THE BOOK OF LIFE IN THE DOUBLE HELIX: CULTURAL DIFFERENCES IN BIOLOGICAL BELIEFS

by

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Abstract

Biological beliefs posit that biological predispositions can sufficiently explain and predict human characteristics, behaviors, or other phenomena (e.g., Paul carries a gene for athletic abilities; he will become good at sports when he grows up.) In two studies consisting scenarios on a variety of developmental domains, participants from Canada and China evaluated the likelihood that a specific trait would develop in a character after reading about the genetic background of that individual. Results showed that, compared to Chinese, Canadians were more likely to rely on biological information in their developmental predictions. Some correlational evidence was found between participants' biological beliefs and their scores on the Belief in Genetic Determinism Scale. These findings were consistent with past cultural research on causal attributions, perception of change, and beliefs in effort and persistence.

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Chapter 1
Introduction

In the past three decades, molecular biology has come under the spotlight for its profound contributions to human genetic research (Conrad, 1997, 1999; Schaffner, 1999). The success of this endeavor has gradually influenced the way people explain various aspects of their life. For example, the following comments are commonly found in conversations these days: “I eat lots, but I never get fat. I guess I don’t have the fat gene”; “I can’t stop drinking. I probably inherited the ‘stuff’ from my alcoholic father”; “I can’t do math and neither can my family. It’s not in our blood.” These remarks, whether meant to be serious or humorous, reflect a strong tendency to use biological accounts to explain why people are the way they are. Whereas the study of human genome continues to sprout every day, the psychological consequences for accepting biological findings have just started to receive serious attention from psychologists (e.g., Brescoll & LaFrance, 2004; Dar-Nimrod & Heine, 2006). Even less is known about how this kind of information is endorsed in different cultures. The present paper attempts to shed light on this under-researched topic.

Biological beliefs, in their most extreme form, assume that human characteristics, such as physical features, personalities, health conditions, and abilities, are controlled exclusively by biological predispositions (Keller, 2005; Keller & Bless, 2004). At present, these predispositions are commonly conceived as hormonal, neurological, or genetic influences. Biological beliefs are not new, and their presence can be found throughout human history in one form or another. For example, the biological perspective has long found its spot in the classical “nature versus nurture” debate, in which innate qualities and personal experience are pitted against one another as the root of human development. Similarly, in some early civilizations, such as Ancient Egypt or Ancient China, people were convinced that the exalted and noble characteristics of the Emperors and their descendents were bound to their blood. Nobility was believed to come by birth, and the only way to possess it was by heredity (Trigger, 2003). Another example is the eugenics movement in the early twentieth century, which was based on a similar notion that important human traits are biological and hereditary by nature (Rothstein, 1999; Proctor, 1988).

Central to biological beliefs is the notion of immutability. That is, they assume that a trait is expected to unfold into its genetically designated form regardless of environmental interventions. In this respect, biological beliefs are in conflict with myriad activities people do in everyday life. When people decide to stay away from cigarettes, consume low-calorie food, practice the piano, or offer their kids a warm home, they are doing so under the assumption that these strategies can lead to desirable developmental outcomes. Whether or not these lifestyle choices are deemed effective or irrelevant to developmental success largely depends on the perceived importance of biological predispositions. The study of biological beliefs, thus, is more than just an intellectual pursuit, because the extent to which people subscribe to these beliefs can alter the significance they attach to environmental interventions, which can, in turn, influence their decisions to carry out these practices.

This paper investigates contemporary cultural differences in biological beliefs between Canadians and Chinese. Public opinions on human development, at least those in these two cultures, appear to have wavered back and forth between the biological and environmental views throughout their respective strand of history. For instance, there were times when Chinese believed that personalities and social status are somewhat fixed at birth (a nature view) and, at other times, when environmental factors were deemed critical to developmental success (a nurture view). Similarly, the perceived importance of social experience, such as parenting styles or learning environments, has varied from time to time in Canada and the United States, possibly under the influences of the respective progress of biological scientists and social theorists (Nelkin

& Lindee, 1995). Whereas the prevalence of biological beliefs changes over time within Canadian and Chinese cultures, the recent accomplishments of human molecular biology seem to promote these beliefs by offering biological explanations for an endless list of human phenomena. This paper, thus, attempts to examine the extent to which these beliefs are endorsed by these two cultures at present, when claims of biological or genetic evidence are widely accessible to the general public.

Before introducing my research hypothesis and studies, I will first review three interrelated areas of research comparing North Americans with East Asians. In this paper, the term "North Americans" primarily refers to Americans or Canadians of European descent, whereas "East Asians" mostly represents people from China, Japan, and Korea. The three lines of research of interest are lay theories of causality, lay theories of change, and lay beliefs in effort and persistence, all of which are closely related to lay theories. They are examined in details in the following sections.

Chapter 2

Literature Review

Lay Theories

Like scientists who construct formal theories to explain phenomena, laypeople also form lay theories to guide their everyday thoughts and behaviors. Lay theories, sometimes called implicit theories, are fundamental cognitive frameworks that people rely on intuitively to process social information (Dweck, Chiu, & Hong, 1995a; Jones & Nisbett; 1972). Different lay theories have different basic assumptions and focuses; thus, when it comes to interpreting an event, two people who do not share the same lay theory are expected to show divergence in the types of information they attend to (i.e., perception) as well as the ways such information is processed (i.e., cognition). The systematic discrepancy in their perceptual and cognitive tendencies in turn affects the way they respond in more specific judgment tasks, such as causal attributions (Choi, Nisbett, & Norenzayan, 1999), trend predictions (Ji, Nisbett, and Su, 2001), visual covariation detection (Ji, Peng, & Nisbett, 2000), object categorization (Ji, Zhang, & Nisbett, 2004), arguments evaluation (Peng & Nisbett, 1999), social groups perception (Yzerbyt, Judd, & Corneille; 2004), and so on. There are individual differences in lay theories, but their prevalence also varies from culture to culture. The following discussion will focus on cultural differences in lay theories of causality and lay theories of change.

Cultural Differences in Lay Theories of Causality

Generally, North Americans approach causal problems very differently from East Asians. In particular, North Americans tend to explain causal events with reference to the internal attributes or dispositions of the target object, a form of lay theories known as dispositionism (Fiske, Kitayama, Markus, & Nisbett, 2001; Nisbett, 2003). Dispositionism is in sharp contrast to situationism[1], a pervasive lay theory in East-Asian cultures in which causal explanations are primarily derived from the environment surrounding the target object (Choi et al., 1999; Fiske et al., 2001; Hirschfeld, 1995; Morris & Peng, 1994). In the context of explaining behaviors, North Americans frequently look for the internal qualities such as personalities, attitudes, or motives within the actor as the basic units of analysis, whereas East Asians focus more on the relationships between the actor and the surrounding contexts.

Cultural divergence in explanations is apparent in events involving human agents. For example, Morris and Peng (1994) examined American and Chinese newspaper reports on two comparable murder cases. As predicted, American journalists were more attentive to the dispositional causes of the perpetrator (e.g., his troubled attitudes, mental instability, and personality foibles.) Chinese journalists, in contrast, were more interested in speculating the situational factors that might have triggered the crime (e.g., poor relationship with his advisor and isolation from his peers.) In a similar study, Lee, Hallahan, and Herzog (1996) analyzed the ways American and Hong Kong newspapers explain sports outcomes. Consistent with previous findings, American columnists placed more emphasis on the internal qualities of the players than the journalists from Hong Kong, who included more situational considerations when they were explaining the same events.

Causal explanations by North Americans and East Asians are dissimilar when the target person is a stranger who they know very little about. Their respective preference for dispositionism and situationism also extends to events involving someone they are familiar with, such as their acquaintance. For instance, when teachers explained misbehaviors of their students, Australian teachers, who were believed to think similarly to North Americans, were found to place stronger weight on the students' lack of abilities than Hong Kong teachers, who viewed

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[1] Sometimes called *contexualism*.

family factors as more important to the students' problems (Ho, 2004). In addition, Yang, Phillips, Licht, and Hooley (2004) found that the relatives of schizophrenic patients in America were more likely to draw dispositional conclusions about the victims' illness, whereas environmental causes were more appealing to their Chinese counterparts.

North Americans and East Asians also assign responsibilities differently to animal behaviors. In one study, Morris and Peng (1994) presented animated cartoons of a group of fish to American and Chinese students. One fish was of different color, and students were asked to describe the movements of this fish. As expected, American students showed a stronger tendency to describe the target fish in terms of internal characteristics (e.g., "the fish swims to look for food"). On the other hand, responses from Chinese students were marked by contextual details external to the fish (e.g., "the fish was chased by other fish"). The same pattern of results emerges even in the causality of physical events. American students who had no formal training in physics made more references to the target object (e.g., shape and weight), an attributional style corresponding to their dispositional tendency. In contrast, Chinese were more likely to perceive causality as deriving from factors external to the target object (e.g., gravity, friction, and medium), a reasoning strategy that reflects situational thinking (Morris & Peng, 1994).

The above discussion describes the qualitative differences in the ways in which past events are interpreted and accounted for by North Americans and East Asians. Will cultural variations also arise in the way they look into the future? The next section will review the literature on future predictions.

Cultural Differences in Lay Theories of Change

A growing body of research indicates that North Americans and East Asians, particularly Chinese, hold dissimilar beliefs on how the future unfolds. In particular, North Americans tend to endorse a linear theory of change, in which events, people, or relationships are expected to develop in the same rate or direction as they have in the beginning. On the contrary, Chinese tend to endorse a nonlinear theory of change: they are more likely than North Americans to expect a trend to deviate from its initial propensity or to progress in its opposite direction (Ji, 2005, 2008).

North Americans and Chinese have different views regarding how large-scale events evolve. In a series of experiments conducted by Ji, Nisbett, and Su (2001), American and Chinese students read fictitious historical trends of a variety of social events, ranging from the growth rate of the world economy to the global death rate for cancer. In general, these events were designed in such a way that the trends were either developing in a positive (growing) or negative (decaying) direction. Participants' task was to predict how each of these events would progress. Consistent with their hypothesis, the researchers found that Americans frequently expected trends to grow or decay in the same direction as they did initially, hence evidence for a linear theory of change. In contrast, it was more common for Chinese students to expect trends (both growing and decaying) to develop reversal patterns, suggesting that a nonlinear theory of change was more natural to Chinese. Additional support was obtained in a stock simulation study, in which participants had to make transactions based on the changes in stock price (Ji, Zhang, & Guo, 2008). The results were interesting: whereas Canadians decided to buy stocks when the price trend was rising and sell when the trend was declining, Chinese did the opposite, meaning that they were motivated to buy at a descending trend and sell at an ascending one. Such decisional pattern was best explained by their respective beliefs in event developments: the Canadians, because of their linear theory of change, expected price trend to progress in correspondence to its propensity, which offered them no reason to buy falling stocks or to sell rising ones. To Chinese, their nonlinear theory of change has prepared them to anticipate reversal developments in stock price, which explains why they saw hopes in falling stocks and dangers in the rising ones.

North Americans and Chinese also form different prospects on how interpersonal events would develop. Ji and colleagues (2001) presented American and Chinese students some social events and ask them to predict how likely an opposite outcome would occur. For example, after reading about two children fighting each other in their kindergarten years, participants were asked to predict how likely these two children would become lovers in the future. Consistent with what a linear theory would predict, Americans on average assigned lower likelihood ratings to these events than did Chinese, suggesting that they expected interpersonal relationships to develop in the same way as how they begin. In contrast, a nonlinear theory of change renders reversal development more probable to Chinese, a reason for why they were more likely to predict opposite outcomes in the same events.

