Effects of Behavioral Immune System on Risk Taking:

The Case of Framing Effect

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ABSTRACT

The framing effect is a heuristic bias, where people respond to a question differently depending on the way in which the question is presented. In this study, we investigated the Behavioral Immune System (BIS), the behavioral defense barrier against infectious diseases, as a potential reason for people's irrational decisions. We tested if pathogen threat influenced people's risky decision making in different frames as a function of perceived vulnerability to disease (PVD), which is a self-report measure of BIS. We collected data from 924 participants, who were randomly assigned to one of three priming conditions: disease threat, negatively valenced threat, or no-threat. After priming participants were asked to respond to a framing question randomly chosen between two alternative frames: loss or gain. The results showed a three-way interaction between framing, disease threat, and PVD levels. That is, when people were primed with disease, those with lower PVD had a higher likelihood to take risks in the gain frame and a lower likelihood in the loss frame. Crucially, this relationship was observed only in the disease prime condition, and not in the negatively valenced prime condition. This suggests that although disease is inherently negative our results were due to the perception of disease but not any negative mood or cognition. The specific effect of BIS on risk taking and implications is argued from an evolutionary perspective.

Keywords: Behavioral Immune System, Framing Effect, Perceived Vulnerability to Disease, Risk Taking

ÖZET

Çerçeveleme etkisi, insanların bir sorunun gösteriliş şekline göre farklı cevaplar verdiği bir sezgisel yanlılık örneğidir. Bu araştırmada bulaşıcı hastalıklara karşı ilk defans hattı olan Davranışsal Bağışıklık Sisteminin (DBS) insanların irrasyonel kararlarında etkisi olup almadığını araştırdık. Etraftaki patojen tehditlerinin bireylerin Algılanan Hastalıklara Açık Olma (AHAO) ile bağlantılı olarak, kişilerin farklı çerçevelerdeki sorularda risk alımı üzerine etkisi olup olmadığı test ettik. 924 kişiden oluşan örneklemde, katılımcılar rastgele bir şekilde üç farklı çağrışım grubundan birine atanmıştır: hastalık tehdidi, negatif tehdit veya tehditsiz durum. Çağrışım manipülasyonu sonrasında katılımcılar iki farklı çerçeve sorusundan birisine atanmıştır: kazanç veya kayıp. Sonuçlar çerçeveleme etkisi, çağrışım manipülasyonu ve AHAO arasında üçlü bir etkileşim olduğunu göstermiştir. Hastalık tehdidi çağrışımı yapıldığında, düşük AHAO'ya sahip kişiler kazanç çerçevesinde daha çok risk alırken, kayıp çerçevesinde daha az risk almışlardır. Bu sonucun negatif tehdit durumunda olmazken sadece hastalık tehdidi durumunda ortaya çıkmış olması önemli bir bulgudur. Sonuçlar göstermektedir ki hastalıklar negatif olarak algınsalar da bizim sonuçlarımız negatif duygu ve bilişten farklı olarak sadece hastalıklara özel bir bulgu yansıtmaktadır. DBS'nin risk alımı üzerindeki etkisi ve olası çıkarımlar evrimsel bir perspektiften tartışılmıştır.

Anahtar Kelimeler: Algılanan Hastalıklara Açık Olma, Çerçeveleme Etkisi, Davranışsal Bağışıklık Sistemi

DEDICATION

To Sarıyer.

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Every creation has an image of its creator inside of it. I might be the one who has written this thesis but many others had part in shaping me to who I am. I want to thank everyone who had and will have a part in making the person who I am.

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CHAPTER 1

INTRODUCTION

People make thousands of decisions everyday, some of which may have unfavorable outcomes. Although the evolved psychological mechanisms help us to make optimal decisions, how these mechanisms work are not in a simple logic like mathematical equations. Different factors can influence these decision-making processes, such as contextual ambiguity or individual differences. In particular, *framing effects* are among the widely studied topics in decision making. The research on framing effects in decision making investigates how people can arrive at different decisions to the same question when the question presented in different ways, or frames. Although framing effects have widely been studied, still more research is needed. For example, little is known about the evolutionary roots of the mechanisms underlying framing effects in human decision making.

People have evolved mechanisms in their attempts to adapt to their environment, such as the physiological and behavioral immune systems. The main objective of these systems is to protect humans from possible infectious diseases and aid their survival. Therefore, human behavioral system is sensitive to pathogens that are potentially harmful to their health. The pathogens around us also affect peoples' decisions in a number of ways, such as with their mating, dietary, and even political choices. In particular, the effects of pathogens have not received much attention in the context of risk taking. The aim of this thesis is to study framing effects from a social psychological perspective, and investigate the people's perception of pathogen as an individual difference variable on framing.

In the following we will introduce the research on decision-making and the effects of

behavioral immune system on decisions. We will continue to discuss risky decisions and framing effects, and then present our questions about the effects of pathogens on framing. The reporting of the empirical study that addressed these questions will follow this.

1. Decision Making

People make more decisions each day than they can count. For instance, people may think that they make 15 food related decisions, however in reality they make almost 200 decisions that are only about the food they consume (e.g. "eat at table or on couch?", "add salt or not?"; Wansink & Sobal, 2007). Decisions are choices selected from a variety of options that are driven by their anticipated outcomes. There are different views of decision making process, and each make different predictions. One such view is the economics viewpoint stating that joy, pleasure, or satisfaction derived from an outcome of a decision is the *utility* of decision. An outcome that brings the most utility is normative, and people will strive to make the decision with the most normative option. The other viewpoint, which is advocated by psychologists, argues that people are not all that rational. These two different viewpoints offer two theories: the *Subjective Expected Utility Theory* (von Neumann & Morgenstern, 1944) and the *Prospect Theory* (Kahneman & Tversky, 1979).

