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Delay Discounting, Probability Discounting, Reward  
Contrast and Gambling: A Cross-Cultural Study

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by

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**A dialogue between a PhD candidate and his then 2.5-year old son**

“Dad, can you play with me after dinner?”

“Sorry son. I have to do reading then.”

“I help you. I help you to turn pages and you will finish your reading very fast.”

A thesis dedicated to my son, Andi

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## Abstract

Problem and pathological gambling has become an increasing public health concern worldwide in recent years, and individuals from China and East Asian countries may be especially vulnerable. Knowledge of how individuals make choices between outcomes that are delayed or uncertain, and of potential differences in decision making across cultures, may contribute to our understanding of factors which increase the risk of problem gambling. Our research is based on a discounting perspective in which the value of a delayed or uncertain reward decreases according to the time until or the odds against its receipt, respectively. We use experimental procedures in which individuals make a series of hypothetical choices so as to estimate an indifference point – an amount of money available immediately or with certainty – that is equal in subjective value to a delayed or uncertain reward. Our starting point is the hypothesis that reward contrast – in which the subjective value of a reward varies inversely with amount of a prior reward – plays a role in choice between delayed or probabilistic outcomes and might contribute to problem gambling. This thesis describes four experiments which investigate these ideas. Experiments 1 and 2 establish that reward contrast is a reliable phenomenon in choice. Indifference points for an intermediate reward (\$475/\$525) varied as predicted if its subjective value was larger when the individual had previously been making choices with a smaller amount (\$50) and smaller when previously making choices with a larger amount (\$5,000). Reward contrast was obtained for both delayed and probabilistic choice, using between-subjects (Experiment 1) and within-subjects (Experiment 2) designs. Experiment 3 used a computerized Card Playing Game (CPG) as an analogue gambling task and also measured delay discounting using the same task as Experiment 2. Participants began with an initial stake and could win or lose 10% of the stake with each card that they played. The critical aspect of the procedure was that the probability of winning for each card decreased as more cards were played. Participants played the CPG four times with stakes of \$50, \$500, \$5,000 and \$500 (order of \$50 and \$5,000 was counterbalanced). Results showed that performance on the CPG

improved over successive trials, suggesting that participants learned the contingencies in the task. Although this confounded our attempt to measure reward contrast within-subjects, participants who had a \$50 stake in the first deck performed better in the second deck with a \$500 stake than those who had a \$5,000 stake in the first deck, consistent with reward contrast. Results from the delay discounting task were correlated with CPG performance, showing that participants who had lower reward contrast and discounting rates, and greater magnitude effects won more money on the CPG task. Experiment 4 used a larger sample ( $N = 182$ ) with both Chinese and Caucasian (New Zealand European) participants and recruited individuals with gambling histories, and compared performance on delay and probability discounting tasks and the CPG. Results showed that Chinese participants had higher delay discounting rates and lower probability discounting rates when data were analyzed according to the area under the discounting curve (AUC). Gamblers (those participants with scores on the South Oaks Gambling Screen [SOGS; Lesieur & Blume, 1987]  $> 1$ ) were less risk averse in probability discounting and had reduced magnitude effects in delay discounting and performed more poorly on the CPG. Closer analysis of the probability discounting data showed that compared with Caucasians, Chinese were more risk averse for high probabilities of reward outcome, and less risk averse for low probabilities. Although results do not suggest that individual differences in reward contrast, as measured using our within-subjects delay discounting task, play a significant role in the maintenance of gambling behavior, the cross-cultural differences in delay and probability discounting in Experiment 4 suggest some factors that might contribute to gambling. In the General Discussion, we propose an account of the probability discounting results in terms of a tendency toward dialectical thinking and emotions in Chinese culture. Based on this result and previous research, we propose a framework for the cross-cultural analysis of risky decision making, and consider some of its broader implications for both research in decision making and issues of globalization.

## Introduction

The idea for this thesis originated from a desire to understand the attraction that gambling has for individuals from China, and East Asian cultures in general. Is there something about the culture, language, history, or habitual ways of thinking that make persons from Chinese societies particularly susceptible to the lure of the casino? If we could identify any culturally-specific factors which make Chinese especially vulnerable to gambling, it might lead to more effective interventions and treatments for problem and pathological gambling, perhaps not only for Chinese but also people in general. We view gambling as an example of a potentially maladaptive choice situation involving rewards that are uncertain and or delayed in the future. Thus, elements of risk, uncertainty and delay are important for gambling situations, and we adopted the discounting framework for choice between delayed and/or probabilistic outcomes that has become increasingly popular in recent years for psychological research on decision making (Green & Myerson, 2004). According to this framework, the value of an uncertain or delayed reward decreases according to a discounting function, and the rate at which rewards decrease as a function of their delay or uncertainty can vary across individuals and for different clinical groups. Our starting point was the hypothesis that reward contrast – the tendency for the subjective magnitude of a stimulus to vary inversely with its surrounding context (Lockhead, 2004) – might play a role in the aetiology of problem gambling and perhaps contribute to the prevalence of gambling among Chinese persons. This thesis describes a series of four experiments which attempts to address these questions<sup>1</sup>.

Chapter 1 is a literature review that covers research on problem gambling from a variety of domains, including epidemiology, psychology, education, economics, and neuroscience, and with a particular focus on New Zealand, the Greater China Region and East Asia. Theories of decision making under uncertainty are described, including Expected Utility Theory and

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<sup>1</sup> All experiments reported here received approval from the UC Human Ethics Committee (Ref: 2007/23).

Prospect Theory, and attention is given to research which has attempted to identify emotional and cultural factors that may play a role in decision making. Research on delay and probability discounting is reviewed, and demographic and other factors which are associated with differences in discounting rates are described. The relationship between delay and probability discounting and gambling is explored. Finally, research on reward contrast is considered and factors which may make individuals from Chinese cultures more susceptible to contrast effects are noted.

Chapter 2 presents two experiments which investigate reward contrast effects in delay and probability discounting. Experiments 1 and 2 use a psychophysical procedure to estimate indifference points – amounts of money (hypothetical) to be received immediately or with certainty, that are judged as equal in subjective value to a delayed or probabilistic reward, respectively. In both experiments, participants respond to a series of questions about an intermediate amount (\$475/\$525) after trials with a larger (\$5,000) or smaller (\$50) amount. According to reward contrast, the subjective value of the intermediate reward should vary inversely with the prior amount. Given the well-established effects of reward magnitude on delay and probability discounting (e.g., Green, Myerson & O'Donoghue, 1999), we would then expect that the present value (i.e., indifference point) of the intermediate reward would be larger for delay discounting after the \$50 amount, and smaller for probability discounting after the \$50 amount. These predictions were confirmed using both a between-subjects design (Experiment 1) and within-subjects design (Experiment 2). The finding that we could measure reward contrast within-subjects was especially noteworthy because it encouraged us to use the same procedure in subsequent experiments. Chapter 2 has been published as Dai, Grace and Kemp (2009) and is included here in its original form.

In Experiment 3 (Chapter 3) we attempted both to replicate the within-subjects contrast effect in delay discounting from Experiment 2 with a different and larger sample, and to develop

a simulated gambling task in which we could also test for potential contrast effects. For this, we adapted a Card Playing Game (CPG) as a computerized task based on Newman, Patterson and Kosson (1987). In this task, participants begin with an initial stake and play a card by clicking a button on the screen. Each card wins or loses 10% of the initial stake, and participants can choose to quit the game at any time. The critical aspect of the task is that the probability of winning decreases as more cards are played, so the question is whether the individual will stop playing or instead persist and ‘chase’ their losses. Participants completed the CPG four times with initial stakes of \$50, \$500, \$5,000 and \$500 (order of \$50 and \$5,000 was counterbalanced). Results from the delay discounting task showed that the reward contrast effect was replicated. An unanticipated finding was that CPG performance improved substantially over repetitions, which confounded our attempt to measure contrast in the task within-subjects. However, results from the first block with a \$500 stake were found to depend on the magnitude of the prior stake (\$50 or \$5,000) in a between-subjects comparison. In addition, both the reward contrast and magnitude effects and discounting rates from the delay-discounting task were significantly correlated with CPG performance, suggesting that individuals who were more impulsive (i.e., higher discounting rates, larger contrast effects, smaller magnitude effects) tended to perform more poorly on the CPG.

Experiment 4 (Chapter 4) addresses the major questions that were the impetus for the thesis. Performance of both Chinese and Caucasian (New Zealand European) participants ( $N = 182$ ) were compared in terms of delay and probability discounting tasks and the CPG. Attempts were made to recruit individuals with gambling histories for both ethnic groups, so that both ethnicity and gambling status could be investigated. Results showed that Chinese participants discounted delayed rewards more steeply and probabilistic rewards less steeply than Caucasians when data were analyzed according to the area under the discounting curve (AUC; Myerson, Green, & Warusawitharana, 2001). The increased delay discounting rate for Chinese was a novel result, while the lower probability discounting rate was consistent with some previous studies

(e.g., Du, Green, & Myerson, 2002). Gamblers (defined as those participants with scores on the South Oaks Gambling Screen [SOGS; Lesieur & Blume, 1987] > 1) had lower rates of probability discounting and a reduced magnitude effect for delay discounting compared with non-gamblers. Reward contrast effects did not depend on ethnicity or gambling status, and the correlations with CPG performance were not significant, failing to replicate Experiment 3. When discounting data were analyzed in terms of indifference points rather than AUC values, a more nuanced picture of the ethnic difference in probability discounting emerged. There was a significant crossover interaction such that compared with Caucasians, Chinese were more risk averse for relatively high probabilities of reward, but less risk averse for relatively low probabilities of reward.

Chapter 5 is a General Discussion. Based on the experimental results, we evaluate the status of reward contrast as a potential factor in gambling-related behavior and consider the differences between Chinese and Caucasians in terms of delay and probability discounting. The difference between probability discounting results based on AUC and indifference points (i.e., ethnic difference in Experiment 4) is explained in terms of skew induced by the odds against transformation. Differences between Chinese and Caucasians in terms of risky decision making are examined in the context of previous cross-cultural research. We develop an account of the ethnic differences observed in Experiment 4 in terms of a tendency toward dialectical thinking and emotions in Chinese people. Based on this result, and a review of previous research, we propose a framework for the cross-cultural analysis of risky decision making. In Chapter 6, we consider some of the broader implications of our empirical results and theoretical analysis both for cross-cultural research in decision making as well as issues of globalization.

## Chapter 1 Literature Review

### 1.1 Gambling

#### 1.1.1 Problem Gambling – A Worldwide Overview

Gambling (or gaming)<sup>2</sup> refers to betting on diverse games, such as cards, dice, lotteries, bingo, roulette, slot machines, sporting events and so forth<sup>3</sup>, all which have in common the risking of something of value such as money or possessions on some outcome of chance with the possibility of winning something of greater value (Abbott & Volberg, 1999a; Thompson, 1997). Inherent in gambling is risk and chance influences the results (Petry, 2005).

Gambling is an ancient form of recreation which has been part of human society since pre-recorded times. Associations between games of chance and divine beings are found by archaeological evidence in ancient Asia (e.g., China, India and Japan), Europe (e.g., Greece and Rome), Africa (e.g., Egypt) and Middle East (Chien & Hsu, 2006; Gabriel, 1996). In ancient times, for the players, gambling represented a way of either passing their leisure time or of providing a chance, however small, to become rich (Petry, 2005). For governments, in certain periods, it served as one of the means to raise revenues during periods when financial institutions were not yet developed or when they were hard pressed by sudden expenses (Brenner & Brenner, 1990). Some early universities, including Harvard, were founded on proceeds from lotteries (Petry, 2005). From these accounts, it is likely that gambling emerged independently in a number of different societies. In more recent times, technological innovations have helped

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<sup>2</sup> Gambling and gaming are always interchangeably used as synonymous terms to mean playing games of chance. Gambling tends to be favoured in research while gaming tends to be favoured by gambling operators (Abbott & Volberg, 2000; Latour, Sarrazit, Hendler, & Latour, 2009).

<sup>3</sup> Some other modern business practices also involve risks such as insurance and investments (on stocks, bonds, real estate, foreign currency exchange transactions etc.), but they are usually studied in the domain of economics rather than gambling research.

gambling practices to be widely transported across geographical and cultural boundaries (Abbott & Volberg, 1999a).

In the past three decades or so, the rapid expansion of commercial gambling has been increasing in every continent in the world except Antarctica (Chien & Hsu, 2006; Lesieur & Rosenthal, 1991). Statistics (Global Betting & Gaming Consultants, 2010) show that global gaming revenue was approximately US\$260 billion in 2009. Worldwide, over 113 countries and regions have legalized gambling (cf. Hung, Yang, & Lee, 2010). Asia is seen as a dynamic industrial marketplace with an enormous growth potential (Gu & Gao, 2006). A survey indicated that gambling revenues in Asian casinos are likely to surpass those in the United States by 2012 (American Gaming Association, 2008).

Gambling activity is generally seen as a “double-edged sword” which can also bring severe adverse consequences to some populations if not all. As Petry (2005) pointed out:

“Although gambling is ubiquitous, and many people partake in it as a relatively harmless recreation, some individuals appear to make poor decisions when chance influences outcomes. From a macroscopic perspective, repeated risky decisions likely will lead to the death of an organism. Natural selection would ultimately dictate the elimination of any lineage that was inclined to engage in behaviors that result in very unlikely but large benefits, especially if such behaviors require a substantive investment of resources” (pp. 4-5).

The passing of centuries seems to have done little or failed to stop or even curb the human desire to gamble. Lotteries and other games of chance have frequently been criticized on the ground that a society becomes worse off if people are given the opportunity to play, and for long periods of time many games were outlawed. It is widely assumed that increases in the availability of gambling will lead to increases in the prevalence of problem gambling. With the development and the legalization of the gambling business worldwide, gambling-related problems are only likely to get worse in the future (see Abbott, Volberg, Bellringer, & Reith, 2004; Welte, Barnes, Wiczorek, Tidwell, & Parker, 2004).

Just as gambling exists in almost every culture, so does problem gambling (e.g., Raylu & Oei, 2002). Many activities involve chance (e.g., sports), but gambling is distinctive in that chance is an intrinsic part of the activity and money/resources are involved. A gambler's excessive gambling or loss of control over gambling can result in harm not only to the gambler, but to their family, close associates and the wider community (Abbott & Volberg, 1999a; Productivity Commission Report (PCR), 1999). Gambling problems can disrupt important personal relationships, cause significant financial problems, and have associated adverse impacts on the gambler's mental and physical well-being (Abbott, 2001; Delfabbro, 2008). Typically, such individuals incur substantial debt and experience family and social relationship problems because of gambling.

Some pathological gamblers even lose their jobs or engage in illegal activities to support their gambling (American Psychiatric Association (APA), 2000; Petry & Armentano, 1999). In Australia, Crofts (2003) examined New South Wales Local and District Court files and found that 75% of the criminal offences were directly related to gambling from 1995-99. In a cross-national review, Williams, Royston and Hagen (2005) found that, among incarcerated populations, half of the crimes were committed to support gambling. Gambling can also disrupt the family unit. For example, Korman et al. (2008) found that 55% of the gamblers they studied reported acts of physical aggression against their partners. According to statistics from Hong Kong, of those who died in suicide in 2003, nearly 10% of the victims were indebted due to gambling prior to death, and 20% showed evidence of gambling behavior (Wong, Cheung, Conner, Conwell, & Yip, 2010).

Perhaps most concerning of all is that problem gambling is likely to persist across generations in a family. Evidence suggests that among children of problem gamblers, approximately 15-20% will also develop problems with gambling (Delfabbro, 2008). Teo et al. (2007) found that among problem gamblers, nearly one third had a family history of gambling.

Gambling is also often related to other forms of dependence which undermine health, such as alcohol, drug abuse and cigarette smoking (Delfabbro, 2008; Petry, 2005).

Gambling behavior lies on a continuum, ranging from experiencing no gambling problems to very severe gambling addiction. In the gambling literature, the term “pathological gambling” is often used interchangeably with “compulsive gambling” and “problem gambling”. The term “compulsive gambling” is commonly used by Gamblers Anonymous ([www.gamblersanonymous.org](http://www.gamblersanonymous.org)) which is an international mutual help group for members with gambling-related problems. “Problem gambling” is used to describe people who gamble to a lesser degree than required by the diagnostic criteria of “pathological gambling” in Diagnostic and Statistical Manual of Mental Disorders (e.g., DSM-IV; APA, 1994), and is classified as an impulse control disorder. The term “pathological” is commonly used by clinicians. However, most researchers consider the term “problem gambling” as appropriate for people who have a wide range of difficulties with gambling, with only the most severe group described as “pathological gamblers” (Petry, 2005; Raylu & Oei, 2002). The term “problem” also avoids the pejorative implication of “pathological” (Walker & Dickerson, 1996). In this thesis, the abbreviation “PG1” is used to refer to “problem gambling” or “probable problem gambling” which is or is suspected at an early stage of gambling problem; and “PG2” is used to refer to “pathological gambling” or “probable pathological gambling”, that is, more severe disordered gambling behaviors. The abbreviation “PG” is used to refer to a wider sense of problem gambling behaviors which may not necessarily meet the diagnostic criteria of pathological gambling. “NG” is used to refer to non-gamblers or non-problem gamblers who score “0” in the various gambling screening scales, such as the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987)<sup>4</sup>.

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<sup>4</sup> There are other gambling screening scales such as, items for pathological gambling in the Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV; APA, 1994), The Diagnostic Interview for Gambling Severity (DIGS; Winters, Specker, & Stinchfield, 2002), Problem Gambling Severity Index (PGSI) of the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001), etc. In this thesis, in order to cause less confusion and highlight the key points, the introduction of prevalence rates from various researches will not come along with the gambling screen tools which researchers used. However, when needed to compare the prevalence rates in different countries and studies, the generality and discrepancies should be treated with caution.

Surveys indicate that pathological gambling afflicts about 1.6% of the general population of the United States, and more than 80% of adults engage in some form of gambling in U.S. annually (Shaffer, Hall, & Vander Bilt, 1999). The American Gaming Association reported that gamblers lost US\$34.1 billion at U.S. casinos in 2007 (cited in McSherry, 2008). Canadian researchers have found prevalence rates similar to those reported in most of the U.S. surveys (Cox, Yu, Afifi, & Ladouceur, 2005; Ladouceur, 1996). Problem gambling was estimated as affecting 4.9% of the Australian population in 1999, with gamblers' losing AU\$10.8 billion in 1997-8. This equates to AU\$730 per adult or 3% of household income (PCR, 1999). Prevalence rates of problem gambling have been estimated for some other Western countries, such as United Kingdom (Wardle et al., 2007), Spain (Becoña, 1993), Switzerland (Bondolfi, Osiek, & Ferrero, 2000), Sweden (Volberg, Abbott, Ronnberg, & Munck, 2001), Norway (Gäestam & Johansson, 2003) and New Zealand (Abbott & Volberg, 1991, 2000, 2006). Several studies have also been conducted in some Asian countries/regions, for example, Korea, Hong Kong and Taiwan (e.g., Chen et al., 1993; Cheng et al., 2008; Hwu, Yeh, & Chang, 1989; Lee et al., 1990; Wong & So, 2003). Under those investigations, prevalence rates of lifetime probable pathological gambling (PG2) usually range from about 1% to 2% worldwide. Prevalence rates of problem gambling (PG1) are slightly higher in most studies, ranging from 2% to 5%. Past-year prevalence rates are about 40% to 60% of lifetime rates. The relative consistency of these estimates, despite the use of a variety of instruments administered in a number of languages, allows for some degree of confidence in this general estimate of worldwide prevalence.

A large number of risk factors for PG have been reported, such as gender, age, income, family history, stress level, mental health status, and alcohol and drug abuse (Petry, 2002b; Sinha, 2004; Welte et al., 2004). Studies have also suggested that the different types of gambling might same affect the risk level of pathology. For example, gambling in a casino is associated with a high risk of PG, whereas lottery, cards and bingo have a moderate association (Welte et al., 2004).

Research also suggests that high rates of problem gambling occur among some cultural groups (e.g. Chinese), ethnic minorities and indigenous groups (e.g. the Maoris in New Zealand and Native Americans in the United States) across several countries, controlling for other socioeconomic and demographic factors (for comprehensive reviews, see Loo, Raylu, & Oei, 2008; Petry, 2005; Welte et al., 2004).

In summary, gambling can be a harmless entertainment activity from which people derive personal enjoyment and which provides other positive social effects. The proceeds from non-commercial gambling provide significant funding for a wide variety of community purposes. If well directed, these funds can enhance empowerment, participation and the quality of life across all types of communities. On the other hand, gambling also has adverse and even severe effects on many individuals, their families and communities. However, it is only relatively recently that excessive gambling has been defined as a mental illness, rather than profligate behavior or wickedness as it has been sometimes been described historically (Tan & Wurtzburg, 2004).

### **1.1.2 Gambling and its Impact in New Zealand**

There appears to be no evidence of gambling in pre-European Maori society in New Zealand (Binde, 2005). Gambling was first introduced by sealers and whalers in the early nineteenth century. From colonisation in 1840, gambling flourished in New Zealand, as it did in the earlier frontier settlements in North America and Australia (Abbott & Volberg, 1999a).

In the last two decades, gambling has become a prosperous industry in New Zealand. This prosperity is mainly associated with electronic gambling machines ('pokies'), which became legal at the same time (Raeburn, 2004). New Zealand has been reported as having "the fastest growth rate of licensed gaming machines per capita anywhere in the world" (Adams, 2001). As a result, total expenditure on the NZ gambling industry (the amount lost or spent by players or the gross profit of the gaming operator) was \$0.2 billion in 1985, and rocketed to \$2 billion in 2009

(in NZ dollars, non-inflation adjusted). Thus, in 2009, gamblers in NZ lost on average over \$5 million dollars per day on gambling activities (Department of Internal Affairs (NZ), 2010). Based on the statistics in other countries, problem gamblers would be expected to constitute approximately 40-50% of the whole expenditure (PCR, 2009). In 2009, the numbers of clients seeking help for problem gambling services increased 59% from the previous year and was a record total (Ministry of Health (NZ), 2010). Therefore, a question may be raised: Except for the adverse consequences, how much has the community benefitted from this profitable market? Pokie machines (located outside casinos, in pubs or restaurants) took in \$889 million in 2009 and are the most harmful form of gambling, as over 78% of problem gamblers use them as their primary mode of gambling (Ministry of Health (NZ), 2008b). For every \$1 that comes into a community organisation from a pokie-funded trust, foundation, society or club, \$3 has been lost from the community (Problem Gambling Foundation (NZ), 2009).

In summary, gambling-related harm is an emerging public health issue in New Zealand, with significant health, social and economic implications. In the last decade, there has been an increase in the use of gambling products and expenditure as well as increases in the number of people seeking help for their own or someone else's gambling (Tan & Wurtzburg, 2004).

New Zealand's Gambling Act of 2003 defines a problem gambler as a person whose gambling causes harm or may cause harm. Harm is also defined in the Act, and in very broad terms such as that caused by a person's gambling, including personal, social or economic harm suffered by the person, their family, community, workplace or by society at large. This suggests that in addition to those who may be described as problem gamblers based on their scores on questionnaires such as the SOGS, at least some of those who score as moderate risk or low risk will also meet the criteria for a problem gambler as set out in New Zealand's Gambling Act 2003 (see Department of Internal Affairs (NZ), 2008). This broader definition of problem gambling has also been supported by a study conducted in Norway. Lund (2007) concluded that at-risk

gamblers differed substantially from no-risk gamblers, and also concluded that the similarity between at-risk gamblers and problem gamblers increased the likelihood that many of them would eventually develop a gambling problem.

