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A Review of Pathogen Identification through the Behavioral Immune System

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Abstract

Objective: Pathogen disgust has evolved as a psychological adaptation in response to the avoidance of disease-causing organisms. Recently, evolutionary social psychologists have proposed the existence of a behavioral immune system that has evolved to avoid pathogens as a psychological adaptation. However, researchers claim that the concept of a behavioral immune system is not the same as pathogen avoidance. Therefore, in this study, the aim is to investigate whether the behavioral immune system is the same as the pathogen avoidance system or has a broader meaning.

Method: Using the Google Scholar database, keywords such as disease avoidance, pathogen disgust, and the behavioral immune system were searched. PubMed for the behavioral immune system, system over perception disease cues, and disease over perception bias was investigated as well. All-time periods were used for this review study and more than two hundred documents were reviewed and extracted according to the criteria.

Results: The findings show that there are three main mechanisms involved in the behavioral immune system. This system includes emotional, cognitive, and behavioral mechanisms. Therefore, the results showed that the behavioral immune system has a broader meaning than the pathogen avoidance system.

Conclusion: Research on physiological correlations with emotional experiences shows that disgust is evoked in response to pathogen-related stimuli and is associated with unique patterns of the autonomic nervous system and neural activity. However little is known about the functional connections between anatomical structures, neurochemical processes, and various cognitive and behavioral phenomena that are the manifestations of the behavioral immune system, and more studies are needed in this area.

Keywords: Behavioral immune system, Avoidance, Pathogen, Disgust.

Introduction

Researchers interested in evolutionary theory have done extensive research on the feeling of disgust and avoidance of pathogens and believe that the pathogen avoidance mechanism has evolved to protect organisms from disease. Those who avoid eating or coming in contact with disease-causing organisms were healthier and more likely to survive and reproduce than other people. As a result, natural selection is expected to lead to the development of rational psychological mechanisms that facilitate the detection of substances rich in pathogens and cause a feeling of disgust toward them (Val Curtis, Aunger, & Rabie, 2004; Valerie Curtis, & Biran, 2001).

Humans are also involved in various behaviors that act as preventive behaviors against pathogen contamination (Prokosch, Gassen, Ackerman, & Hill, 2019). The uses of some strategies, such as vaccination, are neocortical processes that have recently evolved and allow individuals to incorporate a variety of strategies into their rational

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decisions. They help people to have cognitive tools through which they do not avoid becoming infected with pathogens through obsessive-compulsive disorder (Li, Wang, Xue, Zhao, & Zhu, 2020). Also staying home can prevent some infection diseases (Aliakbari Dehkordi, Mohtashami, & Tabrizi, 2020). This can be in line with the behavioral immune system and avoid getting sick. Many overt and covert behaviors seem to be governed by a set of more evolutionary and functional stimulus-response mechanisms that form a kind of "behavioral immune system" (Schaller & Park, 2011; Shakhar, 2019). The behavioral immune system is a term introduced by psychologist Mark Schaller as a set of psychological mechanisms that allow organisms to immediately detect the possible presence of disease-causing pathogens in their environment and engage in behaviors that prevent contact with those objects and people (Schaller, 2015). These mechanisms include sensory neural processes (Regenbogen et al., 2017) through which signs of the presence of infectious contaminants are perceived like odor and smallpox blisters (Zakrzewska, Olofsson, Lindholm, Blomkvist, & Liuzza, 2019). There is also stimulus-response systems that cue trigger response cascades, negative emotions, cognitive, and behavioral reactions (e.g. arousing disgust, automatically activating cognitions related to a disease threat, and avoidance behaviors) (Brown, Keefer, Sacco, & Bermond, 2019; Oaten, Stevenson, & Case, 2009; Park, Faulkner, & Schaller, 2003; Polák, Landová, & Frynta, 2019). Although this arousal of disgust is also present in non-infectious diseases and is part of the behavioral immune system (Šantić, Šantić, Radoja, & Jelinčić, 2020), studies have shown that they are more severe in infectious diseases and cause stigma in individuals (Kwagala & Hares, 2019). This feeling of disgust can even be present in the treatment staff in epidemic diseases (Wouters et al., 2020). The existence of a behavioral immune system has been confirmed in many animal species, including humans. There is a theory that the mechanisms that form the behavioral immune system, even in response to body odor (M. Z. Zakrzewska et al., 2020), have evolved as the first line of defense against disease-causing pathogens (Schaller, 2015). Therefore, the aim is to investigate whether the behavioral immune system is the same as the pathogen avoidance system or has a broader meaning.