Subjective Expected Utility Theory (von Neumann & Morgenstern, 1944) states that people make decisions by calculating the odds for the outcome of each option and anticipate the value for each option. The option with the highest weighting is likely to be chosen as it has the highest utility. For example, the theory assumes that people value money and thus when making a decision involving money the most lucrative option is going to be normative and therefore the preferable choice to make. Alternatively, the Prospect Theory (Kahneman & Tversky, 1979) offers an understanding about when and why people make irrational choices. Previously,

irrational decisions were considered noise, and not worth studying. According to the Prospect Theory people use outcome values just like claimed by the Expected Utility Theory. However, unlike in the Expected Utility Theory the outcomes and values are not identical for every person. People make judgments according to a subjective view, which makes every decision relative (Vohs & Luce, 2010). The notion that people are loss averse is a good way to illustrate the effects of reference points. Loss aversion is argued to be a part of a broader framework called '*bad is stronger than good*' (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Previous work has shown that people are affected by losses twice as much as they are by gains. As an illustration from an interpersonal relations study, couples needed to say five positive comments to neutralize the effects of a negative comment (Gottman, 2014). Although the values of gains and losses are the comparable, their psychological impact is evidently not. We avoid losses as much as we possibly can.

This argument offers much to the study of decision-making. Previous scholars defending the idea that decision-making as a rational process have overlooked the role of biases in human psychology. There are myriad potential influences on decision making and can explain some of the irrational tendencies and biases we observe. One such variable may be *pathogens,* microorganisms that cause diseases. Pathogens may have significant effects on our decision making process, a link that has not yet received much attention.

2. Evolution and Pathogens

Human behavior depends on complex psychological mechanisms. Evolutionary psychologists argue that these mechanisms are the result of evolution by selection as they offered solutions for some adaptive problem (Buss, 1995). The "best" mechanisms helped individuals avoid death, reproduce, and pass on their genes. The human mind is not a blank slate, nor a

sophisticated hardwired machine that simply reacts to the environment. It receives an information input, transforms it into an output through a process, and if the resulting behavior aids the individual's survival, it has solved that adaptive problem.

The fear of snakes is a good way to illustrate how these mechanisms work. The input in this mechanism is a long, slithering object within strike distance. Once the snake is perceived, the input goes through a process of decision rules that activate a behavioral output, such as fleeing or freezing (Marks, 1987). Another good illustration is individual preferences. Preferences motivate humans to seek things with a potential of providing resources, which are needed for survival or reproduction. As an example, people's preferences for landscape suggest that people prefer places without predators, parasites, and toxic foods and seek places with food, water, and low hazard risk (Orians & Heerwagen, 1992).

Adaptive evolutionary mechanisms are also manifest in decision-making processes. According to the Error Management Theory (Haselton & Buss, 2000), a theory concerning perception and cognitive biases in decision-making, when a person faces a problem and has to decide between their belief and the actual state of the world, there are usually four choice alternatives. Say the person has to judge if the long narrow object is a stick or a snake. Among the four cases two are correct decisions: correct detection or true positive (assuming the object is a snake and the object is a snake), and correct rejection, or true negative (assuming the object is not a snake when it is not). The other two cases are wrong decisions: False positive (assuming the object is a snake but it is actually a stick), and false negative (assuming the object is not a snake while the object is actually a snake). Error Management Theory states that, under uncertainty if the costs of false-positive and false-negative errors are different, an effective strategy would be going with the least costly error (Johnson, Blumstein, Fowler & Haselton,

2013). To illustrate, when deciding between whether a car is approaching when actually there is not, and assuming no cars are approaching when a car actually is, it is strategic to act as if there is a car approaching whenever we cross the road (McKay & Dennet, 2009). Smoke detectors provide another great example. Smoke detectors are calibrated to reduce the risk of false-negative errors. As an unavoidable result, they become sensitive to anything that resembles smoke, so they frequently make (irritating yet vital) false-positive errors (Schaller & Park, 2011). This is known as the "smoke detector principle"(Nesse, 2005). The behavioral immune system is a set of evolved mechanisms that adopts the same principle for biases in detection of pathogens (Schaller & Park, 2011).

3. Pathogens and Behavior

Infectious diseases are a powerful threat to human health and fitness (Schaller & Murray, 2008; Wolfe, Dunavan, & Diamond, 2007). In an attempt to increase the adaptive fitness of the human body humans have evolved a range of mechanisms designed to fend off this threat, including the physiological immune system. Although effective the immune system is a metabolically costly safeguard against diseases (Schaller & Park, 2011). To minimize these metabolic costs an additional set of mechanisms have evolved which promote specific behavioral responses preventing contact and transmission of infectious diseases. This system of behavioral responses, called the behavioral immune system, serves as the first defense barrier against pathogens (Schaller & Park, 2011; Murray, 2014). The behavioral immune system is sensitive to pathogenic cues. When detected, these cues activate adaptive psychological responses, such as attitudes, cognitions, and behaviors to reduce the possible disease threats (Schaller & Park, 2011; Tybur, Merriman, Hooper, McDonald, & Navarette, 2010). Ranges of fields, like food preparation, xenophobia, and personality, have been studying the effects of pathogen prevalence.