The first national investigation of prevalence rates of problem gambling in New Zealand was undertaken in 1991 (Abbott & Volberg, 1991) (for review of various studies of prevalence rates in NZ, see Department of Internal Affairs (NZ), 2008). According to the 1991 survey, the pathological gambling and problem gambling prevalence rates were 1.2% and 2.7%, respectively (also see Abbott & Volberg, 1999b; Abbott, Williams, & Volberg, 1999; Gambino, 1999, for adjustments and debates). Eight years later, in 1999, the Department of Internal Affairs organized another nationally-based study and found that 0.3% to 0.7% of adults living in the community were current probable pathological gamblers and a further 0.6% to 1.1% were current problem gamblers (Abbott & Volberg, 2000). The 2002/03 New Zealand Health Survey launched by the Ministry of Health estimated that 1.0% to 1.5% of adults (aged 15 and over) living in the community were current problem gamblers (Ministry of Health (NZ), 2006). The latest statistics in the 2006/07 New Zealand Health Survey of problem gamblers reported a range of adult problem gamblers from 0.3% to 0.5% by using a conservative gambling screening questionnaire (Ministry of Health (NZ), 2008a); a further 1.1% to 1.5% of adults were “moderate risk” gamblers, and 3.1% to 3.9% were “low risk”. The participation rate was highest for Lotto (55.2%), followed by ‘Instant Kiwi’ scratch tickets (26.5%), non-casino gaming machines (10.2%), betting on horse or dog races (8.7%), casino gaming machines (7.7%), and sports betting (5.2%). The discrepancies of the statistics in these reports are believed to be due to the growth in gambling availability and expenditure over time, and methodological differences such as sample size, age inclusion criteria, screening questionnaires, and time period of gambling problem covered. However, all these published figures tend to underestimate the actual prevalence of problem gambling because certain groups such as people living in military barracks, people in hospitals and residential treatment centres, and people in prisons, are

typically omitted from community-based surveys (Ministry of Health (NZ), 2008a). Some of these groups, for example prisoners, are at high risk for gambling problems (Abbott & McKenna, 2000; Abbott, McKenna, & Giles, 2000; Walters, 1997).

It has been reported that a severe problem gambler is likely to affect between 7 and 17 other people (PCR, 1999). This suggests that at any given time, in addition to the 10,000 to 60,000 adults (0.3% and 1.8%) in the 2006/07 New Zealand Health Survey who may be problem gamblers, it is reasonable to expect that the cumulative number of adults and children who are impacted by gambling might be up to 500,000 (Department of Internal Affairs (NZ), 2008). Gambling-related harm and special forms of gambling activities affect some sections of the community more than others. For instance, some Asian groups (e.g., Chinese), other minorities (e.g., Pacific peoples) and indigenous people (e.g., Maori in NZ), are more likely than other groups to suffer harm related to casino gambling (e.g., Department of Internal Affairs (NZ), 2008; Oei & Raylu, 2007; Tse, Wong, Kwok, & Li, 2004).

### **1.1.3 Aetiology of Problem Gambling and its Treatment**

Excessive gambling has been stigmatized as a moral failing, resulting in social isolation and even imprisonment of gamblers and debtors. However, it was only relatively recently that pathological gambling was officially recognized in the publication of the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III; 1980). Unfortunately, knowledge about the aetiology of this disorder is limited and treatment is effective only in part of the population of problem gamblers (e.g., Holst, Brink, Veltman, & Goudriaan, 2010). Scientific research on the aetiology and treatment of disordered gambling is only just emerging. Currently, there is a wide divergence of theory and opinion about the aetiology of problem gambling (Petry, 2005). Various theories have focused on behavioral reinforcement (Skinner, 1953), erroneous beliefs (Ladouceur et al., 2001), difficulty coping with stress (Derevensky, Gupta, & Cioppa,

1996; Gupta & Derevensky, 1998), genetic and physiological factors (Blum et al., 2000; Sharpe, 2002; Slutske, Zhu, Meier, & Martin, 2010), education (Sun & Li, 2005), and perception of risk and regret (Li et al., 2010) as possible explanations of the disorder. One promising view has been proposed by Blaszczynski and Nower (2002) that there are three distinct pathways associated with the onset of problem gambling: (1) people who are *otherwise psychologically normal* may have developed a gambling problem because of wins, erroneous beliefs or social encouragement to gamble; (2) *emotionally vulnerable* gamblers may have developed a gambling problem because they were anxious, depressed, or under a lot of stress; and (3) *impulsive gamblers* may have developed a gambling problem because of a pre-existing impulse control disorder such as attention deficit hyperactivity disorder (ADHD). Blaszczynski and Nower's (2002) pathways model provides a convenient means of integrating the various theoretical positions into an overall framework and suggests that problem gamblers are not a single homogenous group (see also Turner, Macdonald, & Somerset, 2008).

These theories suggest that gamblers should typically respond well to treatment and that that majority can be expected to benefit from treatment, at least in the short term (see Petry, 2005). Our current research will not focus on any specific therapy; instead, one aspect that may contribute to problem gambling behavior will be investigated: the "reward contrast effect", in which the value of a reinforcing outcome (e.g., an amount of money) varies inversely with respect to reinforcement context (e.g., a stake of \$50 may seem very small if the potential gain is \$5,000; see Flaherty, 1996; Lockhead, 2004; Williams, 2002, for reviews). Our hypothesis is that individuals who are susceptible to reward contrast effects may be at higher risk for problem gambling. A second goal of this research is to compare the cross-cultural differences in the decision making related to gambling, in particular between New Zealand European and Chinese ethnic groups.

Research has shown that cultural variables such as values and beliefs, effects of acculturation and culturally-related help-seeking behaviors are often related with increased rates of psychological problems among certain cultural groups (Raylu & Oei, 2002). Given that migration is currently the worldwide “visible face of social change” (Abbott & Volberg, 1999a) and that we are in the early years of “the age of migration” (Castles & Miller, 1993), the ethnic make-up of New Zealand society is changing rapidly. Asians make up the fastest-growing ethnic community in New Zealand today just after European and Maori. Asians accounted for 9.2% of the population in the 2006 NZ census. Chinese are the largest ethnic group within the Asian population, followed by Indian and Korean (Statistics New Zealand, 2006). Problem gambling has become a major public health issue for Asian people in New Zealand. In 2007, 6.9% of new clients to Gambling Helpline, and 7.6% of face-to-face counselling problem gamblers were of Asian descent. Among them, over 78% of Asian clients cite casino-based machines and tables as their primary mode of gambling. Pokies accounted for 13.1% of the primary mode of gambling by Asians (Ministry of Health (NZ), 2008b).

Chinese culture has more than 5,000 years’ history of civilization and some gambling activities are even believed to originate from China and are still widely accepted and played in the Chinese community. It would be reasonable to assume that Chinese problem gamblers should have unique gambling beliefs, behaviors, and effective counselling models should be developed for their gambling problems. The research in this thesis will also investigate cross-cultural differences of decision making when outcomes vary in uncertainty (i.e., probability of receipt) and delay, which may be linked to gambling-related behavior.

## **1.1.4 Chinese Gambling Culture and Gambling Problems in the Chinese Community**

### **1.1.4.1 Chinese Gambling History and Current Status Quo in the Greater China Region**

The earliest documented accounts of gambling were recorded in China where “keno” was first played 3,000 years ago to fund the building of the Great Wall (National Policy Toward Gambling, 1974). Records of Chinese gambling, such as betting on dice and Chinese chess matches date back to around 300 B.C. (Chien & Hsu, 2006). The idea of Blackjack and Poker supposedly developed from a gambling game of shuffling paper money that developed in China around 900 A.D. (Chang, 2004; Wilkinson, 1895). The ancient Chinese divination manual and book of mystical speculations *I Ching* (The Chinese Book of Changes, which is over 5,000 years old) could be used for fortune telling and to predict and interpret future events (De Bary, 1960). The ancient Chinese also believed that inspired and divinely authoritative communications for help, advice, or information could be obtained from tortoise-shell readings. Early predictive writings have been found on long strips of bamboo, silk, and wood. Prediction of fates and dice playing were very popular in ancient China (Chien & Hsu, 2006).

The Chinese are so fascinated with gambling that some forms of gambling have become intertwined with social life and are considered socially acceptable, sometimes even as healthy hobbies. For example, mahjong (a tile-matching game) is a traditional and now still very popular game in the Chinese community. The origin of the game is uncertain, but evidence shows that it might have been developed in central China in the 1870s (Bell, 1976; Headley & Seeley, 1978). This game, which includes the combination of skill, chance and social interaction of Western games like dominoes, bridge and dice, is always played among relatives, friends for enjoyment at festive gatherings (Wan et al., 2005). Some Chinese feel that playing some gambling games like mahjong with comparatively small stakes as an incentive can keep the mind active, especially when they are old, as a way of preventing deterioration in mental functioning (Loo et al., 2008).

However, a study (Zheng, Walker, & Blaszczyński, 2010) investigated the Chinese community in Sydney found that the problem gambling rate among mahjong players was 3.8% among Chinese male and older Chinese, nearly five times higher than the problem gambling prevalence rate of the local general population.

The Chinese have been described as ‘a nation of gamblers’ (Abel, 1997) and gambling as the national pastime in China (Access Asia Limited, 2002). Chinese have also been described as naturally higher risk takers, quicker to adopt new technologies, and more money focused (Cullen, 2000). Many Chinese find modern games of chance, such as roulette, dice, lottery, and baccarat, as well as competitive games of skill, such as chess, checkers, and billiards, to be highly addictive (Chien & Hsu, 2006). Confucius (551-479 B.C.), whose doctrine has influenced Chinese culture for thousands of years, however, condemned such pastimes, referring to Lao-tzu (6<sup>th</sup> or 4<sup>th</sup> century B.C.), the founder of Taoism, as an “ignorant good man” who foolishly encouraged the use of lucky charms and gambling, as no social good derived from gambling (Aero, 1980; Cheng, 2009b). Traditional Confucian morality placed an emphasis on family, friends, and social harmony, which remain important in the modern China (Tsai, 2006). Hu (1997) suggested that one of the primary goals of Confucius’ philosophy was to seek a solution to the socio-political disruption of his time (the “Warring States” period of 476-221 B.C.), thus the importance of societal harmony. In contrast, traditionally most gambling activities represent zero-sum games (i.e., what one player wins another player must lose), and thus put players in adversarial situations, leading to arguments, aggression, extreme debt, deterioration of family life, loss of face and other disharmonious social consequences (Parke & Griffiths, 2005). Therefore, in Chinese society gambling is regarded as a behavior that can undermine social harmony (see Taormina, 2009), although recreational gambling is a way for social interaction and enjoyment with friends and family.

China has a long history which banned or outlawed gambling activities (Chien & Hsu, 2006; Taormina, 2009). Authorities implemented severe punishments for gamblers, including torture, death, and even punishment of an entire community. Thus, the Chinese cultural view of gambling as improper social behavior is long standing and continues today. It seems that there is a paradox or moral relativity in the Chinese attitude to gambling. It can be explained by a Chinese proverb which says: “Small gambling is soothing and relaxing but heavy gambling can affect your mental health.” Chinese people condemn the consequences, but not the activity. On the other hand, some of the popular images of Chinese as a race of gamblers may be a stereotype. The attraction of gambling for Chinese has been proposed to be social and economic, not cultural (Hays, 2008). This proposal is supported by ethnographic research which suggests that gambling is likely among societies which have large settlement sizes, social inequality, social complexity and competitive inter-tribal relations. In contrast, nomadic societies tend to show little evidence of gambling (Binde, 2005).

With a population of over 1.3 billion, the Chinese population residing in the Greater China Region accounts for one fifth of the world’s total (Trappey & Trappey, 2001). The Greater China Region includes mainland China (The People’s Republic of China, PRC), Hong Kong and Macao (now both Special Administrative Regions of PRC since 1997 and 1999, respectively), and Taiwan (also known as The Republic of China, ROC) (see Harding, 1993). In addition, it is estimated that there are 40 ~ 45 million Chinese regardless of citizenship living in diaspora beyond the Greater China Region (cf. Overseas Chinese Affairs Office of The State Council (China), 2010). In the current research, the term “Chinese” refers to all the Chinese nationals and ethnic Chinese who are descendents of Chinese and share the common Chinese cultural heritages and values, regardless of their residence and citizenship (cf. Wang, 1993). Even though gambling has been popular among the Chinese for thousands of years in comparison to Western countries, gambling policy in Chinese society is considered to be more conservative and has been more focused on social rather than economic concerns (Chien & Hsu, 2006).

Over the past 25 years or so, state-owned lotteries have been developed in mainland China, but Casino gambling is still prohibited and illegal (Access Asia Limited, 2002; Chien & Hsu, 2006). Horserace betting is legal in the Special Administrative Regions of Hong Kong and Macao, and table gaming is only permitted in Macao (an illustration of “one country, two systems”). Estimates of the prevalence of problem gambling are not available in mainland China, but the latest report (Cheng et al., 2008) from Hong Kong shows that the estimated percentage of PG1 and PG2 for Hong Kong in 2008 were 2.8% and 1.7%, respectively.

In Macao (also spelled Macau), the history of gaming evolved from illegal gambling houses in the sixteenth century to legalization in 1847 (see Chien & Hsu, 2006; Sun & Li, 2005), and there has been tremendous growth of gambling in recent years. With the vision of a “Las Vegas in Asia”, Macao is a resort attracting not only mainland Chinese, but tourists and gamblers from all over the world. In 2006, revenues associated with the gambling industry were estimated to affect 80% of Macao’s GDP (Zuo, 2008). In total, revenues were a record of US\$6.95 billion, surpassing that of the Las Vegas strip and making Macao effectively the largest casino in the world. Estimates of gambling prevalence rates for Macao in 2003 (Fong & Ozorio, 2005) were 2.5% and 1.8% for PG1 and PG2, respectively, similar to Hong Kong’s statistics in 2008, although Macao is known as a “gambling city”. Sun and Li (2005) found that Macao residents, although surrounded by gambling facilities, were less keen on gambling. They proposed that this maybe due to the government’s strict law for banning public servants and teachers from gambling.

However, evidence suggests that problem gambling in Macao may be getting worse in recent years. The prevalence estimate of probable pathological gambling was 2.6% in 2007, and the latest survey revealed a rate closer to 3% which is much higher than other gambling jurisdictions in the region (Lages, 2010). However, this may reflect an increasing number of problem gamblers from mainland China and Hong Kong. The Macao government is considering

taking proactive measures to combat deterioration and to build a responsible tourist destination with sustainable business practices, such as increasing the minimum age for entering in casinos and employment in the industry from 18 to 21, and strengthening self-exclusion programs (Cheng, 2009a). In addition, a Memorandum has been signed between two universities in Macao and Beijing to cooperate on the problem gambling issue of Mainlanders, as well as studying the feasibility of promoting responsible gambling in mainland China (Lages, 2010).

In general, gambling has been banned throughout most of Taiwan's history, excluding some government issued and managed lotteries. However, gambling has undergone a marked change in image for people on the island (Yu, 2001). Legislators in Taiwan have been debating the legalization of casino gambling for more than 20 years (Ho, 2007). Taiwan is viewed as one of the best potential Asian markets for legalized gambling (Ho, 2007). An early study showed that the prevalence rate of pathological gamblers was 2.7% in rural villages and 4.0% in townships in Taiwan (Yeh, Hwu, & Lin, 1995).

Another country worth noting here is Singapore, as outside the Greater China Region, Singapore is the only country in the world where ethnic Chinese constitute a majority of the population<sup>5</sup>. Chinese Singaporeans are people of Chinese ethnicity who hold Singaporean nationality. According to the latest census, Chinese Singaporeans constitute 74.1% (approx. 2.8 million) of Singapore's resident population, followed by Malays (13.4%) and Indians (9.2%) (Department of Statistics (Singapore), 2010). In 2005, Singapore relaxed the restrictions over gambling which had been in force for almost 40 years, and is now actively building up a tourism industry geared toward gambling (Cheng et al., 2008). In February and April of 2010, Singapore opened two mega-casinos, with Chinese clients as their prioritized targeted patrons (also see Hung et al., 2010).

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<sup>5</sup> That is not to say that Chinese in Singapore is the largest Chinese population beyond the Greater China Region. For example, according to the 2006 census, there were approx. 7.7 million ethnic Chinese in Indonesia but only accounted for 3.4% of the whole population in the country (Overseas Compatriot Affairs Commission (Taiwan), 2006).

According to a forecast from the World Tourism Organization, China will have 100 million outbound travelers and become the fourth largest source of outbound travel in the world by 2020 (World Tourism Organization, 2003). In terms of total outbound travel spending, China is currently ranked fifth and is expected to be the fastest growing in the world and reach the number two slot for total travel spending by 2015 (World Tourism Organization, 2008). The world tourism market expects that economic growth in China and the region would boost demand for shopping, entertainment, gambling and tourism (Yip, 2010).

However, there has been some suggestion that gambling problems associated with Chinese tourists to Macao have been neglected or downplayed on purpose. In order to tackle official corruption related to gambling, the Chinese government has restricted the entrance to Macao for mainland Chinese. However, this also increases the likely number of Chinese tourists who travel to gamble in other Southeast Asian countries, such as Singapore, Malaysia and Cambodia (Yip, 2010).

Two studies (Lee, 2009; Ozorio, Lam, & Fong, 2010) analyzed the gambling expenditure of 42 countries based on the data in 2000, and both found that gambling expenditure was highly positively related to income (represented by the gross domestic product per capita). With the fast growth of economy in China, along with their gambling culture, it is expected that Chinese expenditure on gambling will increase significantly, and so will the behavioral and societal problems associated with gambling.

#### **1.1.4.2 Gambling Problems in the Overseas Chinese Community beyond the Greater China Region**

Rohrmann and Chen (1999) compared the risk perception between Chinese in China and Australians and found that Chinese ranked the hazards related to activities such as gambling,

using hallucinogenic drugs or unsafe sex, as higher than Australians. However, outside the Greater China Region, researchers have found that participation in gambling and rates of problem gambling are higher for overseas Chinese than for individuals of European-Caucasian ethnic background (e.g., Chen et al., 1993). In Australia, Blaszczynski, Huynh, Dumlao, and Farrell (1998) employed a Chinese translation of the SOGS to investigate the rates of probable pathological gambling for Chinese immigrants in Sydney. Using a stringent cutoff score (10), they found a prevalence estimate of 2.9% that was more than twice the estimate for the Australian population in general (1.2%; using the same cutoff score of 10 of SOGS) (Dickerson, Baron, Hong, & Cottrell, 1996), with rates higher for Chinese males (4.3%) compared to females (1.6%). The greater prevalence of problem gambling in the Chinese community was also reflected in the Cultural Partners Australia Consortium report (2000), which demonstrates that rates of problem gambling are higher among Chinese than other ethnic groups (also see Loo et al., 2008).

Similarly, in some Canadian cities such as Toronto or Montreal, Chinese problem gambling treatment services have been developed for the growing number of Chinese-speaking individuals (Shaffer, Hall, & Vander Bilt, 1997). A telephone survey of adult Chinese residents of Toronto, Canada, found that 80 percent reported having gambled in their lifetimes (Kwan, 1997). The study also found that Chinese gamble for many reasons, including making money, escape from problems, excitement, entertainment, social activity, fantasy, charity, and low self-esteem. The Chinese Family Service of Greater Montreal (1997) tested a non-random sample of clients attending its services. Results indicated that 4.7% of the total sample was classified as problem gamblers, and 1.7% were probable pathological gamblers. Demographic variables including length of duration of residence in Canada, male gender, lower educational level and not being actively engaged in the labour force were positively associated with problem gambling. The willingness to risk large amounts of money on a single bet and the propensity to gamble for long periods make the Chinese one of the favourite customer groups for Las Vegas

casinos (Galletti, 2002). Las Vegas is also a favoured destination for Chinese tourists, and 85 percent of the 'high rollers' that play in Las Vegas come from China, Taiwan, and Japan (ABC News, 2002). A comprehensive account of gambling and problem gambling in these countries necessitates consideration of ethnic differences (Abbott & Volberg, 1999a). Indeed, Chinese culture (and more broadly Asian culture), in spite of internal diversity, has distinctive notions of fate, chance, luck, probability, risk and control, and these factors might contribute to problem gambling (Papineau, 2005).

New Zealand's fastest growing ethnic groups are Asian, and Chinese constitute the largest single group within the Asian category (Wong & Tse, 2003). Historically, New Zealand Chinese have had a long association with certain forms of gambling (Grant, 1994). Although it has been maintained that Chinese may have relatively high rates of problem gambling, there has been relatively little scientific research on problem gambling among Chinese people living in New Zealand (Abbott & Volberg, 2000).

Contrary to the findings of greater prevalence rates of problem gambling in Chinese, Clarke et al. (2006) found that in New Zealand, Asian (mainly Chinese) participants were less likely to be classified as pathological gamblers as compared to other ethnic groups, particularly the Pakeha (NZ European) and Maori. However, the authors noted that this result might have been due to the fact that the Asian participants were recruited from cultural and church groups, and thus might not be representative of NZ Chinese as a whole. Similarly, in a study investigating motivations for gambling in an Australian sample, gambling behavior among the Chinese was lower than that of the general community, and Australian Chinese individuals were more likely than Australian Caucasians to report that they had never gambled (Oei, Lin, & Raylu, 2007b).

### **1.1.4.3 Chinese Gamblers' Beliefs, Traits and Help-Seeking Characteristics**

The Chinese in general have a strong belief in the existence of good luck or bad luck compared to Westerners, and the Chinese associate many things with luck. Chinese superstitions even involve colours, numbers, plants, dining and gift giving (Chien & Hsu, 2006; Papineau, 2005). For example, the Chinese like red because it represents happiness (Galletti, 2002; Ning & Bone, 1995), and yellow stands for gold (fortune) and royalty, whereas, the colours white and black are predominantly used in Chinese funerals. For another example, it is believed that numbers can determine a person's fate in Chinese culture. The number four is very unlucky as in Chinese it sounds like the word for death (Simmons & Schindler, 2003). In contrast, the number eight is associated with prosperity and good luck, whereas six is believed to make things run smoothly (Galletti, 2002; Simmons & Schindler, 2003). Many casinos have already removed seat number four from table games and room number four from guest or gaming rooms to adjust to this Chinese belief (Galletti, 2002). Consistent with Western gamblers, cognitive errors and psychological states have been found to influence problem gambling among Chinese gamblers (Lam, 2007b; Oei, Lin, & Raylu, 2007a; Oei, Lin, & Raylu, 2008).

Prior to seeking professional help, Asian gamblers tended to have lost large sums of money (Abbott, 2001). In contrast to Caucasian gamblers who tend to adjust their bets in table games more gradually, Chinese gamblers are likely to make large bet variations depending on the perception of their luck (Chien & Hsu, 2006; Galletti, 2002). Chinese participants were also found to be more likely than Caucasians to claim that they were winning even when they were losing a lot of money (Oei et al., 2007b).

Furthermore, research has shown that Chinese gamblers tend to have stronger beliefs regarding illusion of control, which are linked to specific Chinese cultural beliefs, values, and societal expectations (Oei & Raylu, 2010). This phenomenon is particularly prominent among Chinese male gamblers as compared to females (Hong & Chiu, 1988). This illusion of control

arises from linking superstitions with gambling outcomes, which also leads to faulty beliefs about winning. Such superstitions include associating chances of a lottery win with inanimate objects, the purchase of a new car, or the deceased. These superstitious beliefs are influenced by environmental factors such as friends' and family members' lottery play or the media, which in turn fuels their hopes of winning (Loo et al., 2008).

Chinese gamblers may be predisposed to seek both excitement and the opportunity to attain wealth from gambling (Vong, 2007). As found by Oei and Raylu (2010), intrinsic motivation for stimulation and sensation-seeking was higher among Caucasians than Chinese individuals, whereas extrinsic motivation toward identification (i.e., social standing and importance in the community) was higher among Chinese than Caucasian participants.

