whereas cues with positive associations signal that the current situation is one that could be approached to gain benefits. In the domain of person perception, it has been found that there exists a positive-negative asymmetry, such that when making impressions about individuals, negative information receives more cognitive processing, and has a greater influence on the final impression of an individual (Anderson, 1965; Peeters & Czapinski, 1990). Specific to the perception of and reaction to morphological deviance and communicable threat, it is possible to use the bad is stronger than good principle to develop specific hypotheses about how a general negativity bias would influence our responses. Consider the IAT studies, which test the extent to which two target individuals are implicitly associated with positive and negative (either disease specific or generally aversive concepts). The types of physical deviance represented by these targets are causes of stigma and prejudice, and therefore have a negative social valence attached to them. This suggests we should attend to these cues, and devote our cognitive processes to this target. Additionally, in the semantic concepts which participants were also attending, one always had a negative valence (disease, contagious, unpleasant) relative to its partner concept (healthy, pleasant). Since both the morphologically deviant target and the negative concept would capture attention, and receive more processing, we would expect to see the implicit associations that were found in the studies, such that morphologically deviant individuals were more strongly associated with aversive concepts.

To this point, it does seem that a domain general processing bias could account for the findings reported here. However, on closer inspection we see that the "bad is stronger than good" approach does not, and cannot, account for several important aspects of these results. At a broad level, it cannot provide an account for the reason morphological deviation activates aversive responses in individuals that result in stigma. Specific to the studies described here, in Studies 4, 5.2 and 5.3, the morphologically prototypical target had explicit negative health information associated with them, which, according to this approach, would also have attracted attentional resources. Thus, if adaptive responses to communicable threat were not involved, and all that was occurring was simply negative information overpowering positive information, we would expect to see no difference in implicit associations in these studies, as each target has both negative and positive information associated with them. This was not the case. This is not to say that the general negativity bias which underlies "bad is stronger than good" does not contribute to the extent that people attend to stigmatized individuals. The results of the test of connotative specificity suggest that the behavioral immune system is not limited to domain specific cognitive responses, and it is likely that the behavioral immune system is connected to more general response systems. Therefore, the "bad is stronger than good" approach is by no means inconsistent with the behavioral immune system – it simply represents a more general attentional bias to a broader range of sources of information than the domain specific cues that connote pathogen presence.

Further, the behavioral immune system provides a specific functional response (behavioral avoidance) to a specific adaptive problem (communicable pathogens and parasites) that could not have been solved as effectively by domain general approach. For example, other emotions with negative valences (e.g., fear, anger) motivate different behavioral responses (e.g. flight, fight) which either increase the cost of a false negative identification of a pathogen connoting cue (because it takes more energy to run away than to simply withdraw) or increases the risk of exposure to the threat (fighting requires close contact and the possible exchange of contaminated bodily fluids). Thus, although the psychological mechanisms that make up the behavioral immune system are especially attuned to detect and respond to communicable threat, it is unlikely that the system is unaffected by more domain general processes.

#### **Future Directions**

Thus far, the majority research investigating the effects of pathogen avoidance motivations and processes has addressed the early stages of activation of the behavioral immune system. There is currently little known about the more complex outcomes of the behavioral immune system. Specifically, the influence of disease avoidance processes on conscious decision making and, ultimately, future behaviors suffer from a lack of empirical attention. Future research should utilize our knowledge of disease avoidance processes in order to investigate ways that would help us decrease the stigmatization, stereotyping, and prejudice that occur as a result of these processes. Three specific related, but distinct, lines of research that could extend the current knowledge of the way the behavioral immune system influences social cognition and interaction are explained below.

#### Development and Calibration of a Healthy Prototype

One line of inquiry could answer the following question: What effect does disease salience (both chronic and temporarily increased) have on the range of people any one individual considers healthy, and therefore, normal? We know from previous research (reported both here and in the existing literature) that targets who grossly deviate from a perceiver's idea of normal trigger the behavioral immune system. We also know that deviations are especially likely to activate the system when disease is either temporarily or chronically salient. This suggests that the system is indeed flexible and responsive to relevant information in the physical or social environment. However, we do not yet fully understand three important steps in this process. The first is how we define what is 'normal'. The second is how the salience of communicable disease influences our definition of 'normal'. The third is how the boundaries of what is considered 'normal' are adjusted in response to cues of communicable threat.

The first step is the establishment of a healthy prototype. There is not a lot of information in the literature that speaks to how this might happen, but there are two possibilities: the existence of an innate prototype that was acquired in our evolutionary history, or the developmental acquisition of a prototype from available information. It is

likely that from a young age we use those around us as exemplars of physical information, just as we use them as sources of other information. The added advantage of learned over innate prototypes is that the prototype would be attuned to relevant cultural norms (e.g. body modification, hygiene), just as the physiological immune system calibrates itself to the surrounding environment through exposure to local pathgens, thereby decreasing the number of false alarms and consequent social costs incurred. The cultural differences in responses to elderly people we found suggest that humans find deviant characteristics are more aversive in individuals from ethnic outgroups, rather than from within our own ethnic ingroup. Based on these findings, future research should focus on elucidating the extent to which healthy ideals are culture specific and the processes by which they develop.

Just as it is likely that we learn a prototype from observing the physical characteristics of those around us, it is also likely that in doing so, we also learn what the 'normative' amount of deviation from this prototype might be. Therefore, through our social experience we set what is essentially a confidence interval around the prototype, such that deviations which fall within the limits, or criterion levels, do not activate the behavioural immune system. If this is the case, we should expect that children who grow up with family and friends with heterogeneous physical characteristics should have a more inclusive category of 'normal' than individuals whose early social environment was less diverse. It is also likely that the width of the confidence interval around the prototype is systematically influenced by pathogen load in the immediate environment. In other words, the extent to which infectious pathogens and parasites are prevalent should influence the range of cues which trigger the behavioural immune system. We know that

pathogen load varies by geographic location (Guernier, Hochberg, & Guegan, 2004), and that pathogen load is related to cultural levels of collectivism and certain relevant personality variables (Fincher, Thornhill, Murray, & Schaller, 2008; Schaller & Murray, 2008). We should also be able to predict, based on the level of contagious threat in any specific region, how much deviation from the prototypical norm the behavioural immune system will be calibrated to tolerate. It is likely the case that in geographic locations where pathogen load (and therefore communicable threat) is high, the system will respond to even small deviations from the prototype as though they connote pathogen presence. Whereas in regions with lower pathogen loads, those same slight deviations may fall within the normal range. Although neither the individual or regional hypotheses have been tested directly, there is evidence from cross cultural studies consistent with the environmental pathogen load effect on restrictions in variability. For example, in countries with higher pathogen loads, greater importance is placed on attractiveness, which is positively related to symmetry, and negatively related to deviance of features from cultural average (Gangestad & Buss, 1993, Gangestad, Hasleton & Buss, 2006, Zebrowitz & Rhodes, 2004).

Finally, we need to consider what processes cause alterations in the threshold of what we consider "normal" (e.g., how does this threshold change compared to the prototype?). There are many possible means by which this could be accomplished, either individually or in combination. It could be the case that in response to a cue indicating pathogen threat, attention that would have been allocated elsewhere is now dedicated to the detection of deviations. This would result in an increased likelihood of noticing (potentially deviant) people that you would not have noticed in low threat situations.

Alternatively, the degree to which we compare an observed individual and the prototype may become more detailed, such that a person who would have been considered 'normal overall' is now found to have specific features which deviate too much from the prototype. Yet another possibility is that communicable threat increases the level of reactivity to cues. In this case, we would expect that deviations from the norm which would have been considered unattractive in a low threat situation activate disgust when communicable threat is high. To date, none of these hypotheses has been tested.

Understanding the processes that moderate the flexibility or inclusiveness of an individual's operational definition of 'normal' will contribute to the theoretical understanding of psychological disease avoidance mechanisms. However, the greatest value of this work is the potential it has to prevent many of the negative social consequences which result from activation of the behavioural immune system. If we understand the mechanisms by which the acceptable level of variation from a norm is increased, and how to manipulate these processes, there is the possibility that these same mechanisms can be used to reduce ostracism and discrimination. Increasing the acceptable amount of variability around the norm would decrease the number of people who fall outside the 'normal' range for people by relaxing the 'normal' criterion levels, thereby reducing the number of people who suffer the negative social consequences as a result of behavioural immune system activation.

# From Implicit Associations to Behavioral Avoidance

A second line of research could address the influence of disease avoidance mechanisms on decision making and behaviour by addressing the conceptual question: How do disease avoidance mechanisms influence self-selection into relationships and situations? When confronted with the opportunity to approach or avoid an individual or situation, we make decisions (either consciously or unconsciously) which have consequences for our behavior. Among the plethora of factors that influence these decisions, including social identity threat (Crocker et al., 1998; Major & Obrien, 2005) and stereotype threat (Steele et al., 2002), the effects of communicable threat are not well understood.