The use of culinary spices illustrates the behavioral mechanisms for preventing pathogens. Spices have natural antibiotic qualities, and, thus, their use in food preparation is functionally helpful in the defense against pathogens (Billing & Sherman, 1998). Accordingly, people use more spices in areas with high pathogen levels (Sherman & Billing, 1999). These results not only show that people manifest different behaviors in the presence of pathogens, but also that this difference in pathogen prevalence explains some of the cross-cultural differences.

The Behavioral Immune System Theory also predicts xenophobic responses, as they have been shown to increase by temporary contextual cues that make disease threat temporarily salient (Faulkner, Schaller, Park, & Duncan, 2004). Prejudice against individuals who are perceived to be potential carriers of pathogens or parasites, has an adaptive utility of avoiding possible harmful pathogens and parasites that can transmit through contact with those individuals (Kurzban & Leary, 2001; Park, Faulkner, & Schaller, 2003). Faulkner et al. (2004) suggest that in ancestral environments, where there were many hazardous pathogens for human health, an adaptive tendency would have been to avoid individuals who were possibly carriers of contagious diseases. Therefore, xenophobic attitudes are observed where there is a disease threat. In the same vein, a link between perception of pathogens and extroverted personality trait is also expected. Extroverted people tend to enjoy interactions with others who are possible carriers of pathogens. Consistent with the logic that possible risk of pathogens should be avoided, Schaller and Murray (2008) have reported that in regions that have historically suffered from high levels of infectious diseases, people report lower mean levels of extroversion.

Adaptive behavior patterns can also be socially learned. Socially learned norms provide buffers against specific risks and hazards, and collective benefits associated with social lifestyle require some level of conformity to these norms (Murray & Schaller, 2012). Individuals'

capacity to learn and to conform to local norms has likely served in limiting infection risk (Schaller, Murray, & Bangerter, 2015). According to the previous findings people seem to be more likely to conform in situations in which they feel especially vulnerable to risks. In an experimental study by Murray and Schaller (2012) participants were exposed to a manipulation that made salient their vulnerability to infectious diseases, other dangers, or to no dangers at all. After the manipulation conformity to majority measure was collected. People were found more likely to conform when the threat posed by infectious diseases was made salient.

Another topic that is linked with the BIS is sexual behavior. Life History Theory discusses how organisms allocate effort among various tasks necessary for survival and reproduction (Charnov, 1993; Kaplan & Gangestad, 2005). Accordingly, people who adopt faster strategies tend to make decisions that prioritize mating effort than people who adopt slower strategies. This strategy is plausible as pathogen prevalence is related to mortality risk, the risk of an organism perishing without a chance to reproduce. It has also been empirically shown that perceived pathogen load has an effect on women's desire for sexual variety (Hill, Prokosch, & DelPriore, 2015).

These studies have a common notion that behavioral mechanisms work to eliminate chances of exposure to situations that may risk survival. To die before reproducing, risk of getting infected by other people, or risk of making a decision with adverse consequences, are examples for how these mechanisms are at play. Although these examples involve risky decision-making, the link between pathogens and risk perception has received very little attention. Among a few exceptions, the study by Prokosch and Hill (2016) investigated the effects of disease priming and prophylactic acts on risk taking. Results showed that people were less likely to take risks when primed with disease threat, than when primed with a control

variable. In a second study, participants were asked to wash their hands after reading one of two scenarios. An increased willingness to take risks was observed compared to those who were originally presented with the disease scenario, as compared to the control scenario. An important question to be addressed in this emerging line of research is the effects of BIS on framing effects in risky decision making.

4. Risky Decision Making and Framing Effect

Risk has to do with uncertainty and loss (Lopes, 1983). People know about the risks they are facing from past experience. Economists explain risky choices in terms of computations of expected values, whereas psychologists describe individual differences in risk tolerance as compromises between avoiding failure and desire for success. In consumer research, risk is defined as uncertainty or consequences (Mandel, 2003). Research fields differ in their definitions of risk taking, however constructs like goals, values, options, and outcomes are factors they commonly include. These constructs determine the outcomes tracked by the individual, and the options to be considered. Put simply, risk taking is choosing from the options that could have negative consequences (Byrnes, Milller, & Schaefer, 1999).

As far as decision making process is concerned, besides the available options and their associated outcomes, the way the problem is portrayed, or perceived, is also known to influence the decision outcome. Tversky and Kahneman (1981) describe "decision frame" to discuss the decision makers' conceptualization of acts, and the contingencies that relate outcomes to acts. The frame decision maker uses is partly shaped by the formulation of the problem. In the original demonstration of this phenomenon Tversky and Kahneman (1981, p.453) used their famous Asian disease problem. The problem was presented in one of two versions.

Version 1:

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows: If Program A is adopted, 200 people will be saved. If Program B is adopted, there is 1/3 probability that 600 people will be saved and 2/3 probability that no people will be saved. Which of the two programs would you favor?

Version 2:

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs is as follows: If Program C is adopted, 400 people will die. If Program D is adopted, there is 1/3 probability that nobody will die and 2/3 probability that 600 people will die. Which of the two programs would you favor?

Both versions pose virtually the same problem. From a rational perspective there should not be any choice differences; however, the authors (ibid.) observed a trend to avoid risks in positive frame problems and a trend to seek risk in negative frame problems. These original findings opened up a new research line on the effects of framing. Other studies followed that employed different experimental paradigms (eg. gambling, the tax evasion design, the clinical reasoning). The converging finding was that many different factors contributed to the framing effects on risky decision-making, including risk, task, and participant characteristics (Kühberger, 1998).