Method

Procedure

To find authoritative articles and books in the field of pathogen identification through the behavioral immune system, using Google Scholar database, keywords such as disease avoidance, infectious diseases, stigmatization infectious diseases, search PubMed for the behavioral immune system, system over perception disease cues, and disease over perception bias were searched. All-time periods were used for the search, and more than two hundred documents were reviewed and extracted according to the following criteria. To select the documents, the titles found by the search engine were first examined in terms of thematic relevance. After reviewing the articles, they were selected and used as references. Regarding books, the selection criteria were thematic relevance and accessibility. After reviewing the title, the articles were evaluated in the next step in terms of the relationship between the abstract and the intended purpose. The selected books were thoroughly studied and finalized. The collected materials were divided and summarized.

Ethical statement

Because the article is in the form of a review, there were no special ethical considerations and all quotations were correctly stated.

Results

Recent research shows that people overestimate the symptoms they use to identify disease carriers. Although many diseases cause physical abnormalities in the body (e.g. skin rash, lesions, swelling), such symptoms can be complex and vary in different types of disease. As a result, instead of having strict rules about specific physical symptoms associated with the disease, people use a lower threshold to understand the symptoms that indicate a possible infection (Terrizzi Jr, Clay, & Shook, 2014). The feeling of vulnerability to infection leads people to extreme assumptions about what is a sign of disease (Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010). For example, when there is concern about getting sick, people tend to avoid obese people (Shakhar, 2019), facial symptoms, manifestations of aging (Regenbogen et al., 2017), physical disability (Ackerman et al., 2009), and foreign nationality (van Leeuwen & Petersen, 2018) by making it more predictable. As a result of this over-association of symptoms manifested in a person with an infectious disease, people have an overreaction. These reactions are created to protect against the threat of disease in the face of many groups of people who do not have a contagious disease. Just as the physiological immune system reacts to harmless substances to produce allergies, the behavioral immune system can develop a condition similar to "mental allergy" to a disease that is not contagious like obesity or aging. When people are vulnerable to infection, they react prejudicially to groups of people who think they have the disease and label them as socially sick (Faulkner, Schaller, Park, & Duncan, 2004). So we find that the behavioral immune system does not only work to identify pathogens but also its cognitive mechanisms to avoid obese people and even patients with non-infectious diseases like cancers. Also, people are prejudiced against and see certain signs of physical aggression (angry facial expressions) even if the person is not really angry (Clay, 2017; Huang, Sedlovskaya, Ackerman, & Bargh, 2011; Toth, 2019).

Therefore, considering the importance of the behavioural activation system in avoiding threatening conditions, especially during the epidemic of infectious diseases, we can also pay attention to the factors that activate the behavioral immune system (Gretz & Huff, 2019; Murray, Prokosch, & Airington, 2019). Inactivating the behavioral immune system, there are biases that activate this system under certain conditions. For example, when the environment is full of other people with infectious diseases, social interactions become very difficult and limit a person's ability to achieve important social goals (such as making friends or romantic relationships). Consequently, when the behavioral immune system is active, the extreme perception of the disease should be selectively applied. Evidence suggests that the behavioral immune system is activated by situational cues that indicate the need to protect oneself against disease. For example, reminders of the ease with which bacteria and germs can be transmitted from people in poverty and social exclusion increase the signals of possible infection (Armstrong, Engel, Press, Sonstroem, & Reed, 2019). In addition to experimenting with the effects of locally activated disease-related concerns, research also shows the variable of individual differentiation, i.e. perceived vulnerability to disease. This means that in addition to the fact that all people avoid sick people through the behavioral immune system, some people avoid interaction with other people because they feel to be more vulnerable. In general, it can be said that these people perceive themselves as more vulnerable than others or feel that their immune system is weaker than others (Regenbogen et al., 2017). People differ fundamentally as to whether they are susceptible