Support for this finding was also evident in Oei and Raylu (2007) where although no significant difference was found between Caucasians and Chinese in the rate of problem gambling, the Chinese participants were more likely than their Caucasian counterparts to report excessive parental gambling, especially among their fathers (also see Loo et al., 2008). Cultural influences passed on through familial socialization have also been found to impact Chinese gamblers' familiarity with and preference for certain forms of gambling. Approval of and familiarity with certain gambling activities (e.g., playing cards and mahjong) could be maintained within the culture by passing these values and beliefs about gambling from one generation to another. Moreover, the distinction between recreational and problematic gambling may not always be clear, and individuals may have difficulty in recognizing when and how gambling becomes problematic to themselves and their families (GAMECS Project, 1999; Loo et al., 2008). This familiarity may attract Chinese gamblers to the casino tables.

A large number of studies (e.g., Chan, 2000; Lai, 2006; Oei & Raylu, 2007; Papineau, 2001; Problem Gambling Foundation (NZ), 2010; Scull & Woolcock, 2005; Teo et al., 2007; Wong & Tse, 2003) have examined the factors which may shape Chinese migrants' gambling behaviors.

Chinese migrants may encounter difficulties during their migration process, such as insecurity in their new country, disconnection from their family and friends, and language barriers. Some individuals have little experience of legalized casino gambling prior to coming to Western countries and they tend to use gambling as a form of escape from the problems and difficulties of assimilating into a new culture. According to a report (Chinese Family Life Services of Metro Toronto, 1996) which examined the experience of Chinese in Toronto, Canada, other risk factors for problem gambling for Chinese migrants may include peer influence, need to redeem losses, sensation seeking, emotional problems, stress or frustration, boredom, difficulty with accessing public services, strong ethnic identification, level of education, life satisfaction, involvement in other activities, availability of a large amount of money in terms of life savings or tuition fees, free time for international students, and finally, lack of knowledge about issues related to problem gambling, and difficulty communicating with others in the community. Second-language difficulties can also be a major challenge for Chinese migrants in terms of seeking help for problem gambling (see Chinese Family Life Services of Metro Toronto, 1996; Loo et al., 2008).

There has been considerable research on treatment approaches for pathological gambling (e.g., Gamblers Anonymous, psychotherapy, psychoanalysis, behavior therapy, win therapy, case studies, behavioral and cognitive interventions, etc). Further research concerning clinical practice related to problem gambling has been reviewed by Walker (1992), Lopez-Viets and Miller (1997), Blaszczynski and Silove (1995), Rogers (1988), Raylu and Oei (2002), Toneatto and Ladouceur (2003) and Petry (2005).

Among the most popular treatments for problem gambling are directive therapy models, such as behavioral and cognitive behavioral therapy (CBT). Such programs are modelled on interventions for substance abuse and adopt a relapse prevention perspective, typically include components for cognitive restructuring and problem solving, and have been shown to be

effective at treating gambling problems (Raylu & Oei, 2002). CBT has also been shown to be more effective than non-directive approaches with Chinese clients (Lin, 2002; Miller, Yang, & Chen, 1997). CBT treatments for gambling have been shown to help with gambling problems, to improve emotional functioning and perception of control over gambling at post-treatment, along with maintenance of these gains for up to 2 years (Oei & Raylu, 2007). Empirical studies (e.g., Dai et al., 1999; Yang, 1992) have also demonstrated the effectiveness of CBT in treating depression and self-esteem problems among Chinese. If there are distinctive, culture-related cognitive processes that are associated with risk of problem gambling among Chinese, then their identification could lead to more effective interventions.

## **1.2 Risky Decision Making**

In the next section we review some seminal theories in economics about human decision making under risk<sup>6</sup>, and results from research which has tested these theories. Although these theories have been expressed formally in mathematical terms, our focus is on empirical phenomena rather than mathematical deductions.

### **1.2.1 Classic and Modern Theories of Risky Decision Making**

#### **1.2.1.1 Expected Utility Theory**

Arguably the most important assumption of classical economic theory is that human decision-making in a market context is rational. Expected Utility Theory (EUT; Bernoulli, 1738; von Neumann & Morgenstern, 1944) is accepted as a normative standard model of rational

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<sup>6</sup> This part of review will only focus on risk rather than uncertainty. Risk involves identified or estimated percentage of probabilities, whereas uncertainty refers more on ambiguity. For example, Hofstede (2001) argued that the feeling often accompany the uncertainty is anxiety which has no object attached, whereas risk always elicits fear which focuses on something specific. Therefore, some theories which focus more on uncertainty but not risks will not be mentioned, for example the Ellsberg paradox (Ellsberg, 1961).

choice. EUT explains that investors tend to maximize their utility by choosing the option with the highest expected utility. According to EUT, the overall utility of an option is the utility averaged across the various possible outcomes, with each outcome weighted according to its probability. The utility of a given amount of money is assumed to be a negatively-accelerated function of amount, which implies decreasing negative marginal utility – that is, the increase in utility for a given amount of money decreases as the total amount increases. This implies that a given amount of money (e.g., \$5,000) is valued more when a person is poor than when he is wealthy, and therefore marginal utility decreases as wealth increases (Wu, Zhang, & Gonzalez, 2004).

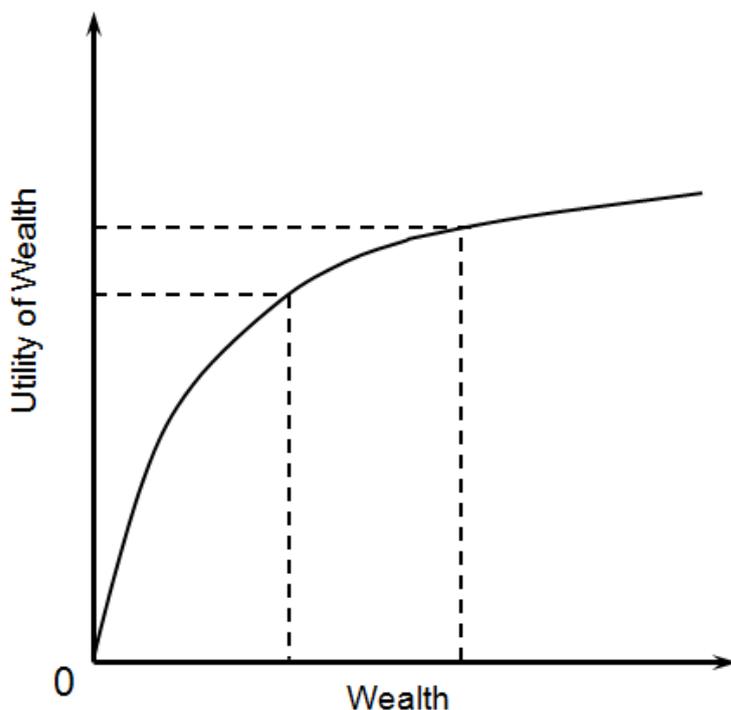


Figure 1.1. Utility function of the Expected Utility Theory for gains (Adapted from Fox & Poldrack, 2009)

von Neumann and Morgenstern (1944) described a set of axioms that are both necessary and sufficient for a decision maker's choices to be described by maximization of expected utility. One of the most important of these is the *independence axiom*, which states that a decision maker's choice for one lottery over another (a 'lottery' is choice alternative that includes one or

more potential outcomes, each described in terms of an amount of money to be received with a specified probability) should be independent regardless of whether a third lottery is available. Other axioms include completeness, transitivity, and continuity (see e.g., Fox & Poldrack, 2009; Wu et al., 2004; Yaqub, Saz, & Hussain, 2009).

If all individual investors choose rationally, the result is an efficient market according to which prices should reflect all available information in terms of fundamental value. However, considerable research has shown that investors fail to choose rationally. Economists and psychologists have frequently found that individuals faced with 'risky prospects', that is, a set of lotteries or gambles for choice, do not make choices that are consistent with EUT. One example is purchasing lottery tickets. According to rational choice theory, lottery play is difficult to explain because the typical player never receives financial reward for playing (Rachlin, 1989). However, public participation in lotteries continues to grow despite the awareness of negative average expected utility (Lyons & Ghezzi, 1995).

It is also hard for EUT to explain why an individual would purchase both insurance and lottery tickets at the same time (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). Such an individual's utility function must be concave (negatively accelerated; if one draws a chord connecting any two points on the curve, the chord will lie strictly below the curve (Baranoff, Brockett, & Kahane, 2009), as illustrated in Figure 1.1) from some wealth levels, but convex (positively accelerated; the curve lies strictly below the chord joining any two points on the curve) for other wealth levels (Friedman & Savage, 1948; Markowitz, 1952).

### **1.2.1.2 Allais Paradox**

Maurice Allais (Allais, 1953) was the first to show that the axioms of EUT are violated. In the famous *Allais paradox* (also known as the *common consequence effect*), Allais posed a strong

empirical challenge of the classical rationality assumption in economics. The Allais paradox is observed when comparing choices in two situations, each of which involves a choice between two pairs of gambles: A vs. B, and C vs. D. The choices in the two situations are defined as follows:

A: \$1 million for certain.

B: 10% chance of \$5 million, 89% chance of \$1 million, and 1% chance of nothing.

C: 11% chance of \$1 million and 89% chance of nothing.

D: 10% chance of \$5 million and 90% chance of nothing.

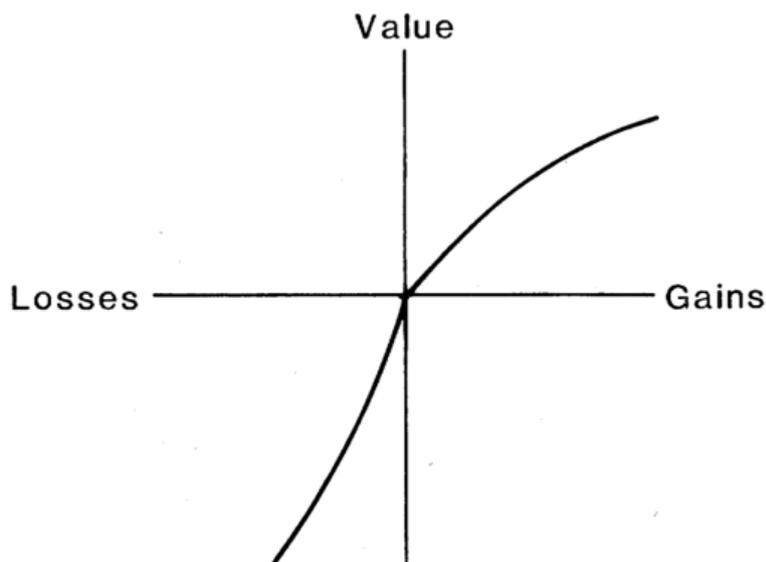
(Adapted from Oliver, 2003)

Note that gambles C and D are obtained by subtracting an 89% chance ('common consequence') of receiving \$1 million from both options A and B. The Allais paradox is arguably the starkest and most celebrated violation of expected utility theory (Fox & Poldrack, 2009). EUT assumes description invariance, that is, preferences among gambles should not depend on how they are described. In other words, EUT requires that a change in a common consequence should not alter preference. Therefore, if a decision maker chooses A over B, he or she must also choose C over D to be consistent. However, most decision makers choose A over B, but D over C. Various studies involving both hypothetical and small real monetary payoffs in Western societies have confirmed the Allais paradox in Western countries and various choice domains, such as stock and football game betting (Tversky & Kahneman, 1992) and health outcomes (Oliver, 2003). The Allais paradox violates the independence axiom of EUT, which implies that preferences between risky prospects should not be affected by adding equal outcomes (common consequence).

The Allais paradox encouraged economists and psychologists to develop new theories that could explain the violation of the independence axiom and replace EUT. The most notable of these accounts are Prospect Theory (PT; Kahneman & Tversky 1979), and Cumulative Prospect Theory (CPT; Tversky & Kahneman, 1992), which are based on the framing effect identified by Tversky and Kahneman (1981) and remain perhaps the most prominent descriptive theories of decision making under risk (see reviews, Fox & Poldrack, 2009; Wu et al., 2004). These theories are based on convincing empirical phenomena which highlight the deficiencies with expected utility (such as the Allais paradox and framing effects), as well as a powerful theory for organizing these results (Wu et al., 2004).

### **1.2.1.3 Prospect Theory**

Unlike the assumption of EUT that utility (value) is dependent on final wealth, according to prospect theory (PT), value is determined by gains and losses relative to a status quo rather than to final assets, and probabilities are replaced by decision weights. The value function is defined in terms of deviations from a reference point (status quo) and is concave for gains (implying risk aversion), but convex for losses (implying risk seeking). Moreover, people are significantly more averse to losses than they are attracted to gains of the same size. As illustrated in Figure 1.2, the mathematical value function used in prospect theory which is normally concave for gains, convex for losses, and is generally steeper for losses than for gains, is an S-shaped function. The increased weighting for losses compared to gains is known as *loss aversion*. The differential weighting of losses may explain much of the irrationality decision makers sometimes display in financial markets. Loss aversion has been found to influence decision making in a wide variety of domains, such as investing, consumer behavior, politics, and health (see Camerer, 2000; Mercer, 2005; Tversky & Kahneman, 1981).



**Figure 1.2. Value function of the Prospect Theory (From Kahneman & Tversky, 1979)**

In addition, Kahneman and Tversky (1979) postulate that people underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty, which is termed the *certainty effect*. The certainty effect suggests that most people tend to overweight gains outcomes that are certain relative to merely probable (as in the preference of Option A to B in the Allais paradox). However, if prospects are negative, people tend to show risk-seeking preferences for larger losses which are probable, rather than smaller certain ones. Tversky and Kahneman (1992) later described this as a ‘fourfold pattern’ of risk attitudes (see Cumulative Prospect Theory).

Kahneman and Tversky (1979) also used the example of Russian roulette problem to illustrate the overweighting small probabilities and underweighting (or diminishing marginal sensitivity to) high probabilities. “Suppose you are compelled to play Russian roulette, but are given the opportunity to purchase the removal of one bullet from the loaded gun. Would you pay as much to reduce the number of bullets from four to three as you would to reduce the number of bullets from one to zero? Most people feel that they would be willing to pay much more for a reduction of the probability of death from  $1/6$  to zero than for a reduction from  $4/6$  to  $3/6$ .

Economic considerations would lead one to pay more in the latter case, where the value of money is presumably reduced by the considerable probability that one will not live to enjoy it” (Kahneman & Tversky, 1979, p. 283).

#### 1.2.1.4 Framing Effect

Apart from the *sign effect* (people’s propensity of weighting more to negative prospects than to positive prospects), PT further observes that individuals evaluate outcomes relative to a reference point, rather than with respect to net asset levels. The signs (i.e., positive and negative prospects) can be switched by different phrasing of the prospects, even though they may be mathematically equivalent. The phenomenon that people change from risk averse for gains to risk seeking for losses (or vice versa) is known as the *reflection effect*. The preference reversal caused by different phrasing of prospects which switch from gains to losses is termed the *framing effect*.

The framing effect was first demonstrated empirically by the ‘Asian Disease Problem’ proposed by Tversky and Kahneman (1981).

Asian Disease Problem:

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

Positive terms:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is 1/3 probability that all 600 people will be saved, and 2/3 probability that no people will be saved.

Negative terms:

If Program C is adopted, 400 people will die.

If Program D is adopted, there is 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die.

(Taken from Tversky & Kahneman's (1981) survey)

Their results showed that when facing the choice between two mathematically identical options (in terms of the expected number of people who would survive relative to an expectation of 600 deaths), when phrased in positive terms (saving lives), most participants preferred Program A. However, when phrased in negative terms (how many would die) most participants chose Program D. Note that A and C are equivalent (as are B and D). The majority choosing the option for sure under positive terms and the risky option under negative terms is affected by the phrasing of the options. People shift preference from risk aversion to risk seeking when the wording is changed from gains (lives saved) to losses (lives lost).

Tversky and Kahneman (1981) note that whether an outcome is perceived as a gain or loss depends on a reference point, which may be manipulated. In this way, it is possible to reverse an individual's preference, as the framing effect shows. The framing effect violates the invariance axiom of EUT, which requires that preferences should depend solely on defined outcomes and probabilities.

### **1.2.1.5 Cumulative Prospect Theory**

In order to improve the poor performance of the PT at the endpoints (i.e., near certainty and impossibility), Tversky and Kahneman (1992) proposed a further elaboration of PT known as Cumulative Prospect Theory (CPT). The new weighting function captures the diminishing marginal sensitivity of an inverse S-shape, that is, concave near 0 and convex near 1 for both

gains and losses. CPT posits that people tend to show a fourfold pattern of risk attitudes which demonstrate risk aversion for gains and risk seeking for losses of medium and high probability (both underweighting); coupled with risk seeking for gains and risk aversion for losses of low probability (both overweighting).

Considerable empirical evidence supports the fourfold pattern of choice (see Fox & Poldrack, 2009). Risk-seeking for low-probability gains may increase the attraction of gambling, whereas risk aversion for low-probability losses may explain why people purchase insurance. Risk aversion for high-probability gains may contribute to the certainty effect, whereas risk-seeking for high-probability losses is consistent with the concept of loss aversion.

Tversky and Kahneman (1992) also proposed a value function and a weighting function (a single-parameter power function). Via the weighting function, a map for weighting of gains and losses is below.

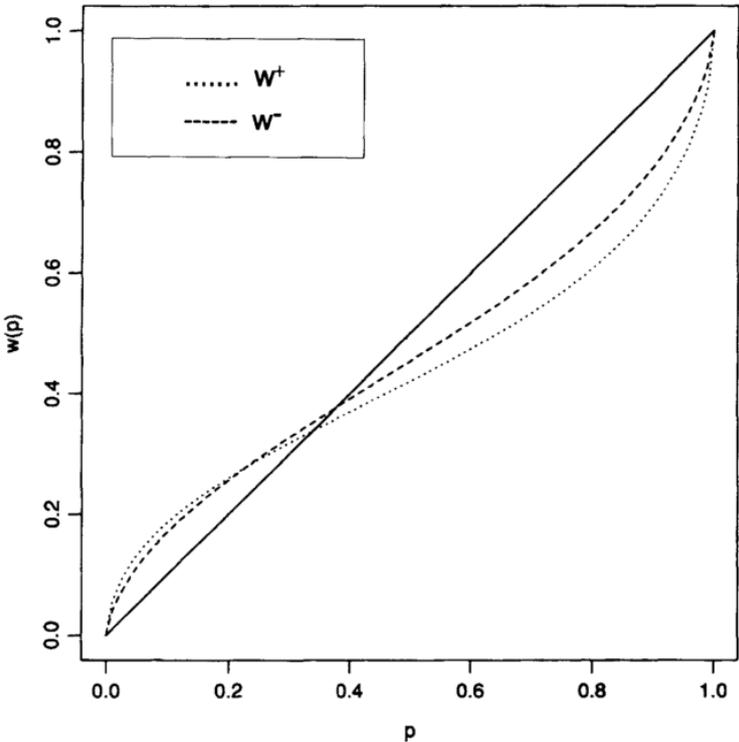


Figure 1.3. Weighting functions for gains ( $w^+$ ) and for losses ( $w^-$ ) of CPT (From Tversky & Kahneman, 1992)

The key predictions of Cumulative Prospect Theory have not only been found valid in Western societies but also in other cultural contexts. For example, Kahneman and Tversky (1979) first tested the Prospect Theory both in Israel and America and found essentially identical results. Loss aversion and framing effects were also found in studies with Chinese participants (Levinson & Peng, 2007; Wang & Fischbeck, 2004a). In particular, the increased weighting for losses rather than gains has received substantial support, including neuroimaging (fMRI) studies in both Western countries and China (De Martino, Kumaran, Seymour, & Dolan, 2006; Gonzalez, Danda, Koshino, & Just, 2005; Tom, Fox, Trepel, & Poldrack, 2007; Xu, Liang, Wang, Li, & Jiang, 2009; Zheng, Wang, & Zhu, 2010). Neuroimaging studies (De Martino et al., 2006; Gonzalez et al., 2005; Zheng, Wang, et al., 2010) also found that gains and losses are associated with the brain region which is related to emotion for both Caucasians and Chinese. Messages framing and product risk perception have an interactive effect with affective states (Chang, 2007). Neural evidence has indicated an asymmetry in gain and loss domains for both risk (Tom et al., 2007) and temporal choices (Xu et al., 2009).

In summary, as Tversky and Kahneman (1992) concluded: “Theories of choice under uncertainty commonly specify 1) the objects of choice, 2) a valuation rule, and 3) the characteristics of the functions that map uncertain events and possible outcomes into their subjective counterparts. In standard applications of expected utility theory, 1) the objects of choice are probability distributions over wealth, 2) the valuation rule is expected utility, and 3) utility is a concave function of wealth.....[In contrast, the PT and CPT posit that] 1) the objects of choice are prospects framed in terms of gains and losses, 2) the valuation rule is a two-part cumulative functional, and 3) the value function is S-shaped and the weighting functions are inverse S-shaped” (p. 316, italics and words in square brackets were added).

As the preceding review has shown, for both the classical EUT model and CPT, three elements have mainly been considered in the study of decision making under risk: objects,

valuation and function. The extent of the deviation from expected values is usually a benchmark to measure riskiness. However, in recent years two major arguments have emerged concerning the applicability of such theoretical accounts of decision making under risk. One controversy has been whether the mental processes underlying these decisions are analytic- or emotion-based (or both). A second controversy is the extent to which decision-making behavior is culturally universal. In the next section we will review these arguments and findings, and also consider results in intertemporal choice (i.e., decision making involving time), as these are also relevant to the research reported in this thesis.

## **1.2.2 Emotional and Cultural Factors in Risky and Intertemporal Choice**

### **1.2.2.1 Emotions and Risk Preference**

Classical (e.g., EUT) and modern (e.g., PT and CPT) theories propose that the processes people use to make decisions involving risky outcomes are based on optimizing positive outcomes (e.g., gains) and minimizing negative outcomes (e.g., losses) in ways that can be described in terms of ‘cold’ mathematical equations (for discussions or reviews, see Kahneman, 1994; Pham, 2007; Simon, 1959; Slovic, Finucane, Peters, & MacGregor, 2007; Weber & Johnson, 2009). However, the valuation process of risk in terms of CPT is based on the deviation from expected value which is still assumed to be the basis of rationality. However, from an evolutionary perspective, it is unlikely that the human brain would have evolved to be able to maximize complex statistical principles and precisely predict the nature of an uncertain choice (Rode & Wang, 2000; Simon, 1959). Especially when under time pressure, people should be less likely to engage in cognitive efforts, and instead might use a ‘gut feeling’ when making decisions involving risk (Li, 2011).

Thus, some researchers have suggested that decision making is predominantly an emotion-laden mental process, or a dual-process with both cognitive and emotional aspects (e.g., Brandstätter, Kühberger, & Schneider, 2002; Epstein, 1994; Finucane, Alhakami, Slovic, & Johnson, 2000; Loewenstein, Weber, Hsee, & Welch, 2001; Ordóñez & Benson, 1997; Slovic, Finucane, Peters, & MacGregor, 2004).