Cultural differences in lay theories of change permeate into the perception of human development as well. Specifically, Americans and Canadians are more likely than Chinese to expect consistent changes in talents, traits, and behaviors. For example, when Americans and Chinese were asked to predict how likely a chess champion will lose to his strongest opponent next game, higher probability ratings were found in the Chinese than in the American sample (Study 1 in Ji et al, 2001). In another study, Canadian and Chinese students made developmental predictions on a person's attributes at ten-year intervals. Again, Canadians were more likely to anticipate linearity in the person's growth, whereas nonlinear or reverse predictions were more characteristic of Chinese (Ji, 2005).

Finally, at least two experimental studies have addressed the role of cultural learning on lay theories of change. In Ji's (2008) study, Canadian and Chinese children of different age groups were recruited from Canada and China respectively. They were asked to make predictions on some scenarios in different domains such as abilities, emotions, friendships, and fortune. The results revealed a clear socialization effect. Specifically, responses from the two cultural groups did not differ statistically at the age of seven. However, marginal differences started to emerge in the nine-year-old groups and eventually became statistically significant in the eleven-year-old cohort, with the Canadian children exhibiting more linear expectations and the Chinese showing more nonlinear ones. Another source of evidence came from Koo and Choi (2005), who asked Korean students to predict the outcomes of a series of social phenomena. These students were majors in either psychology or Oriental medicine, a discipline that emphasizes cyclic changes in its teaching. As predicted, Oriental medicine students who were trained to reason in a cyclic perspective showed more nonlinear thoughts than those who were in psychology, a finding that offered further support to the idea that cultural experience can shape the perception of change.

Thus, whereas the future resembles a beam to North Americans, it looks more like a wave to East Asians, particularly Chinese. Things are more changeable in the eyes of East Asians, including the quality of performance and developmental outcomes. For example, Chinese maintain that a past success does not guarantee future achievements, and that a past failure may motivate a person to succeed in the future. The idea that a positive attribute not found in childhood may eventually appear in adulthood is also more convincing to these individuals. Research has shown that these beliefs held by Chinese are closely related to their cultural views on effort and persistence, a topic to be discussed in the next section.

Cultural Beliefs in Effort and Persistence

Cultural observers have suggested that, in North-American culture, achievements are usually followed by praise (Baumeister, Campbell, Krueger, & Vohs, 2003; Ji, 2008; Heine et al., 2001). When doing well on a task, North-American children generally expect and receive feedback such as “Well done!” or “Great work getting an A on the exam!” However, this practice is far less common in traditional Chinese culture, because it is believed that praise and superlative remarks may cause conceit in children and thus impede their future success (Salili, Hwang, &

Choi, 1989). As a result, praise for success, if any, is often outweighed by comments that stress the achiever's inadequacy and the need for further effort (Ho, 1981). Typical reactions from Chinese parents or teachers are "Well done, *but* you have to work harder next time to get perfect" or "Keep up with your grades or else others will surpass you." These accounts seem to suggest that effort and persistence are not emphasized equally in these cultures.

Much empirical research on effort and persistence has been conducted in the context of academic learning. An early investigation has shown that when Hong Kong students imagined themselves solving a math problem successfully, they were more likely to attribute the achievement to effort than to innate abilities (Salili et al., 1989). Subsequent cultural comparisons also revealed a stronger alignment between effort and academic success in Chinese than in Americans (Stevenson & Lee, 1996; Stevenson & Stigler, 1992). For instance, when explaining the academic excellence of their children, Chinese and Japanese mothers assigned greater importance to hard work than their American counterparts, who focused more on the children's natural talents (Stevenson et al., 1992). Conversely, the lack of effort was believed by Chinese mothers to be the culprit of poor mathematic performance in their children, whereas American mothers tended to question equally their children's innate abilities and effort (Hess, Chang, & McDevitt, 1987).

Cultural studies of effort and persistence also extend beyond academic settings to other developmental domains. For example, a comparison between Japanese and American participants of different age groups has shown that, in general, the Japanese were more optimistic in correcting their negative traits, and they were also more likely to think that effort is the reason that traits are expressed differently among people. In contrast, American participants in general perceived greater trait stability in the process of development, meaning that they were convinced that the present states of traits, whatever they are, are good predictors of future ones (Lockhart, Nakashima, Inagaki, & Keil, 2008). Collateral evidence was obtained from a study conducted by Heine and his colleagues (2001), in which American and Japanese students were asked to estimate the role of effort on a wide range of traits such as intelligence, musical ability, teaching ability, athletic ability, and programming ability. The researchers found that relative to the Americans, the Japanese were more likely to attribute the mastery of these traits to effort. To the Japanese, the compensatory relationship between effort and success appears to be more definite: by trying hard enough on something, one will become increasingly better after each attempt and, eventually, success will arrive. Effort and persistence, in short, seem to be more crucial to developmental success for East Asians than they are for North Americans.

In sum, the many cognitive frameworks used by North Americans and Chinese to solve everyday problems appear to be qualitatively distinct from one other. First, whereas North Americans tend to interpret social behaviors as reflections of the actor's internal attributes, East Asians are more likely to incorporate environmental factors in their causal explanations. Second, North Americans have a stronger tendency to predict event developments as linear, whereas East Asians, in particular Chinese, often predict that events will progress in a nonlinear fashion. Finally, the association between effort and successful developmental outcomes is more explicit in East Asians than it is in North Americans. These three lines of cultural research provide a theoretical basis for the present investigation of biological beliefs.

Present Research

The present studies examined biological beliefs in Canadians and Chinese. Each of the research areas discussed above predicts that Canadians would be more likely to endorse biological beliefs than their Chinese counterparts.

First, given that Canadians and Chinese are characterized by different causal lay theories, it is possible that such cultural preferences would translate into their endorsement of biological beliefs. I argue that the lay theory of dispositionism, the hallmark of thinking in many Canadians, is highly similar to biological beliefs in terms of its basic premises, which render biological beliefs more readily acceptable to Canadians than Chinese. Specifically, in the context of explaining social behaviors, both biological beliefs and lay dispositionism are likely to explain behaviors with reference to the properties within the actor while denying the role of environmental influences. So, if asked to explain why John enjoys bullying younger students at school, a dispositionist answer would be "because John has an aggressive personality," whereas a response pertaining to biological beliefs would be "because John has the genetic tendency for aggression." At the same time, these two accounts would probably downplay the environmental factors that might have caused John's behavior (e.g., "John bullies to release his hatred caused by his troubled parents"). Since environmental factors are important considerations in the causal reasoning of Chinese, biological beliefs should be less appealing to them.

Secondly, the linear theory of change, another prevalent notion found in Canadians, also goes hand in hand with biological beliefs. Specifically, biological elements can be conceptualized as the developmental propensities for traits. So according to a linear theory, if a person carries a particular genetic element, the potential of developing the corresponding trait is high, and thus the chance of this person developing that trait should also be high. Conversely, if a person lacks a particular genetic element, this person also lacks the potential to developing that trait, so the chance of developing this trait should be low. In contrast, Chinese who primarily endorse the nonlinear theory of change are inclined to see trends to deviate from their original propensity. To them, it is not unusual for human development to deviate from its genetic potentials. As a result, carrying the biological elements for a particular trait does not necessarily lead to the actual development of that trait. Similarly, lacking the biological substances for a trait does not necessarily predict the absence of that trait either.

Lastly, the cultural ideology of effort and persistence in Chinese leads to the prediction that biological beliefs would be lower in Chinese than in Canadians. To Chinese, biological endowments are not a decisive factor for developmental success, because inadequacy in the biological background may be compensated for by extra effort. The compensatory relationship between effort and success, however, is not as salient for Canadians, which suggests that their emphasis on biological predispositions should be higher.

Thus, I hypothesized that biological beliefs would be stronger among Canadians than Chinese. In the context of the present research, Canadians should be more likely than their Chinese counterparts to use biological predispositions as clues to guide their developmental predictions. Two studies were conducted to test this hypothesis.

Chapter 3

Study 1

Study 1 measured participants' biological beliefs with four scenarios. In addition, the Belief in Genetic Determinism Scale (BGD Scale; Keller, 2005) was employed to measure their belief in genetic determinism, a notion that is conceptually similar to biological beliefs.

There is a reason to include both the scenarios and the BGD Scale despite their conceptual similarity. According to Peng, Nisbett, and Wong (1997), using scale measures in cross-cultural comparisons is susceptible to a number of methodological concerns, one of which is whether the scale items developed in one culture is equally applicable in another cultural context. Problems can arise when the cultural groups of interest do not interpret item keywords or phrases in the same way. This confound can compromise the validity of the scale and, consequently, the interpretations of results. Peng and his colleagues (1997) recommended the use of concrete behavioral scenarios, which haven been shown to produce greater validity in cross-cultural research. Following their guidelines, I thus developed a number of scenarios to measure biological beliefs. I also decided to include the BGD Scale for exploratory purposes, without making explicit predictions regarding cultural comparisons on the scale.

Participants in Study 1 responded to four scenarios, in which a gene was either described as present in or absent from the target character. Participants' task was to predict how likely it would be for the target person to develop in the future the skill or attribute associated with the gene. These likelihood ratings served to represent participants' biological beliefs. I hypothesized that biological information in the scenarios would have greater influence on the likelihood ratings of Canadians than those of Chinese. Specifically, relative to Chinese, Canadians should predict a higher likelihood for an attribute to develop with the presence of the gene, and a lower likelihood for an attribute to develop with the absence of the gene.

Method

Participants

One hundred and forty-four students participated in this study. The sample contained 55 Canadians (20 males and 35 females; mean age = 20.9 years) from Queen's University in Canada, and 89 Chinese (46 males and 43 females; mean age = 18.7 years) from Huazhong Normal University in China.[2] Primary language, defined as the language participants speak at home, was English for all Canadian participants and Chinese (Mandarin) for all Chinese participants. The Canadian sample received half a course credit for their participation, whereas the Chinese received a small gift.

Materials

Biological Beliefs. Four scenarios measured biological beliefs. The traits of interest were artistic ability, diabetes, alcoholism, and nurturance tendency (see details in Appendix A). Participants were randomly assigned to either one of the two experimental conditions: gene present or gene absent. In the present condition, a particular gene was described as being present in the target character in each scenario. In the absent condition, the same gene was absent from the character. Participants' task was to predict, on a scale from 1 (highly unlikely) to 8 (highly likely), the extent to which the corresponding traits or attributes would develop in the characters later in their life. A sample item is as follows:

In a study using twins as subjects, genetic scientists found that people with a particular gene often have higher artistic ability, such as the ability to paint.
Sally, a grade-two student, has the particular gene for painting ability.
How likely do you think Sally will be good at painting when she grows up?