to the disease. While some people are concerned about transmitting infectious diseases from others to others, some are less concerned about potential disease threats. Even in the absence of other underlying diseases, people who are chronically concerned about infectious diseases show more biases in the behavioral immune system (Ackerman et al., 2009; Shakhar, 2019). According to this research literature, it is expected that even in the conditions of complete physical health (i.e. in the absence of pre-existing disease), a higher level of perceived vulnerability to the disease with a greater tendency of people to avoid situations of infectious disease is accompanied. In other words, how much people avoid infectious diseases and their symptoms in other people does not depend on their health but depends on their perception of their own health and safety. In contrast, those who perceive themselves to be less susceptible to the disease are less likely to be concerned about disease and therefore less likely to exaggerate prejudice against and consequently stigmatize patients (Schaller, Miller, Gervais, Yager, & Chen, 2010).

In summary, the findings show that there are three main mechanisms involved in the behavioral immune system. These systems include the emotional, cognitive, and behavioral systems (figure 1). The emotional system is the first system to be illuminated in the patient's observation situations. Feelings of disgust play a key role in the behavioral immune system, a set of disease prevention processes that is a front line of defense against pathogenic threats. The second system is cognition. This system is activated by thoughts that in contact with the sick person there is a possibility of getting sick. The third system is the behaviors that the person performs to avoid getting sick, for example when an infectious disease spreads, people avoid being in crowded places.

The body of research literature shows that the behavioral immune system is not limited to the detection of pathogens. This system has evolved to protect people from any danger and many mechanisms are involved in it. In fact, this system even reacts in contact with very old or obese people or of other nationalities and causes a feeling of

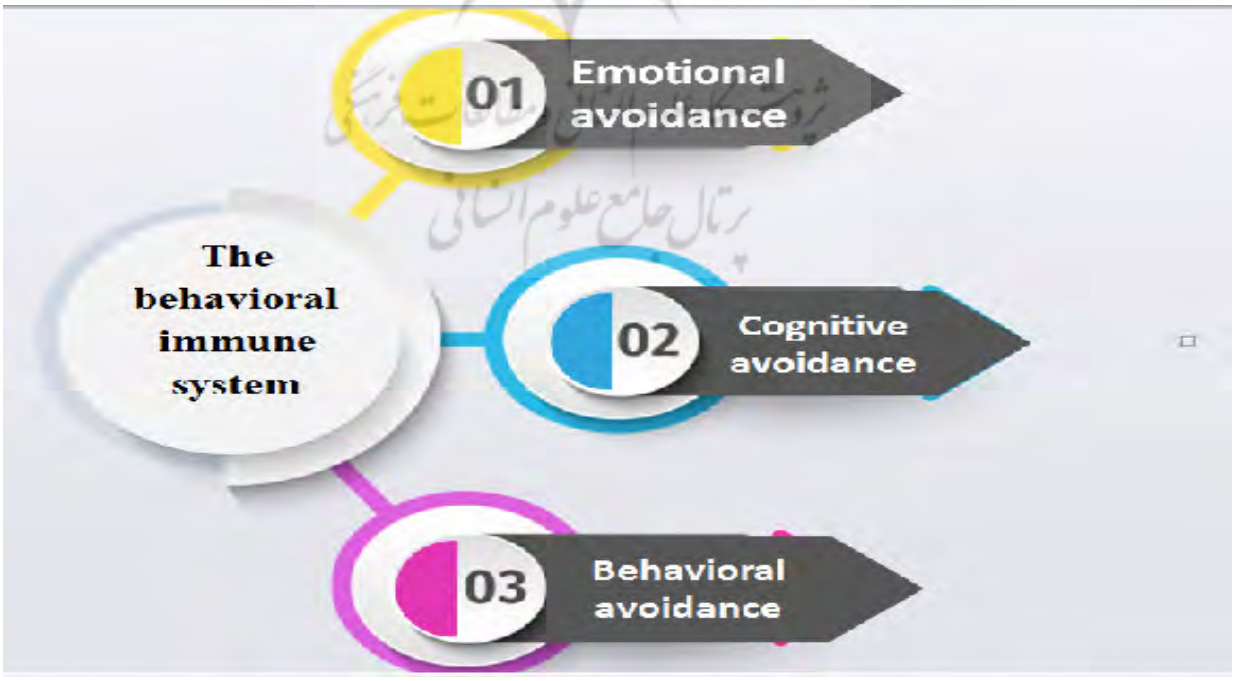

Figure 1: Behavioral immune system has three components: emotional, cognitive and behavioral