Although the contribution of emotions to decision making remains controversial, there has been growing recognition of the importance of emotions for decision making in general (see review by Pham, 2007). Numerous studies have found that in general, positive emotions (e.g., elation, happiness, optimism, surprise and hope) trigger optimistic risk assessments and result in approach, while negative emotions (e.g., sadness, anxiety, fear, disappointment and regret) lead to more pessimistic risk assessments and result in avoidance (e.g., Druckman & McDermott, 2008; Eysenck, 1992; Johnson & Tversky, 1983; Loewenstein & Lerner, 2003). An exception to this is anger, which may trigger risk-seeking (e.g., gambling) (Fessler, Pillsworth, & Flamson, 2004; Leith & Baumeister, 1996). One possibility is that intense negative emotional states like anger might have disruptive effects on self-control, and thus increase the likelihood of risk-taking behavior (Pham, 2007). Shead and Hodgins (2009) found that regular gamblers have strong expectations that gambling augments positive mood and relieves negative affect.

Brandstätter et al. (2002) proposed that the probability weighting function in CPT may be shaped by emotions. Specifically, they suggested that the overweighting of small probabilities reflects an anticipated elation, given that winning was unlikely. Conversely, the underweighting of large probabilities results from a disappointment effect, given that winning was likely. Thus, the probability is assumed to influence utility. Based on an analysis in which a power function was fit to their data, they proposed that probability = .50 is a critical point for emotion switching and the slope of disappointment is higher than elation, although they only investigated the lotteries with various probabilities of gains.

A recent study found similar results with Chinese participants. With Hong Kong students majoring in business, Li (2011) investigated the relation between different probabilities (0, 20%, 40%, 60%, 80%, and 100%) of a new venture's success and their anticipated emotions. It was found that Chinese students exhibited both anticipated trait-type and contingency effects. Li (2011) suggested that anticipated emotions play a major role in determining the subjective probability judgments for Chinese.

Additional evidence of the role of emotions in decision making is also provided by neuroimaging studies (De Martino et al., 2006; Gonzalez et al., 2005; Zheng, Wang, et al., 2010). The general conclusion from these studies is that the amygdala – the brain region associated with emotions and emotional responses, is activated when making risky decisions.

### **1.2.2.2 Emotions and Time Discounting**

A substantial research literature on intertemporal choice suggests that the value of future rewards decreases as a function of the delay until receipt (see Green & Myerson, 2004, for a review). The discounting of delayed rewards is particularly important in self-control situations, which involve a tradeoff between a smaller reward available in the short term, and a larger reward available in the longer term (see Pham, 2007, for a review). Compared to the study of emotions in decision making under risk, there are relatively fewer studies which have examined the role of emotions in intertemporal choice. Nevertheless, the proposal that emotions do play a role in decisions involving delayed rewards does receive neurological and theoretical support.

In a neuroimaging study, McClure, Laibson, Loewenstein, and Cohen (2004) showed that whereas regions of the lateral prefrontal cortex and posterior parietal cortex are activated in intertemporal choice, preferences for immediate rewards are associated with greater activation in parts of the limbic system associated with emotions. Their study further indicates that separate

neural systems may get involved in the immediate and distant delayed rewards. Xu et al. (2009) found that for Chinese participants, the lateral prefrontal and posterior parietal areas were activated for both gains and losses in a delayed future, and the activation was stronger for future losses. They also found greater levels of activation in the insula, thalamus and dorsal striatum during intertemporal choices involving losses, suggesting that increased sensitivity to losses may be associated with negative emotions. Their results may provide a neural basis for the observation that future losses are discounted less steeply than future gains (Estle, Green, Myerson, & Holt, 2006; Thaler, 1981).

Construal Level Theory (CLT; Trope & Liberman, 2003, 2010) proposes that people construe different psychological distances to the proximal and distant future. Assuming the self in the 'here and now' as a reference point, people would construe far future events more abstractly and a low-level of emotions would be elicited. By contrast, near future events are construed more concretely and elicit a higher level of emotions (Trope & Liberman, 2010). Abstract emotions have been defined by Fishbach, Eyal, and Finkelstein (2010) as those which are associated with a comparison of one's current situation with an alternative that is distant (either physically, socially or temporally), Concrete emotions are those that involve a comparison of the current situation with an alternative that is near. However, there is as yet little empirical evidence for the distinction between abstract and concrete emotions.

Regulatory Focus Theory (RFT; Higgins, 1997, 1998) makes a distinction between self-regulatory processes that focus on promotion and prevention for goal pursuit, in order to explain preferences for stability or change. An individual with a 'promotion' focus will tend to emphasize hopes and accomplishments, with goals as ideals, and a strategic concern with gains (presence of positives) vs. non-gains (the absence of positives). Such individuals tend to approach desired end-states. In contrast, an individual with a prevention focus will emphasize safety and the fulfilment of responsibility. Goals are viewed as 'oughts', and there is a strategic

concern with non-losses (absence of negatives) versus losses (presence of negatives). Prevention individuals seek to avoid mismatches with undesired end-states (Higgins et al., 2001).

CLT or/and RFT have been used to explain some results in intertemporal choice, including cultural differences. Research has found that promotion orientation is associated with a distant temporal perspective and facilitates global processing, whereas a prevention orientation is associated with a proximal temporal perspective and enhances local processing (Förster & Higgins, 2005; Pennington & Roese, 2003). Moreover, individuals in cultures that favour independence (e.g., Western) are more likely to adopt a distant temporal construal and process information at a more abstract, global level (i.e., promotion-focused); whereas those from interdependent cultures (e.g., East Asian), tend to adopt a near temporal construal and process information at a more concrete, local level (i.e., prevention-focused) (Lee & Semin, 2009). Chen, Ng, and Rao (2005) also found that the cross-cultural difference is sensitive to the way that outcomes are framed: American culture-primed participants were more apt to expend monetary resources to achieve a desirable outcome, whereas Singaporean culture-primed participants were more apt to expend monetary resources to avoid an undesirable outcome. In terms of emotions involved in self-regulatory orientation, Lee, Aaker, and Gardner (2000) found that Americans show a propensity for positive emotions such as happiness, whereas Chinese tend to show more negative emotions such as anxiety. As a result, Caucasians who are in a promotion-focused culture are more likely to pursue maximal goals, accomplishments and are more willing to adopt change, take risks, and construe future events with a more distant temporal perspective. In contrast, Chinese who are in a prevention-focus culture are more concerned about safety, security and potential losses, and are more likely to pursue minimal goals and take less risks (see Lee et al., 2000; Lee & Semin, 2009).

### 1.2.2.3 Cultural Differences in Decision Making – An Emerging Research Area

Culture is a complex concept with various definitions. According to a well-known definition by Geert Hofstede (2001, p. 9): “[Culture is] the collective programming of the mind that distinguishes the members of one group or category of people from another.” Values are a core element of culture, which shape attitudes, and attitudes form individuals’ behavior (Hofstede, 2001). Cultural beliefs and values can be passed either directly through family members, other respected members of a cultural group, or indirectly through historical texts, stories and myths (Raylu & Oei, 2004b).

Both classic (EUT) and modern models of decision making under risk (PT, CPT) assume that human behaviors are universalistic and that these models apply to individuals regardless of culture. However, there is increasing evidence of systematic cross-cultural differences in risk judgment and decision making (see discussions in Breuer & Quinten, 2009; Levinson & Peng, 2007), such as probability judgment (e.g., Yates et al., 1989), confidence judgment (e.g., Li, Chen, & Yu, 2006; Yates, Lee, & Bush, 1997; Yates, Lee, & Shinotsuka, 1996; Yates, Lee, Shinotsuka, Patalano, & Sieck, 1998), and risk preference (Hsee & Weber, 1999; Rohrman & Chen, 1999; Weber & Hsee, 1998; Weber, Hsee, & Sokolowska, 1998). Because the cross-cultural comparison between Caucasian and Chinese is a major focus of the present thesis, the reviews below will only refer to those studies which involve Chinese and Caucasian comparisons.

Several studies (Li, 1993; Li, 2001; Wu, 2009) with Chinese participants (or mainly Chinese as they were from Singapore, Hong Kong and mainland China) have shown that Chinese responded differently to the Allais paradox for the first pair of questions compared to Caucasians. (Note: Some of the studies altered the large and small amounts proportionally but retained the ratios of probabilities). In the first pair of questions, most Chinese prefer the risky option (i.e., Option B, involving a larger amount with low obtaining probabilities, plus a smaller

amount with high obtaining probabilities and a tiny probability of loss) rather than the certain choice (i.e., Option A, smaller amount with certainty of obtaining). However, the Caucasians and Chinese had no significant difference to choose Option D for the second pair of questions. In other words, the Allais paradox does not seem to be necessarily “paradoxical” for Chinese.

Chinese responses to the Asian Disease Problem reveal another side of the story. Zhang, Xiao, Ma, and Miao (2008) study replicated the Asian Disease Problem questions to investigate the effect of framing on Chinese students. When comparing their results with Tversky and Kahneman (1981), they found that there was a significant difference between the Chinese sample in contrast to studies using Caucasian sample in Western societies under positive format, but found no difference under the negative format. That is, in the first pair of questions, the majority of Chinese chose Program B (more lives saved under risk) rather than Program A (less lives saved with certainty), similar to Americans although the two programs have the same expected value. However, there was no difference when the programs had negative framing. In other words, both Americans and Chinese prefer Program D – the risky option under negative terms, showing risk-seeking when the situation is framed as losses. Furthermore, Brumagim and Wu (2005) designed the Asian Disease Problem-like tasks in financial, medical, or group (e.g., family members) decision situations. Chinese preference for the risky choice of the first pair questions was found in all the three conditions. Their results show that Chinese would demonstrate propensity for preferring risky options with larger rewards compared to smaller rewards with certainty, consistent with their performance in the Allais paradox task (Li, 1993; Li, 2001; Wu, 2009). Levinson and Peng (2007), Wang and Fischbeck (2004a) reported that Chinese are more prone to framing effects, and are more affected by social context, when making decisions about insurance products.

Bontempo, Bottom, and Weber (1997) observed cross-cultural differences in the perception of the riskiness of financial gambles by comparing students and security analysts

from the U.S., the Netherlands, Hong Kong, and Taiwan, but no main effect in terms of risk judgments. In their study, participants were asked to rate the risk of a series of lotteries. Results showed that the cultural background of respondents was a stronger determinant of risk perception than occupation and corresponding income level. They found that positive outcomes had a smaller effect on perceived risk for the Chinese than for the two Western samples. On the other hand, the magnitude of losses for Chinese and the probability of negative outcomes for Caucasians had larger effects, respectively.

In terms of the time perspective in cross-cultural context, Hofstede (2001) describes one of his cultural dimensions as the long-term orientation (LTO) which originated from Chinese culture (a former name of it is Confucian Dynamism). It opposes long-term to short-term aspects of Confucian thinking: thrift and respect for tradition<sup>7</sup>. In this dimension, the top three country/regions are all rooted in Chinese culture (i.e., mainland China's score is 118 the highest, followed by Hong Kong – 96 and Taiwan – 87), and scores of most Western countries are much lower if not the lowest (e.g., New Zealand and United States are quite similar – 30 and 29, respectively) (see p. 356). In other words, according to Hofstede (2001), Chinese culture is more patient, forward looking and future-oriented than Caucasian (Hofstede & Bond, 1988).

Because Caucasians and Chinese show similar neural mechanisms in terms of the empirical effects associated with Prospect Theory (e.g., sign effect; De Martino et al., 2006; Gonzalez et al., 2005; Tom et al., 2007; Xu et al., 2009; Zheng, Wang, et al., 2010), their differences in decision making might be attributable to cultural factors. Specifically, considering that emotions may play important roles in decision making as discussed above, it would be worthy to investigate the cross-cultural emotional differences when making decisions under risk or with time delays. For example, in comparison to Caucasians, Chinese are found to experience

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<sup>7</sup> Hofstede originally included the following aspects of LTO: persistence, personal stability, thrift and respect for tradition (p. 351), but later excludes the first two and only remains the scores of the thrift and respect for tradition for measuring LTO and found the two factors negative correlated mutually and both correlated with the external criterion of marginal propensity to save. He gave a revised formula for  $LTO = -20 \times \text{Mean}(\text{Thrift}) + 20 \times \text{Mean}(\text{Respect for tradition}) + 40$  (see p. 497).

more emotional complexity (e.g., Bagozzi, Wong, & Yi, 1999; Peng & Nisbett, 1999) (see Chapter 5 for more discussion).

Recently, researchers (e.g., Breuer & Quinten, 2009; Pryke & Gay, 2007) have suggested that a new discipline of ‘cultural finance’ should be recognized. This discipline would attempt to integrate cultural factors into the analysis of financial decision making.

### **1.3 Delay and Probability Discounting**

People often make choices in which one or more potential outcomes may be delayed. For example, suppose you won a lottery and had a choice between a cash prize of \$450 to be received immediately and \$500 to be received in one year. The reward given after a year’s wait is greater, yet some people will still choose the smaller amount, which can be obtained immediately. The process whereby the value of an outcome decreases as a function of its delay is called *temporal discounting* or *delay discounting* (Chapman, 1998; Rachlin, Raineri, & Cross, 1991) (for critical reviews of the delay discounting literature, see Frederick, Loewenstein, & O’Donoghue, 2002; Green & Myerson, 2004). However, delay is not the only variable which can discount a reward. For example, consider a choice between receiving \$450 for sure or a 90% chance to receive \$500. Some people would choose 100% certainty over 90%, even though the uncertain alternative sum is larger. When choosing between certain and uncertain outcomes, individuals are assumed to discount the value of uncertain outcomes on the basis of the likelihood of their occurrence; this process is termed *probability discounting* (e.g., Myerson et al., 2001).

Delay and probability discounting have been the focus of considerable research interest in recent years (see Green & Myerson, 2004, for review). One particular question has been whether the two types of discounting represent a single underlying process (e.g., Green, Myerson, & Ostaszewski, 1999; Myerson, Green, Hanson, Holt, & Estle, 2003; Prelec & Loewenstein, 1991).

Research on discounting also has applied implications, as it might provide insight into problem behavior and disorders that are linked with impulsivity and deficits in self-control. For example, problem behavior for which discounting is relevant includes pathological gambling and substance abuse as well as other kinds of behavior that are often assumed to involve impulsivity (e.g., Bickel & Marsch, 2001; Green & Myerson, 1993; Rachlin, 1995). The discounting perspective can also be applied to professional contexts, such as administrative and career-related decision making (Logue & Anderson, 2001; Schoenfelder & Hantula, 2003). In general, our understanding of issues concerning self-control and maladaptive decision making may be enhanced by knowledge of how individuals discount delayed and probabilistic outcomes.

Researchers have shown that the same mathematical function can describe both the decrease in subjective value with delay (i.e., temporal discounting) and the decrease in subjective value with odds against (Rachlin et al., 1991). The basic equation is:

$$V = A / (1 + kD)^s \quad , \quad (1)$$

where  $V$  represents subjective value,  $A$  represents the amount of reward,  $k$  is a parameter that governs the rate of discounting, and  $s$  is a nonlinear scaling parameter, which modifies the form of the hyperbola so that when  $s$  is less than 1.0, it flattens the curve causing it to level off as  $D$  increases.  $D$  represents the discounting variable, either the time until (delay discounting) or the odds against (probability discounting) receiving a reward. The form of this model is based on a simple hyperbola (Mazur, 1987) but the denominator is raised to a power, so it was referred to as a ‘hyperbola-like’ model (Green, Fry, & Myerson, 1994). Analyses of individual and group data have shown consistently that both delay and probability discounting data are better described by hyperbola-like functions than by exponential and simple hyperbolic functions for both gains (e.g., Green, Myerson, & McFadden, 1997; Kirby, 1997; Kirby & Santiesteban, 2003; Myerson & Green, 1995; Simpson & Vuchinich, 2000) and losses (Estle et al., 2006; Mitchell & Wilson, 2010). However, one difficulty with Equation 1 is that both  $s$  and  $k$  can affect the shape of the

discounting function, and so is problematic if the goal is to obtain a single measure of discounting. To solve this problem, Myerson, Green and Warusawitharana (2001) proposed that the area under the empirical discounting function could serve as an alternative measure of discounting that did not make assumptions about the specific functional form. The area is calculated on the basis of proportions (e.g., the observed subjective values as a proportion of nominal value of the outcome and the delay until or odds against the outcome as a proportion of the maximum delay or odds against studied). In such proportional coordinates, an area of 1.0 represents no discounting, with the area decreasing to a minimum of 0.0 as the degree of discounting increases. The primary advantage of this measure is because it can be calculated without fitting a mathematical function to the data, the obtained area measure does not require any theoretical assumptions about the form of the discounting function.

Another well-established result in discounting is the *magnitude effect*: Temporal discounting rates in humans typically decrease as the amount of reward increases (Grace & McLean, 2005). To illustrate, an individual may be indifferent between receiving gifts of \$400 now or \$500 in one year, yet strongly prefer \$15,000 in one year to \$12,000 now. Although in both cases the actual return for waiting is 25%, the preferences differ depending on the absolute reward sizes involved, and imply that the discounting rate for \$15,000 is less than that for \$500. The magnitude effect is a robust finding, having been obtained in numerous studies with humans making hypothetical choices about money (Benzion, Rapoport, & Yagil, 1989; Green et al., 1997; Myerson & Green, 1995; Thaler, 1981), choices about real monetary outcomes (Holcomb & Nelson, 1992; Kirby, 1997), taxicab, hair salon, and restaurant tips (Green, Myerson, & Schneider, 2003), health outcomes (Chapman, 1996), tipping and speeding fine scenarios (Chapman, 1998), career decisions (Schoenfelder & Hantula, 2003), and personal relationships (Tayler, Arantes, & Grace, 2009). Studies have generally reported no evidence for amount-dependent discounting in research with non-humans (Grace, 1999; Green, Myerson, Holt, Slevin, & Estle, 2004; Ong & White, 2004) (also see an argument, Andersen, Harrison,

Lau, & Rutström, 2011). However, a recent report by Grace, Sargis and White (2012) suggests that pigeons may discount larger food rewards at lower rates than smaller food rewards when faced with a self-control choice (i.e., choice between a smaller-sooner and larger-later reward).

Magnitude of reward has also been found to affect the rate of probability discounting, but in the opposite direction compared with delay discounting. Humans discount larger rewards more steeply as a function of the probabilities or odds against than smaller rewards (Christensen, Parker, Silberberg, & Hursh, 1998; Estle et al., 2006; Green et al., 1999; Myerson et al., 2003; Myerson, Green, & Morris, 2011; Yi & Bickel, 2005). That is, people generally show greater risk aversion with larger amounts (i.e., a higher rate of discounting depending on probabilities or odds against receiving the reward). For example, someone who is indifferent between \$100 for sure and a 40% chance of receiving \$300, is likely to prefer receiving \$1,000 for sure over a 40% chance of receiving \$3,000. The magnitude effect in probability discounting has also been found with other experimental paradigms, such as lottery buying/selling experiments (Holt & Laury, 2002, 2005). Also, the magnitude effect was found in lottery buying experiments for gains either with hypothetical or real payoffs for both Caucasian and Chinese participants. That is, increased incentives lead to greater risk aversion (Fehr-Duda, Bruhin, Epper, & Schubert, 2010; Harrison, Johnson, McInnes, & Rutström, 2005; Holt & Laury, 2002, 2005; Kachelmeier & Shehata, 1992). On the other hand, the magnitude effect was not found for losses (Fehr-Duda et al., 2010; Mitchell & Wilson, 2010), or was only found at small probabilities of losses (Etchart-Vincent, 2004).

Previous studies indicated that choice involving delayed and probabilistic rewards underlies the assumption that the subjective value of a reward is increasingly discounted from its nominal amount as the delay until or the odds against receiving the reward increase, and that individuals choose the reward with the higher (discounted) subjective value (e.g., Green &

Myerson, 1993; Loewenstein & Elster, 1992). There has been a debate about whether the two types of discounting are based on a common underlying psychological process or not (see Green & Myerson, 2004). Some hold a single-process view (e.g., Rachlin et al., 1991), given that both processes describe a decrease in present value, whereas others researchers have found only weak correlations between time and risk preferences, and suggest that discounting rates are affected by different factors (e.g., Chapman & Weber, 2006; Holt, Green, & Myerson, 2003; Ostraszewski, Green, & Myerson, 1998).

Furthermore, Ohmura et al. (2006) examined the psychometric reliability of delay and probability discounting over a 3-month period for both differential stability (stability of individual differences) and absolute stability (stability of the group mean). The results demonstrated that standard delay and probability discounting parameters (e.g., hyperbolic and area under the curve) had both differential stability and absolute stability across 3 months. Therefore, they proposed that delay and probability parameters are reliable and stable measures to predict future behavior.

### **1.3.1 The Comparison between WTA/WTP and the Titration Procedure**

The certainty equivalent of a risky decision is the amount available for sure for which a decision maker is indifferent with when given a choice with an uncertain prospect (Ben-Tal & Teboulle, 2007). The most straightforward method of eliciting a certainty equivalent is to ask individuals directly for the sure amount of money that they are ‘willing to accept’ (WTA) or ‘willing to pay’ (WTP) for a risky decision (e.g., a lottery)<sup>8</sup>, and make subjective riskiness evaluations (for a combined example, see Weber & Hsee, 1998).

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<sup>8</sup> WTA and WTP are also widely used in cost-benefit analysis of nonmarket public goods and environmental impact assessments; see Venkatachalam (2004) for a review and discussion.

Determining a buying or/and selling price with lotteries is an experimental methodology based on WTA/WTP. Buying (or selling) price for a lottery is a maximal (or minimal) sure amount which the decision maker is willing to pay for (or accept to forgo) a lottery with specified probabilities of winning (for a combined example, see Sasaki, Xie, Ohtake, Qin, & Tsutsui, 2008). In order to improve ecological validity, some researchers have used large, real payoffs in terms of hypothetical ones. Although Holt and Laury's studies (2002, 2005) used combined real and hypothetical rewards for American participants, due to budget limitations, most of the lottery buying and selling experiments using real rewards were typically conducted in developing countries, e.g., China (Fehr-Duda et al., 2010; Kachelmeier & Shehata, 1992; Sasaki et al., 2008). However, researchers have suggested that these direct matching procedures should be used with caution.

For example, there is often a difference between the WTA and WTP for an object, such that individuals will often nominate a greater WTA than WTP. This result is known as the 'endowment effect' and can be explained by Prospect Theory in the following way: Selling an object is perceived as a loss, relative to the seller's reference point (status quo), whereas buying an object is perceived as a gain relative to the reference point. Because individuals are generally loss averse, they tend to place a higher value on objects they consider selling rather than objects they are considering to buy (also see Trope & Liberman's (2010) explanation from the perspective of the Construal Level Theory).

Fox and Poldrack (2009) noted several problems with the design of WTA/WTP experiments, including that people tend to give more weight to outcomes relative to probabilities when they price prospects rather than choose between them (e.g., Tversky, Slovic, & Kahneman, 1990), that people tend to be more risk averse when they match prospects by varying probabilities rather than by varying outcomes (Hershey & Schoemaker, 1985). As an alternative, they suggested that procedures in which a repeated series of choices were used to estimate cash

equivalents directly might avoid these problems. Such approaches are commonly used in behavioral research on intertemporal choice (see Green & Myerson, 2004, for review), and are adopted in this thesis (e.g., the bisection method used in Experiments 1 and 2).