Every person is unique so characteristics of the participants have an essential part on the study of framing effects. Consequently, many studies have been conducted to show how

individual differences affect the framing effect. One of the most studied variables was gender. In a study regarding condom use and framing a moderating effect gender was found to be present (Kiene, Bartha, Zelenski, & Cothran, 2005). Participants were asked to rate convincingness of message frames. Results suggested that while females had differences between their ratings in loss and gain frames, the same effect was not present for males. Another study about gender differences in voluntary public goods and framing found women to be more generous in their contribution than men in the negative-frame (Fujimoto & Park, 2010). Besides gender, "big five" personality traits have also been shown to influence framing effects. People low on conscientiousness and high on openness were more likely to choose the risky choices in framing conditions (Levin, Gaeth, Schreiber, & Lauriola, 2002).

Framing effects nonhuman species have also been subject to curiosity (see Marsh & Kacelnik, 2002). Chen, Lakshminarayanan, and Santos (2006) designed an experimental token economy paradigm in which capuchin monkeys could trade tokens with human experimenters in exchange for food. Monkeys could do the exchange with two experimenters who gave on average the same amount of apple pieces but differed in how they framed the final payoff. The gain-framed experimenter started by showing one apple piece and sometimes added another piece, and the loss framed experimenter who started by showing two pieces and sometimes removed one. Monkeys showed a greater preference for the gain frame experimenter over the loss frame experimenter. This finding suggests that framing biases have evolutionary roots that are shared across species (Santos & Rosati, 2015).

5. Perceived Vulnerability to Disease as an Individual Difference

Many threats to human life have shaped the human mind to be more adaptive and make the best possible decisions to avoid threats. Pathogens have been one of the most lethal threats in

humans' evolutional history, and people evolved BIS as a defense. It is highly plausible notion that BIS affects our decision making processes to avoid the threats of pathogens. Prospect Theory showed that decisions are relative for each situation and person, and the threat of pathogens can possibly influence decision biases in framing effects. Perceived vulnerability to disease (henceforth PVD), an individual difference measure of BIS, may be an individual difference that may show an effect on the framing effects.

People are not equally defensive against potential health risks. PVD is an individual difference variable that has been shown to predict behavior when threat of disease is salient (Murray, Jones, & Schaller, 2013). PVD is linked with health beliefs, big five personality traits, and disgust sensitivity (Duncan, Schaller, & Park, 2009). Experimental studies on mating behavior have also shown that PVD has effects on mating orientations and sexual variety. When disease threat was made salient PVD was negatively correlated with short-term mating orientation (Murray et al., 2013). Another study found that when women were shown a slideshow to increase disease threat the ones with high PVD ratings predicted a greater desire for a variety of partners (Hill et al., 2015). Also, it has been shown extraversion, a personality trait associated with higher risks of pathogen transmission, is negatively correlated with people's chronic germ aversion (Hamrick, Cohen, & Rodriguez, 2002; Duncan et al., 2009). Since we have evolved mechanisms to avoid possible losses and harms it is highly plausible that individual levels of PVD would influence the decisions they make on the framing effect problem.

In the present study we aimed to understand the relation of BIS and risk taking. To that end we addressed two questions. In the first one we asked if people who are under the threat of disease approach risks differently than those who are not. Second, we asked if people's perceived vulnerability to disease moderated this relationship.

CHAPTER 2

METHOD

1. Participants

A total of 924 participants contributed in the study (678 Female; Age range: 18–70 years, Mage = 24.18 years, SDage = 5.81). The study was run with Qualtrics, an online stimulus presentation program. The participants were reached using the social media and the Koç University Subject Pool. The social media participants were included a lottery for 25 TL worth gift card from a bookstore. Koç University students were offered extra course credit.

2. Materials

2.1. Priming condition

We used a priming manipulation to induce threat. Priming was included as between-subjects variable. Participants were randomly assigned to either of the disease threat, negatively valenced (or negative) threat, and no-threat conditions. In each condition a slideshow containing 8 colored pictures was presented. The disease threat prime condition had photographs of people with marked morphological or behavioral symptoms of infectious diseases (e.g. coughing, red eye). The negative threat prime condition had photographs of anger, riots, and people holding guns. In the no-threat condition household furniture was shown. Participants viewed each slide for a minimum of five seconds before they chose to move onto the next slide. As a priming manipulation check, we asked participants to write what they thought the slideshow was about.

A pretest was conducted to avoid arousal as a confound between negative and disease threat conditions. A separate sample of 38 people was asked to rate how arousing they found 41

pictures (21 for negative, 20 for disease conditions). Then 10 pairs of pictures were selected from the 41 matched for their arousal levels.

2.2. Framing Problem

Two experimental paradigms are used to study framing effects: classic vignette-based task (e.g. Asian disease problem) and a recently developed reward-based gambling task (De Martino, Kumaran, Seymour, & Dolan, 2006). These tasks have low convergent validity (Zhen & Yu, 2016), and therefore we chose to use the more common one, the vignette-based task. To assess the framing effect the Turkish version of the damaged paintings problem developed by Rönnlund, Karlsson, Laggnäs, Larsson, & Lindström (2005) was used (see Appendix B).