disgust. On the other hand, research findings show that this mechanism is involved in the self-healing of some organisms and their use of therapeutic plants. In addition to providing an alarm to the organism before infection, it plays an important role in the treatment of the disease and after the infection. In fact, this system serves as the survival system for organisms and only is not limited to the diagnosis of pathogens.

Discussion and conclusion

In recent studies, disgust is a major component of the concept of behavioral safety system (BIS). This system is an evolved set of disease prevention processes that serve as the first psychological line of defense against pathogenic threats in the environment (Schaller, 2006). The BIS is consisting of a collaborative suite of evolved psychological mechanisms that are responsible for (1) aversive emotional, (2) cognitive responses processing and inferring potential risks of infection through perceptual cues, and (3) motivating avoidance behaviors in order to neutralize the perceived threat (Culpepper, Havlíček, Leongómez, & Roberts, 2018). All three systems are intertwined and overlap and do not operate independently.

Today, although extensive studies have been conducted in the field of the behavioral immune system and it has been identified that it has different mechanisms and has a wide range of functions, there are many things we do not yet know about the behavioral immune system. For example, it may be valuable to know to what extent behavioral immune systems are involved in the development and content of people's intuitive theories about infectious diseases (Gassen et al., 2018).

It will also be more important to examine more closely the interrelationships between the emotional, cognitive, and behavioral responses that describe the behavioral immune system. The study of specific cognitive and behavioral responses is often independent of research on disgust (Murray & Schaller, 2016). It is not yet clear what the exact role of disgust is in the production of various cognitive and behavioral effects of the system, or whether some of these additional manifestations occur even if disgust does not respond. Some types of disgust seem to be associated with certain types of cognitive and/or behavioral responses (e.g. xenophobic responses to aliens), but disgust may be merely a causal prediction. In contrast, other preventative behaviors, such as compliance and non-compliance, may not be accompanied by immediate arousal. But this does not mean that disgust has no causal consequences for these behaviors. In fact, because of its effects on memory, attitude formation, and interpersonal communication, the experience of disgust at any given moment may have important causal implications for the effective establishment of these behavioral strategies in the long run (Ji, Tybur, & van Vugt, 2019).

Also, many inferential inputs that stimulate the behavioral immune system may be the output of an assessment system that evolves separately and operates on a wider range of sensory signals (Mitzel, Vanable, & Carey, 2019). But there may also be unique assessment mechanisms that have evolved to serve the function of identifying pathogenic signs. In this case, such mechanisms may act within certain sensory states, such as olfactory (Kurzban & Leary, 2001).

Finally, understanding the biological contexts of the behavioral immune system will be helpful. Research on physiological correlations with emotional experiences shows that disgust is evoked in response to pathogen-related stimuli and is associated with unique patterns of autonomic nervous system activity and neural activity (Zebrowitz, Fellous, Mignault, & Andreoletti, 2003). But little is known about the functional

connections between anatomical structures, neurochemical processes, and various cognitive and behavioral phenomena that are manifestations of the behavioral immune system. Even their genetic backgrounds are less known. Research has been done to document the genetic link between disgust and other potential variables, but we do not yet know much about the genetic basis of the system for exploring these psychological phenomena. To find more solid information about these phenomena in the context of human evolution, it would be useful to know about genetic information in the behavioral immune system that is activated by the pressures imposed by infectious diseases. Because this genetic information within the organism reveals unique elements of human physiology that make people learn a lot about the behavioral immune system and avoid prejudice and labeling when faced with diseases, and as a result avoid the psychological consequences associated with these stigmas.

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