Genetic Determinism. Keller's (2005) Belief in Genetic Determinism Scale (BGD Scale, as shown in Appendix B) measures the belief that human phenomena are predetermined by genetics, a construct that is conceptually similar to biological beliefs measured by the scenarios. Past research has shown that the BGD Scale has high internal reliability ($\alpha = .85$) and produced one dominant factor which, on average, accounted for 29% of total variance. This factor represents the biological component of psychological essentialism, or the belief that social categories have underlying, unchangeable essence that makes them what they are. Example items in this scale are "I believe that many talents that individuals possess can be attributed to genetic causes" and "In my opinion, alcoholism is caused primarily by genetic factors." Participants indicated their agreement with each of the 18 items on an eight-point scale (0 = strongly disagree, 7 = strongly agree). Items 6, 8, 10, and 14 were reversely coded. This scale was included as another measure of biological beliefs.

Demographic data. Participants reported their gender, age, and the number of biology-related courses they had completed prior to their participation. In addition, they also evaluated themselves on the four traits that appeared in the biological beliefs scenarios. These self-perception questions were prepared to control for any self-serving effects that might have influenced how participants responded to the scenarios. For artistic ability and nurturance tendency, participants were asked whether they were "good at painting" and whether they were "a nurturing person." They rated their answers on a scale ranging from 1 (definitely not) to 8 (definitely yes). For diabetes and alcoholism, participants indicated whether or not they were diabetic or alcoholic by answering "yes" or "no." I also asked participants to estimate the number of times they had read about biological research from newspapers, magazines, online resources, or textbooks in the past six months. Finally, participants expressed their opinions on the extent to

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[2] Gender had no significant effects, $F < 1$, *ns.*, and thus was not included in further analysis.

which biological predispositions influence various developmental categories, including personalities, physical characteristics, talents, and diseases. They rated their answers on a scale ranging from 1 (very little influence) to 8 (very big influence). See Appendix C for details.

Procedure

Participants answered the biological beliefs questionnaire before the BGD Scale. Demographic information was collected at the end of the questionnaire. After the experiment, participants were thanked, debriefed, and compensated.

For Chinese participants, all materials were translated into Chinese before they were administered. The translation was verified independently by three researchers proficient in both languages. The same procedure was carried out in both studies reported in this paper.

Study 1 Results

Data Transformation

For each participant, the likelihood ratings were averaged across four biological beliefs scenarios to produce a single prediction score (the internal consistency among the scenarios was $\alpha = .79$ for Canadians and .35 for Chinese, respectively). Their individual scores on the BGD Scale were also averaged ($\alpha = .72$ for Canadians and .81 for Chinese, respectively). In addition, participants' frequency reports of their exposure to various media channels were summed. These new variables were used in subsequent analysis.

Hypothesis Testing

The main hypothesis of this study was that relative to Chinese, Canadians would predict that a particular trait be more likely to develop when the corresponding gene is present, and less likely to develop when the gene is absent. To test this hypothesis, a 2 (culture) x 2 (gene condition: present vs. absent) analysis of variance (ANOVA) was performed, with the average likelihood ratings in the biological beliefs scenarios as the dependent variable. There was no significant culture main effect, $F(1, 140) < 1$, $p = .71$. The respective means and standard deviations for Canadians were 4.65 and .89, and for Chinese, 4.59 and .89. The main effect of condition was highly significant, $F(1, 140) = 50.88$, $p < .0005$, $\eta_p^2 = .27$, indicating that participants in general predicted the traits to be more likely to develop in the gene present condition ($M = 5.17$, $SD = .91$) than in the gene absent condition ($M = 4.08$, $SD = .92$). More importantly, a significant interaction emerged between culture and condition, $F(1, 140) = 42.54$, $p < .0005$, $\eta_p^2 = .23$. As shown in Figure 1, Canadian participants were more likely to predict that the traits would develop in the present condition ($M = 5.69$, $SD = .80$) than in the absent condition ($M = 3.61$, $SD = .70$), $t(53) = 10.19$, $p < .0005$, indicating that their developmental predictions indeed corresponded with the presence or absence of the gene. The tendency to make predictions based on the presence or absence of genes was not found in the Chinese sample ($M = 4.64$, $SD = .97$ in the present condition, $M = 4.55$, $SD = .95$ in the absent condition), $t(87) < 1$, $p = .65$.

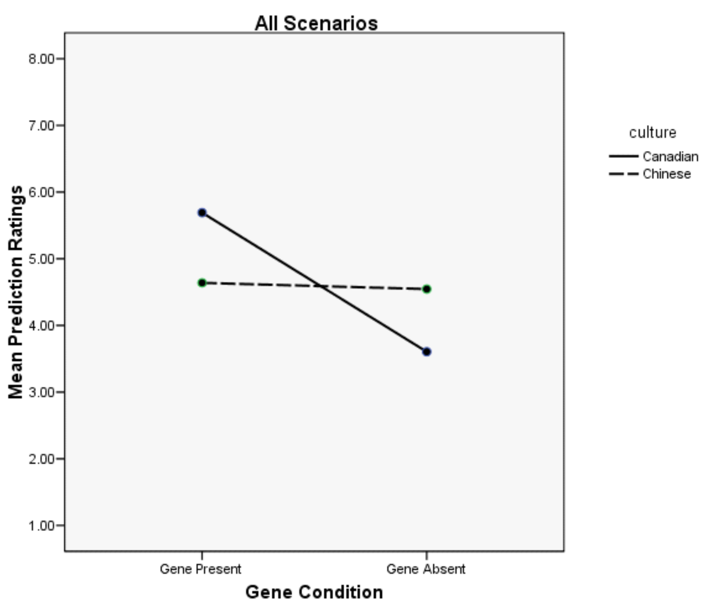

Figure 1.

I also analyzed each of the four scenarios separately using identical statistical procedures. The same pattern of results was found in each of the four scenarios (see Figure 2). The interaction effects between culture and gene condition were significant for all scenarios: for artistic ability: $F(1, 140) = 20.80$, $p < .0005$, $\eta_p^2 = .13$; for diabetes: $F(1, 140) = 17.95$, $p < .0005$, $\eta_p^2 = .11$; for alcoholism: $F(1, 140) = 20.16$, $p < .0005$, $\eta_p^2 = .13$; and for nurturance tendency: $F(1, 140) = 5.43$, $p = .02$, $\eta_p^2 = .04$.

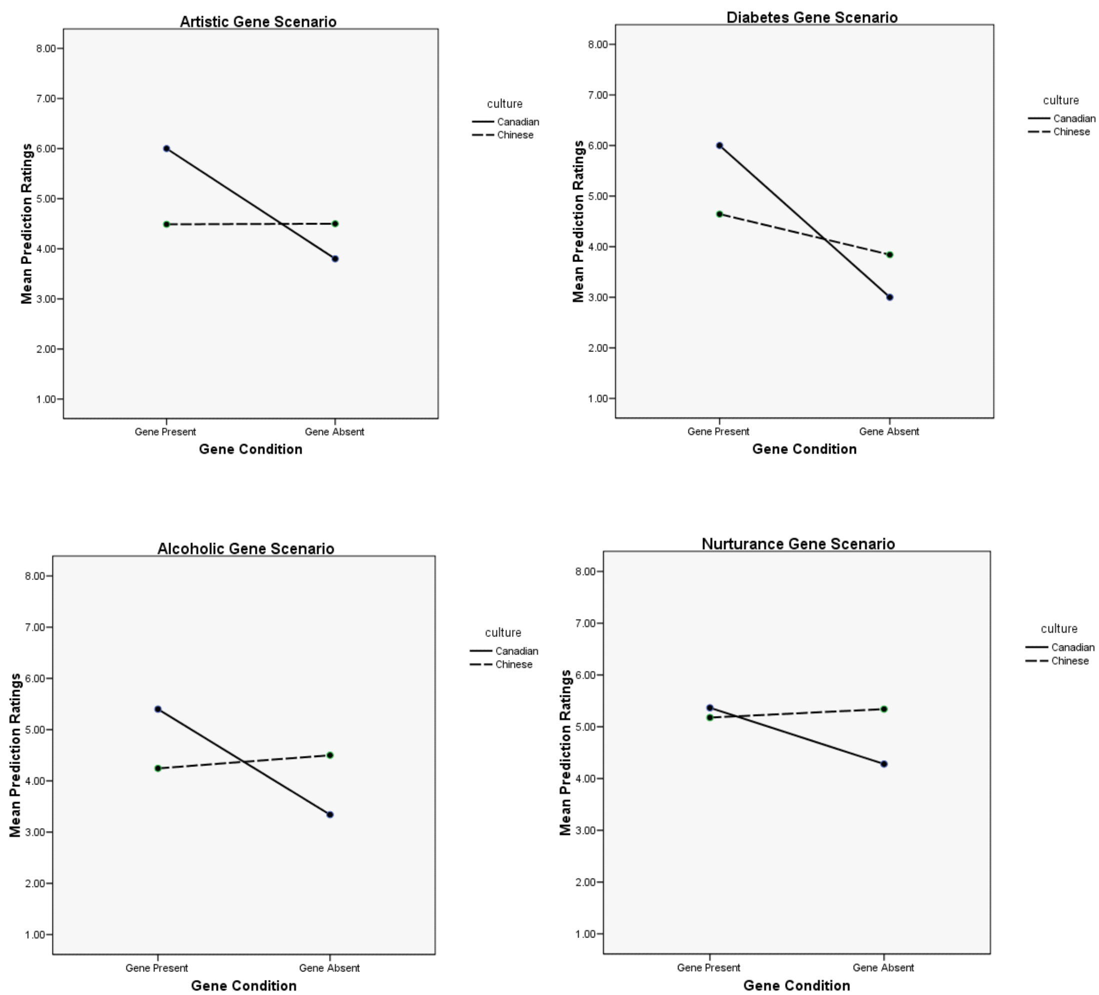

Figure 2.

Testing of Alternative Explanations

Education in biological sciences. Canadian participants ($M = 2.42$, $SD = 1.18$) reported having taken more biology and genetic courses than did their Chinese counterparts ($M = 1.18$, $SD = 1.52$), $t(129) = 4.27$, $p < .0005$. Thus, it is possible that the observed pattern of results in biological beliefs was not due to the cultural differences in cognitive tendencies as hypothesized, but was simply a result of education levels in biology and genetics. An analysis of covariance (ANCOVA) was conducted to test this possibility[3]. Results showed that the number of biology-related courses taken did not affect biological beliefs, $F(1, 125) < 1$, $p = .35$. The interaction between biology-related courses and gene condition was not significant, $F(1, 125) = 1.10$, $p = .30$. That is, participants who had more academic training in biology did not respond to the gene manipulation any differently from those who had received less training. Lastly, when the number of biology-related courses was controlled for, the interaction between culture and gene condition remained significant, $F(1, 125) = 30.24$, $p < .0005$, $\eta_p^2 = .20$. There were slight changes in the adjusted means, but the overall pattern of results was the same.

Media exposure. Another alternative explanation stems from the fact that Canadian participants ($M = 22.77$, $SD = 19.82$) on average received more biological information from the media than did Chinese ($M = 14.06$, $SD = 10.92$), $t(142) = 2.99$, $p = .004$. An ANCOVA revealed that media exposure did not affect biological beliefs, $F(1, 138) < 1$, $p = .77$. The interaction between media exposure and gene condition was not significant, $F(1, 138) < 1$, $p = .43$. Thus, the way participants responded to the gene manipulation was not affected by the levels of biological findings they received from the media. More importantly, controlling for media exposure did not influence the significance of the interaction between culture and gene condition, $F(1, 139) = 41.88$, $p < .0005$, $\eta_p^2 = .23$. The overall pattern of the adjusted means remained the same.