2.3. Perceived vulnerability to disease (PVD)

Participants completed the Turkish version of the 14-item PVD scale (Duncan et al., 2009; Cronbach's alpha = 0.78; Appendix C) to assess individual differences in perceived vulnerability to disease. The original questionnaire consists of two subscales: Germ Aversion and Perceived Infectability. Germ Aversion subscale includes 8-items measuring the discomfort of individual in situations that imply high likelihood of pathogen transmission (e.g., "It really bothers me when people sneeze without covering their mouths."). Perceived Infectability subscale consists of 7-items assessing their personal susceptibility to disease and illness (e.g., "I am more likely than the people around me to catch an infectious disease."). All ratings were made on 7-point scales (1= *strongly disagree*, 7= *strongly agree*). The scale was translated into Turkish with the back translation method. The item "I avoid using public telephones because of the risk that I may catch something from the previous user" of the germ aversion subscale was discarded because public telephones are not frequently used in Turkey.

3. Procedure

Participants were told they would participate in a study about individual differences and decision-making. All instructions and stimuli were presented through Qualtrics. The participants were first asked to sign the consent form, which was immediately followed by the experiment. The experiment consisted of two sections: the experimental section and the survey section. In the experimental section the participants were told that one of the aims of this study is to understand how information is presented, and were told that they will see some slides and asked to carefully view them. Then the software randomly assigned the participants into one of the three priming conditions: disease threat, negative threat and no-threat. Following this, the participants were again randomly assigned to one of the two-frame versions (Gain or Loss) of the damaged paintings problem where their assignment was to choose between a safe and a risky program. Then in the second section participants responded to the PVD scale and to demographic questions (Appendix D).

CHAPTER 3

RESULTS

A chi-square analysis was carried out as a preliminary analysis to test if the framing question worked. To test the sole effect of framing this test was performed only with participants who were in the no-threat condition. The relationship between *Frame Type* (Gain vs. Loss) and the *Option* chosen (Risky vs. Safe) was found significant (X^2 (1) =18.43, p <.01). The cross tab analysis (Table 1) revealed a trend, such that people in the loss frame condition were more likely to choose the risky option (56.6%) while people in the gain frame condition were more likely to choose the safe option (67.5%).

Table 1. *Cross tab analysis for factors* Frame *and* Option

	Gain Frame		Loss Frame	
Groups	N	%	N	%
Risky Option	50	32.5	90	56.6
Safe Option	104	67.5	69	43.4

Next, to confirm that the participants' PVD was not influenced by the priming manipulation, we conducted a univariate ANOVA with PVD as the dependent variable and priming (disease threat vs. negative threat vs. no-threat) as the independent variable. The results did not show an influence of priming manipulation on PVD levels, $F(2, 921) = .92$, $p > 0.05$.

To test our hypotheses we ran a four level hierarchical binary logistic regression analysis. We used the chosen decision option, risky vs. safe, as the dependent variable. The dependent variable was arranged as 0 for times the safe option was chosen and 1 for the times the risky option was chosen. The independent variable frame was arranged as 1 for loss frame and 0 for the gain frame. The other independent variable, priming was also entered as dummy codes and as

two different dummy variables (Disease and Negative). The no-threat condition was entered as 0 for both times. While the negative threat was entered as 1 for the Negative, Disease threat was entered as 1 for Disease. Negative threat was entered as 0 for the Disease while Disease threat was entered as 0 for the Negative. The continuous independent variable PVD was mean centered before prior to the analysis. The analysis regressed the risky option on *Prime*, *Frame*, *PVD*, and their interactions. At stage one, factors *Frame* and *Prime* were entered as dummy variables. At the second stage their interactions were added to the model. At the third stage *PVD* and *PVD*'s two-way interactions were included. At the fourth and final stage the three way interactions of *Prime*, *Frame*, and *PVD* were added. The log of odds, standard errors, odds ratios, and the effect sizes of the models are demonstrated in Table 2.

Table 2. *Hierarchical logistic regression analysis for predicting the choice of risky option.*

Variable	*B*	*SE B*	*(Exp)B*	Negelgerke R^2
Model 1				.045
Frame	0.751***	0.135	2.119	
Negative	-0.086	0.166	0.918	
Disease	-0.019	0.164	0.981	
Model 2				.048
Frame	0.998***	0.235	2.713	
Negative	0.121	0.245	1.129	
Disease	0.17	0.239	1.186	
Frame*Negative	-0.387	0.334	0.679	
Frame*Disease	-0.359	0.329	0.698	
Model 3				.050
Frame	1.015***	0.237	2.76	
Disease	0.192	0.241	1.145	
Negative	0.135	0.246	1.145	
Frame*Negative	-0.396	0.336	0.673	
Frame*Disease	-0.379	0.331	0.685	
PVD	-0.124	0.156	0.883	
PVD*Frame	0.144	0.153	1.155	
PVD*Negative	-0.085	0.185	0.919	
PVD*Disease	0.023	0.188	1.023	
Model 4				.059
Frame	0.992***	0.236	2.697	
Disease	0.164	0.246	1.115	
Negative	0.109	0.241	1.178	
Frame*Negative	-0.371	0.336	0.69	
Frame*Disease	-0.346	0.332	0.708	
PVD	0.097	0.195	1.102	
PVD*Frame	-0.27	0.267	0.763	
PVD*Negative	-0.261	0.281	0.77	
PVD*Disease	-0.441	0.272	0.644	
PVD*Negative*Frame	0.34	0.374	1.4052	
PVD*Disease*Frame	0.919**	0.382	2.506	

$^{**}p < .05$, $^{***}p < .01$

The analysis revealed that our fourth model had the highest explanatory value (R^2 = 0.59), which showed a framing effect (b = .992, $p < .01$), and also a significant three-way interaction of Disease, Frame, and PVD (b = .919, $p < .05$). This result indicates that the odds of choosing the risky option increased by 2.5 in one unit increase of PVD level for participants in the disease threat and loss frame condition. Previous studies had shown gender differences on PVD and as an individual difference that influences the framing effect in certain situations. Therefore, the same analysis was repeated for males and females separately, and no gender difference was found ($p < .05$).