Studies that have investigated the effects of behavioral immune system activation and cues which connote communicable threat reveal that people are less likely to sit in close proximity to people with facial birthmarks (Houston & Bull, 1994) and more likely to have physiological threat responses when involved in social interactions with birthmark-bearing individuals (Blascovich, Mendes, Hunter, Lickel & Kowai-Bell, 2001). Obese people are more likely to report institutional and day-to-day interpersonal discrimination than are normal weight individuals (Carr & Friedman, 2005) and elderly people suffer from abuse, neglect and social isolation (Choi & Mayer, 2000; Lachs, Williams, O'Brien, Hurst & Horowitz, 1997; O'Keefe et al., 2007; Bugental & Hehman, 2007; Hagestad & Uhlenberg, 2005). While this evidence is consistent with the expected effects of disease avoidance motivations, there is little work on the extent to which the perceiver's concerns with communicable threats influence these outcomes. As the findings reported in this thesis suggest, these relationships are not as straightforward as initially thought. Therefore, individual differences in perceivers concerns with pathogen avoidance need to be better understood, as the extent that an individual is either hypervigilant to cues associated with disease threat, feels especially vulnerable to communicable threat, or both, may influence their willingness to enter situations or engage with individuals who could embody this threat.

Beyond specific interactions with morphologically anomalous individuals, the effect of concerns with communicable threat has implications for a wide range of important decisions individuals consciously make over the course of their lives. Consider the choice of career path. An individual's attitudes concerning the environment they will be working in and the people they will be working with are known to be important contributing factors in this decision (Weiss, 2002). As work-related attitudes are unlikely to be immune to the automatic processes of the behavioral immune system, disease avoidance motivations may well influence the career paths people consider entering. As an example, imagine two individuals, each equally interested in a career than involves helping and nurturing others, who differ only in the extent to which they are chronically concerned with the threat of communicable pathogens, such that one is relatively unconcerned, while the other is highly aware of potential sources of infection. This logic would predict, unsurprisingly, that the unconcerned individual is more likely to pursue a career in medicine, while the other may be more likely to choose a work environment where communicable threat is not an explicit part of the job description – perhaps in education. From a social psychological perspective, more interesting hypotheses can be made. Now imagine that our educator has the option of pursuing a career in a mainstream classroom or working with students with physical or mental disabilities. Although the objective threat of contagion is no higher in either situation, the effects of the behavioral immune response would uniquely predict that subjectively vulnerable individuals would be less likely than subjectively invulnerable individuals to choose to interact with individuals who deviate from the physical (and behavioral) norm.

The opposite of self-selection is ostracism, the act of ignoring or rejecting others. At this time, there is a paucity of research that specifically addresses the influence of disease avoidance mechanisms on ostracism. As we know that the behavioral immune system evolved to prevent an individual from contracting disease by eliciting behavioral avoidance of individuals who display cues associated with disease, we can make two predictions. The first is that individuals who display cues associated with disease are especially likely to be ostracized. The second is that those individuals who display cues connoting pathogen presence are especially likely to be avoided if disease is also salient. Findings from geriatric populations are consistent with these hypotheses, as it is elderly individuals with physical illness are at the highest risk of neglect (Lachs, Williams, O'Brien, Hurst & Horowtiz, 1997, Choi & Meyer, 2001); however, research should work to expand the range of populations on which this hypothesis is tested. Once again, focusing on how pathogen avoidance motivations affect the perceiver could inform our understanding of the factors which influence responses to deviant individuals. Specifically, I predict that individuals who are concerned with communicable threats will be especially likely to ostracize individuals who have physical characteristics which act as triggers for the behavioral immune system. The finding that people who are higher in PVD are less likely to have friends or family members with disabilities (Park et al., 2003) is a good indication that chronic concerns with pathogen threat do influence the extent to which one ostracises others, however more research is needed on this topic.

Finally, it may also be the case that the effects of pathogen avoidance motivations on social interactions are not applicable to every context, but may indeed be more pronounced in situations where the potential for the transmission of infectious agents is especially great. If so, individuals who deviate from an accepted norm will be systematically excluded from specific opportunities based solely on the fact that they display morphological (or potentially behavioral) anomalies. For example, as a result of the many mechanisms which contribute to the stigmatization and ostracism of deviant others, an individual with burn scars may well be considered distasteful when applying for a job as a mechanic, and be less likely to obtain that position as a result. However, if the same individual applied for a position in the hospitality or food service industries (where there is a strong explicit emphasis on hygiene because of the high potential for communicable disease transmission), they may be subject to an even higher level of aversion. No direct tests of this potential domain specific implication have yet been undertaken.

Taken together, disease avoidance mechanisms likely have important, but as of yet, poorly understood ramifications for behavioral and decision making as they relate to specific situations, interpersonal choices or hiring decisions.

#### **Reduction of Negative Consequences of Pathogen Avoidance Processes**

Another line of research that could take the theoretical understanding of the behavioral immune system outside the lab and into the real world involves applications aimed at preventing or mitigating the negative social consequences of the behavioral immune system. Using our current understanding of the cues that trigger affective, cognitive and behavioral anti parasite responses, programs could be designed to reduce the stigma, stereotyping and prejudice from which morphologically deviant individuals frequently suffer. Educating people about the behavioral immune system may lead to small reductions in domains in which pathogen avoidance motivations are one of many, complex contributors, (e.g., xenophobia). However, it is likely that the use of programs which educate people about the social consequences regarding pathogen avoidance motivations will be especially effective in decreasing stigmatization and prejudice (a) by people who are chronically concerned with disease, (b) in situations when communicable threat is salient, and (c) for individuals or groups who trigger disease avoidance motivations.

Individuals who are chronically concerned with disease (as measured by the PVD) are more likely to have negative associations with facially disfigured individuals (Chapter 4), less likely to have friends with disabilities (Park et al., 2003), and more likely to have negative attitudes towards subjectively foreign ethnic outgroups (but not subjectively familiar ones, Faulkner et al., 2003). The relationship between subjective vulnerability and negative associations with non-normative groups or individuals suggests one means of decreasing the negative consequences of behavioral immune system activation. To the extent that an individual's chronic feelings of vulnerability to communicable threat could be reduced, the perception of deviant others as posing a threat would decrease, limiting both the extent to which they activate the behavioral immune system, and the aversive associations that result. One possible means of achieving this goal comes from the proposed relationship between disgust, disease avoidance motivations, and certain specific phobias (Matchett & Davey, 1991; Davey, 1991; Woody & Teachman, 2000). One form of treatment for specific phobias is exposure therapy, a form of cognitive behavioral therapy in which repeated exposure to feared stimuli reduces the aversive associations through habituation. The effectiveness of this therapy for phobias

recommends it as a possible avenue to decreasing chronic levels of perceived vulnerability to disease, which could reduce stigmatism and prejudice.

To date we have manipulated the prominence of pathogens in order to increase the salience of communicable threat, and in certain studies have succeeded in increasing aversive reactions to deviant individuals (Park et al., 2003; Park, Schaller & Crandall, 2007), including elderly people (Chapter 6). These findings suggest that negative reactions to deviant individuals could be reduced by decreasing the salience of communicable threat. However, it is not always possible to decrease the salience of communicable threat in an environment, nor is it necessarily advisable to do so. In hospitals, for example, the awareness of the threat of infectious disease can serve the crucial purpose of motivating workers to perform the proper hygiene behaviours necessary to keep transmission low (Erasmus, Brouwer, van Beeck, Oenema, Daha, Richardus, Vos, Brug, 2009; Kretzer & Larson, 1998). Another solution may be possible, in the form of raising the awareness of the effects of pathogen avoidance processes on person perception among individuals who are frequently in settings with high salience of infectious threats (physicians, nurses, social workers, volunteers). Simply raising the awareness of unconscious processes that activate negative responses towards individuals or groups who deviate from a perceived norm (with whom contact is especially likely in health care settings) may reduce, or at the very least provide an understanding of, aversion felt for specific individuals or clinical situations (Holmes, Perron, O'Bryne, 2006). It would be beneficial, both theoretically and socially, to investigate ways in which our knowledge of pathogen avoidance processes could be used to reduce the negative responses deviations from a healthy norm elicit.