Self-perceptions. Whether or not participants themselves endorsed the traits of interest might have systematically influenced the way they responded to the scenarios. For example, would participants who identified themselves as artistic respond to the artistic gene scenario differently from those who claimed to be less artistic? This possibility was tested by a series of correlational analyses. As shown in Table 1, correlational evidence emerged between participants' self-perception of alcoholic tendency and their prediction ratings in the alcoholism scenario ($r[60] = -.27$, $p = .04$ in the gene present condition), meaning that participants' responses to the alcoholism scenario was somehow affected by their alcoholic tendency. No other significant correlation was found between participants' self-perceptions of the other three traits and their prediction ratings in the corresponding scenarios. This was true when the two cultures were analyzed separately (*ps* > .19) or together (*ps* > .27). See Table 1 for details.

Table 1

Correlations between Biological Beliefs and Self-Perceptions within Each Scenario (Study 1)

Scenario	Condition	Canadians	Chinese	Combined
Artistic ability	Present	.26 ($p = .27$)	-.06 ($p = .72$)	-.02 ($p = .87$)
	Absent	-.20 ($p = .42$)	.09 ($p = .56$)	.06 ($p = .67$)
Diabetes	Present	--	--	--
	Absent	--	.20 ($p = .19$)	.15 ($p = .27$)
Alcoholism	Present	-.41 ($p = .07$)	-.10 ($p = .55$)	-.27* ($p = .04$)
	Absent	.30 ($p = .24$)	-.27 ($p = .08$)	-.04 ($p = .74$)

[3] All ANCOVAs in this paper satisfied the homogeneity-of-slopes assumption.

Table 1 (cont.)

	Condition	Canadians	Chinese	Combined
Nurturance	Present	-.07 (p = .77)	-.09 (p = .56)	-.09 (p = .48)
	Absent	-.21 (p = .40)	.14 (p = .38)	-.08 (p = .57)

Note. Gene Present condition (n = 75), Gene Absent condition (n = 69).
*Three of the four cells in the Diabetes Scenario contained non-diabetic participants only, thus correlational analyses could not be performed.

An ANCOVA was conducted specifically on the alcoholism scenario. Participants' self-perception of alcoholic tendency had no main effect on their biological beliefs ratings, $F(1, 114) = 1.83$, $p = .18$. The interaction between self-perception and gene condition was not significant, $F(1, 114) < 1$, $p = .70$. In other words, whether or not participants were excessive drinkers did not produce any difference in the way they responded to the gene manipulation in the scenarios. Moreover, the interaction between culture and gene condition remained significant when self-perception was controlled for, $F(1, 114) = 10.20$, $p = .0021$, $\eta_p^2 = .08$. This result suggested that participants' self-perception of alcoholic tendency could not explain the observed cultural differences in biological beliefs.

Measurement error. Given the sizeable gap between Canadians ($\alpha = .79$) and Chinese ($\alpha = .35$) in their reliability coefficients for the scenarios, one could argue that the observed cultural differences in biological beliefs were due to measurement error. That is, the "noise" of the experiment might have caused Chinese participants to respond to the scenarios in an inconsistent manner, thus creating a false impression that the presence or absence of the genes was unimportant to their prediction ratings. To test this possibility, I performed a point-biserial correlation analysis on each culture to examine the relationship between gene condition (0 = gene absent, 1 = gene present) and their prediction ratings in the scenarios. For Canadians, the correlation was $r(55) = .81$, and for Chinese, $r(89) = .05$. After correction for unreliability, the respective correlation of the two cultural groups became $r(55) = .91$ and $r(89) = .08$. In other words, when measurement error was removed from the analysis, the presence or absence of the genes in the scenarios still failed to predict the likelihood ratings of Chinese participants. Measurement error, thus, could not explain why Chinese participants were unaffected by the gene manipulation.

Biological Beliefs and the BGD Scale

Genetic determinism scores on the BGD scale were correlated with the biological beliefs ratings measured in the scenarios, positively in the gene present condition and negatively in the gene absent condition (as seen in Table 2). That is, when both cultural groups were analyzed together, those who scored high on the BGD Scale tended to predict that the particular traits be more likely to develop in the characters when the corresponding genes were present, $r(75) = .44$, $p < .0005$, and that the traits be less likely to develop when the corresponding genes were absent, $r(75) = -.25$, $p = .04$.

Further analyses were conducted within each culture. When only the gene present condition was examined, Canadians showed a correlation of $r(30) = .34$, $p = .06$ between their scenario prediction ratings and BGD score, whereas the correlation for the Chinese sample was $r(45) = .41$, $p = .006$. When the same analysis was performed on the gene absent condition only, the correlation for the Canadian sample was $r(25) = -.35$, $p = .09$, Chinese $r(44) = -.27$, $p = .08$. These findings, though not entirely significant, are all in the expected directions. The same analyses were conducted on each of the four scenarios. Correlational results can be seen in Table 2.

Finally, Canadian ($M = 3.41$, $SD = .68$) and Chinese ($M = 3.21$, $SD = .96$) participants did not differ in their scores on the BGD Scale, $t(142) < 1$, $p = .14$.

Table 2

Correlations between Biological Beliefs in Scenarios and Belief in Genetic Determinism Scores (Study 1)

Scenario	Condition	Canadians	Chinese	Combined
Artistic ability	Present	.32 (p = .08)	.47** (p = .001)	.49** (p < .0005)
	Absent	-.37 (p = .07)	-.37** (p = .01)	-.35** (p = .003)
Diabetes	Present	.30 (p = .11)	.06 (p = .68)	.19 (p = .11)
	Absent	-.10 (p = .64)	.11 (p = .47)	.05 (p = .69)
Alcoholism	Present	-.04 (p = .85)	.28 (p = .07)	.29** (p = .01)
	Absent	-.28 (p = .18)	-.08 (p = .61)	-.12 (p = .34)
Nurturance	Present	.25 (p = .19)	.10 (p = .52)	.14 (p = .24)
	Absent	-.11 (p = .60)	-.36* (p = .02)	-.25* (p = .04)
All Scenarios	Present	.34 (p = .06)	.41** (p = .006)	.44** (p < .0005)
	Absent	-.35 (p = .09)	-.27 (p = .08)	-.25* (p = .04)

Note. Gene Present condition (n = 75), Gene Absent condition (n = 69).

Opinions on Biological Influences

In the demographic section, a number of items explicitly asked for participants' opinions on the extent to which various developmental categories are influenced by biological predispositions

(See Appendix C). These ratings were totaled to create an index for each participant. A higher score on this index reflected stronger belief in biological influences.

As expected, Canadian participants ($M = 21.32$, $SD = 3.37$) scored higher on this index than did their Chinese counterparts ($M = 18.40$, $SD = 5.11$), $t(142) = 4.13$, $p < .0005$. In other words, the influences of biological predispositions on human development were believed to be stronger to Canadians than to Chinese.

Discussion

Study 1 established three things. First, the results supported the main hypothesis that Canadians would show stronger biological beliefs compared to their Chinese counterparts, as reflected in the Canadians' greater tendency to use biological information to guide their developmental predictions. This finding, as mentioned earlier, could be due to cultural differences in lay theories of causality, lay theories of change, and beliefs in effort and persistence, although this study offered no direct evidence to support these speculations. Study 1 also showed that the differential emphasis on biological information between the two cultural groups cannot be explained by their education in biology or genetics, the amount of biological findings they learned from the media, or their endorsement of the traits examined in this study. Ruling out these alternative explanations provided indirect support for the above mechanism hypothesis. Finally, participants' prediction ratings in the scenarios showed moderate correlations in the expected directions with their scores on the BGD Scale, suggesting that these two measures point to the same psychological construct.

Chapter 4

Study 2

If biological beliefs are deep-rooted notions that assume an invariable alignment between genotypes and phenotypes as hypothesized, then cultural differences in these beliefs should not be limited to the four particular characteristics examined in Study 1, but should exist in other developmental domains as well. I thus conducted Study 2 to replicate the main cultural differences found in Study 1, with a similar methodology but different scenarios.

Method

Participants

One hundred and forty-two students were recruited for this study. The sample consisted of 52 Canadians (17 males and 35 females; mean age = 19.5 years) from Queen's University in Canada, and 90 Chinese students (36 males and 54 females; mean age = 18.5 years) from Huazhong Normal University in China[4]. All Canadians indicated English as their primary language, and all Chinese were native Chinese speakers (Mandarin). Canadian students were compensated with half a course credit for their participation. Chinese participants received a small gift.

Materials

Biological Beliefs. Four different scenarios were used to measure biological beliefs. The traits of interest were memory ability, obesity, gambling tendency, and aggressive personality (See Appendix D). As before, participants were randomly assigned to the gene present or the gene absent condition. For each scenario, they were asked to predict, on a scale from 1 (highly unlikely) to 8 (highly likely), the extent to which the corresponding traits would develop in the characters later in their life.

Genetic Determinism. Keller's (2005) Belief in Genetic Determinism Scale (BGD Scale) was employed.

Demographic data. The same demographic information was collected from participants as in Study 1, except in the four self-perception questions, participants were asked to rate themselves, on a scale from 1 (definitely not) to 8 (definitely yes), the extent to which they endorsed the four new traits. See Appendix E for details.

Procedure

Identical to the procedure carried out in Study 1.

Study 2 Results

Data Transformation

Participants received a mean score for their four prediction ratings in the biological belief scenarios ($\alpha = .80$ for Canadians and .53 for Chinese, respectively). Participants' scores on the BGD Scale were averaged ($\alpha = .82$ for Canadians and .73 for Chinese, respectively). I also totaled their reports on the number of times they had been exposed to biological information from the media. These new variables were used in subsequent analysis.

Hypothesis Testing

A 2 (culture) by 2 (gene condition: present vs. absent) ANOVA was conducted, with the prediction ratings in the biological beliefs scenarios as the dependent variable. The main effect for culture was marginally significant, $F(1, 138) = 3.28$, $p = .07$, $\eta_p^2 = .02$. The respective means and standard deviations for Canadians were 4.55 and .99, and for Chinese, 4.24 and .99. There was a significant main effect for gene condition, $F(1, 138) = 38.97$, $p < .0005$, $\eta_p^2 = .22$, indicating that participants in general were more inclined to give higher ratings in the gene present condition ($M = 4.93$, $SD = 1.03$) than in the absent condition ($M = 3.86$, $SD = 1.01$). More

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[4] Gender had no significant effect in this study, $F < 1$, *ns*., and thus will not be discussed further.

importantly, a significant interaction between culture and gene condition was replicated, $F(1, 138) = 27.44$, $p < .0005$, $\eta_p^2 = .17$. As seen in Figure 3, Canadians had a stronger tendency to predict that the traits would develop in the gene present condition ($M = 5.53$, $SD = .84$) than in the absent condition ($M = 3.56$, $SD = .73$), $t(50) = 9.06$, $p < .0005$. In contrast, Chinese did not exhibit the tendency to make predictions based on the presence or absence of the genes ($M = 4.32$, $SD = 1.07$ in the present condition, $M = 4.15$, $SD = 1.09$ in the absent condition), $t(88) < 1$, $p = .45$.