Next, to thoroughly explore the influence of the PVD we divided our sample into two groups for PVD, relatively high (above median) and relatively low (below median). Then we conducted another binary logistic regression analysis where we regressed priming, framing, and their interactions on risky decision making in the two samples (Fig. 1). The variables were coded in the same way with the previous logistic regression analysis. For negative threat the interaction with framing was not significant for both PVD levels ($p > .05$). An interaction of disease threat and framing was present in the low PVD group. Low PVD people when primed with disease threat averted risk in the loss frame more so than in other priming conditions (b = -1.199, p = .008). This result revealed that for those who have a relatively low PVD, in the loss frame the odds of choosing the risky option decreases by .301 with one unit increase on the PVD level when people are in disease threat than other conditions. However, we did not find any effect of disease threat for people with high PVD ($p > .05$).

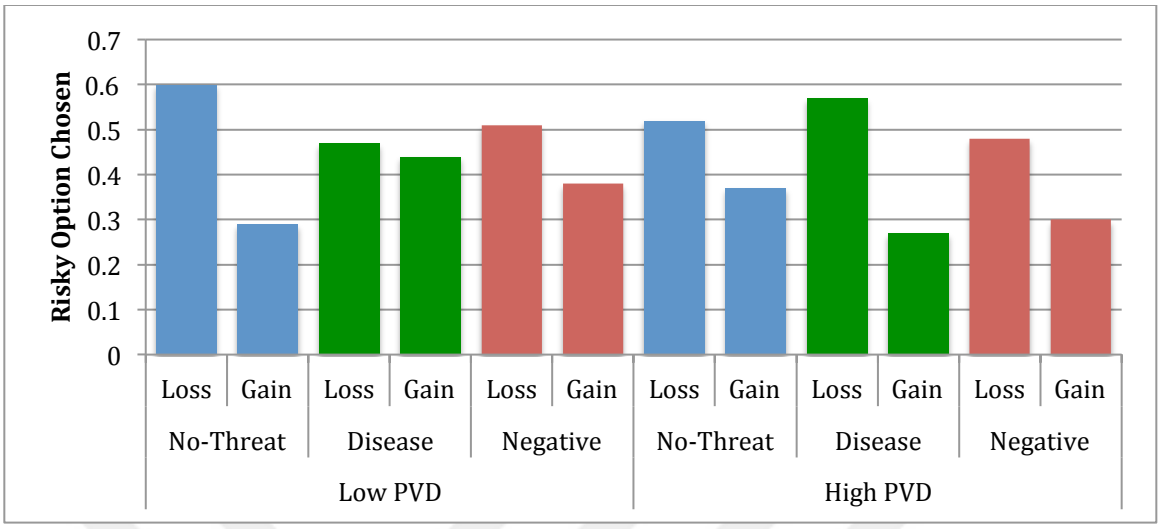

Figure 1. *Mean risky option chosen in Priming and Frame conditions, separately shown for low and high PVD participants*.

CHAPTER 4

DISCUSSION

This study aimed to identify a possible influence of the BIS on risky decision-making. Specifically the possible effects of disease threat and peoples' perceived vulnerability to disease on the framing effect was investigated. Our study revealed three major findings: (a) The framing effect was replicated. (b) An interaction of PVD and Framing manipulation was only present in the Disease threat condition. (c) In disease threat condition people with low PVD were inclined to choose the opposite option than the general sample.

People in the no-threat condition showed a standard framing effect, which replicated previous studies (Tversky & Kahneman, 1981; Cassotti et al., 2012). The finding showed that people tend to seek risks when in a loss frame, while they become risk averse when in a gain frame. The framing effect was previously been replicated in Turkey using the Asian Disease problem (Klein et al., 2014), yet this was the first time it was replicated using the Damaged Paintings problem. This result showed that this problem could also be used as a material to assess framing effect in Turkish samples.

We predicted an effect of our priming manipulation on the framing effect. To our surprise we did not observe a main effect of priming on risk taking. However, the interaction between priming and PVD which supported our prediction regarding individual differences. When primed with disease threat and those in the loss frame were more inclined to choose the risky option as their PVD levels increased. The crucial part of this finding was that the interaction effect was observed only in the disease threat condition and not the negative threat condition. This strongly indicates that our results were driven by the perception of disease *per se* and not any negative

mood or cognition. Consistent with this, a previous study also did not observe an effect of negative emotional context on framing effect when compared to a neutral context (Cassotti et al., 2012). Although "disease" is inherently negative, we found a difference between disease threat and no-threat, while there was no difference between negative threat and no-threat. This strongly suggests that people's perception of pathogen threat has a particular influence on how they respond to risky decisions as a function of their vulnerability to potential diseases.

When we explored the interaction between Frame, Prime and PVD we observed that people with high PVD levels differed in their choice of option in the disease threat condition from those with low PVD levels. While people with high PVD were more likely to choose the risky option in loss frame like others, people with low PVD were less likely to choose the risky option. This meant that the choice of the risky option was reversed for people with low PVD and in the disease threat.