One final application of our understanding of the effects of pathogen avoidance motivations on social cognition would be to inform individuals who have morphological deviations that act as triggers of the behavioral immune system of its effects. Facial deviation, among other types of deviation can have severe negative impacts on quality of life, mostly due to the difficulties disfigurement causes in social interactions (Macgregor, 1990; Rumsey, Bull, Gahagan, 1982). These social difficulties are likely due to a combination of the target's awareness of discomfort that their disfigurement activates in perceivers (Langer, Fiske, Taylor, and Chanowitz, 1976) and the uncertainty of both the perceiver and the target of the most appropriate reaction to the disfigurement. This can provoke defensive reactions of disfigured individuals to people who stare, avoid or ignore them (Bull & Rumsey, 1988). Interventions addressing these two factors may increase the smoothness of social interactions. This could be accomplished by providing individuals who have non-normal physical or behavioral characteristics with information about the behavioral immune system's triggers, processes and the possible behavioral outcomes. The goal here is not to condone discrimination or prejudice, but to help targets of ostracism or social awkwardness understand why people might, at least initially, react differently to them than they do to individuals who do not display non-normal characteristics. Although this may not decrease the extent to which they elicit negative reactions in perceivers, it may facilitate social interactions by providing a comprehensive explanation for reactions. This has implications for preventing the potentially severe social and health consequences associated with disfigurement, which include depression, self medication (e.g. alcoholism) or avoidance of social contact (McGouther, 1997). It may also be helpful to provide similar information to people likely to be in contact with

individuals who deviate from the norm, to help them understand why they may have aversive initial reactions to these individuals. It is likely this type of program would be especially helpful for social or health care workers, and even for children who are in a classroom with special needs students.

There are many varied and likely complex ways in which pathogen avoidance motivations to contribute to stigmatism, ostracism and prejudice. However, there are also many opportunities to apply our current understanding of the behavioral immune system to decrease, or even prevent, these negative social consequences. In addition to the individual and societal level benefits that could result from programs based on our understanding of pathogen avoidance processes, the design and implementation of programs such as the ones described here would contribute to our theoretical understanding of the mechanisms themselves. The effectiveness of these programs would provide invaluable information about the malleability of physical prototypes and chronic concerns with communicable threat. Investigations focused on decision-making processes (such as deciding between two activities that may superficially seem unrelated to concerns with communicable threat) in real world situations have the potential to extend our understanding of the effect of the behavioural immune system on conscious cognitive processes. This information could then be used to inform possible solutions to personnel shortages in areas such as geriatric medicine and social work. Even something as simple as providing people with information to help them understand why they may initially feel uncomfortable around a morphologically anomalous individual has the potential to decrease ostracism and inform our understanding of the extent to which automatic aversive affective or cognitive activation can be modified with conscious

effort. Indeed, there is a broad range of useful practical and theoretical outcomes which have yet to be explored.

#### Conclusion

There are myriad factors that influence social cognition, many of which have been the focus of vast amounts of research. One important influence that has, until relatively recently, been overlooked is the effect of psychological processes which evolved to solve the adaptive problem of posed by infectious disease. The behavioural immune system is a suite of attentional, affective, cognitive, and behavioural responses which function to decrease the probability of contracting pathogens by activating aversive responses to indirect cues that heuristically connote the presence of infectious agents. These cues, however, are at best probabilistically related to the actual presence of pathogens, because the majority of pathogens are too small to be detected. Using the principles of error management theory, which suggest threat avoidance systems should be biased towards making the least costly errors, specific hypotheses were developed to test the influence of pathogen avoidance motivations affect specific aspects of person perception.

The research reported in this thesis was designed to increase our understanding of three broad topics related to pathogen avoidance motivations. The first focused on individual variation in concerns with pathogens. The behavioral immune system is theorized to be functionally flexible. However, investigations of the effects of chronic concerns with communicable threat suffered from the lack of a psychometrically valid measure of perceived susceptibility to infectious disease. To address this problem, a new self report instrument with which to measure individual differences in chronic concerns with communicable threat was developed. The second topic addressed pertains to the types of physical features that act as triggers to activate the behavioural immune system. Beyond finding that facial disfigurement, emaciation and facial features associated with old age are cues that connote pathogen presence, the studies reported here show that facial disfigurement and extreme weight deviations automatically activate disease cognitions, and that emaciation is a stronger cue of pathogen presence than obesity. The studies also investigated the effects of chronic and temporarily salient awareness of communicable threat on our responses to these triggers. Together, this represents a vast increase in the understanding of the types of deviations from physical norms that elicit aversive reactions that are due, in part, to pathogen avoidance motivations.

The third topic addressed the extent to which pathogen avoidance mechanisms may play a role in the way we learn cues which connote pathogen presence. The studies here provide the first evidence that there is a bias in responses to social cues connoting pathogen presence, and that this bias is functionally flexible.

In conclusion, this thesis provides some evidence which is consistent with the operation of a psychological system which functions to prevent the transmission of infectious threats. The results reported here represent both a substantial contribution to our understanding of the subtle effects of these processes on early cognitive process and a starting point for the application of our existing knowledge to solving real world problems that have great potential for providing social and theoretical rewards.

#### REFERENCES

- Ackerman, J. M., Becker, D. V., Mortensen, C. R., Sasaki, T., Neuberg, S. L., & Kenrick,D. T. (in press). A pox on the mind: Disjunction of attention and memory in the processing of physical disfigurement. *Journal of Experimental Social Psychology*.
- Aiken, L. S., & West, S. G. (1991). Multiple regression: Testing and interpreting interactions. Newbury Park, CA: Sage.
- Allison, D. B., Basile, V. C., & Yuker, H. E. (1991). The measurement of attitudes toward and beliefs about obese persons. *International Journal of Eating Disorders*, 5, 599–607.
- Altemeyer, B. (1988). *Enemies of freedom: Understanding right-wing* authoritarianism. San Francisco: Jossey-Bass.
- Anderson, N. H. (1965). Averaging versus adding as a stimulus-combination rule in impression formation. *Journal of Personality and Social Psychology, 2,* 1-9.
- Araujo, A., & Ferreira, L. F. (2000). Paleoparasitology and the antiquity of human hostparasite relationships. *Mem Inst Oswaldo Cruz*, 95, 89-93.
- Arkes, H. R., & Tetlock, P. E. (2004). Attributions of implicit prejudice, or "would Jesse Jackson 'fail' the implicit association test?" *Psychological Inquiry*. *15*, 257-278.
- Bargh, J. A. (1989). Conditional Automaticity: Varieties of Automatic Influence in Social
  Perception and Cognition. In J. Uleman and J. Bargh (Eds.) *Unintended thought*,
  (pp. 3-51). New York: Guilford Publications.
- Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology*, 71, 230–244.

- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173-1182.
- Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology*, 5, 323-370.
- Behringer, D. C., Butler, M. J., & Sheields, J. D. (2006). Avoidance of disease by social lobsters. *Nature*, 441, 421.
- Berscheid, E. & Walster, E. (1974). Physical attractiveness. *Advances in Experimental Social Psychology*, *7*, 157-215.
- Biddle, J. E., & Hamermesh, D. S. (1998). Beauty, productivity, and discrimination: Lawyers' looks and lucre. *Journal of Labor Economics*, 16, 172-201.
- Bishop, G. D., Alva, A. L., Cantu, L., & Rittiman, T. K. (1991). Responses to persons with AIDS: Fear of contagion or stigma? Journal of Applied Social Psychology, 21, 1877-1888.
- Blascovich, J. Mendes, W. B., Hunter, S.B. & Lickel, B., & Kowai-Bell, N. (2001). Perceiver threat in social interactions with stigmatized others. *Journal of Personality and Social Psychology*, 80, 253-267.
- Bozman, R., Saxon, E., Utt, K. (Producers), & Demme, J. (Director). (1991). The silence of the lambs [Motion picture]. United States: Orion Pictures.
- Bregman, E. (1934). An attempt to modify the emotional attitudes of infants by the conditioned response technique. *Journal of Genetic Psychology*, 45. 169-198.
- Brothwell, D., & Sandison, A. T. (1967). Diseases in antiquity. Springfield IL: Thomas.

- Brown, W., Cronk, L., Grochow, K., Jacobson, A., Liu, K., Popović, Z., & Trivers, R. (2005). Dance reveals symmetry especially in young men. *Nature*, 438, 1148-1150.
- Brown, J. K. M. (2003). A cost of disease-resistance: Paradigm or peculiarity. *Trends in Genetics*, 19, 667-671.
- Butler, R. N. (1989). Dispelling ageism: The cross-cutting intervention. *The Annals of the American Academy of the Political and Social Sciences*, 503, 138-147.
- Bugental, D.B. & Hehman, J.A. (2007). Ageism: A review of research and policy implications. *Social Issues and Policy Review*, *1*, 173-216.
- Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality & Social Psychology*, 42, 116-131.
- Campos, J. J., & Stenberg, C. R. (1981). Perception, appraisal and emotion: The onset of social referencing. In M. E. Lamb & L. R. Sherrod (Eds.), *Infant social cognition: Empirical and theoretical considerations* (pp. 273–314). Hillsdale, NJ: Erlbaum.
- Carr, D. & Friedman, M. A. (2005). Is obesity stigmatizing? Body weight, perceived discrimination and psychological well being in the united states. *Journal of Health and Social Behavior, 46*, 244-259.
- Carver, L. J. & Vaccaro, B. G. (2007). 12-month-old infants allocate increased neural resources to stimuli associated with negative adult emotion. *Developmental Psychology*, 43, 54-69
- Case, T. I., Repacholi, B. M., & Stevenson, R. J. (2006). My baby doesn't smell as bad as yours: The plasticity of disgust. *Evolution and Human Behavior*, 27(5), 357-365.