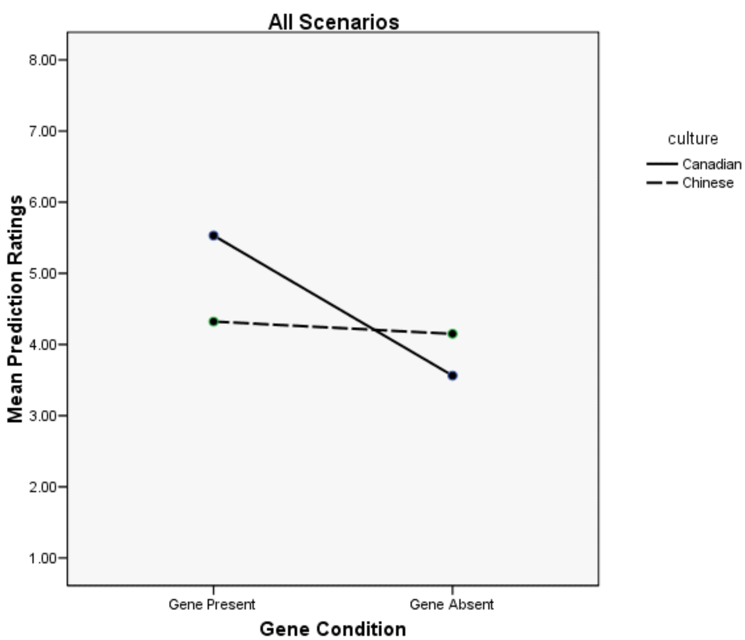

Figure 3.

I also performed an ANOVA on each scenario separately. As shown in Figure 4, the interaction between culture and gene condition remained significant in three of the four scenarios. For memory: $F(1, 138) = 17.99$, $p < .0005$, $\eta_p^2 = .12$; for gambling tendency: $F(1, 138) = 11.88$, $p = .001$, $\eta_p^2 = .08$; and aggression: $F(1, 138) = 27.19$, $p < .0005$, $\eta_p^2 = .17$. Surprisingly, the obesity scenario failed to show a significant interaction, $F(1, 138) = 1.36$, $p = .25$.

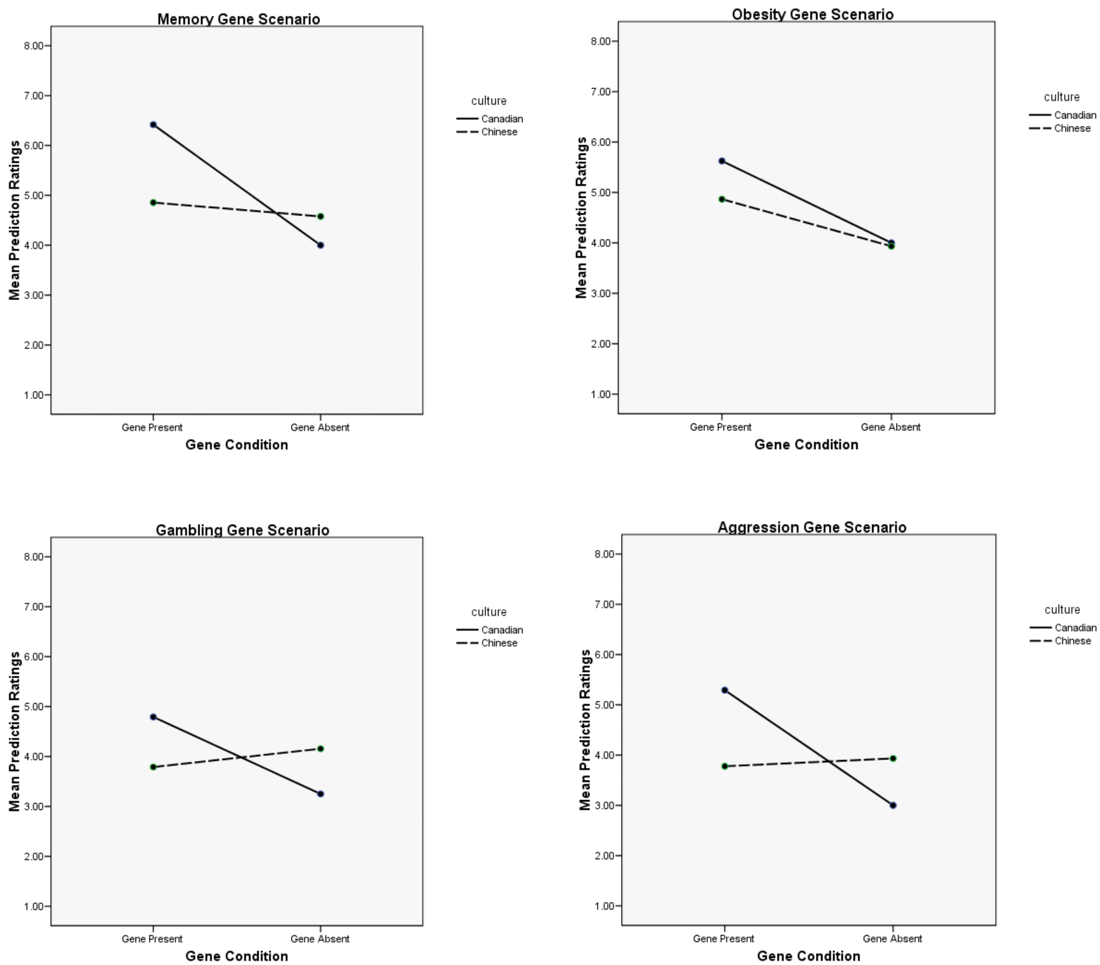

Figure 4.

Testing of Alternative Explanations

Education in biological sciences. As in Study 1, Canadians (M = 2.73, SD = 2.55) on average indicated to have taken more biology-related courses than their Chinese counterparts (M = .81, SD = .74), $t(107) = 5.24$, $p < .0005$. Thus, an ANCOVA was conducted to examine whether their education background had an influence on their biological beliefs ratings in the scenarios. Results showed that the number of biology-related courses taken did not have a significant effect, $F(1, 103) < 1$, $p = .48$. The interaction between biology-related courses and gene condition was not significant, $F(1, 103) < 1$, $p = .60$; that is, participants in general responded to the gene manipulation in the same fashion regardless of their levels of academic training in biology. More importantly, culture and gene condition remained significant after covariating biology courses taken, $F(1, 103) = 19.57$, $p < .0005$, $\eta_p^2 = .16$, indicating that the cultural differences in biological beliefs could not be explained by participants' academic background in biology or genetics. The overall pattern of the adjusted means did not change.

Media exposure. The Canadian sample (M = 21.52, SD = 18.28) reported to have received more biological information from the media than the Chinese (M = 12.70, SD = 10.77); $t(140) = 3.18$, $p = .002$. An ANCOVA was conducted to examine whether this variable had an effect on participants' biological beliefs ratings. The main effect for media exposure on biological beliefs was significant, $F(1, 136) = 4.73$, $p = .03$, $\eta_p^2 = .03$. The interaction between media exposure and gene condition was not significant, $F(1, 136) < 1$, $p = .83$. Hence, the amount of biological information participants received from the media did not affect the way they responded to the gene manipulation in the scenarios. Finally, controlling for media exposure did not change the significance of the interaction between culture and gene condition, $F(1, 136) = 29.41$, $p < .0005$, $\eta_p^2 = .18$. There was no change in the overall pattern of the adjusted means.

Self-perceptions. To ensure that participants' endorsement of the four traits of interest did not influence their responses in the scenarios, I correlated participants' self-perceptions of each of the four traits with their prediction ratings in the corresponding scenarios. As shown in Table 3, correlational evidence was found in the obesity and aggression scenarios, suggesting that participants' self perceptions of obesity and aggressive tendency systematically affected the way they responded to these two scenarios.

Table 3

Correlations between Biological Beliefs and Self-Perceptions within Each Scenario (Study 2)

Scenario	Condition	Canadians	Chinese	Combined
Memory ability	Present	.02 (*p* = .93)	-.16 (*p* = .30)	-.04 (*p* = .78)
	Absent	-.02 (*p* = .94)	.19 (*p* = .23)	.11 (*p* = .39)
Obesity	Present	.01 (*p* = .97)	.05 (*p* = .74)	-.05 (*p* = .68)
	Absent	-.18 (*p* = .45)	$.45^{**}$ (*p* = .003)	$.25^{*}$ (*p* = .05)
Gambling tendency	Present	-.27 (*p* = .28)	-.02 (*p* = .89)	-.08 (*p* = .53)
	Absent	.36 (*p* = .13)	-.003 (*p* = .99)	.08 (*p* = .55)
Aggressive personality	Present	$.49^{*}$ (*p* = .04)	.28 (*p* = .07)	.22 (*p* = .09)
	Absent	.45 (*p* = .06)	.30 (*p* = .06)	$.34^{**}$ (*p* = .007)

Note. Gene Present condition (*n* = 69), Gene Absent condition (*n* = 73).

ANCOVAs were conducted on these two scenarios to examine the effects of self-perceptions on biological beliefs ratings. First, for the aggression scenario, self-perception of aggressive tendency had a significant main effect on participants' biological beliefs ratings, $F(1, 116) = 12.56$, $p = .001$, $\eta_p^2 = .10$. The interaction between aggressive tendency and gene condition was not significant, $F(1, 116) < 1$, $p = .90$. When aggressive tendency was controlled for, the interaction between culture and gene condition remained significant, $F(1, 116) = 26.11$, $p < .0005$, $\eta_p^2 = .18$. Hence, self-perception of aggressive tendency could not account for the observed cultural differences in biological beliefs. For the obesity scenario, self-perception of obesity affected prediction ratings at the marginal level, $F(1, 115) = 3.69$, $p = .06$, $\eta_p^2 = .03$, and the interaction between culture and condition remained nonsignificant when this variable was controlled for, $F(1, 115) < 1$, $p = .78$.

Measurement error. Similar to Study 1, the reliability coefficients for the scenarios were quite different between Canadians ($\alpha = .80$) and Chinese ($\alpha = .53$). Thus, the fact that Chinese participants were unaffected by the gene manipulation might have been a consequence of measurement error. To ensure that this was not the case, I conducted a point-biserial correlation analysis on each culture to examine the relationship between gene condition (0 = gene absent, 1 = gene present) and their prediction ratings in the scenarios. The correlation was $r(52) = .79$ for Canadians and $r(90) = .08$ for Chinese. After correcting for unreliability, their respective correlation became $r(52) = .88$ and $r(90) = .11$. This finding, replicating what was found in Study 1, shows that measurement error could not explain why the presence or absence of the gene in the scenarios failed to produce an effect in the Chinese sample.

Biological Beliefs and the BGD Scale

Genetic determinism scores on the BGD Scale were correlated positively with biological beliefs ratings in the scenarios in the gene present condition, $r(69) = .40$, $p = .001$. That is, in general, participants who scored high on the BGD Scale were more likely to predict that the traits would develop when the corresponding genes were present. The same pattern of results was found within each culture: in the Canadian sample, *r*(24) = .34, *p* = .11; and in the Chinese sample, *r*(45) = .46, *p* = .001. These results replicated what was found in Study 1.