In addition to the criticisms of (Fox & Poldrack, 2009), we would like to note a few other potential drawbacks of the WTA/WTP method, especially as used in lottery buying/selling experiments. First, some studies have used both low and high payoffs with various probabilities in a within-participant design (e.g., Fehr-Duda et al., 2010). This may alleviate the financial pressures of limited research budgets and allow the size of incentives to be varied. However, the possibility of contrast effects (Dai, Grace, & Kemp, 2009, or see Experiment 1 and 2 in this thesis), in which subjective amount varies inversely with the value of a prior reward, for example when a smaller amount appears after a larger amount, the smaller amount will be valued less, could introduce a confound. Second, if real rewards are to be used, due to the limit of research budgets usually the large payoffs are only applied for a few probabilities but not varied enough (e.g., Fehr-Duda et al., 2010). The result is that the risk attitude of the large payoffs would be only investigated at some certain probabilities. Third, similar to the second point, some lottery experiments claimed to use large payoffs but refer to the cumulative outcomes of a series of bets with various probabilities. However, the payoff for each probability was still small rather than large as they claimed (e.g., Fehr-Duda et al., 2010; Kachelmeier & Shehata, 1992; Sasaki et al., 2008). Four, another possible problem of using the cumulative gambling outcome involves the sequence of outcomes, such as the ‘house-money’ effect (the increase in risk taking when a gambler has earned money on prior choices; Gneezy, Kapteyn, & Potters, 2003; Thaler & Johnson, 1990), or disposition effect (the increase in risk taking following a loss; Odean, 1998; Weber & Camerer, 1998). The latter effect can also be interpreted as loss aversion (Kahneman & Tversky, 1979), especially for problem gamblers who may exhibit strong loss-chasing behaviors after a series of losses and expect a big win (Campbell-Meiklejohn, Woolrich, Passingham, & Rogers, 2008).

In an attempt to enhance the sensitivity of measurement in study of risky choices, a titration procedure has been developed as a standard method (Rachlin, Logue, Gibbon, & Frankel, 1986; Rachlin et al., 1991). The Probability Discounting (PD) paradigm can be used to investigate the effect of reward probability on decision making by determining the amount to be received for sure that is equally preferred to a risky outcome. The PD paradigm is widely-used in studies of risky decision making (Green & Myerson, 2004), but is not without drawbacks. For example, the multi-round and bisection approaches to eliciting cash equivalents cannot easily be made compatible with real incentives (see Fox & Poldrack, 2009, for a discussion). On the other hand, empirical tests of these methods of eliciting cash equivalents indicate that the bisection method performs best (Fox & Poldrack, 2009). Also, unlike the literature on ‘cognitive illusions’ where human performance can be compared to an objective standard (e.g., Bayes’ theorem), ‘errors’ in studies of discounting do not exist there are no normatively correct answers (Yi & Bickel, 2005), although Yi and Bickel (2005) propose that that if probabilistic information is presented as relative frequencies rather than probabilities, it may enhance self-control decisions.

Similar to PD, the Delay Discounting paradigm (DD) also usually uses titration methods to investigate how people trade off time and money. In this paradigm, participants are given a series of choices between an amount of money available now and a (usually larger) amount of money available after a delay. Typically, the value of the immediate reward is adjusted until an indifference point is reached – the amount for which the participant is equally likely to choose the immediate and delayed rewards. Studies have used different methods for presenting choices (e.g., displayed on cards or a computer screen), method for titrating immediate reward value, and delays assessed.

### 1.3.2 Demographic Factors Which Affect Delay and Probability Discounting

Empirical evidence regarding age differences in temporal discounting is mixed. Whereas some studies have found that greater age was associated with a decreased rate of delay discounting (Green, Fry, et al., 1994; Green, Myerson, Lichtman, Rosen, & Fry, 1996; Green et al., 1999; Löckenhoff, O'Donoghue, & Dunning, 2011; Olson, Hooper, Collins, & Luciana, 2007; Reimers, Maylor, Stewart, & Chater, 2009), others have found that the relationship between age and discounting rate is curvilinear, with minimal discounting rates in mid-life (Harrison, Lau, & Williams, 2002; Read & Read, 2004; Sozou & Seymour, 2003; Trostel & Taylor, 2001), or an absence of age effects (Coller & Williams, 1999; de Wit, Flory, Acheson, McCloskey, & Manuck, 2007).

Age has been investigated as a potential factor in delay and probability discounting (for review, see Green & Myerson, 2004; Read & Read, 2004). Some studies report that the delay discounting rate shows a linear decreasing trend by age. In other words, patience or ability to delay gratification appears to increase across the lifespan (Green, Fry, et al., 1994; Green et al., 1996; Green et al., 1999; Löckenhoff et al., 2011; Olson et al., 2007; Reimers et al., 2009). For example, Green, Fry, et al. (1994) found that preteens ( $M = 12$  years) discounted delayed rewards more than young adults ( $M = 20$  years), who in turn discounted more than the elderly ( $M = 67$  years).

However, other studies suggest a curvilinear relationship between age and time discounting (Harrison et al., 2002; Read & Read, 2004; Sozou & Seymour, 2003; Trostel & Taylor, 2001). The discrepancies across studies may be due to differences in demographic factors in the samples and discounting measures used in each study (Löckenhoff et al., 2011; Read & Read, 2004). For example, using a wide range of ages (especially including a middle-aged group) as well as taking a number of different discounting measures (Read & Read, 2004) showed that older people ( $M = 75$  years) discount more than younger ones ( $M = 25$  years), however, middle-

aged people ( $M = 44$  years) discount less than either group and the effects were particularly strong for discounting over long delays, and for holidays. This curvilinear relationship between age and time discounting was also supported by Harrison et al. (2002) in a Danish sample. Olson et al. (2007) found developmental changes of delay discounting in adolescence (aged 9 to 23 years). Löckenhoff et al. (2011) found that increased age was associated with a lower rate of future discounting, but the effect was only significant for gains and not losses. Analyses with covariates suggested that the age effects were due to differences in mental health and emotional functioning, and not cognitive or demographic variables.

Some studies found no relationship between age and rate of delay discounting, for example de Wit et al. (2007) (sample mean age  $45.18 \pm 6.6$ , range 30-54 years), and Coller and Williams (1999) (graduate and undergraduate students), but the age range of these two studies were narrower than those noted above. On the other hand, they may demonstrate that rates of delay discounting are broadly stable during adulthood.

There is limited research on the effects of age on probability discounting, but the available studies, which have used small real payoffs, indicate that rates of probability discounting do not change with age, for example, Olson et al. (2007) (aged 11 to 23 years) and Scheres et al. (2006) (6-17 years), unlike delay discounting. One reason for this discrepancy may be that maturation, by definition, involves increasing experience with longer temporal periods, but does not necessarily involve greater experience with odds or probabilities (Olson et al., 2007). However, Gächter, Johnson, and Herrmann (2007) found that loss aversion, measured in both risky and riskless consumer choice situations, increased with age.

It is widely accepted that rates of problem gambling among youth and younger adults are two to four times those of older adults (Hardoon & Derevensky, 2002; Raylu & Oei, 2002; Shaffer et al., 1999). Age seems to be inversely related to gambling problems in studies universally across countries (see Petry, 2005). Considering that college students are

predominantly early adults, and opportunities for gambling are likely to increase, college students may represent a risk group for higher rates of disruptive and problem gambling. With less parental and social control imposed on them compared to adolescence, college students, as a broad definition, are found to engage in health-compromising behaviors and risky activities, including gambling. In a recent meta-analysis, the estimated rate of problem gamblers among college students in Canada and the USA was 8% (Blinn-Pike, Worthy, & Jonkman, 2007).

The investigation of gender differences in delay and probability discounting is limited. Olson et al. (2007) found that gender was unrelated to either delay or probability discounting for participants aged from 9 to 23 years. However, most studies report that women are more patient than men when making decisions with respect to time preferences (Coller & Williams, 1999; Donkers & van Soest, 1999; Read & Read, 2004). Gender stereotyping of risk propensity has been consistently reported, that is, both men and women perceive women to be more risk averse than men (Daruvalla, 2007; Eckel & Grossman, 2008; Siegrist, Cvetkovich, & Gutscher, 2002), and this gender risk stereotype also is found among Chinese (He, Liang, & Liu, 2002). There is evidence of gender differences in sensitivity to risk and whereas most studies have found that men are less risk-averse than women, the size of the effect differs depending on the task domain (for a meta-analysis, see Byrnes, Miller, & Schafer, 1999). For example, women were found to have higher levels of risk aversion in making financial decisions (e.g., investing and gambling) (Anbar & Eker, 2010; Booij & van Praag, 2009; Charness & Gneezy, 2007; Eckel & Grossman, 2008; Weber, Blais, & Betz, 2002), and showed a greater degree of loss aversion than men (Brooks & Zank, 2005; Schmidt & Traub, 2002). This trend also exhibit in some non-financial decisions, such as health, safety, recreational, traffic, and labor markets (Croson & Gneezy, 2009; Hersch, 1996; Weber et al., 2002), but not in the social domain (Weber et al., 2002). Weber et al. (2002) found that gender and domain differences in apparent risk taking may be due to differences in the perception of benefits and risks associated with particular outcomes. Gender differences in risk perception, with men perceiving fewer risks, may be largely accounted for by

gender differences in self-reported emotions (i.e., fear) (Lerner, Gonzalez, Small, & Fischhoff, 2003). Bruhin, Fehr-Duda, and Epper (2010), Fehr-Duda, De Gennaro, and Schubert (2006), Harrison and Rutström (2009) found that women were less sensitive to changes in probability than were men, and generally departed more strongly from linear probability weighting than do men. Some studies have failed to find gender differences (Holt & Laury, 2002, 2005; Kruse & Thompson, 2003), or even contradicted the stereotype that women were more risk-averse. For example, females were found risk-prone than males when potential losses were involved (Schubert, Brown, Gysler, & Brachinger, 1999). On the other hand, a Canadian study found that female gamblers were likely to progress faster to problem gambling than male gamblers (Tavares, Zilberman, Beites, & Gentil, 2001). Regarding gender differences and their role as risk factors or predictors of problem gambling among Chinese, it was found that males participated more in gambling than females and were at higher risk of gambling problems (Chen et al., 1993; Clarke et al., 2006; Fong & Ozorio, 2005; Lai, 2006; Sin, 1997). However, when compared to Chinese male gamblers, female gamblers had a higher frequency of physical ailments and suicidal thoughts, but had similar financial problems and interpersonal issues (Tang, Wu, & Tang, 2007). Chinese female gamblers had an older age of onset, shorter duration of gambling, and were more ready to admit the detrimental effects of problem gambling (Tang et al., 2007).

Higher levels of education may be important in improving judgment in risky decision making. Research has found that better-educated people are less risk-seeking than less well-educated people (Dohmen et al., 2006; Kapteyn & Teppa, 2003). However, from an alternative perspective, schooling attainment, especially higher education, can be seen as a risky investment which aims to obtain higher wages in the future (Hartog & Bajdechi, 2007). Other studies have found a positive correlation between education levels and risk-seeking preference (Chew, Heckman, Yi, Zhang, & Zhong, 2010; Halek & Eisenhauer, 2001; Harrison, Lau, Rutström, & Sullivan, 2005). From an intertemporal choice perspective, higher education is a long-term investment and requires a forward-looking orientation. More highly-educated individuals tend to

have lower rates of temporal discounting (Chew et al., 2010; Harrison et al., 2002; Kapteyn & Teppa, 2003).

Income level has also been found to affect time preferences, with lower-income individuals showing greater impatience (i.e., higher rates of temporal discounting) (Green et al., 1996; Kapteyn & Teppa, 2003; Read & Read, 2004). One possible reason for this result may be liquidity constraints – by definition, individuals with a larger income are wealthier and can ‘afford’ to wait (Booij & van Praag, 2009). The classical EUT model (Bernoulli, 1738; von Neumann & Morgenstern, 1944) posits that risk-seeking decreases with wealth because the same monetary amount becomes relatively less important as overall wealth increases (i.e., decreasing marginal utility). Lower socioeconomic status is found to be associated with disordered gambling in most prevalence studies (see Petry, 2005). In the research domain of risk management, Sokolowska and Tyszka (1995) found that people in poor countries are less concerned about technological and environmental hazards. Lower-income individuals’ risk prone propensity is explained as poorer ability to understand the probabilities associated with less education, propelled by their desperate situations, or even the interaction of genetic and social context (see Petry, 2005).

However, the effects of income level on delay and probability discounting, previously noted, may appear inconsistent with the magnitude effect. If the same nominal amount is more valuable to a low-income individual, they should discount a given delayed amount less steeply than high-income individuals. In terms of probability discounting, low-income individuals would be expected to discount a given amount at a higher rate than high-income individuals (i.e., show more risk aversion). On the contrary, people with low income discount delays more steeply than high-income individuals and show more risk-seeking behavior. Further research is needed to examine the basic mechanisms underlying income and magnitude effects (Green & Myerson, 2004). On the other hand, lower socioeconomic status is often confounded with other variables, such as less education, ethnic minority groups and psychiatric disorders. The unique or shared variability

with respect to time and risk propensity associated with these variables is hard to ascertain (Petry, 2005).

Other demographic factors have also been found to be potentially related to either time or risk attitude. For example, biological/genetic factors (e.g., carriers of short/long allele of the serotonin transporter gene have different risk preference in investment and gambling tasks) (e.g., He et al., 2010; Homberg, van den Bos, den Heijer, Suer, & Cuppen, 2008; Kuhnen & Chiao, 2009); intelligence (inversely correlated with delay discounting rate, especially verbal intelligence) (de Wit et al., 2007; Olson et al., 2007), marital status (individuals that are single or divorced are more likely to develop gambling problem) (Petry, 2005; Volberg & Abbott, 1994); religious orientation (religious individuals are more forward-looking) (Becker & Mulligan, 1997; Booij & van Praag, 2009); personality traits (such as extraversion, conscientiousness and agreeableness are associated with risk taking or framing effects) (Levin, Gaeth, Schreiber, & Lauriola, 2002; Nicholson, Soane, Fenton-O’Creevy, & Willman, 2005; Weber et al., 2002); mental health status, for example ADHD (Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Hurst, Kepley, McCalla, & Livermore, 2010; Scheres et al., 2006), pathological gambling (see more in a later section) and some other unhealthy behaviors (e.g., smoking, binge drinking, overeating and substance abuse) demonstrate impulsive (preference for the sooner smaller reward) and/or less risk aversion (e.g., Bickel et al., 2007; Bickel, Odum, & Madden, 1999; Kirby & Petry, 2004; MacKillop et al., 2011; Petry, 2005; Reynolds, Richards, Horn, & Karraker, 2004). Interestingly, in genetic twins studies, the heritability of economic risk attitude was found accounting for 57% of Chinese (Zhong et al., 2009), and 14% of Swedish (Cesarini, Dawes, Johannesson, Lichtenstein, & Wallace, 2009).

A proposed mechanism for how cultural values might affect decision making is through being able to activate goals situationally or to elevate their accessibility (Weber, Ames, & Blais, 2005). There are some special cultural beliefs which may affect time and risk preference or self-

control (e.g., Oei & Raylu, 2007; Pitta, Fung, & Isberg, 1999). For example, there are unique beliefs related to fate, chance, luck, risk and control in Chinese culture, which suggests that cognitive biases which support gambling might be different or more prevalent among Chinese compared to other cultures (Oei & Raylu, 2007; Papineau, 2005; Tang & Wu, 2010). Although cultural differences in discounting rates have been reported, there are also strong similarities in terms of the process underlying evaluation of delayed and probabilistic rewards (Du et al., 2002). There is a growing body of research concerned with cultural differences in discounting (Green & Myerson, 2004; Weber & Morris, 2010). This will be reviewed in a later section.

### **1.3.3 Delay/Probability Discounting and Problem/Pathological Gambling**

Research on impulse-control disorders, including pathological gambling, using a discounting framework and based on a behavior-analytic perspective is a fairly recent phenomenon, even though, for the case of pathological gambling, the prevalence has been increasing over the last 20 years (Petry, 2005). The general result is that individuals with impulse-control disorders tend to have higher rates of delay discounting than controls. Measures of discounting have been found to discriminate between different groups, for example, drug users, offenders, problem drinkers, smokers and non-substance-using controls (e.g., Bickel et al., 1999; Madden, Petry, Badger, & Bickel, 1997a; Petry, 2001b; Reynolds et al., 2004). Pathological gamblers have been found to be more impulsive in terms of having higher rates of delay discounting. According to this view, pathological gambling can be conceptualized as a series of impulsive choices whereby the gambler selects the smaller, less probable and/or more immediate opportunity to obtain money over the larger, more probable delayed opportunity to save money (Dixon, Marley, & Jacobs, 2003; Petry, 2001a). However, Holt et al. (2003) reported no statistically-significant differences in temporal discounting between college students designated as gamblers and non-gamblers, but group differences in probability discounting were

observed. Furthermore, pathological gamblers were found to discount delayed monetary consequences to a greater degree when in a gambling context than when outside that context (Dixon, Jacobs, & Sanders, 2006). Recasting problems such as drug addiction, dietary excess, underutilization of health care, and gambling in terms of intertemporal choice allows methods and concepts developed in basic studies of choice and decision making to be brought to bear on these socially-significant problems (Bickel & Vuchinich, 2000; Dixon, Marley, et al., 2003).

Studies of delay discounting have indicated that animals and humans tend to prefer a smaller immediate reward to a larger delayed reward (e.g., Grace, 1999; Rachlin & Green, 1972; Rachlin et al., 1991). These results suggest that both humans and nonhumans discount the value of a reward that is further away in time. The preference for immediate rewards is often termed impulsivity as opposed to self-control, which is choice for the larger, more delayed reward (e.g., Dixon, Rehfeldt, & Randich, 2003; Rachlin & Green, 1972). Redefining problems such as drug addiction, dietary excess, underutilization of health care, and gambling in terms of deficits in intertemporal choice allows methods and concepts developed in basic studies of choice and decision making to be brought to bear on these socially-significant problems (Bickel & Vuchinich, 2000; Dixon, Rehfeldt et al., 2003).

Research on delay discounting has found that children are more impulsive than adults (Green, Fristoe, & Myerson, 1994; Read & Read, 2004), males are more impulsive than females (Charness & Gneezy, 2007; Kirby & Maraković, 1996) (although no gender difference was found in Tayler et al., 2009), and pathological gamblers (Alessi & Ptery, 2003; Petry, 2001a) and various drug-dependent populations (Bickel & Marsch, 2001) are more impulsive than controls. Different delay discounting rates have been observed in clinical populations when DSM-IV diagnoses were used as predictors of impulsive behavior (Green & Myerson, 2004). A number of studies have found that pathological gamblers discounted monetary rewards to a greater degree than did non-gamblers (e.g., Dixon, Marley, et al., 2003; Petry, 2001a). Meanwhile, gamblers

may be thought of as being impulsive also because they engage in risky behavior despite the outcome being uncertain and the possibility of long-term negative consequences.

Holt et al. (2003) compared both delay and probability discounting between gamblers and non gamblers, using scores on the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) to differentiate between gamblers and non-gamblers (the mean SOGS score for non-gamblers was 0.3, and for gamblers was 6.5). Holt et al. (2003) found that gamblers discounted probabilistic rewards less steeply than non-gamblers, suggesting more impulsive and risk-seeking of gamblers. However, gamblers did not discount delayed rewards more steeply than non-gamblers. Based on their results, Holt et al (2003) suggested that impulsivity was not a unitary process or general trait that was associated with both an inability to delay gratification and a propensity for risk taking. In accord with Holt et al (2003), Madden, Petry, and Johnson (2009) compared delay and probability discounting involving participants who had more severe gambling problems (i.e., pathological gamblers; SOGS score range = 7-20). They found no significant difference in delay discounting rate between pathological gamblers and controls, but the difference approached significance when education and ethnicity were included as covariates. Madden et al. (2009) also found that pathological gamblers discounted hypothetical probabilistic monetary rewards significantly less steeply than matched controls, showing a propensity for risk taking. In contrast, among college students' gamblers, Shead, Callan, and Hodgins (2008) found no relation between problem gambling severity (screened by Canadian Problem Gambling Index (Ferris & Wynne, 2001)) and probability discounting for either gains or losses using real but small monetary rewards (\$20). The lack of significance might be due to that in their sample, there was a high proportion classified as either low- or moderate-risk gamblers (81.4%), with smaller proportions of students classified as non-problem gamblers (8.5%) and problem gamblers (10.2%).

Research on gambling behaviors with non-Caucasian ethnic groups has received increasing interest in recent years, as some of these groups have been reported to have higher problem gambling prevalence rates (e.g., Loo et al., 2008; Welte et al., 2004). As far as Chinese problem gambling or risk propensity are concerned, there have been studies from a variety of perspectives, including anthropological (e.g., Papineau, 2005) cultural background analysis (e.g., Raylu & Oei, 2004b; Wong & Tse, 2003), cognitions and motivations (e.g., Oei et al., 2008; Oei & Raylu, 2010), and delay and probability discounting (e.g., Du et al., 2002). However, no studies have directly compared Chinese gamblers and non-gamblers. Noticeably, Lau and Ranyard (2005) compared probabilistic thinking and risk taking of male gamblers and non-gamblers in UK and Hong Kong (measured by a view of uncertainty questionnaire and a hypothetical horse-race task, respectively). Although they did not include measures of discounting, they proposed that Chinese exhibited less probabilistic thinking and higher levels of risk taking than English speakers, similar to Du et al.'s (2002) conclusion.

## **1.4 Reward Contrast**

### **1.4.1 Contrast Effects in Various Research Areas**

One of the most important and far-reaching generalizations in experimental psychology is that the impact of environmental stimuli is relative, not absolute. Contrast effects – in which the effect of a stimulus varies inversely with its context – have been demonstrated in a wide variety of domains including perception, cognition, and behavior. Contrast effects have been demonstrated in several sensory systems such as vision, taste and audition. For example, when a hot-adapted and a cold-adapted hand are simultaneously put into water, the temperature of the water would be felt as cold or warm, respectively, indicating that perceived temperature depended on the relation of the actual water temperature to a physiological neutral point. This neutral point could be raised or lowered by prolonged exposure, as when tepid water is felt as

cold after one steps out of a hot bath (Boring, 1942; Helson, 1964; Kahneman, 2003). In visual perception, a small gray square will look dark on a white background, light on a black background, blue on yellow, and reddish on green (Kahneman, 2003; Suls & Wheeler, 2007). In terms of subjective feelings about commercial options, sometimes, less is better. For example, people are willing to pay more for an overfilled ice cream serving with 7 oz compared to an underfilled serving with 8 oz of ice cream (Hsee, 1998). Our perception of stimuli is always determined by the relationship to a context. This fundamental aspect of perception has practical importance in a wide variety of situations, including marketing. For example, some retail stores (e.g., Briscoes, the homewares franchise in NZ) offer year-round discounting prices to advertise their merchandise to attract customers. Even though our rational mind may be aware that the original list prices are unrealistic, they provide an anchor against which the sales price is automatically compared.

A contrast effect is the enhancement or diminishing of perceptions, cognitions, judgments and related behavior as a result of immediately previous or simultaneous exposure to a stimulus in a context (Plous, 1993; Suls & Wheeler, 2007). Much research in psychology over the past 50 or so years has examined how this psychological context shapes our judgments (Mussweiler, 2007). The term contrast was first used by von Helmholtz (1866; cited in Suls & Wheeler, 2007) to describe perceptual distortions that were associated with the exaggeration of sensory differences.

Contrast effects are ubiquitous for both humans and nonhumans alike, and have been found in the wide variety of different research areas such as psychophysical judgment and experimental psychology (e.g., sensory contrast), social psychology (e.g., Social Comparison Theory, hedonic contrast), educational psychology (big-fish-little-pond effect; see below), industrial and organizational psychology (e.g., performance evaluation contrast). In all of these domains, the effect of a given stimulus value involves a comparison such that the psychological impact of a

stimulus is due not solely to its absolute value, but also to its value relative to that of other stimuli presented either in the same context or in the past. In following, some research examples will be given to elaborate contrast effects found in various fields.

Fechner (1860/1966) was the first to recognize the relevance of contrast for feelings of pleasure or satisfaction. According to his principle of hedonic contrast, an object (or stimulus, or event) which provides pleasure, gives more pleasure when it is compared with other objects that provide less pleasure (see Suls & Wheeler, 2007). This principle may be seen at work in recent decades in the field of 'hedonomics' (e.g., Diener & Biswas-Diener, 2002; Easterlin, 1995; Hsee, Hastie, & Chen, 2008), which attempts to improve people's perception of happiness by utilizing favorable comparisons between different life choices.