- Charash, M. & McKay, D. (2002). Attention bias for disgust, *Journal of Anxiety Disorders, 16,* 529–541.
- Choi, N.G., & Mayer, J. (2000). Elder abuse, neglect and exploitation: risk factors and prevention strategies. *Journal of Gerontological Social Work, 33*, 5-25.
- Constantine, R., McNally, R. J., & Horning, C.D. (2001). Snake fear and the pictorial emotional stroop paradigm. *Cognitive Therapy and Research*, 25, 757-746.
- Cook, M. & Mineka, S. (1989). Observational conditioning of fear to fear-relevant versus fear-irrelevant stimuli in Rhesus Monkeys. *Journal of Abnormal Psychology 98*, 448-459
- Cook, M. & Mineka, S. (1990). Selective associations in the observational conditioning of fear in Rhesus Monkeys. *Journal of Experimental Psychology 16*, 372-389.
- Cook, M., Mineka, S., Wolkenstein, B. & Laitsch, K. (1985). Observational conditioning of snake fear in unrelated Rhesus Monkeys. *Journal of Abnormal Psychology 94*, 591-610
- Cooper, J., Gordon, I. J., & Pike, A. W. (2000). Strategies for the avoidance of faeces by grazing sheep. Applied Animal Behaviour Science, 69, 15-33.
- Cosmides, L., & Tooby, J. (2005). Neurocognitive adaptations for social exchange. In D.M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 584-627). JohnWiley & Sons, Hoboken, NJ.
- Crandall, C. S., & Martinez, R. (1996). Culture, ideology, and antifat attitudes. *Personality and Social Psychology Bulletin, 22*, 1165–1176.
- Crandall C. S. & Moriarty, D. (1995). Physical illness stigma and social rejection. *British Journal of Social Psychology*, *34*, 67-83.
- Crandall, C. S. (1994). Prejudice against fat people: Ideology and self-interest. *Journal of Personality and Social Psychology*, 66, 882–894.
- Crocker J, Major B, Steele C. 1998. *Social stigma*. In *The Handbook of Social Psychology*, ed. DT Gilbert, ST Fiske, 2: 504–53. Boston, MA: McGraw-Hill
- Crowne, D. P. & Marlowe, D. (1964), *The approval motive*. New York: John Wiley &Sons.
- Cuddy, A. J. C., & Fiske, S. T. (2002). Doddering, but dear: Process, content, and function in stereotyping of older persons. In T. Nelson (Ed.), *Ageism: Stereotyping* and prejudice against older persons (pp. 3–26). Cambridge, MA: MIT Press.
- Cuddy, A.J.C., Norton, M. I., & Fiske, S. T. (2005). This old stereotype: The stubbornness and pervasiveness of the elderly stereotype. *Journal of Social Issues*, 61, 267-285.
- Curtis, V., Aunger, R., & Rabie, T. (2004). Evidence that disgust evolved to protect from risk of disease. *Proceedings of the Royal Society B*, *271*, *S*131–S133.
- Curtis, V., & Biran, A. (2001). Dirt, disgust, and disease: Is hygiene in our genes? *Perspectives in Biology and Medicine*, 44, 17-31.
- Darwin, C. (1872). The expression of the emotions in man and animals.: John Murray.
- Dasgupta, N., & Greenwald, A. G. (2001). On the malleability of automatic attitudes:Combating automatic prejudice with images of admired and disliked individuals.*Journal of Personality and Social Psychology*, *81*, 800–814.
- Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. JSAS Catalog of Selected Documents in Psychology, 10, 85.

- Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease:
   Development and validation of a 15-item self report instrument. *Personality and Individual Differences*, 47, 541-546.
- Duncan, L. A. & Schaller, M. (in press). Prejudicial attitudes toward older adults may be exaggerated when people feel vulnerable to infectious disease: Evidence and implications, *Analyses of Social Issues and Public Policy*.
- Duncan, L. A., Park, J. H., Faulkner, J., Schaller, M., Neuberg, S. L., & Kenrick, D. T. (2007). Adaptive allocation of attention: Effects of sex and sociosexuality on visual attention to attractive opposite-sex faces. *Evolution and Human Behavior*, 28, 359-364.
- Duncan, L. A. (2005). Heuristic Cues Automatically Activate Disease Cognitions Despite
   Rational Knowledge to the Contrary. Unpublished Masters Thesis. University of
   British Columbia.
- Eagly, A. H., Ashmore, R. D., Makhijani, M. G., & Longo, L. C. (1991). What is beautiful is good, but...: A meta-analytic review of research on the physical attractiveness stereotype. Psychological Bulletin, 110, 109-128.
- Edwards, M. & Watson, A. C. H. (1980). Psychosocial aspects of cleft lip and palate. In Edwards, M. and Watson, A. C. H., (Eds). Advances in the management of cleft palate. New York: Churchill Livingstone.

Eibl-Eibesfeldt, I. (1979). The biology of peace and war. New York: Viking.

Eisenberg, M. E., Neumark-Sztainer, D., Story, M., & Perry, C. (2005). The role of social norms and friends' influences on unhealthy weight-control behaviors among adolescent girls, *Social Science and Medicine*, 60, 1165-1173. Ekman, P. (1992). An argument for basic emotions. Cognition & Emotion, 6(3), 169-200.

- Ekman, P., & Friesen, W. V. (1978). Facial action coding system: A technique for the measurement of facial movement. Palo Alto, CA: Consulting Psychologists Press.
- Ekman, P., Levenson, R. W., & Friesen, W. V. (1983). Autonomic nervous system activity distinguishes between emotions. *Science*, 221, 1208-1210.

Epstein, P. R. (1999). Climate and health. *Science*, 285, 347–348.

- Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive– experiential and analytical–rational thinking styles. *Journal of Personality and Social Psychology*, 71, 390–405.
- Erasmus, V., Brouwer, W., van Beeck, E. F., Oenema, A., Daha, T. J., Richardux, J. H., Vos, M. C., & Brug, J. (2009). A qualitative exploration of reasons for poor hand hygience among hospital workers: Lack of positive role models and of convincing evidence that hand hygiene prevents cross-infection. *Infection Control and Hosptial Epidemiology*, 30, 415 – 419.
- Ewald, P. W. (1993). *Evolution of infectious disease*. New York: Oxford University Press.
- Expert Group on Weight Standards Report. (1988). Canadian guidelines for healthy weights. Minster of Supply and Services, Canada: Ottawa, ON.
- Faulkner, J., Schaller, M., Park, J. H., & Duncan, L. A. (2004). Evolved diseaseavoidance mechanisms and contemporary xenophobic attitudes. *Group Processes* & *Intergroup Relations*, 7, 333-353.
- Feinman, S. (1982). Social referencing in infancy. *Merrill-Palmer Quarterly* **28** (1982), pp. 445–470.

- Ferguson, E. & Daniel, E. (1995). The illness attitudes scale (IAS): A psychometric evaluation of a non-clinical population. *Personality and Individual Differences*, 18, 463-469.
- Fessler, D.M.T., Eng, S.J., & Navarrete, C.D. (2005). Elevated disgust sensitivity in the first trimester of pregnancy: Evidence supporting the compensatory prophylaxis hypothesis. *Evolution and Human Behavior*, 26, 344-351
- Fessler, D.M.T., & Navarrete, C.D. (2003). Domain-specific variation in disgust sensitivity across the menstrual cycle. *Evolution and Human Behavior*, 24, 406– 417.
- Fincher, C. L., Thornhill, R., Murray, D. R., & Schaller, M. (2008). Pathogen prevalence predicts human cross-cultural variability in individualism / collectivism. *Proceedings of the Royal Society B*, 275, 1279-1285.
- Fink, B., & Penton-Voak, I. (2002). Evolutionary psychology of facial attractiveness. *Current Directions in Psychological Science*, *11*, 154-158.
- Finkelstein, L. M., & Burke, M. J. (1998). Age stereotyping at work: The role of rater and contextual factors on evaluations of job applicants. *Journal of General Psychology*, 124, 317–345.
- Ford, E. S., Williamson, D. F., Liu, S. (1997). Weight change and diabetes incidence: findings from a national cohort of US adults. *American Journal of Epidemiology*, 146, 214-222.
- Fox, E., Russo, R., Bowles, R. J., & Dutton, K. (2001). Do Threatening Stimuli Draw or Hold Visual Attention in Subclinical Anxiety? Journal of Experimental Psychology: General, 130, 681-700.