Unlike in Study 1, however, when correlation analysis was conducted in the gene absent condition only, participants' biological beliefs ratings on the scenarios did not correlate negatively with their BGD scores as they were expected to show, *r*(73) = -.03, *p* = .81. No significant correlation was found when each culture was analyzed separately, for the Canadian sample, *r*(28) = .33, *p* = .09; and the Chinese sample, *r*(45) = -.11, *p* = .47. Further analysis was done on each scenario separately and only in the gene absent condition. For memory scenario: *r*(73) = -.12, *p* = .20; for obesity scenario: *r*(73) = .19, *p* = .11; for gambling tendency scenario: *r*(73) = -.03, *p* = .80; and for aggression scenario: *r*(73) = -.04, *p* = .77. See Table 4 for details.

Table 4

Correlations between Biological Beliefs in Scenarios and Belief in Genetic Determinism Scores (Study 2)

Scenario	Condition	Canadians	Chinese	Combined
Memory ability	Present	.33 (*p* = .12)	.29* (*p* = .05)	.29* (*p* = .02)
	Absent	.13 (*p* = .52)	-.20 (*p* = .19)	-.12 (*p* = .20)
Obesity	Present	.31 (*p* = .15)	.31* (*p* = .04)	.31** (*p* = .01)
	Absent	.60** (*p* = .001)	-.05 (*p* = .73)	.19 (*p* = .11)

Table 4 (cont.)

	Condition	Canadian	Chinese	Combined
Gambling tendency	Present	.21 (p = .33)	.34* (p = .02)	.31** (p = .01)
	Absent	.20 (p = .31)	-.06 (p = .69)	-.03 (p = .80)
Aggressive personality	Present	.17 (p = .43)	.33* (p = .03)	.27* (p = .02)
	Absent	-.42 (p = .03)	.06 (p = .68)	-.04 (p = .77)
All Scenarios	Present	.34 (p = .11)	.46** (p = .001)	.40** (p = .001)
	Absent	.33 (p = .09)	-.11 (p = .47)	-.03 (p = .81)

Note. Gene Present condition (n = 69), Gene Absent condition (n = 73).

Finally, a t-test revealed no significant cultural difference between Canadians (M = 3.30, SD = .83) and Chinese (M = 3.08, SD = .77) in their scores on the BGD Scale, $t(140) = 1.59$, p = .12. This finding was consistent with what was found in Study 1.

Opinions on Biological Influences

Similar to Study 1, participants' opinion ratings on the extent to which various developmental categories are influenced biological predispositions were summed into an index (See Appendix E). A high score on this index represented strong belief in biological influences.

Canadians (M = 21.31, SD = 3.83) were found to score significantly higher on this index than did Chinese (M = 18.23, SD = 4.48), $t(130) = 4.08$, $p < .0005$, replicating the finding in Study 1. In other words, Canadian participants tended to believe that biological influences are more important to human development than their Chinese counterparts.

Discussion

Study 2 successfully replicated the main results of Study 1 using different trait measures. Again, whereas the developmental predictions made by the Canadians corresponded to the presence or absence of the target gene, those of the Chinese did not exhibit this tendency. This finding offers further evidence for the observed cultural differences in biological beliefs in a different set of scenarios.

Like Study 1, the BGD Scale failed to show cultural differences. In addition, two unexpected findings emerged: (a) the interaction between culture and gene condition appeared in all but the obesity scenario and (b) the BGD Scale failed to correlate negatively with biological beliefs ratings in the gene absent condition. I will discuss these puzzling results in greater detail in the General Discussion below.

Chapter 5

General Discussion

The present research investigated cultural differences in biological beliefs, a topic that is still in its infant stage in psychology. Across two studies, eight scenarios, varying in domain and valence, were developed to explore the prevalence of biological beliefs in Canadian and Chinese cultures. Consistent with my hypothesis, Canadian participants in both studies assigned higher predictive values to biological information than did the Chinese. Such cultural differences were not attributable to media influences, academic training in biology, or personal endorsement of the traits (in most cases). In addition, biological beliefs were found to be correlated, mostly, with the belief in genetic determinism measured by the BGD Scale. Finally, the variety of scenarios used in this research suggests that biological beliefs could be more than mere individual ideas about specific aspects of human characteristics. Instead, they seem to be a set of well-organized ideas that frame people's outlook on human development in a particular way.

Speculations on the Puzzling Results of Study 2

The failure to obtain a significant interaction in the obesity scenario in Study 2 poses an interesting question. It appears that the lack of interaction was primarily driven by the Chinese participants, who unexpectedly responded in the same fashion as did the Canadians[5] (See Figure 4). A closer look at the scenarios reveals that, of the eight traits examined, seven are examples of psychological traits or behavioral tendencies, and obesity is the only trait that falls into the category of physical characteristics. This discrepancy leads to the following speculation: although Chinese strongly believe in the power of the environment to mold behavioral tendencies or personality traits, this idea might be less applicable to the developments of physical

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[5] In the Chinese sample, prediction ratings in the gene present and absent conditions were significantly different in the obesity scenario, $p = .02$. Such a difference was not found in the other three scenarios, *ns*.

characteristics such as height, weight, and other bodily features. Whether or not physical characteristics are deemed less flexible than psychological traits in Chinese culture is presently unknown, but it will be an excellent question for future research.

Another unexpected finding of Study 2 was the lack of correlation between biological beliefs ratings and the BGD Scale in the gene absent condition. Although the reason for this exception is unclear, one speculation is that people in general hold different developmental beliefs regarding socially desirable and undesirable traits. Specifically, memory ability was the only socially desirable trait examined in Study 2, and it appears that it was the only scenario that was correlated with the BGD Scale in the expected direction ($r = -.12$, $p = .20$). In contrast, the scenarios on obesity, gambling tendency, and aggressive personality were either correlated with the BGD Scale in the opposite direction, or they showed no correlation at all (See Table 2). This pattern also appeared in Study 1 (See Table 1), in which the same phenomenon was found only in the diabetes and alcoholism scenarios, two other undesirable traits. These findings seem to suggest an interaction effect between the BGD Scale and the valence of the traits. That is, the BGD Scale seems to be able to predict quite adequately participants' responses to the scenarios (both the gene present and absent conditions), but this is true only when the traits of interest are socially desirable. When the scenarios involve socially undesirable traits, an asymmetry will occur, such that the BGD Scale is only predictive of participants' responses in the gene present condition and not in the gene absent condition. It is possible that desirable and undesirable traits have invoked different forms of motivations in participants, which, consequently, led to the asymmetric pattern in their responses. This explanation is speculative and definitely requires empirical investigations. In short, the question of whether the valence of the traits would bring systematic effects to the BGD Scale remains unanswered. This will be another task for future researchers.

Limitations of the Present Research and Future Research Directions

Identifying the psychological variables responsible for cultural differences, or "unpackaging cultures", has been recommended as a standard task in cross-cultural research (Bond, 1994). In this paper, I proposed three psychological factors which may account for the cultural differences in biological beliefs: lay theories of causality, lay theories of change, and cultural beliefs in effort and persistence. However, due to the meager body of literature on the subject, I chose to focus more on exploring and describing the cultural phenomenon than explaining it. One suggestion for future research, thus, is to present empirical supports for these three potential mediators, as well as to search for other psychological or cultural mechanisms that give rise to cultural differences in biological beliefs. For example, it would be useful for future studies to include scenario or behavioral measures of lay theories of change, one of the potential mechanisms, so that the belief in change can be correlated with culture and biological beliefs. Should meaningful correlations emerge among these three variables, one can then proceed to mediation analysis to formally test this hypothesized mediator (Baron & Kenny, 1986). This research strategy is recommended by a number of cultural researchers and has been shown to be useful in some studies (Kwan, Bond, & Singelis, 1997; Oppedal, 2008).

Moderation is a hallmark of East-Asian ideology (Peng & Nisbett, 1999; Nisbett, 2003). It is thus possible that the need to conform to this cultural standard might motivate Chinese to cluster their responses towards the midpoint on a Likert rating scale, a possibility that might have confounded the results of the present research. Studies on this hypothesis are scarce, and results have been inconclusive. For example, whereas Chen, Lee, and Stevenson (1995) reported a small but significant tendency in Chinese and Japanese participants to use the midpoint on a scale, other researchers have found that such a tendency appeared only in specific scales, such as those measuring positive emotions (Lee, Jones, Mineyama, & Zhang, 2002). The nature of this phenomenon is presently unclear, but as far as the present research is concerned, the credibility of the present results on biological beliefs, due to the use of rating scales, could be compromised by this unresolved issue. It is thus necessary for future attempts to employ different methodology. Open-ended scenarios or multiple-choice methods that do not rely on scales are effective strategies. For instance, asking participants to recommend the number of hours of exercise a person should do in a month if he or she does not carry the gene for obesity, or the amount of money they are willing to pay for a genetic screening test can gauge their biological beliefs without invoking the three possible response biases described above. This method is employed in my ongoing research project.

Just as a popular car appears in a city more often than a less popular one, a prevailing belief or idea should also reveal itself more often in a culture than a less common one. Based on this assumption, future research, instead of relying on participants, can study biological beliefs by examining the cultural products within different cultures–the number of books on genetics sold in local bookstores in a month, the average price for genetic testing services, the number of biological reports featured by newspapers or magazines, the box office revenues of genetically-themed movies, the popularity of genetics-related online forums, and so forth. Systematic comparisons of these cultural products can provide a novel and interesting perspective on the way in which biological beliefs are readily accepted by a particular culture.

Although the present research focused on cultural differences in biological beliefs, there is no doubt that differences also exist on the individual level. Here arises an important and fascinating question: would biological beliefs influence people's daily behaviors and decisions? For example, everything else being equal, would people who hold strong biological beliefs actually consume more processed food, spend less time on their exercise bike, or express more tolerance to those who are predisposed to certain undesirable traits? Conversely, would people who champion environmental influences be more likely to force their children to play a music instrument, spend money on pedagogical products, or express sympathy towards those who had a troubled childhood? These questions are just as worthy of pursuing on the individual level as they are on the cultural level. Addressing these inquiries will not only provide novel intellectual contributions to areas within and outside psychology, but also have practical impacts in other social domains, such as the merchandise industry, legal system, or health care programs.

Implications of Biological Beliefs

It is important to note that biological beliefs should not be regarded as "cognitive demons" that everyone should avoid endorsing. Rather, I argue that just like many other attitudes or organized ideas about the world, biological beliefs can cause harm at either extreme of the spectrum. In the final section of this paper, I will remark briefly on the possible consequences of, on the one hand, the perspective that largely dismisses biological influences and, on the other, the perspective that biological predispositions are by and large indicative of human development.

Problems can arise when the role of biological influences is minimally acknowledged, or to put it another way, the role of environmental influences is overemphasized. There is little question that biological endowments do account for some level of developmental success and failure. Holding unrealistic beliefs in the extent to which the social environments can control developmental outcomes can be harmful, especially in the context of childrearing. For instance, parents who believe that persistent training can definitely make up for a lack of inborn talent might compel their child to practice a task ceaselessly, even if the child clearly shows no sign of aptitude or interest. This type of parenting strategy, which has been shown to produce long-lasting psychological and behavioral problems in children (Lamborn, Mounts, Steinberg, & Dornbusch, 1991), could become a childrearing standard for parents whose biological beliefs are largely absent. Equating upbringing conditions and persistence with developmental success also invites attributional biases. For example, when a child fails to progress at the same as pace as his or her peers, it is possible that this child will be accused for not devoting enough effort relative to other children, when the true cause of the child's learning problems is a biological one. Criticisms might also extend to the parents of the child for failing to provide a nurturing environment, thus leading to the poor performance of the child. The unmitigated belief in environmental influences might also become justifications for bringing group division practices a step further. For example, troubled by the idea that problem students might "contaminate" the well-behaved ones, would schools introduce class placement processes such that the "bad apples" would learn and socialize in isolation from the well-behaved students? These examples may sound extreme, and they may or may not arise. Nonetheless, weaker versions of these circumstances can be seen, at least once in a while, in our everyday lives. Exaggerating the relationship between environmental factors and human development can bring forth a whole spectrum of social issues. A community withstanding biological beliefs need not be a good place.