In 1950s, psychologists proposed social comparison theory (Festinger, 1954; Festinger, Torrey, & Willerman, 1954), which proposes that the perception of others may affect an individual's self-views and behaviors via contrast effects. Further studies (Wills, 1981; Wood, Taylor, & Lichtman, 1985) showed that people who experience a threat to self-esteem can increase their subjective well-being by comparing themselves with someone less fortunate; whereas comparison with someone more fortunate would make them feel worse about themselves. Therefore, distressed populations can use downward comparison to repair well-being (e.g., Buunk & Gibbons, 1997; Hsee et al., 2008; Suls & Wills, 1991). Social contrast effects also occur in behavior performance ratings. For example, an average interviewee may get a poor rating if he or she is interviewed after a good interviewee (Kravitz & Balzer, 1992; Maurer & Alexander, 1991; Maurer, Palmer, & Ashe, 1993).

Based on social comparison theory, educational psychologists have proposed that students of equal ability will have lower academic self-concepts in higher average-ability schools but higher self-concepts in comparatively lower average-ability schools, which has been termed the big-fish-little-pond effect (BFLPE) (Blanton, Buunk, Gibbons, & Kuyper, 1999; Davis, 1966;

Marsh, 1991; Marsh & Craven, 2002; Marsh & Parker, 1984). In other words, whether one perceives oneself as a 'big fish' depends on the average size of the other fish in the pond. The stronger the peer group as a frame of reference, the lower one's academic self-concept (little fish in a big pond). By the same token, weaker peer groups lead to higher academic self-concepts (Dai & Rinn, 2008). BFLPE findings have been generalized over a wide variety of different individual student and contextual level characteristics, settings, countries, and over long-term follow-up (e.g., Marsh & Craven, 2006; Marsh & Hau, 2003; Seaton, Marsh, & Craven, 2009).

In a marketing context, research shows that consumers use contextual cues to judge sales personnel, retail establishments, packaged goods, prices, quality, advertisements, and real estate. Marketers facilitate processing by manipulating sales situations, brands, and advertisements (see Dato-on & Dahlstrom, 2003, for a review). Contrast effects are also widely used by retailers to influence consumers' judgment, who for example, sometimes mark up a higher original price then offer a discounted one for sale.

#### **1.4.2 Assimilation – the Opposite of Contrast**

Assimilation refers to situations whereby perception and judgment are displaced toward the context (Suls & Wheeler, 2007). Whereas contrast effects reflect a negative (inverse) relationship between the judgment and a surrounding context, assimilation effects reflect a positive relation between the surrounding context and a judgment (Bless, Schwarz, & Wänke, 2003). Contrast and assimilation together are referred to as context effects (Sarris, 2006), and they both first investigated by psychological researchers investigating sensation and perception in the 19th century (for a comprehensive review of contrast and assimilation effects in social psychology, see Suls & Wheeler, 2007).

Assimilation may occur in social psychological situations perhaps because humans seek merger or unity with other humans (Suls & Wheeler, 2007). For example, in the BFLPE, contrast

occurs when higher school-average achievement levels (the context) lead to lower individual student academic self-concepts (target judgment), whereas assimilation can occur if higher school-average achievement leads to higher academic self-concepts (Marsh, 1984). Famous brands (e.g., Coca Cola and Pepsi), after establishing their reputation, are able to expand their product categories. On the other hand, social psychologists found that if people are primed with extreme exemplars (e.g., Einstein for intelligence), contrast effects typically result, but with moderate exemplars as primes (e.g., classmates or colleagues), assimilation is more common (Herr, Sherman, & Fazio, 1983). Biernat and Manis (2007) proposed that zero-sum behaviors in the workplace (i.e., those involving allocation of a limited resource, such as hiring, placement into positions/assignments, and allocation of money) tend to show assimilation to group stereotypes, whereas nonzero-sum behaviors (i.e., those involving a limitless resource, such as nonverbals, vocal or written feedback delivered toward others) tend toward contrast.

### **1.4.3 Cross-Cultural Studies of Contrast-Type Phenomena**

There has been limited research on whether contrast effects differ across cultures. In research in educational settings, several studies have obtained support for the cross-cultural generalizability of the BFLPE, demonstrating that the contrast effect on academic self-concepts among school students generalized across collectivist and individualist cultures and across economically developing and developed nations (Marsh & Hau, 2003; Seaton et al., 2009). These two studies tested the BFLPE for school students in 26 and 41 countries, respectively, in which includes some individualist-culture countries, such as United States, Australia, United Kingdom, Canada, and New Zealand, and some collectivist-culture countries, such as Japan, Russia, Brazil, Mexico, Portugal, China (only Hong Kong and Macao), and Korea. [Classification of countries was based on the Individualism Index of Hofstede's cultural dimensions].

However, studies (McFarland & Buehler, 1995; Seaton et al., 2009) have also shown that the BFLPE is less pronounced in collectivist countries than in individualist countries, regardless of its generalizability across cultures. Furthermore, Cheng and Lam (2007) studied the BFLPE at a secondary school in Hong Kong and reported that the contrast effect was found only for people with independent self-construal; for those with interdependent self-construal, the contrast effect was attenuated. They suggested that interpersonal competition within school appears to activate an “I” frame of mind, which in turn leads students to focus on their individual performance, and in this case the contrast effect is enhanced. On the other hand, inter-school competition activates school identification and a stronger sense of membership within a school. This encourages a “we” frame of mind that leads students to put less emphasis on comparison with schoolmates but rather to focus on their collective performance. In this case, the contrast effect is reduced. It is noteworthy, however, that both studies (i.e., Marsh & Hau, 2003; Seaton et al., 2009) found that the BFLPE (the negative effect of school average ability) was not significant in Korea. The authors speculated that in Korea the prestige of attending a high-ability school (a reflected glory effect) was so strong that it counterbalanced the negative effect of the BFLPE. Marsh, Kong, and Hau (2000) also found that a reflective effect partially – but not completely – counteracted the BFLPE in Hong Kong. Indeed, after controlling for the reflective glory effect (based on a separate measure), the negative effect of school average ability (i.e., the BFLPE) was substantially more negative in their study.

To our knowledge, the above studies are the only ones which have investigated contrast effects in a cross-cultural/cross-national context. However, they all focused on the contrast effect primed with social cues (e.g., life satisfaction, BFLPE), and we were unable to find any study which has compared contrast effects for different ethnic and cultural groups using simple sensory stimuli.

#### 1.4.4 Origins of Contrast Effects

When the contrast effect was first found in the late 19 century, early psychologists such as von Helmholtz, Wundt, Wertheimer, Kohler, and Koffka attempted to explain it. The emphasis on the frame of reference by Gestalt psychologists is perhaps their strongest intellectual legacy, especially for social psychology (see Suls & Wheeler, 2007, for a historical review). In particular, three models of psychophysical scaling and judgment, with intellectual roots in psychophysics and attitude scale construction, have been important in the understanding of contrast. They are Adaptation-Level Theory (Helson, 1947, 1964), Range Theory (Volkman, 1951) and Range-Frequency Theory (Parducci, 1968, 1995). These models have been developed on the basis of experiments conducted with simple stimuli, such as tones and geometrical shapes, but the general principles have been widely applied to other areas, including pleasure and pain, economic value, physical attractiveness, and life satisfaction (see Suls & Wheeler, 2007).

Researchers have suggested other factors that might contribute to contrast phenomena, including attitude and emotion (Crespi, 1942; Krauth-Gruber & Ric, 2000; Sherif & Hovland, 1961), exploration (Elliot, 1928), and loss of habit strength (Zeaman, 1949) (for a systematic review, see Flaherty, 1996). More recently, Dato-on and Dahlstrom (2003) conducted a meta-analysis of 55 social psychology and marketing studies which reported effect sizes for contrast phenomena (published from 1973 to 1999), and concluded that the extremity of the priming condition, presentation form, stimulus form, and type of prime had the most important influences on contrast effects in judgment.

Biernat and Manis (2007) questioned the default assumption of contrast effects in social psychological judgment, proposing that many of the contrast effects that have been reported are likely to reflect mere changes in response language rather than changes in the perception or representation of the target, whereas contrast is the more typical outcome in psychophysical judgments. They proposed that the context effect may depend on the type of judgment, the nature

of the object of judgment, and the strength of the context. On the other hand, Wedell, Hicklin, and Smarandescu (2007) believed that both assimilation and contrast can be generated in either an automatic or effortful fashion, so that either one can serve as a default or as a corrective process.

#### **1.4.5 Can Contrast Effects be Counteracted?**

There is a debate regarding whether contrast effects can be counteracted. Some believe that when people are aware that a reliance on accessible information is inappropriate and that this may create a bias in their judgment, they are likely to instigate processes to correct for that bias. Depending on the ability and motivation to de-bias judgments, such correction processes may result in null or reverse priming effects (see Martin, 1986; Schwarz & Bless, 1992; Stapel, Martin, & Schwarz, 1998; Wegener & Petty, 1995). However, Shapiro and Spence (2005) argued and provided evidence that contrast effects can emerge automatically in spite of the resistance from conscious effort.

Maurer, Palmer, and Ashe (1993) reported that although diaries and checklists are recommended to be used to record or check rates' behavior in order to eliminate the judges' bias, diaries were found not only to be ineffective at reducing contrast effects on corresponding ratings, but also may strengthen those effects. In a second study, Maurer et al. (1993) found that whereas checklists compared favourably with diaries in their impact on contrast effects for corresponding evaluations, checklists did not eliminate the effects entirely. Cheng and Lam (2007) proposed that contrast effects can be reduced when there is a de-emphasis on competition in the classroom. Another strategy is to promote interdependent self-construal by students, such that they regard their schoolmates as teammates rather than competitors.

Martin (1986) conducted three studies which evaluated a set/reset model. He used a blatant priming task with a completion versus interruption procedure to manipulate the extent to which

individuals engaged in thought perseverance. He found evidence of contrast in the task-completion condition but not in the task-interruption condition, even though he held constant the temporal distance between the priming task and the impression formation task. Thus, judges found it more difficult to avoid the use of the primed concepts when they continued to think about the prime (i.e., in the interrupted-task condition) than when they stopped accessing the concept at the priming task (i.e., the completed-task condition). In another study, Martin, Seta, and Crelia (1990) demonstrated the resource intensive nature of this process by showing that contrast did not occur when participants were distracted, given social loafing instructions, or were low in need for cognition.

#### **1.4.6 Context Dependence and East Asian/Chinese Cultures**

There is a substantial research literature which has found that for cognitive tasks involving attention, contextual processing, categorization, and reasoning, East Asians are more likely to process context, use categories less, and are more likely to use intuition rather than formal reasoning compared with individuals from Western cultures. Specifically, Kitayama and colleagues (Duffy & Kitayama, 2007; Kitayama, Duffy, Kawamura, & Larsen, 2003) found that Japanese are better at judging the length of a line relative to the size of a surrounding box than Americans, whereas Americans were better at estimating the absolute length of the same line. These studies show that Americans tend to pay more attention to details and perform better on a test of absolute judgment, whereas Asians pay more attention to context and perform better on tests of relative judgment. Hedden, Ketay, Aron, Markus, and Gabrieli (2008) replicated Kitayama et al.'s research and also found differences in brain activation using fMRI technology. They found that the same brain areas were used by both Americans and Japanese for both tests, but performance of the more difficult test for each cultural group (relative test for Americans, absolute test for East Asians) was associated with increased activation in brain areas associated

with attention (frontal-parietal region). Other researchers have suggested that different perceptual styles are used by East Asians and Westerners when decoding a visual scene, such that Westerners are more likely to take an analytical, detail-oriented, context-free approach, whereas East Asians focus more on relationships and background context (Chua, Boland, & Nisbett, 2005; Nisbett & Miyamoto, 2005).

In a neuroimaging study, Tang et al. (2006) examined Caucasian and Chinese participants performing a mathematical addition and comparison task. Results showed that Caucasians had higher activation in the peisylvian regions (including the Broca and Wernicke areas), whereas Chinese showed higher activation in the visuo-premotor association areas, particularly during the comparison task. Based on these results, Tang et al. (2006) suggested that the activation of different brain regions indicated that Caucasians and Chinese used different cognitive processes to perform the mathematical tasks, which were likely culturally-specific.

Masuda and Nisbett (2001), Morris and Peng (1994) reported that Chinese and Japanese participants, after viewing pictures of fish swimming in an underwater environment, recalled more about the surrounding context, whereas American participants remembered more about the central figure in the scene. Subsequent studies (Boduroglu, Shah, & Nisbett, 2009; Masuda & Nisbett, 2006) found that East Asian were more sensitive to contextual changes than to focal object changes than Westerners. In an eye-tracking study, Chua et al. (2005) reported that the eye movements of Americans fixated longer and more on focal objects, whereas Chinese participants had shorter fixation durations and more saccades to background scenes. When viewing faces, East Asians sampled elements of scenes more frequently and distributed gaze more broadly than Caucasians (Blais, Jack, Scheepers, Fiset, & Caldara, 2008). However, when processing emotional faces, East Asians were less accurate than Americans when discriminating fear versus disgust, and also showed a more limited scanning pattern for faces than Americans when judging emotions (Jack, Blais, Scheepers, Schyns, & Caldara, 2009).

Edward Hall was the first to propose the distinction of high versus low context as a way of understanding different cultural orientations (Hall, 1976). In a low context culture, such as most Western cultures, individuals usually communicate through explicit statements, and show linear thinking, whereas communications in high-context cultures like most Asian cultures usually include many non-verbal cues such as body language and silence, demonstrating holistic thinking. Hall's theory received empirical support in subsequent studies (Gudykunst et al., 1996; Kim, Pan, & Park, 1998; Koeszegi, Vetschera, & Kersten, 2004). For a comprehensive review of cultural differences in cognition, particularly between Eastern and Western cultures, see Heine & Ruby (2010).

## Chapter 2 Experiment 1 and 2 – Reward Contrast in Delay and Probability Discounting<sup>9</sup>

### Abstract

Our study examined whether reward contrast influences choice between delayed or probabilistic outcomes. Specifically, we predicted that the subjective value of an intermediate reward would seem relatively larger or smaller, respectively, if it followed choices involving a smaller or larger reward, and produce corresponding changes in rates of delay and probability discounting. In Experiment 1, participants made choices about hypothetical \$5,000 or \$50 outcomes, and then made choices about \$500 outcomes. Delay discounting rates for the \$500 outcome were larger for Group \$5,000 than for Group \$50, whereas the opposite result was obtained for probability discounting rates. Experiment 2 used a design that allowed for contrast effects to be assessed within subjects. Two groups made choices about delayed or probabilistic rewards. After completing question blocks in which the amount was \$5,000 and \$50, participants responded to questions with an intermediate amount (\$475/\$525). For Group Delay, the present value of the intermediate reward was greater after the \$50 block than after the \$5,000 block, whereas the opposite was obtained for Group Probability. Results from both experiments confirmed the predictions of reward contrast, and suggest that the subjective value of a monetary reward varies inversely with the prior reward amount.

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<sup>9</sup> Dai, Z., Grace, R. C., & Kemp, S. (2009). Reward contrast in delay and probability discounting. *Learning & Behavior*, 37(3), 281-288.

Two factors that influence decision making are delay and risk. For example, suppose a lottery winner had to decide between a cash prize of \$450 available now or \$500 to be received in one year. Although the delayed reward is greater, he/she might choose the \$450 which could be spent right away. Thus, the subjective value of the \$500 at the time of choice is decreased by having to wait a year to receive it. The process whereby the value of an outcome decreases as a function of its delay is called temporal discounting (Chapman, 1998; Rachlin et al., 1991).

Another factor that can influence decision making is risk – the degree of uncertainty that a reward might not be received (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). For example, consider a choice between receiving \$450 for sure or a 90% chance to receive \$500. Although the expected values of the choices are equal ( $.90 \times 500 = 450$ ), many might prefer \$450 for sure; at the time of choice, the subjective value of the \$500 may be lower because its receipt is uncertain. The decrease in value of an outcome due to its uncertainty is termed probability discounting (Green et al., 1999; Rachlin et al., 1991). Delay and probability discounting are processes that influence behavior which could be described more broadly as intertemporal and risky choice, respectively (Myerson et al., 2003).

Research on intertemporal and risky choice has been informed by comparable studies with nonhumans. For example, the hyperbolic function proposed by Mazur (1984) to describe pigeons' choice between immediate and delayed food rewards provides a better account of humans' intertemporal choice than the normative model of economics, which assumes an exponential discount function (Kirby, 1997; Myerson & Green, 1995). In the domain of risky choice, Pietras, Locey and Hackenberg (2003) showed that humans' choices between certain and uncertain alternatives varied with overall energy budget according to predictions of risk-sensitive models for foraging in behavioral ecology (Bateson & Kacelnik, 1998; Caraco, Martindale, & Whittam, 1980). Comparative research has documented similarities in temporal and probability discounting in both humans and nonhumans (e.g., Rodriguez & Logue, 1988). In particular,

hyperbolic functions provide a good description of results from experiments on both intertemporal and risky choice (with probability scaled as ‘odds against’ in the latter; see Green & Myerson, 2004, for review).

One issue that has not been addressed in delay and probability discounting is the possible role of reward contrast effects. Typically, contrast effects are said to occur when the value or effectiveness of a stimulus varies inversely with the surrounding context. For example, Reynolds (1961) found that pigeons’ rate of keypecking maintained by a constant variable-interval (VI) schedule increased or decreased, respectively, when the reinforcement rate provided by an alternative schedule was changed to extinction or a richer schedule (see Williams, 1983, 2002, for review). Such contrast effects are ubiquitous phenomena in research on conditioning and learning in nonhumans (Flaherty, 1996; Williams, 2002), as well as studies of psychophysical judgment with humans (Lockhead, 2004). Applied to typical choice scenarios studied in temporal and probability discounting, which involve hypothetical monetary outcomes, reward contrast would predict that the subjective value of, say, a \$500 reward would seem subjectively larger or smaller, respectively, if the individual had recently made a decision about a smaller (e.g., \$50) or larger (e.g., \$5,000) reward.

To the extent that contrast influences the subjective value of a reward, such effects could have strong effects on intertemporal and risky choice because discounting rates vary depending on reward magnitude. Research with humans has consistently found that rates of temporal discounting decrease as the amount of reward increases (Johnson & Bickel, 2002). To illustrate, someone might be indifferent between receiving \$400 now or \$500 in one year, yet strongly prefers \$15,000 in one year to \$12,000 now. Because the delayed amount is 25% larger than the immediate amount in both cases, the preference for the delayed amount in the latter choice suggests that the discounting rate for \$15,000 must be less than the corresponding rate for \$500. Evidence for a magnitude effect in temporal discounting has been obtained with both real and

hypothetical monetary rewards (Johnson & Bickel, 2002; Madden, Begotka, Raiff, & Kastern, 2003), taxicab, hair salon, and restaurant tips (Green et al., 2003), as well as outcomes related to health (Chapman, 1996), career decisions (Schoenfelder & Hantula, 2003), and personal relationships (Tayler et al., 2009). By contrast, no evidence for amount-dependent discounting has been found in research with nonhumans (e.g., Grace, 1999; Green et al., 2004; Richards, Mitchell, de Wit, & Seiden, 1997).

Magnitude of reward has also been found to affect rates of probability discounting, but in the opposite direction. Humans discount larger rewards more steeply as a function of the odds than smaller rewards (Christensen et al., 1998; Estle et al., 2006; Green et al., 1999). That is, people show a greater degree of risk aversion with larger amounts (i.e., higher rate of discounting depending on odds against receiving the reward). For example, someone who is indifferent between \$100 for sure and a 40% chance of receiving \$300, is likely to prefer receiving \$1,000 for sure over a 40% chance of receiving \$3,000. The only comparable study with nonhumans is Mazur (1988), who found that fixed-delay indifference points obtained with rats in an adjusting-delay procedure for certain versus uncertain rewards did not change systematically with the overall number of food pellets. Thus there is no evidence of a magnitude effect on probability discounting with nonhumans, although additional research is warranted.

The goal of the present study was to determine whether reward contrast might influence delay and probability discounting in humans. We hypothesized that the subjective value of a monetary outcome might appear larger or smaller, respectively, if an individual had previously been making choices involving smaller or larger amounts. If reward value is influenced by contrast effects, then rates of temporal and probability discounting should change because of the magnitude effects noted above. For example, the temporal discounting rate for a \$500 reward should be reduced if it follows a smaller reward (\$50), but increased if it follows a larger reward (\$5,000). For probability discounting, the opposite effects would be expected: The rate of

probability discounting for \$500 should increase if it follows a smaller reward (\$50) but decrease if it follows a larger reward (\$5,000).

We describe two experiments that use both between-subjects and within-subjects designs to test for reward contrast effects in delay and probability discounting. In Experiment 1, different groups of participants made decisions about a medium-sized reward (\$500) after previously making decisions about either a smaller (\$50) or larger (\$5,000) reward in delay and probability discounting tasks. Reward contrast was assessed indirectly through changes in the discounting rates. In Experiment 2, we used a within-subjects design and evaluated reward contrast more directly in terms of changes in the present value of a discounted \$500 reward.

As a secondary aim, we sought to evaluate predictions based on the view that impulsivity might underlie individual differences in discounting. Impulsivity is a personality trait or behavioral propensity which involves difficulty with delaying gratification and a low degree of risk aversion, and is believed to be a contributing factor to addictive behavioral disorders such as substance abuse and problem gambling (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). According to this view, impulsive individuals should have high rates of temporal discounting, and low rates of probability discounting. However, previous studies have generally failed to find negative correlations between temporal and probability discounting rates, which raises questions about whether such rates are measuring the same construct as impulsivity (Holt et al., 2003; Myerson et al., 2003).

It is interesting to note that one way to interpret the magnitude effect on delay and probability discounting is in terms of a tendency to limit impulsive choice. That is, when the amount is relatively large, rates of delay and probability discounting shift in the direction associated with less impulsive choice (i.e., delay discounting rates decrease and probability discounting rates increase), whereas when the amount is relatively small, rates of delay and probability discounting shift towards more impulsive choice. Thus in Experiment 2 we also

examined whether two psychometric variables that are commonly used in studies of impulsivity, the Barratt Impulsiveness Scale 11 (BIS-11; Patton, Stanford, & Barratt, 1995) and the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) were correlated with delay and probability discounting rates, and reward contrast.

## Experiment 1

Experiment 1 used a between-subjects design to test for reward contrast effects in temporal and probability discounting. Participants responded to a series of questions about hypothetical monetary outcomes. In the temporal discounting conditions, one outcome was an amount of money available immediately, while the other outcome was a larger, standard amount that was available after a delay. In the probability discounting conditions, one outcome was certain while the other outcome was to be obtained with a specified probability. In both conditions, a bisection algorithm was used to determine the amount of money available immediately or for sure that was equal in value to the delayed or probabilistic outcome, respectively. All participants completed two blocks of temporal and probability discounting questions. The amount of the immediate or certain outcome in the first block was either \$50 or \$5,000 (for different groups), while the corresponding amount for the second block was always \$500. If reward contrast effects are present, then the temporal discounting rate for \$500 should be greater for Group \$5,000 than for Group \$50, while the probability discounting rate for \$500 should be greater for Group \$50 than for Group \$5,000.

## Method

*Subjects.* Thirty-two students were recruited from the University of Canterbury. There were 20 females and 12 males, and the average age was 21.84 years. All received a \$10 petrol voucher in return for their participation in the experiment.