- Freeland, W. J. (1976). Pathogens and the evolution of primate sociality. *Biotropica*, *8*, 12–24.
- Gangestad, S. W. (2007). Reproductive strategies and tactics. In R. I. M. Dunbar & L.
  Barrett (Eds.), *Oxford handbook of evolutionary psychology* (pp. 321-332).
  Oxford, UK: Oxford University Press.
- Gangestad, S. W., & Buss, D. M. (1993). Pathogen prevalence and human mate preferences. *Ethology and Sociobiology*, *14*, 89–96.
- Gangestad, S.W., Haselton, M. G., & Buss, D. M. (2006). Evolutionary foundations of cultural variation: Evoked culture and mate preferences. *Psychological Inquiry*, 17, 75-95.
- Garcia, J., Hankins, W. G. & Rusiniak, K. (1974). Behavioral regulation of the milieu interne in man and rat. *Science*, *185*, 824-831.
- Garcia, J., & Koelling, R. A. (1966). Relationship of cue to consequence in avoidance learning. *Psychonomic Science*, *4*, 123-124.
- Garcia, J., Kimeldorf, D. J., & Koelling, R. A. (1955). Conditioned aversion to saccharin resulting from exposure to gamma radiation. *Science*, *122*, 157-158.
- Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J., & Wheatley, T. (1998).Immune neglect: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology*, 75, 617-638.
- Gilchrest, B.A. (1996). A review of skin ageing and its medical therapy. *British Journal* of Dermatology, 135, 867-875.
- Glassner, B. (1999). *The culture of fear: Why Americans are afraid of the wrong things.* New York: Basic Books.

- Gonzalez-Ulloa, M., & Stevens-Flores, E. (1965). Senility of the face: Basic study to understand its causes and effects. *Plastic and Reconstructive Surgery*, 36, 239-246.
- Goodall, J. (1986). Social rejection, exclusion, and shunning among the Gombe chimpanzees. *Ethology and Sociobiology*, *7*, 227–39.
- Greenberg, J., Schimel, J., & Martens, A. (2002). Ageism: Denying the face of the future.In T. D. Nelson (Ed.), *Ageism: Stereotyping and prejudice against older people* (pp. 3–26). Cambridge, MA: MIT Press.
- Greenwald, A. G., Nosek, B. A., & Banaji, M. (2003). Understanding and using the implicit association test: An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85, 197–216.
- Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality & Social Psychology*, 74(6), 1464-1480.
- Grillon, C., Pellowski, M., Merikangas, K. R., & Davis, M. (1997). Darkness facilitates acoustic startle reflex in humans. *Biological Psychiatry*, *42*, 453–60.
- Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition and Emotion*, *9*, 87–108.
- Guernier, V., Hochberg, M. E., & Guégan, J.-F. (2004). Ecology drives the worldwide distribution of human diseases. *Public Library of Science Biology*, *2*, 740–746.
- Guerra, F. (1993). The European-American exchange. *History and Philosophy of the Life Sciences, 15*, 313-327.

Guthrie, R. D. (1976). Body hot spots. New York: Van Nostrand Reinhold.

- Hagestad, G. O., & Uhlenberg, P. (2005). The social separation of old and young: A root of ageism. *Journal of Social Issues*, *61*, 343–360.
- Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, 16, 701-713.
- Harvey, T., Troop, N. A., Treasure, J. L., & Murphy, T. (2002). Fear, disgust, and abnormal eating attitudes: A preliminary study. *International Journal of Eating Disorders*, 32, 213–218.
- Haselton, M. G., & Nettle, D. (2006). The paranoid optimist: An integrative evolutionary model of cognitive biases. *Personality and Social Psychology Review*, 10, 47–66.
- Heatherton, T. F., Kleck, R. E., Hebl, M. R., & Hull, J. G. (2000). *The social psychology of stigma*. New York: Guilford Press.
- Henderson, D., Kopelson, A., Katz, G. (Producers) & Peterson, W. (Director). (1995). Outbreak. [Motion picture]. United States: Warner Brothers Pictures.
- Hodgson, R. J. & Rachman, S. (1977). Obsessive-compulsive complaints. *Behaviour Research and Therapy*, *15*, 389–395.
- Hodson, G. & Costello, K. (2007). Interpersonal disgust, ideological orientations, and dehumanization as predictors of intergroup attitudes. *Psychological Science*, 18, 691-698.
- Holmes, D., Perron, A., & O'Byrne, P. (2006). Understanding Disgust in Nursing:Abjection, Self, and the *Other. Research and Theory for Nursing Practice: An International Journal*, 20, 305-315.

- Nornick, R., Risenhoover, N., & Gunnar, M. (1987). The effects of maternal positive, neutral, and negative affective communications on infant responses to new toys. *Child Development*, 58, 937-944.
- John, O. P., & Srivastava, S. (1999). The Big Five Trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 102-138). New York: Guilford Press.
- Johnson, C., Beaton, R., & Hall, K. (1975). Poison-based avoidance learning in nonhuman primates: Use of visual cues. *Physiology and Behavior, 14*, 430-407.
- Jones, B.C., Little, A. C., Penton-Voak, I. S., Tiddeman, B. P., Burt. D. M., & Perrett,D. I. (2001). Measured facial asymmetry and perceptual judgements of attractiveness and health. *Evolution and Human Behaviour*, 22, 417-429.
- Kanwisher, N. (2000). Domain specificity in face perception. *Nature Neuroscience*, *3*, 759–63.
- Karpinski, A., & Hilton, J. L. (2001). Attitudes and the implicit association test. *Journal* of Personality and Social Psychology, 81, 774-788.
- Kavaliers, M., Colwell, D. D., Braun, W. J., & Choleris, E. (2003). Brief exposure to the odour of a parasitized male alters the subsequent mate odour responses of female mice. *Animal Behaviour*, 65, 59-68.
- Kawai, T. & Akira, S. (2006). Innate immune recognition of viral infection. *Nature Immunology*, *7*, 131-137.
- Kellner, R. (1986). Somatization and hypochondriasis. Praeger Publishers, New York.

- Kiesecker, J. M., Skelly, D. K., Beard, K. H., & Preisser, E. (1999). Behavioral reduction of infection risk. *Proceeding of the National Academy of Sciences*, 96, 9165-9168.
- Kinsella, K., & Velkoff, V. A. (2001). An aging world. US Census Bureau series P95/01-1. Washington: US Government Printing Office.
- Kite, M. E., & Wagner, L. S. (2002). Attitudes toward older adults. In T. D. Nelson (Ed.), *Ageism: Stereotyping and prejudice against older persons* (pp. 129–161). Cambridge, MA: MIT Press.
- Klein, S. L., & Nelson, R. J. (1999). Influence of social factors on immune function and reproduction. *Reviews of Reproduction*, *4*, 168-178.
- Kretzer, E.K., Larson, E. L. (1998). Behavioral interventions to improve infection control practices. *American Journal of Infection Control*, *26*, 245-253.
- Kurth, T., Gaziano, J. M., Rexrode, K. M., Kase, C. S., Cook, N. R., Manson, J. E., & Buring, J. E., (2005). Prospective study of body mass index and risk of stroke in apparently healthy women. *Circulation*, 111, 1992-1998.
- Kurzban, R., & Leary, M. R. (2001). Evolutionary origins of stigmatization: The functions of social exclusion. *Psychological Bulletin*, 127, 187–208.
- Lachs, M. S., Williams C., O'Brien S., Hurst L., & Horwitz R. (1997). Risk factors for reported elder abuse and neglect: A nine-year observational cohort study. *The Gerontologist*, 37, 469-474.
- Langer, E. J., Blank, A., & Chanowitz, B. (1978). The mindlessness of ostensibly thoughtful action: The role of "placebic" information in interpersonal interaction. *Journal of Personality & Social Psychology, 36*(6), 635-642.

- Langer, E. J., Fiske, S., Taylor, S. E. & Chanowitz, B. (1976). Stigma, staring, and discomfort: A novel-stimulus hypothesis, *Journal of Experimental Social Psychology*, 12, 451–463.
- Langer, E. J., & Moldoveanu, M. (2000). The construct of mindfulness. *Journal of Social Issues*, 56(1), 1-9.
- Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological Science*, *1*, 115-121.
- Larsen, R.J., & Diener, E. (1987). Affect intensity as an individual difference characteristic: A review. *Journal of Research in Personality*, *21*, 1-39.
- Larsen, R. J. (1984). Psychology of personality: A structured learning workbook. Champaign, IL: University of Illinois Office of Continuing Education and Public Service.
- Latner, J. D., Stukard, A.J. (2002). Getting worse: The stigmatization of obese children. Obesity Research, 11, 452-456
- Levy, B. R., & Langer, E. J. (1994). Aging free from negative stereotypes: Successful memory in China and among the American deaf. *Journal of Personality and Social Psychology*, 66, 935-943.
- Low, B. S. (1990). Marriage systems and pathogen stress in human societies. *American Zooologist*, *30*, 325-339.
- Lippi, D., & Conti, A. A. (2002). Plague, policy, saints and terrorists: A historical survey. *Journal of Infection*, 44, 226-228.
- Lochmiller, R. L. & Deerenberg, C. (2000). Trade-offs in evolutionary immunology: just what is the cost of immunity? *Oikos*, *88*, 87–98.