On the other hand, making predictions regarding how and what individuals will become on the basis of their biological background can also lead to a number of problems. Such a perspective, as discussed, denies the merits of environmental interventions. In fact, some social scientists have already pointed out this growing concern (Conrad, 1997, 1999; Nelkin & Lindee, 1995). For instance, with the increasing confidence in molecular research, some insurance companies around the globe have started to accept customers strategically by means of genetic screenings (Globalchange, 1999; Kerr, 2004; Kjono, 1997). There is a chance that this procedure will eventually expand to other industries or social sectors, and if it does, what kind of social issues would this procedure bring about? Would those who are cursed with socially undesirable genes, already genetically disadvantaged, become even more unfortunate because they now have to live with a new form of prejudice? Biological beliefs also lead to the possibility of babydesigning. Whereas the original premise of human genetic engineering involves the curing of deadly diseases by means of genetic modifications, some people have warned that these techniques will eventually be applied to other developmental domains, such as abilities or intelligence (Kerr, 2004). An extreme form of biological beliefs, thus, might motivate future parents to make genetic arrangements for their children. These speculations may at present seen unrealistic or distant, but at the current pace that human genetic research is burgeoning, these concerns can soon become real possibilities. Whereas it is important to study the ways in which our thoughts and behaviors are influenced by biological factors, how these findings come back to affect our thoughts and behaviors is worthy of at least equal concern.

Chapter 6

Conclusion

We long to understand who we are and what we will become. For thousands of years, our ancestors have stared up to the twinkling stars in the open sky, trying to explore the mystery of our souls. Today, we look through a high-powered microscope, attempting to resolve the very same problem. The book of life, once thought to be written in celestial movements, is now seen as encrypted in the double helix within our body. With the advent of the “genetic age,” more human characteristics, simple or complex, will become targets of molecular investigations. While we are anticipating the hopes molecular research will bring, let us not forget about how its fruits can be accepted by people or groups differently. Equally important are the psychological, social, legal, and ethical issues associated with these findings, which are, perhaps, far more complicated than the findings themselves.

References

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., Campbell, J. D., Krueger, J. I., & Vohs, K. D. (2003). Does high self-esteem cause better performance, interpersonal success, happiness, or healthier lifestyles? *Psychological Science in the Public Interest, 44,* 1-44.

Bond, M. H. (1994). Emotions and their expression in Chinese culture. *Journal of Nonverbal Behaviors, 17,* 245-262.

Brescoll, V., & LaFrance, M. (2004). The correlates and consequences of newspaper reports of research on sex differences. *Psychological Science, 15(8),* 515-520.

Chen, C., Lee, S., & Stevenson, H. W. (1995). Response style and cross-cultural comparisons of rating scales among East Asian and North American students. *Psychological Science, 6*(3), 170-175.

Choi, I., Nisbett, R. E., & Norenzayan, A. (1999). Causal attribution across cultures: Variations and universality. *Psychological Bulletin, 125*(1), 47-63.

Conrad, P. (1997). Public eyes and private genes: Historical frames, news constructions, and social problems. *Social Problems, 44*, 139-154.

Conrad, P. (1999). A mirage of genes. *Sociology of Health and Illness, 21*, 228-241.

Dar-Nimrod, I., & Heine, S. J. (2006). Exposure to scientific theories affect women's math performance. *Science, 314*, 435.

Dweck, C. S., Chiu, C., & Hong, Y. (1995a). Implicit theories and their role in judgments and reactions: A world from two perspectives. *Psychological Inquiry, 6,* 267-285.

Fiske, A. P., Kitayama, S., Markus, H. R., & Nisbett, R. E. (2001). The cultural matrix of social psychology. In D. T. Gilbert, S. T., Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (pp. 915-981). New York: McGraw-Hill.

Globalchange (1999). Should gene screening for insurance be allowed? Retrieved June 25, 2009, from http://www.globalchange.com/genescreen.htm

Heine, S. J., Kitayama, S., Lehman, D. R., Takata, T., Ide, E., Leung, C., & Matsumoto, H. (2001). Divergent consequences of success and failure in Japan and North America: An investigation of self-improving motivations and malleable selves. *Journal of Personality and Social Psychology, 81*(4), 599-615.

Hess, R. D., Chang, C. M., & McDevitt, T. M. (1987). Cultural variations in family beliefs about children's performance in mathematics: Comparisons among People's Republic of China, Chinese-American, and Caucasian-American families. *Journal of Educational Psychology, 79*(2), 179-188.

Ho, D. Y. F. (1981). Traditional patterns of socialization in Chinese society. *Acta Psychologica Taiwanica,23*, 81-98.

Ho, I. T. (2004). A comparison of Australian and Chinese teachers' attributions for student problem behaviors. *Education Psychology, 24*(3), 375-390.

Hirschfeld, L. A. (1995). Anthropology, psychology, and the meanings of social causality. In D. Sperber, D. Premack, & A. Premack (Eds.), *Causal cognition: A multidisciplinary debate* (pp. 313-350). Oxford, England: Oxford University Press.

Ji, L.J. (2005). Culture and Lay Theories of Change. In R. M. Sorrentino, D. Cohen, J. M. Olson & M. P. Zanna (Eds.), *Cultural and social behavior: The Ontario Symposium: Vol. 10* (pp. 117-135). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Ji, L.J. (2008). The leopard cannot change his spots, or can he? Culture and the development of lay theories of change. *Personality and Social Psychology Bulletin, 34*(5), 613-622.

Ji, L. J., Zhang, Z. Y., & Guo, T. Y. (2008). To buy or to sell: Cultural differences in stock market decisions based on price trends. *Journal of Behavioral Decision Making, 21*, 399-413.

Ji, L.J., Nisbett, R. E., & Su, Y. (2001). Culture, change, and prediction. *Psychological Science, 12*(6), 450-456.

Ji, L.J., Peng, K., & Nisbett, R. E. (2000). Culture, control and perception of relationships in the environment. *Journal of Personality and Social Psychology, 78*(5), 943-955.

Ji, L.J., Zhang, Z., & Nisbett, R. E. (2004). Is it culture or is it language? Examination of language effects in cross-cultural research on categorization. *Journal of Personality and Social Psychology, 87*(1), 57-65. London: Routledge.

Jones, E. E. and Nisbett, R. E. (1972). The actor and the observer: Divergent perceptions of the causes of the behavior. In E. E. Jones, D. E. Kanouse, H. H. Kelley, R. E. Nisbett, S. Valins and B. Weiner (eds.), *Attribution: Perceiving the causes of behavior* (pp. 79-94). Morristown, NJ: General Learning Press.

Keller, J. (2005). In genes we trust: The biological component of psychological essentialism and its relationship to mechanisms of motivated social cognition. *Journal of Personality and Social Psychology*, *88*, 686–702.

Keller, J., & Bless, H. (2004). Evolutionary thought and psychological essentialism: The belief in genetic predispositions and its relationship to basic processes of social cognition. *Journal of Cultural and Evolutionary Psychology, 2,* 123-141.

Kerr, A. (2004). Genetics and society: A sociology of disease. London and New York: Routledge.

Kjono, J. (1997). Genetic screening. Retrieved June 23, 2009, from http://www.ndsu.nodak.edu/instruct/mcclean/plsc431/students/kjono.html

Koo, M., & Choi, I. (2005). Become a holistic thinker: Training effect of Oriental medicine on reasoning. *Personality and Social Psychology Bulletin, 31*(9), 1264-1272.

Kwan, V. S. Y., Bond, M. H., & Singelis, T. S. (1997). Pancultural explanations for life satisfaction: Adding relationship harmony to self-esteem. Journal of Personality and Social Psychology, 73, 1038-1051.

Lamborn, S. D., Mounts, N. S., Steinberg, L., & Dornbusch, S. M. (1991). Patterns of competence and adjustment among adolescents from authoritative, authoritarian, indulgent, and neglectful families. *Child Development, 62*, 1049-1065.

Lee, F., Hallahan, M., & Herzog, T. (1996). Explaining real-life events: How culture and domain shape attributions. *Personality and Social Psychology Bulletin, 22*(7), 732-741.

Lee. J., Jones, P. S., Mineyama, Y., & Zhang, X. (2002). Cultural differences in responses to a Likert scale. *Research in Nursing and Health, 25*(4), 295-306.

Lockhart, K. L., Nakashima, N., Inagaki, K., and Keil, F. C. (2008). From ugly duckling to swan? Japanese and American beliefs about the stability and origins of traits. *Cognitive Development, 23,* 155-179.

Morris, M. W., & Peng, K. (1994). Culture and cause: American and Chinese attributions for social and physical events. *Journal of Personality and Social Psychology,* 67, 949-971.

Nelkin, D., & Lindee, M. S. (1995). *The DNA mystique: The gene as a cultural icon.* New York, NY: Freeman.

Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently ... and why*. New York: The Free Press.

Oppedal, B. (2008). Psychosocial profiles as mediators of variation in internalizing problems among young immigrants with origins in countries of war and internal conflicts. *European Journal of Developmental Psychology, 5*(2), 210-234.

Peng, K., & Nisbett, R. E. (1999). Culture, dialectics, and reasoning about contradiction. *American Psychologist, 54*(9), 741-754.

Peng, K., Nisbett, R. E., and Wong, N. Y. C. (1997). Validity problems comparing values across cultures and possible solutions. *Psychological Methods, 2*(4), 329-344.

Proctor, R. (1988). *Radical hygiene: Medicine under the Nazis*. Cambridge: Harvard University Press.

Salili, F., Hwang, C.E., & Choi, N. F. (1989). Teachers' evaluative behavior: The relationship between teachers' comments and perceived ability in Hong Kong. *Journal of Cross Cultural Psychology, 20*(2), 115-132).

Schaffner, K. F. (1999). Complexity and research strategies in behavioral genetics. In R. A. Carson & M. A. Rothstein, (Eds.), *Behavioral genetics: The clash of culture and biology* (pp. 61–89). Baltimore and London: The John Hopkins University Press.

Stevenson, H. W., & Lee, S. Y. (1996). The academic achievement of Chinese students. In M. H. Bond, (Ed.), *The handbook of Chinese psychology* (pp. 124–142). New York, NY, US: Oxford University Press.

Stevenson, H. W., & Stigler, J. M. (1992). *The learning gap: Why our schools are failing and what we can learn from Japanese and Chinese education*. New York: Summit Books.

Stevenson, H.W., Lee, S., Chen, C., Stigler, J.W., Hu, C.C., & Kitamura, S. (1992). Context of achievement: A study of American, Chinese, and Japanese children. *Monographs of the Society for Research in Child Development, 221*(55), 1-107.

Triandis, H. C., Bontempo, R., Leung, K., & Hui, C. H. (1990). A method for determining cultural, demographic, and personal constructs. *Journal of Cross-Cultural Psychology, 21*(3), 302-318.