*Procedure.* The subjects were tested in small groups, seated individually in front of a computer in a laboratory room. Subjects were told that they would be presented with a series of questions displayed on the computer, which involved hypothetical choices between different amounts of money. They were asked to answer those questions as realistically and accurately as they possibly could. In some cases, the choices were between amounts of money available either immediately or after a delay. In other cases, the choices were between amounts of money to be received for certain (100% chance) or with a specified probability of receipt (< 100% chance). For each choice, there were two alternatives, displayed on the left and right sides of the screen. Participants indicated their choice by pressing the “z” key (left alternative) or the “/” key (right alternative). If, at any time, an “incorrect” choice were made (i.e., the wrong key was pressed), participants could press the space bar to repeat the question. The selected alternative was highlighted in yellow for 0.75 sec to provide feedback for the response. The computer program was written in FreePascal (<http://www.freepascal.org>).

The experiment comprised two pairs of trial blocks, one pair which involved delay discounting and one which involved probability discounting. In each block, indifference points were determined that were estimated to be equal in value to a standard amount. The standard amount for the second block in each pair was always \$500, and participants were randomly assigned to two groups in which the standard amount for the first block in each pair was either

\$50 or \$5,000. The currency was New Zealand dollars, which at the time the study was conducted (April – May 2006) had an exchange rate of approximately NZ\$1 = US\$0.63.

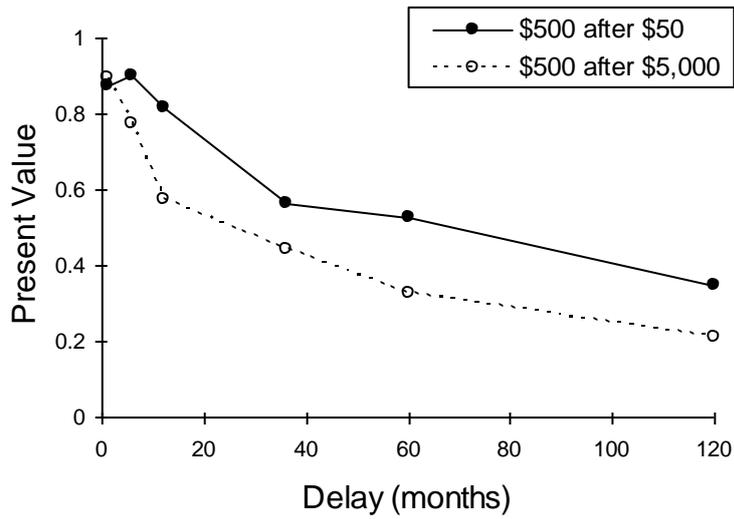
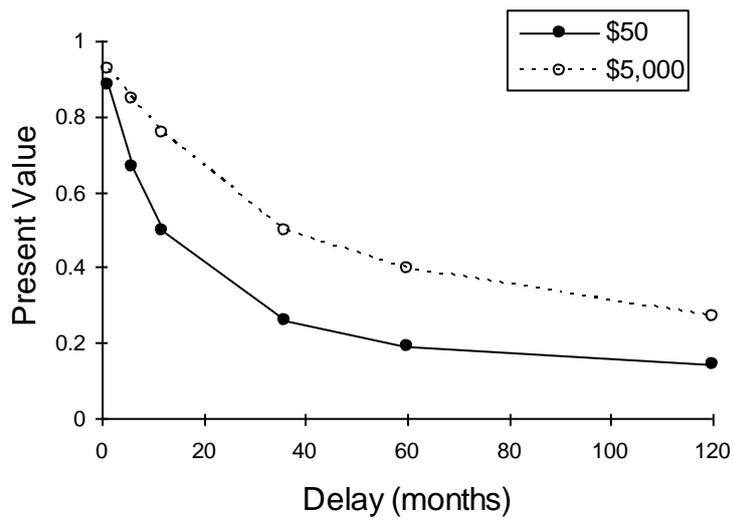
In each block, the standard amount was studied at six different delays or probabilities. For the delay discounting blocks, the delays were: 1 month, 6 months, 1 year, 3 years, 5 years and 10 years. For the probability discounting blocks, the probabilities were: 95%, 90%, 70%, 40%, 10% and 5% (These were the same delays and probabilities used by (Green et al., 1999). For each delay or probability, a series of questions was presented to determine an indifference point – the amount available immediately or for sure, respectively, that was equal in value to the delayed or probabilistic amount. To estimate indifference points efficiently, the amount of the immediate or certain option was changed across successive questions according to a bisection algorithm. For example, in the delay discounting block with a standard amount of \$500 and 1 year delay, the first question presented was \$500 delayed 1 year or \$500 now (i.e., the immediate amount was equal to the standard amount). If the immediate amount was chosen, then the immediate amount for the next question would be the midpoint of the interval defined by the maximum and minimum potential values of the indifference point (which were defined at the start of each question series as the standard amount and \$0). The second question would then be \$500 delayed 1 year or \$250 now. If the delayed amount was now chosen, the immediate amount would be increased for the next question to \$375 (the midpoint of \$250 and \$500). If the delayed amount was chosen again, for the next question the immediate amount would be \$437.50 (the midpoint of \$375 and \$500). Thus, the immediate amounts converged on an indifference point over successive questions. For each question series, the indifference point was estimated as the immediate amount obtained after eight questions, which ensured that estimates were precise (there were  $2^7 = 128$  possible indifference points that were less than the delayed amount). Across the series, the change in the immediate amount based on the response to each question was halved each time, and thus given a delayed amount of \$500, was \$250, \$125, \$62.50, \$31.25,

\$15.63, \$7.81, \$3.91, and \$1.95 for the eight questions. A similar procedure was used to obtain indifference points in the probability discounting blocks.

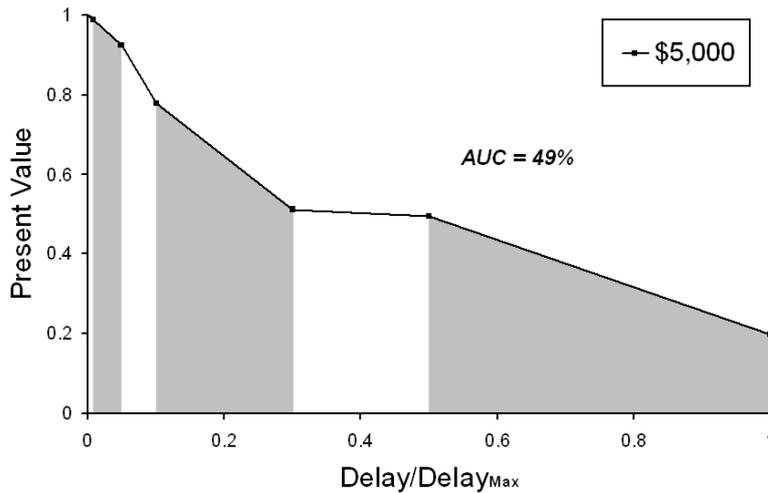
For each response in a series, there was a 1-s interval after the 0.75-s feedback had been provided before the next question was presented. There was an interval of 3 s between question series within a block, and an interval of 5 s between different blocks. Similar to Green et al. (1999), the delays and probabilities were presented in an increasing/decreasing order, respectively (so that discounting increased across trials within blocks for both delay and probability). Whether the delay discounting blocks were completed first followed by the probability discounting blocks, or vice versa, was counterbalanced.

## Results

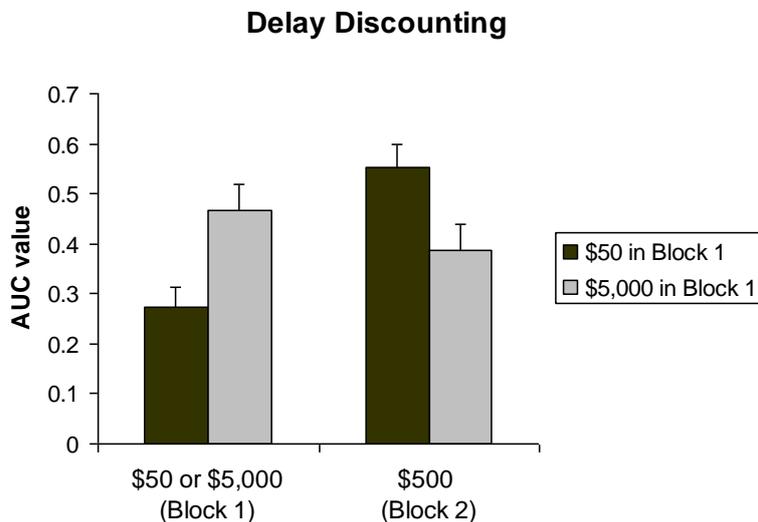
Each indifference point was expressed as a ‘present value’ (*PV*), that is, as a percentage of the standard reward in the question series. Figure 2.1 shows the average *PV* for each question series in the delay-discounting task. Results for the first block (\$50 or \$5,000) are shown in the upper panel. As expected, *PV* decreased as delay increased for both amounts, and was greater for \$5,000, suggesting that discounting rates varied inversely with amount, consistent with the magnitude effect. Results for the second block (\$500) are shown in the lower panel. Overall, *PV* for \$500 when \$50 had been the amount in the first block (\$500 after \$50) was greater than when \$5,000 had been the amount in the first block (\$500 after \$5,000). This is consistent with the predictions of reward contrast, because it suggests that the discounting rate was greater for \$500 after \$5,000, as required by the magnitude effect if \$500 was subjectively smaller when following the larger amount.



**Figure 2.1.** Average *PV* data for each question series from the delay discounting task in Experiment 1. The upper panel shows results from the first block in which the amount was either \$50 or \$5,000 for different groups of participants. The lower panel shows results from the second block in which the amount was \$500 for both groups.



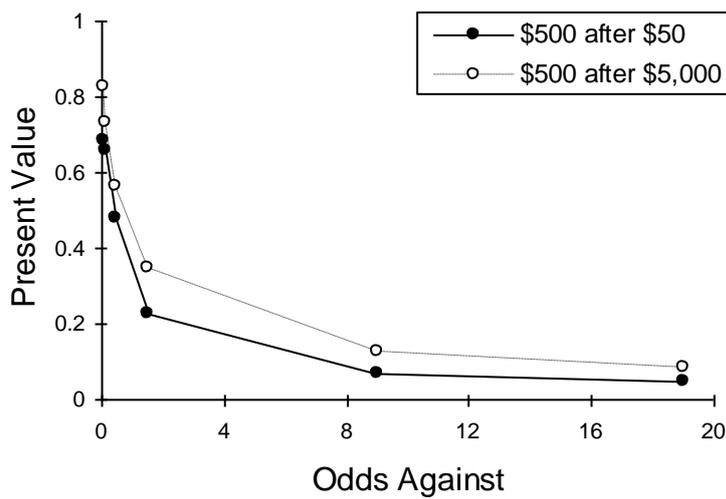
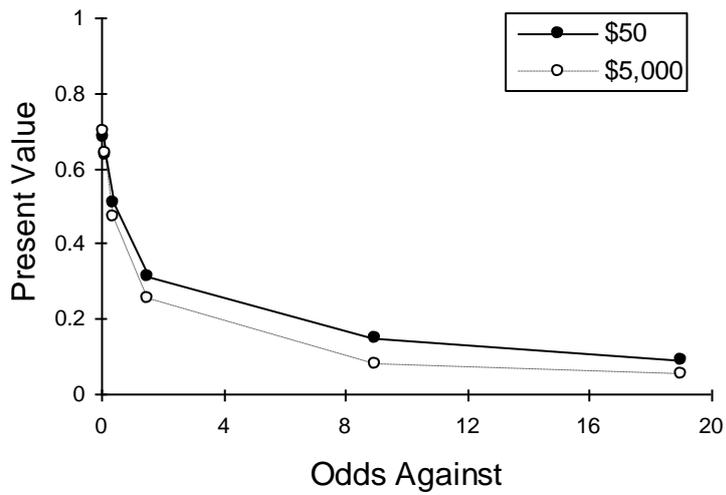
**Figure 2.2.** Illustration of how the area under the discounting curve (AUC) is calculated. Data are taken from a randomly-selected participant in Experiment 1 for the delay discounting task with \$5,000 as the standard amount. See text for more explanation.



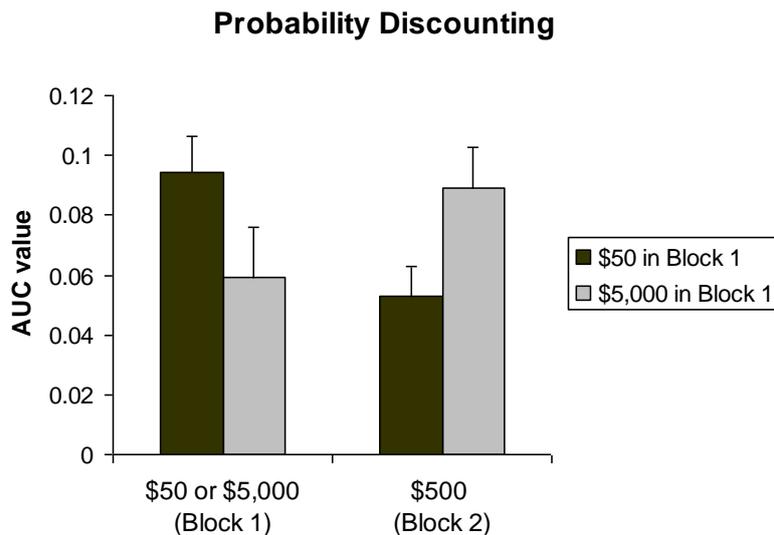
**Figure 2.3.** Average AUC values for the delay discounting task in Experiment 1. Bars indicate +/- 1 SE.

For a more precise assessment of delay discounting rates, we calculated the area under the empirical discounting curve (AUC; Myerson et al., 2001) for individual subjects. Figure 2.2 illustrates how the AUC is computed, using the average data from the \$5,000 block. *PV* is plotted as a function of the normalized delay (i.e., delay divided by the maximum delay), and then areas for each trapezoidal segment, as indicated by the blank or shaded regions in Figure 2.2, are summed. The AUC has the advantage of not requiring a specific mathematical form for the discounting function, and is an inverse measure of the discounting rate: Larger AUC values correspond to lower rates of discounting, and vice versa.

Figure 2.3 shows the average AUC values for the delay discounting data. As Figure 2.3 shows, discounting rates were greater for \$50 compared to \$5,000 (mean AUCs = .27 and .47, respectively), and greater for \$500 after \$5,000 than for \$500 after \$50 (mean AUCs = .39 and .55). A repeated-measures analysis of variance (ANOVA) with first or second block of discounting questions as a within-subjects factor and amount during the first block (\$50 or \$5,000) as a between-groups factor confirmed these observations. There was a significant block  $\times$  amount interaction,  $F(1, 30) = 44.12, p < .001$ , and planned comparisons showed that AUC was greater for \$5,000 in the first block,  $F(1, 30) = 8.94, p < .01$ , and greater for \$500 after \$50 in the second block,  $F(1, 30) = 5.80, p < .05$ . The main effect of block was significant,  $F(1, 30) = 13.76, p < .001$ , indicating that AUC values were greater in the second block overall. The main effect of amount during the first block was not significant,  $F(1, 30) = 0.06, ns$ . These results support the predictions of reward contrast: Delay discounting rates for \$500 were greater (i.e., AUC values were lower) when it followed \$5,000 than when it followed \$50, and also confirmed that the expected effect of reward magnitude was obtained in the first block, with discounting rates greater for \$50 than \$5,000.



**Figure 2.4.** Average *PV* data for each question series from the probability discounting task in Experiment 1. The upper panel shows results from the first block in which the amount was either \$50 or \$5,000 for different groups of participants. The lower panel shows results from the second block in which the amount was \$500 for both groups.



**Figure 2.5.** Average AUC values for the probability discounting task in Experiment 1. Bars indicate +/- 1 SE.

Figure 2.4 shows the average *PV* for each question series in the probability discounting task. Overall, *PV* was lower than in the delay task (cf. Figure 2.1), suggesting that participants discounted more rapidly as a function of odds against. *PV* decreased as the odds against receiving the reward increased, and was greater for \$50 than for \$5,000 (upper panel). This suggests that probability discounting rates varied directly with amount, consistent with expectations based on the magnitude effect. Conversely, *PV* for \$500 after \$50 was lower than for \$500 after \$5,000, suggesting that the subjective value of \$500 varied inversely with the amount in the first block.

A repeated-measures ANOVA of the AUC data, shown in Figure 2.5, supported these conclusions. There was a significant interaction between block and amount during the first block,  $F(1, 30) = 21.31, p < .001$ . A planned comparison between AUC values in the first block approached significance,  $F(1, 30) = 2.96, p < .10$ , suggesting that AUC was greater for \$50 than \$5,000, consistent with the expected effect of magnitude on probability discounting (i.e., lower AUC for \$5,000 implies a higher discounting rate for the larger amount). A planned comparison for the data from the second block found that AUC values were higher for \$500 when it followed \$5,000 than when it followed \$50,  $F(1, 30) = 4.50, p < .05$ . This confirms the prediction of reward contrast, because it shows that discounting rates were higher (i.e., lower AUC) for \$500

when it followed \$50, suggesting that the subjective value of \$500 was larger when it followed the smaller amount.

To obtain an estimate of the size of the contrast effect for delay and probability discounting, we calculated the average difference between the AUC values for the \$500 reward depending on whether the standard amount in the first block was \$50 or \$5,000, divided by the pooled standard deviation. The resulting values (Cohen's  $d$ ) were 0.85 and -0.75 for delay and probability discounting, respectively (note that the signs were opposite because reward magnitude has opposite effects on delay and probability discounting).

Finally we examined the correlation between delay and probability discounting rates. For each participant, the average AUC value was computed for both delay and probability discounting. The correlation was positive,  $r = .15$ , but failed to reach significance ( $p > .40$ ). Thus, there was no support for the hypotheses that individual differences in discounting can be linked to impulsivity as a personality trait, which predicted a negative correlation.

## Experiment 2

Results of Experiment 1 confirm that reward contrast effects were obtained for both delay and probability discounting. The discounting rate for the \$500 reward varied in the direction expected if its subjective value varied inversely with the standard amount in the first block, for both delay and probability discounting. To test the generality of contrast effects, Experiment 2 used a different design in which contrast effects were assessed more directly using a within-subjects design. Participants responded to two series of discounting questions in which the standard amounts were \$50 and \$5,000. For Group Delay, indifference points for delays of 1 month, 6 months, 1 year, 3 years, 5 years and 10 years were obtained for each series. For Group

Probability, indifference points for reward probabilities of 95%, 90%, 70%, 40%, 10% and 5% were obtained. After each series, an indifference point for an intermediate amount (\$475 or \$525) was determined in a set of test questions. Different intermediate amounts for the two sets of test questions were used to make it less likely that subjects would respond similarly in the two tests. If reward contrast effects are present, there should be an interaction between type of discounting (delay/probability) and standard amount (\$50/\$5,000) in the prior question series: The indifference point for the intermediate reward should be greater after \$50 than after \$5,000 for delay discounting, but should be less after \$50 than after \$5,000 for probability discounting.

## Method

*Subjects.* Sixty-four students were recruited from introductory psychology classes at the University of Canterbury. Subjects were randomly divided into Group Delay and Group Probability. For Group Delay ( $N = 32$ ) there were 17 females and 15 males, with an average age of 22.41 years. For Group Probability there were 14 females and 16 males, with an average age of 19.97 years. Two subjects assigned to Group Probability failed to complete the experiment and their data were not included ( $N = 30$ ). All received course credit in return for their participation.

*Procedure.* All details of the procedure were the same as Experiment 1 with the following exceptions. Subjects completed two series of discounting questions involving hypothetical amounts of money displayed on a computer screen, in which the standard amounts were \$50 and \$5,000. For Group Delay, indifference points were obtained for a range of delays (1 month, 6 months, 1 year, 3 years, 5 years and 10 years), whereas for Group Probability they were obtained for a range of reward probabilities (95%, 90%, 70%, 40%, 10% and 5%). After each series, a set of test questions was conducted which determined an indifference point for an intermediate

amount (\$475 or \$525) for a 1-year delay (Group Delay) or 70% probability (Group Probability). After the first discounting series and intermediate amount, subjects completed two paper-and-pencil questionnaires: The Barratt Impulsiveness Scale 11 (BIS-11; Patton et al., 1995) and South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). Whether the standard amounts for the two series were \$50 and \$5,000 (or vice versa) and whether the intermediate amounts were \$475 and \$525 (or vice versa) were counterbalanced.

## Results

Similar to Experiment 1, indifference points from the two discounting series were converted to present values (*PV*). Figure 2.6 shows the average *PV* for each question series for Group Delay (left panel) and Group Probability (right panel). For delay discounting, *PV* was greater for \$5,000 than for \$50, whereas the opposite was obtained with probability discounting. Both these results are consistent with expectations based on the magnitude effect.

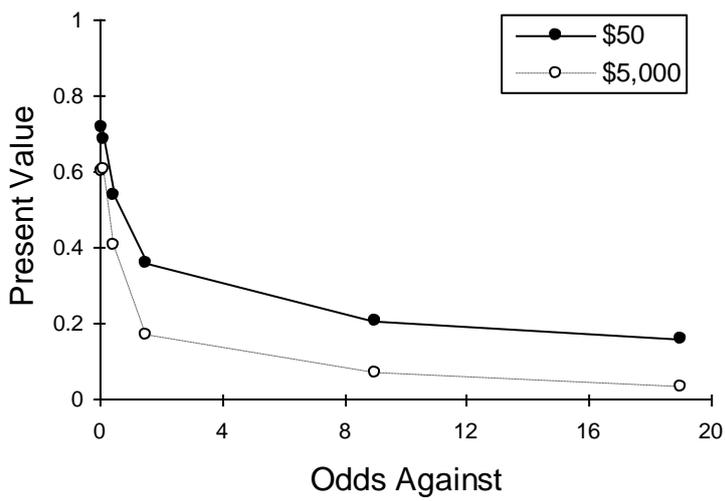
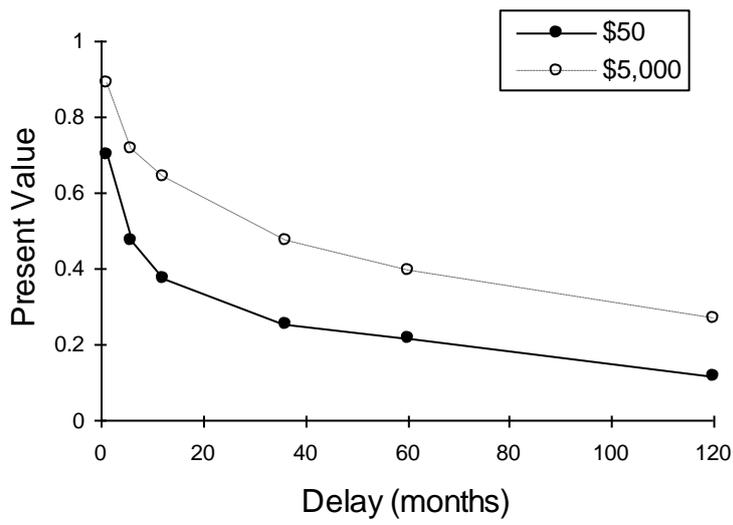
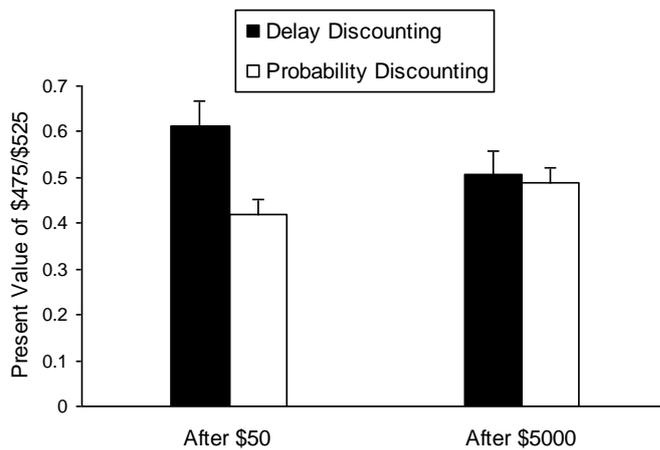


Figure 2.6. Average PV data for each question series for the delay (upper panel) and probability (lower panel) discounting tasks in Experiment 2.