- Loehle, C. (1995). Social barriers to pathogen transmission in wild animal populations *Ecology*, 76, 326-335.
- Lovibond, P. F. (2004). Cognitive processes in extinction. *Learning and Memory*, *11*, 495-500.
- Macdonald, A. (Producer) & Boyle, D. (Director). Trainspotting. [Motion Picture] United Kindom: Channel Four Films.
- MacGregor, F. (1990). Facial disfigurement: problems and management of social interaction and implications for mental health. *Aesthetic Plastic Surgery*, *14*, 249–257.
- Major, B.N., & O'Brien, L.T. (2005). The social psychology of stigma. *Annual Review of Psychology*, *56*, 393-421.
- Maksimowich, D. S., & Mathis, A. (2001). Pheromonal markers as indicators of parasite load: parasite-mediated behavior in salamanders (Plethodon angusticlavius). *Acta ethologica*, *3*, 83-87.
- Mandairon, N., Poncelet, J., Bensafi, M., & Didier, A. (2009). Humans and mice express similar olfactory preferences. *PLoS One, 4*.
- Maner, J. K., Gailliot, M. T., & Miller, S. L. (2009). The implicit cognition of relationship maintenance: Inattention to attractive alternatives. *Journal of Experimental Social Psychology*, 45, 174-179.
- Maner, J. K., Gailliot, M. T., Rouby, D. A., & Miller, S. L. (2007). Can't take my eyes off you: Attentional adhesion to mates and rivals. *Journal of Personality and Social Psychology*, 93, 389-401.

- Maner, J. K., Kenrick, D. T., Neuberg, S. L., Becker, D. V., Robertson, T., Hofer, B., Delton, A., Butner, J., & Schaller, M. (2005). Functional projection: How fundamental social motives can bias interpersonal perception. *Journal of Personality and Social Psychology*, 88, 63-78.
- Martens, A., Goldenberg, J. L., & Greenberg, J. (2005). A terror management perspective on ageism. *Journal of Social Issues*, *61*, 223-239.
- Matchett, G. & Davey, G.C.L. (1991). A test of a disease-avoidance model of animal phobias, *Behaviour Research and Therapy*, *29*, 91–94.
- Matter, D. E., & Matter, R. M. (1989). If beautiful is good, then ugly must be ...:
  Confronting discrimination against the physically unattractive child. *Elementary School Guidance and Counseling*, 24, 146–152.
- Maynard Smith, J. (1978). The Evolution of Sex, Cambridge University Press, Cambridge.
- McCann, R. M., Ota, H., Giles, H., & Caraker, R. (2003). Perceptions of intra- and intergenerational communication among young adults in Thailand, Japan, and the U.S.A. *Communication Reports*, 16, 1–23.
- McConnell, A.R., & Leibold, J.M. (2001). Relations among the implicit association test, discriminatory behavior, and explicit measures of racial attitudes. *Journal of Experimental Social Psychology*, *37*, 435–442.
- McConnell, A. R., Rydell, R. J., Strain, L. M., & Mackie, D. M. (2008). Social group association cues: Forming implicit and explicit attitudes toward individuals. *Journal of Personality and Social Psychology*, 94, 792-807.
- McGraw-Hill Text-Films (1955). Sniffles and Sneezes [Motion picture]. United States, Audio Productions.

- McMullin, J. A., & Marshall, V. W. (2001). Ageism, age relations, and garment industry work in Montreal. *The Gerontologist*, *41*, 111–122.
- Michie, H. R. (1996). Metabolism of sepsis and multiple organ failure. *World Journal of Surgery*, *20*, 460-464.
- Mineka, S. (1987). A primate model of phobic fears. In H. J. Eysenck & I. Martin (Eds.), *Theoretical foundations of behaviour therapy* (81-111). New York: Plenum.
- Mineka, S., & Cook, M. (1986). Immunization against the observational conditioning of snake fear in rhesus monkeys. *Journal of Abnormal Psychology*, *95*, 307-318.
- Mineka, S., & Cook, M. (1993). Mechanisms involved in the observational conditioning of fear. *Journal of Experimental Psychology: General, 122, 23-38.*
- Mineka, S., & Keir, R. (1983). The effects of flooding on reducing snake fear in rhesus monkeys: Six-month follow-up and further flooding. *Behavioural Research and Therapy*, 21, 527-536.
- Mineka, S., Davidson, M., Cook, M., & Keir, R. (1984). Observational conditioning of snake fear in rhesus monkeys. *Journal of Abnormal Psychology*, *93*, 355-372.
- Montagne, B., Kessels, R. P. C., Frigerio, E., De Haan, E., & Perret, D.I. (2005) Sex differences in the perception of affective facial expressions: Do men really lack emotional sensitivity? *Cognitive Processing*,*6*, 136–141.
- Mundy, P. & Newell, L. (2007). Attention, joint attention and social cognition. *Current Directions in Psychological Science*, *16*, 269-274.
- Murray, D. R., & Schaller, M. (in press). Historical prevalence of infectious diseases
   within 230 geopolitical regions: A tool for investigating origins of culture.
   Journal of Cross-Cultural Psychology

- Navarrete, C.D., Fessler, D.M.T., & Eng, S.J. (2007) Elevated ethnocentrism in the first trimester of pregnancy. *Evolution and Human Behavior*, 28, 60-65.
- Navarrete, C. D., & Fessler, D. M. T. (2006). Disease avoidance and ethnocentrism: the effects of disease vulnerability and disgust sensitivity on intergroup attitudes. *Evolution and Human Behavior*, 27, 270-282.
- Nesse R. M. (2001). The smoke detector principle: Natural selection and the regulation of defensive responses. *Annals of the New York Academy of Sciences*, 935, 75-85.
- Nesse, R. M. (2005). Natural selection and the regulation of defenses: A signal detection analysis of the smoke detector principle. *Evolution and Human Behavior*, 26, 88– 105.
- Nesse, R. M., & Williams, G. C. (1995). *Why we get sick: The new science of Darwinian medicine*. New York: Times Books.
- Neuberg, S. L., & Cottrell, C. A. (2006). Evolutionary bases of prejudices. In M. Schaller,
  J. A. Simpson, & D.T. Kenrick (Eds.), *Evolution and social psychology* (pp. 163–187). Psychology Press: New York.
- Neuberg, S. L., Smith, D. M., & Asher, T. (2000). Why people stigmatize: Toward a biocultural framework. In T. F.Heatherton, R. E.Kleck, M. R.Hebl, & J. G.Hull (Eds.), *The social psychology of stigma* (pp. 31–61). New York: Guilford Press.
- Neuberg, S. L., & Newsom, J. T. (1993). Personal need for structure: Individual differences in the desire for simple structure. *Journal of Personality and Social Psychology*, 65, 113–131.

- Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Harvesting intergroup implicit attitudes and beliefs from a demonstration Web site. *Group Dynamics*, *6*, 101–115.
- Oaten, M., Stevenson, R. J., & Case, T. I. (2009)Disgust as a disease avoidance mechanism. *Psychological Bulletin*, 135, 303-321.
- Öhman, A., & Mineka, S. (2001). Fear, phobia, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review*, *108*, 483–522.
- Ohman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention:Detecting the snake in the grass. *Journal of Experimental Psychology: General, 130, 466-478.*
- Ohman, A., Eriksson, A., & Olofsson, C. (1975). One trial learning and superior resistance to extinction of autonomic responses conditioned to potentially phobic stimuli. *Journal of Comparative and Physiological Psychology*, 88, 619-627.
- Ohnuki-Tierney, E. (1984). *Illness and culture in contemporary Japan*. Cambridge, UK: Cambridge University Press.
- O'Keeffe, M., Hills, A., Doyle, M. et al., (2007). UK Study of Abuse and Neglect of Older People: Prevalence Survey Report. Department of Health, London.
- Olatunji, B. O., Williams, N. L., Tolin, D. F., Abramowitz, J. S., Sawchuk, C. N., Lohr, J.
  M., & Elwood, L. (2007). The disgust scale: Item analysis, factor structure, and suggestions for refinement. *Psychological Assessment*, 19, 281-297.
- Olatunji, B. O., Sawchuk, C. N., Lohr, J. M., & de Jong, P. J. (2004). Disgust domains in the prediction of contamination fear. *Behaviour Research and Therapy*, 42, 93-104.