One explanation for this surprising finding is that participants with low PVD may have perceived the disease prime in a different way than the others. In our priming manipulation we used pictures that would pose a threat of disease. For those who perceive themselves as relatively less vulnerable this prime could have prompted their sense of resilience to disease instead of prompting a sense of threat. While the findıng was unexpected, there is literature that can explain it. Firstly, we know that people's fear levels have an influence on their decisions against threats (Sadler, Lineberger, Correll, & Park, 2005). Of particular interest, one study has shown that after people were shown a clip of a threatening terrorist and were asked to indicate what policy should be adopted to defend against terror threat, those who were relatively more fearful preferred submission to terrorist's demands, while those with less fear preferred to fight against it (Iyer, Hornsey, Vanman, Esposo, & Ale, 2015). This suggests that whether it is the fight or flight

response that gets activated in a threating situation can affect how they will act accordingly. Low PVD people having being triggered with their resilience could have given a fight response rather than a flight response that could have led to this result. Future studies should investigate the effect of disease priming in individuals with low PVD with respect to fight or flight response to better understand such a link.

An important implication of our results concerns the medical professionals. The influence of framing effect on medical decision making has repeatedly been demonstrated (Gong et al., 2013), albeit with slight differences. For example, although some studies showed that people are persuaded more easily in positive framed conditions than in negative conditions, other researchers have presented conflicting results (Banks, Salovey, Greener, & Rothman, 1995; Detweiler, Bedell, Salovey, Pronin, & Rothman, 1999). Several modulating variables have been proposed (e.g. culture, visual aids) and argued that there are many more to be defined (Gong et al., 2013). Specifically, how relevant people find the framed question to themselves has been shown to be another modulator (McElroy & Seta, 2003). Our finding shows that people with low and high PVD levels show difference on framing effects. People's PVD level can be affecting how relevant people find the framing, or it can have a separate modulating effect of it's own. Exploring the possible effects of PVD on medical decision making and framing effect can be beneficial to understand the heterogeneity of findings.

We should also be mindful of the limitations of this study. We collected data from Turkish participants. Previous research on BIS had shown that pathogen prevalence has an influence on people's personality and group behavior (Schaller & Murray, 2008; Tybur et al., 2016). Data from other cultures and populations with higher or lower disease threat might reveal a different pattern of results. The cultures with high pathogen levels could be less likely to take

risks than our sample due to the higher possibility of disease risk. Another limitation concern our priming manipulation. As a main effect we had expected disease threat to decrease risk taking in gain condition and increase risk taking in loss condition, however we did not observe such a main effect. Alternative methods of disease priming such as additional olfactory cues, or verbal information in the form of vignettes (see Tybur, Frankenhuis, & Pollet, 2014) could also be considered in the future.

On the whole, this study provides strong support for the role of BIS on the framing effects. In pathogen threat and peoples' PVD levels affect how people consider risky decisions. More specifically we see that when primed with disease threat how people perceive framing effects differ according to their PVD. This result show us that while people live in a high-tech world, our evolutionary roots still affect our cognition.

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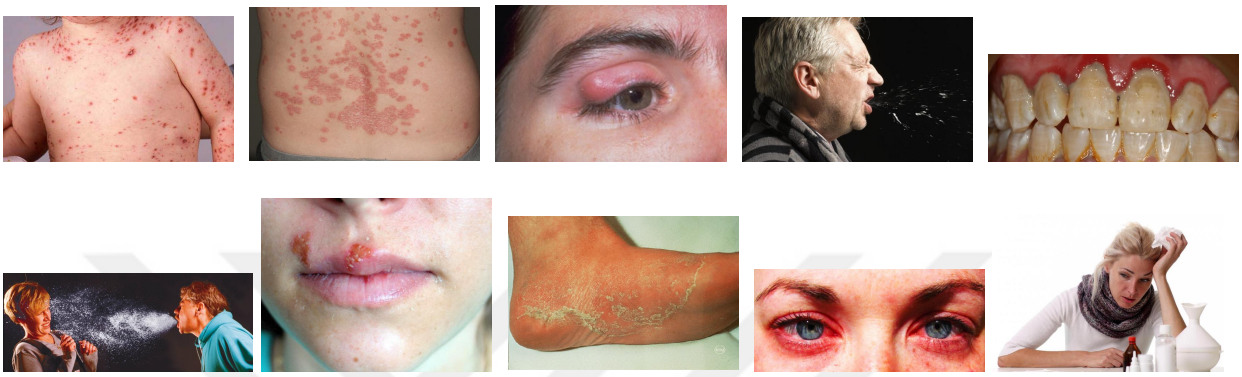
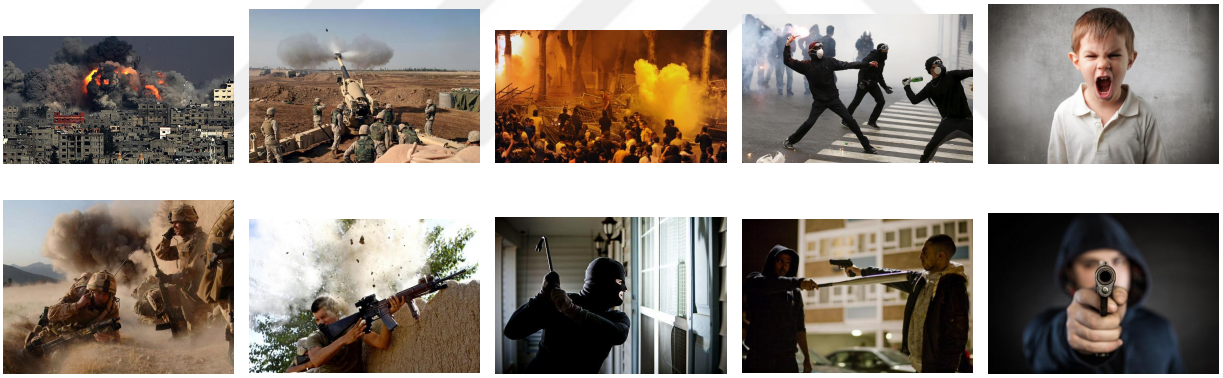
APPENDICES