Trigger, B. G. (2003). *Understanding early civilizations: a comparative study*. Cambridge, NY: Cambridge University Press.

Yang, L. H., Phillips, M. R., Licht, D. M., & Hooley, J. M. (2004). Causal attributions about schizophrenia in families in China: Expressed Emotion and Patient Relapse. *Journal of Abnormal Psychology, 113*(4), 592-602.

Yzerbyt, V., Judd, C. M., & Corneille, O. (2004). The psychology of group perception: Perceived variability, entitativity, and essentialism. In V. Yzerbyt, C. M. Judd & O. Corneille, (Eds.), *The psychology of group perception: Perceived variability, entitativity, and essentialism* (pp. 1–22). New York, NY, US: Psychology Press.

Appendix A

Biological Beliefs Scenarios for Study 1

Instructions: Please read the following questions carefully. Answer each question on the scale provided by circling the number that corresponds to your opinion. All descriptions below are genuine scientific information.

GENE PRESENT CONDITION

1) In a study using twins as subjects, genetic scientists found that people with a particular gene often have higher artistic ability, such as the ability to paint.

Sally, a grade-two student, has the particular gene for painting ability.
How likely do you think that Sally will be good at painting when she grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

2) In 2004, genetic researchers have isolated a gene that can increase the risk for the development of diabetes.

Richard, 6 years old, carries the gene that can increase the risk for developing diabetes.
How likely do you think that Richard will develop diabetes when he grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

3) In 2003, scientists discovered a gene that is related to alcoholism. Those who carry this gene tend to develop alcoholism.

Paul, 10 years old, has the gene that associates with alcoholism.
How likely do you think that Paul will develop alcoholism when he grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

4) A journal published recently has reported that a person's tendency to provide nurturance to others (especially towards children) is related to whether or not he or she has a particular gene.

Gary, in his first grade, is predisposed to the gene that contributes to nurturance.
How likely do you think that Gary will be a nurturing person when he grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

GENE ABSENT CONDITION

1) In a study using twins as subjects, genetic scientists found that people with a particular gene often have higher artistic ability, such as the ability to paint.

Sally, a grade-two student, does not have the particular gene for painting ability.
How likely do you think that Sally will be good at painting when she grows up?

```
           1       2       3       4       5       6       7       8
           |-------|-------|-------|-------|-------|-------|-------|
Highly Unlikely                                                    Highly Likely
```

2) In 2004, genetic researchers have isolated a gene that can increase the risk for the development of diabetes.

Richard, 6 years old, does not carry the gene that can increase the risk for developing diabetes.
How likely do you think that Richard will develop diabetes when he grows up?

```
           1       2       3       4       5       6       7       8
           |-------|-------|-------|-------|-------|-------|-------|
Highly Unlikely                                                    Highly Likely
```

3) In 2003, scientists discovered a gene that is related to alcoholism. Those who carry this gene tend to develop alcoholism.

Paul, 10 years old, does not have the gene that associates with alcoholism.
How likely do you think that Paul will develop alcoholism when he grows up?

```
           1       2       3       4       5       6       7       8
           |-------|-------|-------|-------|-------|-------|-------|
Highly Unlikely                                                    Highly Likely
```

4) A journal published recently has reported that a person's tendency to provide nurturance to others (especially towards children) is related to whether or not he or she has a particular gene.

Gary, in his first grade, is not predisposed to the gene that contributes to nurturance.
How likely do you think that Gary will be a nurturing person when he grows up?

```
           1       2       3       4       5       6       7       8
           |-------|-------|-------|-------|-------|-------|-------|
Highly Unlikely                                                    Highly Likely
```

Appendix B

Belief in Genetic Determinism Scale

For each statement below, rate the extent to which you agree or disagree with the statement. Indicate your rating by circling a number between 0 and 7 **(0 = Not at all true; 7 = Completely true)**.

Not at all true 0 1 2 3 4 5 6 7 Completely true

1. I think the chief reason why parents and children are so alike in behavior and character is that they possess a shared genetic inheritance. _______
2. In my opinion, alcoholism is caused primarily by genetic factors. _______
3. I think that differences between men and women in behavior and personality are largely determined by genetic predisposition. _______
4. I believe that children inherit many of their personal traits from their parents. _______
5. In my view, the development of homosexuality in a person can be attributed to genetic causes. _______
6. I am convinced that a very few behavioral traits of humans can be traced back to their genes. _______
7. I believe that many talents that individuals possess can be attributed to genetic causes. _______
8. I think that the upbringing by parents and the social environment have far greater significance for the development of abilities and personal traits than genetic predispositions. _______
9. I believe that many differences between humans of different skin color can be attributed to differences in genetic predispositions. _______
10. I think that genetic predispositions have little influence on a person's personality characteristics. _______
11. In my view, many forms of human behavior are biologically determined and can therefore be seen as instinctual. _______
12. The fate of each person lies in his or her genes. _______
13. I am of the opinion that intelligence is a trait that is strongly determined by genetic predispositions. _______

14. I believe that genetic predispositions have no influence whatsoever on the developmental of intellectual abilities. _______

15. I am convinced that the analysis of the genetic predispositions of an embryo allows good predictions as to which characteristic and abilities the child will develop. _______

16. I think the genetic differences between Asians and Europeans are an important cause for the differences in abilities between individuals from these groups. _______

17. I think that twins, because of their identical genetic predispositions, will be very similar in their behavior even if they were adopted and raised in different families. _______

18. I believe that an analysis of my genetic predispositions will allow a trained scientist to predict many of my abilities and traits without having any personal knowledge of me. ______

Appendix C

Demographics for Study 1

Your cultural background (please check):

European __________ Chinese ___________ Other (Please specify) __________

Gender: male female Age: __________

How many courses in biology or genetics have you taken in total (high school and university)? __________

Do you think you are good at painting?

Definitely not Definitely yes

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

Do you think you are a nurturing person?

Definitely not Definitely yes

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

Do you have diabetes? Yes _______ No _______

Do you drink excessively or abuse alcohol? Yes _______ No ________

Primary language (language you speak at home): _________________

In the past 6 months, approximately **how many times** have you read or learn about genetic research or findings reported in:

Newspapers? _______
Magazines? _______
Online resource (e.g. websites, forums)? _______
School (e.g. in textbooks)? _______

Please answer the following questions on a 1 to 8 scale.

very little influence very big influence

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

In general, to what extent do you think **biological predispositions or/and inheritance** influence:

Personalities? _______
Physical characteristics (e.g. height, weights)? _______
Talents (e.g. athletic, artistic, academic)? _______
Diseases or health conditions (e.g. cancer, high cholesterol, high blood pressure)? _______

Appendix D

Biological Beliefs Scenarios for Study 2

Instructions: Please read the following questions carefully. Answer each question on the scale provided by circling the number that corresponds to your opinion. All descriptions below are genuine scientific information.

1) A scientific magazine has reported a specific gene that can influence memory performance in humans. Those who have this gene tend to have better memory.

Anthony, a grade-two student, has the specific gene that can influence memory.
How likely do you think that Anthony will have very good memory when he grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

2) In 2004, genetic researchers have isolated a gene that can increase the risk for obesity.

Alice, 6 years old, carries the specific gene that can increase the risk for obesity.

How likely do you think that Alice will become obese when she grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

3) In 2003, scientists discovered a gene that is related to gambling. Those who carry this gene tend to be addicted to gambling.

Jasmine, 10 years old, carries the gene that associates with compulsive gambling.
How likely do you think that Jasmine will become a problematic gambler when she grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

4) A newsmagazine has reported that a specific gene is associated with impulsive violence. According to the researchers, people who carry this gene are less able to control aggression.

Natalie, in her first grade, has the specific gene contributing to impulsive violence and involuntary aggression.
How likely do you think that Natalie will be aggressive when she grows up?

1 2 3 4 5 6 7 8
|---------|---------|---------|---------|---------|---------|---------|
Highly Unlikely Highly Likely

GENE ABSENT CONDITION

Instructions: Please read the following questions carefully. Answer each question on the scale provided by circling the number that corresponds to your opinion. All descriptions below are genuine scientific information.

1) A scientific magazine has reported a specific gene that can influence memory performance in humans. Those who have this gene tend to have better memory.

Anthony, a grade-two student, does not have the specific gene that can influence memory. How likely do you think that Anthony will have very good memory when he grows up?

```
            1        2        3        4        5        6        7        8
            |--------|--------|--------|--------|--------|--------|--------|
Highly Unlikely                                                     Highly Likely
```

2) In 2004, genetic researchers have isolated a gene that can increase the risk for obesity.

Alice, 6 years old, does not carry the specific gene that can increase the risk for obesity. How likely do you think that Alice will become obese when she grows up?

```
            1        2        3        4        5        6        7        8
            |--------|--------|--------|--------|--------|--------|--------|
Highly Unlikely                                                     Highly Likely
```

3) In 2003, scientists discovered a gene that is related to gambling. Those who carry this gene tend to be addicted to gambling.

Jasmine, 10 years old, does not carry the gene that associates with compulsive gambling. How likely do you think that Jasmine will become a problematic gambler when she grows up?

```
            1        2        3        4        5        6        7        8
            |--------|--------|--------|--------|--------|--------|--------|
Highly Unlikely                                                     Highly Likely
```

4) A newsmagazine has reported that a specific gene is associated with impulsive violence. According to the researchers, people who carry this gene are less able to control aggression.

Natalie, in her first grade, does not carry the specific gene contributing to impulsive violence and involuntary aggression.
How likely do you think that Natalie will be aggressive when she grows up?

```
            1        2        3        4        5        6        7        8
            |--------|--------|--------|--------|--------|--------|--------|
Highly Unlikely                                                     Highly Likely
```

Appendix E

Demographics for Study 2

Your cultural background (please check):

European __________ Chinese ___________ Other (Please specify) __________

Gender: male female Age: __________

How many courses in biology or genetics have you taken in total (high school and university)?
____

Do you think you are a person with good memory?

```
Definitely not                                             Definitely yes
          |---------|---------|---------|---------|---------|---------|---------|
          1         2         3         4         5         6         7         8
```

Do you think you are an obese person?

```
Definitely not                                             Definitely yes
          |---------|---------|---------|---------|---------|---------|---------|
          1         2         3         4         5         6         7         8
```

Do you have a tendency towards gambling addiction?

```
Definitely not                                             Definitely yes
          |---------|---------|---------|---------|---------|---------|---------|
          1         2         3         4         5         6         7         8
```

Do you have a tendency towards aggression?

```
Definitely not                                             Definitely yes
          |---------|---------|---------|---------|---------|---------|---------|
          1         2         3         4         5         6         7         8
```

Primary language (language you speak at home): _________________

In the past 6 months, approximately **how many times** have you read or learn about genetic research or findings reported in:

Newspapers? _______
Magazines? _______
Online resource (e.g. websites, forums)? _______
School (e.g. in textbooks)? _______

Please answer the following questions on a 1 to 8 scale.

very little influence   very big influence

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

In general, to what extent do you think **biological predispositions or/and inheritance** influence:

Personalities? ________
Physical characteristics (e.g. height, weights)? ________
Talents (e.g. athletic, artistic, academic)? ________
Diseases or health conditions (e.g. cancer, high cholesterol, high blood pressure)? ________