- Olson, M. A., & Fazio, R. H. (2004). Reducing the influence of extrapersonal associations on the implicit association test: Personalizing the IAT. *Journal of Personality & Social Psychology*. 86, 653-667.
- Pachuta, D. M. (1996). Chinese medicine: The law of five elements. In A. A. Sheikh, &K. S. Sheikh (Eds.), *Healing East & West* (pp. 64–90). New York: Wiley.
- Panksepp, J. (2007). Criteria for basic emotions: Is DISGUST a primary emotion? *Cognition and Emotion, 21*, 1819-1828.
- Panksepp, J. (1998). Affective Neuroscience: The Foundations of Human and Animal Emotions. New York: Oxford University Press.
- Park, J. H., Schaller, M., & Crandall, C. S. (2007). Pathogen-avoidance mechanisms and the stigmatization of obese people. *Evolution and Human Behavior*, 28, 410-414.
- Park, J. H. (2005). Cue-recognition mechanisms and person perception. Unpublished Doctoral Thesis. University of British Columbia.
- Park, J. H., Faulkner, J., & Schaller, M. (2003). Evolved disease-avoidance processes and contemporary anti-social behavior: Prejudicial attitudes and avoidance of people with physical disabilities. *Journal of Nonverbal Behavior*, 27, 65–87.
- Patterson, K. D. & Pyle, G. F. (1991). The geography and mortality of the 1918 influenza pandemic. *Bulletin of the History of Medicine*, 65, 4-21.

Pavlov, I. P. (1927). Conditioned reflexes. Oxford, England: Oxford University Press.

Peeters, G., & Czapinski, J. (1990). Positive-negative asymmetry in evaluations: The distinction between affective and informational negativity effects. In W. Stroebe & M. Hewstone (Eds.), *European review of social psychology* (Vol. 1, pp.33-60). New York: Wiley.

- Pilowsky, I. (1967). Dimensions of hypochondriasis. *British Journal of Psychiatry*, *113*, 39-43.
- Pratto, F., Sidanius, J., Stallworth, L. M., & Malle, B. F. (1994). Social dominance orientation: A personality variable predicting social and political attitudes. *Journal* of Personality and Social Psychology, 67, 741–763.
- Pryor J.B., Reeder G.D., Yeadon C., & Hesson-McInnis M., (2004), A dual-process model of reactions to perceived stigma, *Journal of Personality and Social Psychology*, 87, 436-452
- Puhl, R. & Brownell, K. D. (2001). Bias, discrimination, and obesity. *Obesity Research*, 9, 788-805.
- Quinlan, R. J. (2007). Human prenatal effort and environmental risk. *Proceedings of the Royal Society B*, 274, 121-125.
- Reeder, G. D., & Pryor, J. B. (2008). Dual psychological processes underlying public stigma and the implications for reducing stigma. In A. R Singh & S. A. Singh (Eds.), *Medicine, mental health, science, religion, and well-being, MSM, 6*, 175-186.
- Reggio, G. (Producer), & Coppola, F. F. (Director). (1983). Koyaanisqatsi [Motion Picture]. United States: IRE Pictures.
- Rempel, J. K., & Baumgartner, B. (2003). The relationship between attitudes towards menstruation and sexual attitudes, desires, and behavior in women. *Archives of Sexual Behavior 32*, 155-63.

- Rhodes, G., Zebrowitz, L. A., Clark, A., Kalick, S. M., Hightower, A., & McKay, R.
  (2001). Do facial averageness and symmetry signal health? *Evolution and Human Behavior*, 22, 31–46.
- Rimm, E. B., Stampfer, M. J., Giovannucci, E., Ascherio, A., Spiegelman, D., Colditz,
  G.A., & Willett, W. C. (1995). Body size and fat distribution as predictors of
  coronary heart disease among middle-aged and older U.S. men. *American Journal* of Epidemiology, 141,1117-1127.
- Robb, C., Chen, H., & Haley, W. E. (2002). Ageism in mental health care: A critical review. *Journal of Clinical Geropsychology*, *8*, 1–12.
- Roujeau, J. C. (2001). Clinical criteria and risk factors. *Annales de Dermatologie et de Venereologie, 128,* 376-381.
- Rozin, P. & Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion, *Personality and Social Psychology Review*, 5, 296–320.
- Rozin, P., & Fallon, A. E. (1987). A perspective on disgust. *Psychological Review*, 94, 23-41.
- Rozin, P., Millman, L., & Nemeroff, C. (1986). Operation of the laws of sympathetic magic in disgust and other domains. *Journal of Personality and Social Psychology*, 50, 703–712.
- Rozin, P., Haidt, J., & McCauley, C. R. (1993). Disgust. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions*. (pp. 575-594): Guilford Press.
- Rubio-Godoy, M., Aunger, R., & Curtis, V. (2007). <u>Serotonin A link between disgust</u> and immunity? *Medical Hypotheses*, 68, 61-66.

- Rumsey, N., Bull, R., & Gahagan, D. (1982). The effect of facial disfigurement on the proxemic behaviour of the general public. *Journal of Applied Social Psychology*, *12*, 137–150.
- Salkovskis, P.M., Rimes, K. A., Warwick, H. M. C., & Clark, D.M. (2002). The Health Anxiety Inventory: development and validation of scales for the measurement of health anxiety and hypochrondriasis. *Psychological Medicine*, *32*, 843-853.
- Scaife, M. & Bruner, J. S. (1975). The capacity for joint visual attention in the infant. *Nature*, *253*, 265–266.
- Schaller, M., & Murray, D. R. (2008). Pathogens, personality and culture: Disease prevalence predicts worldwide variability in sociosexuality, extraversion, and openness to experience. *Journal of Personality and Social Psychology*, 95, 212-221.
- Schaller, M., & Neuberg, S. L. (2008). Intergroup prejudices and intergroup conflicts. In
  C. Crawford & D. L. Krebs (Eds.), *Foundations of evolutionary psychology* (pp. 399-412). Mahwah NJ: Lawrence Erlbaum Associates.
- Schaller, M., & Duncan, L. A. (2007). The behavioral immune system: Its evolution and social psychological implications. In J. P. Forgas, M. G. Haselton, & W. von Hippel (Eds.), *Evolution and the social mind: Evolutionary psychology and social cognition* (pp. 293– 307). New York: Psychology Press.
- Schaller, M., Park, J. H., & Kenrick, D. T. (2007). Human evolution and social cognition. In R. I. M. Dunbar & L. Barrett (Eds.), *The Oxford handbook of evolutionary psychology* (pp. 491-504). Oxford UK: Oxford University Press.

- Schaller, M., & Abeysinghe, A. M. N. D. (2006). Geographical frame of reference and dangerous intergroup attitudes: A double-minority study in Sri Lanka. *Political Psychology*, 27, 615-631.
- Schaller, M., Park, J., & Faulkner, J. (2003). Prehistoric dangers and contemporary prejudices. *European Review of Social Psychology*, *14*, 105 137.
- Schaller, M., Park, J. H., & Mueller, A. (2003). Fear of the dark: Interactive effects of beliefs about danger and ambient darkness on ethnic stereotypes. *Personality and Social Psychology Bulletin, 29*, 637-649.
- Sharps, M. J., Price-Sharps, J. L., & Hanson, J. (1998). Attitudes of young adults toward older adults: Evidence from the United States and Thailand. *Educational Gerontology*, 24. 655–660.
- Schupp, H. T., Junghöfer, M., Weike, A. I., & Hamm, A. O. (2004). The selective processing of briefly presented affective pictures: An ERP analysis. *Psychophysiology*, 41, 441-449.
- Schwartz, M. B., Chambliss, H. O., Brownell, K. D., Blair, S. N., & Billington, C. (2002).
  Weight bias among health professionals specializing in obesity. *Obesity Research*, 11,9 1033-1039.
- Seligman, M. E. P. (1970). On the generality of the laws of learning. *Psychological Review*, 77, 406-418.
- Seligman, M. E. P. (1971). Phobias and preparedness. Behavioral Therapy, 2, 307–320.
- Sell, A., Cosmides, L., Tooby, J., Sznycer, D., von Rueden, C., & Gurven, M. (2009). Human adaptations for visual assessment of strength and fighting ability from the

body and face. *Proceedings of the Royal Society London (Biological Sciences)*, 276, 575-584.