APPENDIX A- PRIMING PHOTOGRAPHS

Disease Threat



Negative Threat



No-threat

APPENDIX B- DAMAGED PAINTINGS PROBLEM

Gain Frame:

Büyük bir müze çıkan bir yangın sonrasında tahrip olmuştur. Dünyanın en ünlü 600 resmi yok olma riski altındadır. Resimlerin kurtarılabilmesi için iki alternatif yöntem sunulmuştur:

Eğer A yöntemi kullanılırsa, 200 resim kurtarılacaktır.

Eğer B yöntemi kullanılırsa; 1/3 olasılık ile 600 resim kurtarılacak, 2/3 olasılık ile hiçbir resim kurtarılamayacaktır.

Siz hangi yöntemi seçiyorsunuz?

- A yöntemi
- B yöntemi

Loss Frame:

Büyük bir müze çıkan bir yangın sonrasında tahrip olmuştur. Dünyanın en ünlü 600 resmi yok olma riski altındadır. Resimlerin kurtarılabilmesi için iki alternatif yöntem sunulmuştur:

Eğer A yöntemi kullanılırsa, 400 resim yok olacaktır.

Eğer B yöntemi kullanılırsa; 1/3 olasılık ile hiçbir resim yok olmayacak, 2/3 olasılık ile 600 resim yok olacaktır.

Siz hangi yöntemi seçiyorsunuz?

- A yöntemi
- B yöntemi

APPENDIX C - PERCEIVED VULNERABILITY TO DISEASE SCALE

Aşağıda kişilerin bulaşıcı hastalıklara yakalanma olasılığı veya hastalık bulaşabilme durumlarında hissedebileceği huzursuzluk ile ilgili ifadeler verilmiştir. Bu ifadeleri 1 kesinlikle katılmıyorum'dan, 7 kesinlikle katılıyorum'a kadar size uygunluk durumuna göre işaretleyiniz.

Kesinlikle Katılmıyorum	Ne Katılıyorum Ne katılmıyorum	Kesinlikle Katılıyorum

(1)----------2----------3----------(4)----------5----------6----------(7)

1. İnsanların ağızlarını kapamadan hapşırması beni gerçekten rahatsız eder.
2. Eğer çevrede bir hastalık 'salgını' varsa ben de kaparım.
3. Bir arkadaşımla aynı su şişesini paylaşmakta rahatımdır.
4. Başka bir insanın daha önceden çiğnediği belli olan bir kalemle yazmaktan hoşlanmam.
5. Önceki tecrübelerimden gördüğüm kadarıyla arkadaşlarım hasta olsa bile ben hasta olmaya eğilimli değilim.
6. Kişisel tarihimde bulaşıcı hastalık geçirmeye yatkınlığım vardır.
7. Biriyle el sıkıştıktan kısa bir zaman sonra elimi yıkamayı tercih ederim.
8. Genelde soğuk algınlığı, nezle ve diğer bulaşıcı hastalıkları geçirmeye yatkınımdır.
9. Kullanılmış kıyafet giymeyi sevmem çünkü kıyafeti bir önce giyen kişinin nasıl biri olduğunu bilemezsin.
10. Benim bulaşıcı bir hastalığa yakalanma ihtimalim çevremdeki diğer insanlara göre daha olasıdır.
11. Para elledikten sonra ellerimi pislenmiş hissetmem.
12. Eğer çevrede bir soğuk algınlığı, nezle veya başka hastalık salgını varsa benim o hastalıklara yakalanmam olası değildir.
13. Hasta insanların çevresinde olmak beni tedirgin etmez.
14. Bağışıklık sistemim beni diğer insanların kaptığı çoğu hastalıktan korur.

APPENDIX D - DEMOGRAPHIC QUESTIONS

1) Cinsiyetiniz

- Erkek
- Kadın
- Diğer
- Cevap vermek istemiyorum

2) Yaş:_____

3) Doğduğunuz ay:_____

4) Eğitim durumunuzu belirtiniz

- İlkokul
- Ortaokul
- Lise
- Üniversite
- Yüksek Lisans
- Doktora

5) Kendinizi ne kadar dindar bir insan olarak tanımlıyorsunuz. (0 Hiç, 6 En Yüksek olacak şekilde değerlendiriniz.

Hiç 0----------1----------2----------3----------4----------5----------6 En Yüksek

6) Politik görüşünüzü değerlendiriniz. (1 Sol, 7 Sağ olacak şekilde değerlendiriniz.

Sol 1----------2----------3----------4----------5----------6----------7 Sağ

7) 9 basamaklı bir merdivende kendinizi Türkiye'deki diğer insanlarla gelir, eğitim ve meslek açısından karşılaştırdığınızda kendinizi hangi basamağa koyardınız (1 alçak 9 yüksek olacak şekilde değerlendiriniz).

1------2------3------4------5------6------7------8------9