- Sherman, P. W., Billing, J. (1999). Darwinian gastronomy: Why we use spices. *Bioscience*, *49*, 453–463.
- Simpson, J. A., & Gangestad, S. W. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology*, 60, 870–883.
- Singh, D. (2002). Female mate value at a glance: relationship of waist-to-hip ratio to health, fecundity and attractiveness. *Human Ethology and Evolution*, *23*, 81-91.
- Smith, D.W. (1978). Growth. In D.W. Smith, E.L. Bierman, & N.M. Robinson (Eds.), *The biological ages of man: from conception through to old age* (2nd ed.).
  Philadelphia: W.B. Saunders .
- Snyder, M. L., Kleck, R. E., Strenta, A., & Mentzer, S. J. (1979). Avoidance of the handicapped: An attributional ambiguity analysis. *Journal of Personality and Social Psychology*, 37, 2297-2306.
- Source, J. F., Emde, R. N., Campos, J., & Klinnert, M. D. (1985). Maternal emotional s: signaling: Its effect on the visual cliff behavior of 1-year-olds. *Developmental Psychology*, 21, 195-2000.

Sprengelmeyer R., Young, AW Pundt, I Sprengelmeyer, A., <u>Calder</u>, A.J., Berrious, G.,
Winkel, R., Vollmoeller, W., Kuhn, W., Sartory, G., & Przuntek, H. (1997).
Disgust implicated in obsessive-compulsive disorder.; *Proceedings of the Royal Society of London Series B - Biological Sciences*; 264,1767-1773.

- Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In M.P. Zanna (Ed.), *Advances experimental social psychology* (Vol. 34, pp. 379-440). San Diego, CA: Academic Press.
- Tabachnick, B. A. & Fidell, L. S. (2001). Using Multivariate Statistics (4th Ed.).Needham Heights, MA: Allyn & Bacon.
- Teachman, B. A., Gapinski, K. D., Brownell, K. D., Rawlins, M., & Jeyaram, S. (2003). Demonstrations of implicit anti-fat bias: The impact of providing causal information and evoking empathy. *Health Psychology*, 22, 68–78.
- Thornhill, R., & Gangestad, S. W. 2006. Facial sexual dimorphism, developmental stability and susceptibility to disease in men and women. *Evolution and Human Behavior* 27:131-144.
- Thornhill, R., & Gangestad, S. W. (1999). Facial attractiveness. *Trends in Cognitive Sciences*, *3*, 452-460.
- Tomarken, A. J., Mineka, S., & Cook, M. (1989). Fear-relevant selective associations and covariation bias. *Journal of Abnormal Psychology*, *98*, 381-394.
- Tomarken, A. J., Sutton, S. K., & Mineka, S. (1995). Fear-relevant illusory correlations:
   What types of associations promote judgmental bias? *Journal of Abnormal Psychology*, *104*, 312-326.
- Tooby, J. (1982). Pathogens, polymorphism, and the evolution of sex. *Journal of Theoretical Biology*, 97, 557-576.
- Toronchuk, J. A. & Ellis, G. F. R. (2007). Disgust: Sensory affect or primary emotion system? *Cognition & Emotion*, 21, 1799-1818.

- Tracy, J. L., Robins, R. W., & Schriber, R. A. (in press). Development of a FACS=verified set of basic and self-conscious emotions expressions. *Emotion*.
- Tracy, J. L., & Robins, R. W. (2008). The automaticity of emotion recognition. *Emotion*, 8, 81-95.
- Tybur, J.M., Lieberman, D, & Griskevicius, V. (in press). Mircrobes, Mating, and Morality: Individual Differences in Three Functional Domains of Disgust. *Journal of Personality and Social Psychology*
- Vaish, A., Grossman, T. and Woodward, A. (2008) Not all emotions are created equal: the negativity bias in social-emotional development. *Psychological Bulletin*, 134, 383-403.
- Van Blerkom, L. M. (2003). Role of viruses in human evolution. *Yearbook of Physical Anthropology*, 46, 14-46.
- Wang, S.S., Brownell, K.D., & Wadden, T.A. (2004). The influence of the stigma of obesity on overweight individuals. *International Journal of Obesity & Related Metabolic Disorders*, 28, 1333-1337.
- Wang, J.-Y. (1991). Psychosomatic illness in the Chinese cultural context. In L.
  Romanucci- Ross, D. E. Moerman, & L. R. Tancredi (Eds.), *The anthropology of medicine* (2nd. Ed., pp. 322–342). New York: Bergin & Garvey.
- Ward, D. (2000). Ageism and the abuse of older people in health and social care. *British Journal of Nursing*, *9*, 560–563.
- Ware, J., Jain, K., Burgess, I., & Davey, G.C.L. (1994). Factor analysis of common animal fears: Support for a disease-avoidance model. *Behaviour Research and Therapy*, 32, 57–63.

- Watson, J. B. & Rayner, R. (1920). Conditioned emotional reactions. Journal of Experimental Psychology, 3, 1-14.
- Weir, E. C. (2004). Identifying and preventing ageism among health-care professionals. *International Journal of Therapy and Rehabilitation*, 11, 56-63.
- Weiss, G. (2002). Europe wakes up to aging. Science of Aging Knowledge Environment, 48, ns10.
- Welling, L. L. M., Conway, C. A., DeBruine, L. M., & Jones, B. C. (2007). Perceived vulnerability to disease predicts variation in preferences for apparent health in faces. *Journal of Evolutionary Psychology*, *5*, 131-139.
- Wilcoxon, H. C., Dragoin, W. B., & Kral, P. A. (1971). Illness-induced aversions in rat and quail: Relative salience of visual and gustatory cues. *Science*, 171, 826-828.
- Wilson, B., & Ryan, A. S. (1990). Working with the terminally ill Chinese-American patient. In J. K. Parry (Ed.), *Social working practice with the terminally ill: A transcultural perspective* (pp. 145–158). New York: The Haworth Social Work Practice Press.
- Wolfe, N. D., Duncavan, C. P., & Diamond, J. (2007). Origins of major human infectious diseases. *Nature*, 447, 279-283.
- Woody, S.R. & Teachman, B.A. (2000). Intersection of disgust and fear: Normative and pathological views, *Clinical Psychology: Science and Practice*, *7*, 291–311.
- Van Blerkom, L. M. (2003). Role of viruses in human evolution. *Yearbook of Physical Anthropology*, *46*, 14-46.
- Zebrowitz, L. A., Fellous, J. M., Mignault, A. & Andreoletti, C. (2003). Trait impressions as overgeneralized responses to adaptively significant facial qualities: Evidence

from connectionist modeling. *Personality and Social Psychology Review*, 7, 194–215.

- Zebrowitz, L. A., & Montepare, J. (2006). The ecological approach to person perception:
  Evolutionary roots and contemporary offshoots. In M. Schaller, J. A. Simpson, &
  D. T. Kenrick (Eds.), *Evolution and social psychology* (pp. 81-111). New York:
  Psychology Press.
- Zebrowitz, L. A., & Rhodes, G. (2004). Sensitivity to "bad genes" and the anomalous face overgeneralization effect: Cue validity, cue utilization, and accuracy in judging intelligence and health. *Journal of Nonverbal Behavior*, 28, 167-185.
- Zebrowitz, L.A. (1997). *Reading Faces: Window to the Soul?* Boulder, CO: Westview Press.
- Zebrowitz, L.A. (1990). *Social perception*. Buckingham, England: Open University Press.

## **Appendix 1: BREB Certificates 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- MINIMAL RISK RENEWAL

PRINCIPAL INVESTIGATOR: DEPARTM	AENT:	UBC BREB NUMBER:			
Mark Schaller UBC/Arts/F	Psychology, Depa	artment H07-02678			
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):					
Lesley Duncan					
Jessica Tracy					
SPONSORING AGENCIES:					
N/A					
PROJECT TITLE:					
Detecting Emotions in Facial Expressions (1 &	2)				

#### EXPIRY DATE OF THIS APPROVAL: October 14, 2009

### APPROVAL DATE: October 14, 2008

The Annual Renewal for Study 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

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



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- MINIMAL RISK RENEWAL

PRINCIPAL INVESTIGATOR:	DEPARTMENT:		UBC BREB NUMBER:		
Mark Schaller	UBC/Arts/Psychol of	ogy, Department	H05-80473		
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					
<b>CO-INVESTIGATOR(S):</b> N/A					
SPONSORING AGENCIES:					
Social Sciences and Humanities Research Council of Canada (SSHRC) - "Disease Cues and Person					
Perception"					
PROJECT TITLE:					
Disease Cues and Person Perception	n				

### EXPIRY DATE OF THIS APPROVAL: July 24, 2009

#### APPROVAL DATE: July 24, 2008

The Annual Renewal for Study 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 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

- Duncan, L.A., & Schaller, M. (2009). Perceived Vulnerability to Disease: Development and Validation of a 15 item self report instrument. *Personality and Individual Differences*. Chapter 3 is a version of this article.
- Duncan, L.A., & Schaller, M. (in press). Prejudicial Attitudes Toward Older Adults MayBe Exaggerated When People Feel Vulnerable to Infectious Disease: Evidenceand Implications. Chapter 6 is a version of this article.