**Figure 2.7.** Results from the test series in Experiment 2. Shown are the average present values for the intermediate (\$475/\$525) amount discounted by one year delay or 70% probability of receipt, following a question block with either \$50 or \$5,000 as the standard amount. Results are shown separately for Group Delay (filled bars) and Group Probability (unfilled bars). Bars indicate +/- 1 SE.

AUC values were computed for individual subjects, and average values are shown in Figure 2.7. A repeated-measures ANOVA with type of discounting as a between-subjects factor and amount (\$50 or \$5,000) as a within-subjects factor found a significant interaction,  $F(1, 60) = 55.11, p < .001$ . Planned comparisons showed that AUC was greater for \$5,000 than \$50 for delay discounting,  $F(1, 60) = 37.67, p < .001$ , whereas the opposite was true for probability discounting,  $F(1, 60) = 19.28, p < .001$ . This confirms that the expected effect of reward magnitude was obtained for both discounting tasks. The main effect of discounting type was also significant,  $F(1, 60) = 19.52, p < .001$ , indicating that AUC values were overall greater (and discounting rates lower) for delay discounting.

To assess whether reward contrast effects were obtained, the indifference points for the intermediate amounts (\$475/\$525) from the test series were converted to present values. A repeated-measures ANOVA found a significant interaction between amount and type of discounting,  $F(1, 60) = 10.46, p < .01$ . As Figure 2.4 shows, this was a crossover interaction in which the PV for the intermediate amount was greater after \$50 than after \$5,000 for delay discounting, but was greater after \$5,000 than after \$50 for probability discounting. Planned comparisons found that the difference in PV for the intermediate amount was significant for delay discounting,  $F(1, 60) = 7.97, p < .01$ , and approached significance for probability

discounting,  $F(1, 60) = 3.13, p = .08$ . This result is consistent with predictions based on reward contrast, and suggests that the subjective value of the intermediate amount varied inversely depending on the standard amount in the previous question series.

To obtain an estimate the size of the contrast effect within-subjects, we calculated the difference between the present values of the intermediate amount following \$5,000 and \$50 (i.e.,  $PV_{\$475/\$25 \text{ after } \$5,000} - PV_{\$475/\$25 \text{ after } \$50}$ ). This yielded average contrast effect (CE) estimates of 0.11 [ $SE = .03$ ] and -0.07 [ $SE = .05$ ] for Group Delay and Group Probability, respectively. This suggests that the subjective value of the intermediate (\$475/\$525) reward changed by approximately 11% or 7%, for Group Delay and Group Probability, respectively, depending on whether the subject had previously been making choices with a \$5,000 or a \$50 reward.

Finally, we examined correlations between the BIS-11 and SOGS, delay and probability discounting rates, and contrast estimates. The correlation between BIS-11 and SOGS was positive and significant,  $r = .28, p < .05$ , consistent with the view that both measures are related to impulsivity. For Group Delay, correlations between the average AUC values and BIS-11/SOGS both failed to reach significance,  $r_s = -.23$  and  $-.23$ , respectively, as did the correlations between CE and BIS-11/SOGS,  $r_s = .17$  and  $-.11$ , respectively. For Group Probability, correlations between average AUC and BIS-11/SOGS were  $r = -.18$  and  $r = .15$ , both *ns*, and between CE and BIS-11/SOGS were  $r = .11$  and  $r = -.33$ , both *ns*. Thus, there was no evidence that the BIS-11 and SOGS were correlated with measures of delay and probability discounting.

## General Discussion

The goal of the present research was to determine whether reward contrast effects can influence humans' intertemporal and risky choices. Specifically, we asked whether the discounting rates and present values of delayed or probabilistic monetary rewards changed depending on whether participants had previously been making choices about larger or smaller amounts of money. In Experiment 1, participants made choices about hypothetical \$5,000 or \$50 outcomes, and then made choices about \$500 outcomes. Delay discounting rates for the \$500 outcome were greater when participants had previously been making decisions about \$5,000, and probability discounting rates for the \$500 outcome were greater when participants had previously been making decisions about \$50. Both these results are consistent with predictions of reward contrast, and suggest that the subjective value of the \$500 reward varied inversely with the preceding amount. Experiment 2 used a design that allowed for contrast effects to be assessed more directly within-subjects. Two groups made choices about delayed or probabilistic rewards. After completing blocks of questions in which the amount was \$5,000 and \$50, participants responded to a series of test questions with an intermediate amount (\$475/\$525). For Group Delay, the present value of the intermediate reward was greater after the \$50 block than after the \$5,000 block, whereas the opposite was obtained for Group Probability. This result is similar to Experiment 1 and suggests that the subjective value of the intermediate reward varied inversely with the amount in the prior question series.

Thus our results confirm that contrast effects can play a role in humans' choice for delayed and probabilistic outcomes. The magnitude of the effects were fairly substantial: When assessed between-subjects (Experiment 1), contrast effect sizes (Cohen's  $d$ ) for delay and probability discounting rates as measured by AUC were 0.85 and -0.75, respectively. Experiment 2 permitted a direct calculation of the difference in the present value ( $PV$ ) of the \$500 reward: For

delay discounting, the *PV* changed by 11% depending on whether the amount in the prior question series was \$5,000 or \$50, and for probability discounting, by 7%. Future research should examine whether the size of the contrast effect depends on variables such as the relative amounts. For example, the subjective value of \$500 should decrease more in the context of previous choices about \$50,000 than \$5,000.

As noted in the introduction, impulsivity offers a potentially attractive framework for understanding individual differences in discounting and the effect of reward magnitude: The opposite effect of magnitude on delay and probability discounting can both be understood in terms of an individual choosing less impulsively when larger rewards are involved, in that they are more able to delay gratification (i.e., lower delay discounting rate) and more risk averse (i.e., higher probability discounting rate). However, we found no evidence that responses on the BIS-11 and SOGS, two psychometric variables that are related to impulsivity, were correlated with delay or probability discounting rates, or with estimates of the contrast effect.

Our study suggests that reward contrast effects in delay and probability discounting are a robust phenomenon, because they were obtained in two experiments with different designs. Experiment 1 used a between-subjects design in which contrast was assessed indirectly, through changes in discounting rates. Experiment 2 used a within-subjects design in which contrast was measured more directly, in terms of changes in the *PV* of a standard reward. It is important to note that contrast could be assessed in other ways. For example, after exposure to either a smaller or larger reward, participants could be asked for their willingness to purchase a good for an intermediate amount (e.g., an LCD TV for \$500) that previous research had shown that 50% of people would be willing to buy. Thus future research should explore whether the generality of contrast effects extends beyond the kind of discounting task studied here.

Reward contrast effects may play an important role in real-world decision making. For example, a casino that has the croupier for a roulette table display a large stack of chips at the

ready may increase the likelihood of risky or impulsive choice by gamblers, by making their bets seem relatively small in comparison. Legislators with budgetary responsibility who routinely make decisions involving billions of dollars may become more likely to agree to an urgent funding request in the millions. Investigating the influence of reward contrast effects in specific decision-making contexts and with more ecologically-valid tasks (e.g., realistic gambling scenarios) should be a focus of future research.

Although we only tested for contrast effects on reward amount, it is likely that other variables in the decision tasks, such as delay and probability, are also affected by contrast. This has methodological implications because it makes comparison of discounting rates across studies problematic: Discounting rates in a given study will likely depend on the range of reward magnitudes, delays, and probabilities.

Overall, the present study has demonstrated that the discounting rates in intertemporal and risky choice situations vary in the direction expected if the magnitude of a reward varies inversely with the reward context. Future research should examine whether individual differences in contrast effects might contribute to susceptibility to maladaptive choice, for example problem gambling.

## **Chapter 3 Experiment 3 – Testing Reward Contrast in DD and a Simulated Gambling**

### **Task (Card Playing Game)**

#### **3.1 Introduction**

Results of Experiments 1 and 2 showed that reward contrast effects are obtained in delay and probability discounting, in addition to replicating the well-established effects of reward magnitude. That is, the subjective value of an intermediate reward (\$475/\$525) was larger or smaller, respectively, if the amount in a previous block had been \$50 or \$5,000. Contrast effects were confirmed by changes in the present value of the immediate reward that were consistent with reward magnitude effects, in which discounting rates vary inversely with amount for delay discounting but directly with amount for probability discounting. The major goal of Experiment 3 was to develop a simulated gambling task that could be used to test for a relationship between gambling behavior and reward contrast.

For this, we adapted a procedure developed initially by Newman, Patterson and Kosson (1987). Newman et al. compared the tendency of psychopathic and non-psychopathic prisoners to persevere on a risky task – that is, to continue in a maladaptive course of action. In their procedure, cards from a deck of 100 were presented on a computer monitor, one card at a time. Cards were either face cards (Jack, King, Queen, or Ace) or number cards. Participants began with a stake of 10 chips (each worth 5c), and pressed a button on a response box to show a card. If it was a face card, they won 5c whereas if it was a number card they lost 5c. Participants played as many cards as they wanted but could stop at any time by pressing a second button. The probability of winning on each card was initially high but decreased by 10% over each successive block of 10 cards. Newman et al. showed that psychopathic prisoners played an average of 90 cards before opting out, compared to an average of 60 for nonpsychopathic offenders, and thus lost more money. They concluded that psychopathic offenders had a greater

tendency towards response perseveration, that is, they had difficulty with recognizing the change in probability and deciding to stop the game, compared to the nonpsychopathic offenders.

Breen and Zuckerman (1999) adapted a version of Newman et al.'s (1987) procedure to study 'chasing' among gamblers. 'Chasing' has been identified as a characteristic of pathological gambling and consists of more frequent involvement and/or persistence in gambling in an attempt to regain money that has been lost. In their study, college students who gambled ( $N = 248$ ) were given an initial stake of US\$10 and given the option to play a computer-based task similar to Newman et al. (1987). Breen and Zuckerman showed that a measure of impulsivity (from the Zuckerman-Kuhlman Personality Questionnaire; Zuckerman, Kuhlman, Joireman, Teta & Kraft, (1993)) discriminated 'chasers' (i.e., participants who perseverated and lost money) from 'nonchasers' (participants who quit while they were ahead), and Breen and Zuckerman's (1994) Gambling Attitude and Beliefs Survey discriminated players from non-players (i.e., participants who kept the initial stake and refrained from playing). Similar computerized card-playing tasks have been used to investigate the role of emotion in gambling situations (Bowman & Turnbull, 2004; Hills, Hill, Mamone, & Dickerson, 2001).

We developed a computerized version of Newman et al.'s (1987) task that we hoped would be suitable for repeated administration. In our version (Card Playing Game; CPG), participants began with an initial stake and clicked a button on the screen to turn over a card. If the card was from a red suit (hearts or diamonds), they won 10% of their initial stake, whereas if the card was from a black suit (clubs or spades) they lost an equivalent amount. As in Newman et al.'s procedure, participants could quit at any time and the probability of winning increased and then decreased over blocks of 10 cards.

In Experiment 3, participants played four CPG decks, with stakes of \$50 or \$5,000 (counterbalanced) for the first and third decks, and \$500 for the second and fourth decks. The first two and last two decks were played one after another, but separated by a questionnaire task.

In this way, we planned to test whether performance in the decks with \$500 stakes would be affected by whether the prior deck had a stake of \$50 or \$5,000, that is, show evidence of reward contrast. If participants showed reward contrast, we would expect performance to be better after the \$50 stake than after the \$5,000 stake.

In addition to the CPG, participants also completed the same delay-discounting task from Experiment 2, which allowed us to obtain a measure of reward contrast within-subjects.

Participants also completed two gambling-related questionnaires: the South Oaks Gambling Screen (SOGS; Lesieur & Bloom, 1987) and the Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004) and the Barratt Impulsivity Scale (BIS-11; Patton, Stanford & Barratt, 1995). We predicted that performance on the CPG would be predicted by the gambling self-report measures (with higher gambling-related scores associated with poorer performance), and that participants who had higher rates of delay discounting and impulsivity (as measured by the BIS-11) would also perform more poorly on the CPG.

## **3.2 Method**

### **3.2.1 Subjects**

Eighty-eight students were recruited either from the Introductory Psychology course at the University of Canterbury or from advertisements on campus. Four were omitted for failing to follow instructions or to complete all tasks, leaving a final sample of 84. Of these, 40 were males and 44 were females, and ages ranged from 19 to 25 years. Course credit was earned by some participants, and a \$5 grocery voucher was given to others. In addition, a prize (valued at \$70 in grocery vouchers) was provided for the participant who won the most amount of (hypothetical) money in the card playing task.

### 3.2.2 Measures

A delay discounting task and card playing game were used to investigate participants' temporal discounting and behavior in a simulated gambling situation. In addition, participants completed several paper-and-pen questionnaires, which included demographic information, impulsivity, gambling-related cognitions and extent of problem gambling.

*Information Sheet.* This was used to collect participants' demographic information, such as gender, age and incomes.

*South Oaks Gambling Screen.* Since the advent of DSM-III (APA, 1980), a number of instruments have been developed for screening and classifying gambling behaviors (Abbott & Volberg, 1999a; Petry, 2005). There is no universally-accepted gambling screen, so a variety of instruments are currently used (Shaffer et al., 1997). The most commonly used instrument for assessing disordered gambling is the 20-item, self-administered South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). Advantages of SOGS include that it is self-administered and the questions are generally easy to follow. It has adequate to good construct validity, internal consistency, and test-retest reliability (see Petry, 2005). SOGS has been used to investigate the prevalence of gambling behavior of a variety of populations, such as university students, alcohol/drug abusers, prisoners, psychiatric hospital inpatients and hospital employees (e.g., Lesieur & Blume, 1987; Lesieur & Rosenthal, 1991; Stinchfield, 2002). The SOGS is the instrument that has been used most often for classifying individuals with respect to disordered gambling. The SOGS assesses the impact of gambling along several dimensions, including emotional, family/social, occupational/educational and financial (Lesieur & Blume, 1987; Lesieur & Blume, 1993). The SOGS is simple and quick to use, and completed as a self-report questionnaire or administered by professional or non-professional interviewers (Lesieur & Blume, 1987). Scores range from 0 to 20, and individuals can be classified as probable problem gamblers (PG1) or probable pathological gamblers (PG2) by tallying a total score based on the

problematic gambling behavior endorsed in a lifetime. Although there is a clear consensus that scores of zero correspond to “no problems with gambling (NG)”, definitions vary from study to study for the diagnosis of problematic and pathological gamblers. Some investigators classify individuals who endorse one to four items as PG1 gamblers, whereas others use 3 or 4 points as cutoffs for classifying PG1 or PG2 gambling behaviors (e.g., Clarke, 2004; Lightsey & Hulse, 2002). A score of 5 or more typically is indicative of PG2. Some researchers, however, have used a much higher cutoff value of over 10 (Dickerson et al., 1996; Petry, 2002a) to address the concern of its false positive prevalence estimates in community samples relative to DSM criteria<sup>10</sup> (Abbott & Volberg, 1992; Shaffer et al., 1997; Stinchfield, 2002). Some have also suggested using the higher cut scores for different samples (e.g., Chinese) (Blaszczynski et al., 1998; Tang, Wu, Tang, & Yan, 2010). Whilst a number of criticisms have been made about the SOGS, it remains the best available instrument to screen for problem gambling (Abbott & Volberg, 2006; Gambino & Lesieur, 2006). Although individuals who present with problems with gambling have been conceptualized differently across research, it is clear that the increase in scores on the SOGS universally represent more severe gambling problems. The original SOGS demonstrated strong correlation with the DSM-III and DSM-IV (APA, 1980; 1994) definition of pathological gambling (Ferris & Wynne, 2001; Lesieur & Blume, 1987). An important goal in developing the SOGS was to address the restrictive nature of the DSM which would miss less severe cases by using a quantitative dimensional approach with cutoff scores to indicate possible or probable pathological gambling (Lesieur & Blume, 1987).

*Gambling Related Cognitions Scale.* The Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004) is a five-factor, 23-item self-report questionnaire which assesses gambling related thoughts/cognitions. Each statement is rated for agreement on a seven-point Likert scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The items are divided into five

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<sup>10</sup> For example, Abbott and Volberg (1992) reported that individuals in New Zealand were more likely to respond positively to particular items than individuals in America.

subscales, which correspond to five cognitive biases found in problem gamblers. These include: *Inability to Stop Gambling (IS)*, e.g., “It is difficult to stop gambling as I am so out of control”; *Predictive Control (PC)*, e.g., “When I have a win once, I will definitely win again”; *Gambling Expectancies (GE)*, e.g., “Gambling makes me happier”; *Interpretive Bias (IB)*, e.g., “Relating my losses to bad luck and bad circumstances makes me continue gambling”; and *Illusion of Control (IC)*, e.g., “Praying helps me win”. For each subscale, item scores are averaged to produce a mean rating. Higher scores are related to more agreement with the cognitive biases associated with gambling. The GRCS is reported to have excellent internal consistency, e.g., Cronbach’s  $\alpha = 0.93$  for the overall scale (Raylu & Oei, 2004a).

*The Barratt Impulsiveness Scale.* The Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995) is a self-report questionnaire designed to measure the personality and behavioral construct of impulsiveness. It contains a total of 30 items, each of which is answered on a 4-point Likert scale (rarely/never = 1, occasionally = 2, often = 3, almost always/always = 4), and a level of impulsiveness is calculated by summing up the scores for each item. There are two ways to interpret the BIS-11 with different scoring systems: First-order subscales: Attention, Motor, Self-control, Cognitive complexity, Perseverance, and Cognitive instability; or second-order subscales: Attentional, Motor, and Non-planning. The total score can range from 30 to 120. These scales have been shown to have good reliability and validity and are correlated with other measures of impulsiveness (see Stanford et al., 2009). As suggested by researchers, scores of 72 or above to be used to classify an individual as highly impulsive. Total scores between 52 and 71 are thought of as within normal limits for impulsiveness. Scores lower than 52 usually are representative of an individual that is either extremely over-controlled or who has not honestly completed the questionnaire (Helfritz et al., 2006; Knyazev & Slobodskaya, 2006; Stanford et al., 2009; or see Stanford et al., 2009).

*Delay Discounting Task.* The delay discounting (DD) task used in this experiment was a computer-based task identical to that used in Experiment 2. That is, it also used the delays of 1 month, 6 months, 1 year, 3 years, 5 years and 10 years, with both \$50 and \$5,000 as standard amounts, and the contrast amounts of \$475/\$525 for each participant. Participants completed two blocks of trials in which indifference points were obtained for each standard amount and delay. After each block (in which the standard amount was either \$50 or \$5,000), an indifference point was determined for \$475/\$525 at a delay of one year.

*The Card Playing Game.* The Card Playing Game (CPG) was used to assess decision-making in a simulated gambling situation. The CPG used here was adapted from similar card playing tasks described in the experiments of Newman and colleagues (Newman et al., 1987; Newman, Patterson, & Kosson, 1992), Breen and Zuckerman (1999), Hills et al. (2001), and Bowman and Turnbull (2004). Participants played the CPG four times with different decks, each with a different stake (initial amount). Two decks started with the hypothetical standard stakes of \$50 or \$5,000 (counterbalanced), and both were followed by a deck with a stake of \$500. The purpose of the different stakes across the four card game trials was to produce a contrast effect: With \$500 after \$50, the amount in the gambling game should seem relatively large, but with \$500 after \$5,000, the amount should seem relatively small. The CPG was implemented in a computer program written in Visual Basic.

The gambling task consists of 7 or 8 blocks of cards but not from one set. In each deck, every win (implied by red cards, i.e., Hearts and Diamonds) or loss (implied by black cards, i.e., Spades and Clubs) is the 1/10 of the original stakes. That is, for example, every win or loss in the deck with initial stake of \$5,000 is \$500, in the deck with initial stake of \$500 is \$50, and in the deck with initial stake of \$50 is \$5. There was a total of eight (for decks with the stakes of \$50 and \$5,000) or seven rounds (for decks with the stakes of \$500), each consisting of ten trials. In order to prevent differential effects of early or late losses on quitting the task, the blocks of cards

do not appear in the sequence of ratios (see Table 3.1, Table 3.2 and Table 3.3). The ratios of wins:losses in each block of 10 cards are shown in Tables 3.1 and 3.2. Individual cards were presented pseudorandomly to each participant subject to the wins:losses ratio for the particular block. Participants were asked to read the instruction sheet for DD and CPG before the experiment started. The instructions for DD were similar to Experiment 2. The instructions for the CPG were as follows:

The next part of experiment includes four computer-based card playing games, and some paper-and-pen questionnaires between and after the games.

Each of the four card playing games will begin with some hypothetical amount of money as your stake in the game (they vary in different games). The cards in each game are from a standard deck, but the two Joker cards are not included. The rules for win/loss are quite simple. After you make a mouse-click on the back of the top card, a red or black card will turn over. Red cards (i.e., Hearts and Diamonds) represent monetary gains and black cards (i.e., Spades and Clubs) represent monetary losses. Every win or loss is hypothetical \$5, \$50 or \$500 in each game depends on different games. Cards are randomly shuffled by the computer for every round (1 round = 10 cards).

After every click in the game, you will see the results of how much hypothetical money you won or lost and the balance on the “card table”. There is a “Quit” button always appearing on the left down corner of the “card table”. Whenever you want to stop playing the game, just click the “Quit”, then game is over. Or you can keep playing the game and the computer will indicate when the game is over. If the words “Game is over” appear, you need to click the button “Quit” to terminate the game and go on to the next game.

Your goal is to win as much hypothetical money as possible at the end of the four games (the stakes which are endowed to you at the beginning of every game are added to your final scores). There is a prize, \$70 petrol/grocery voucher for the participant(s) who win the overall largest amount of money after the four card playing games.

You need to make a mouse-click on the first card to begin the game when you are ready, then every time click the top card to see the next one. Good luck and have fun!

The dependent variable in the gambling task is the hypothetical money won (or lost) before the participant stopped. The currency was New Zealand dollars, which at the time the experiment was conducted (March-April 2010) had an exchange rate of approximately NZ\$1 = US\$0.70.

Block	1	2	3	4	5	6	7	8	Total loss
Ratio of wins to losses (every win or loss is \$5)	6:4	7:3	4:6	2:8	5:5	3:7	1:9	0:10	
Winning probabilities	60%	70%	40%	20%	50%	30%	10%	0%	
Outcome (plus \$50)	\$60	\$80	\$70	\$40	\$40	\$20	-\$20	-\$70	-\$120

**Table 3.1. The illustration of the Card Playing Game for smaller stake (\$50)**

Block	1	2	3	4	5	6	7	Total loss
Ratio of wins to losses (every win or loss is \$50)	6:4	7:3	4:6	2:8	5:5	3:7	1:9	
Winning probabilities	60%	70%	40%	20%	50%	30%	10%	
Outcome (plus \$500)	\$600	\$800	\$700	\$400	\$400	\$200	-\$200	-\$700

**Table 3.2. The illustration of the Card Playing Game for contrast stake (\$500)**

Block	1	2	3	4	5	6	7	8	Total loss
Ratio of wins to losses (every win or loss is \$500)	6:4	7:3	4:6	2:8	5:5	3:7	1:9	0:10	
Winning probabilities	60%	70%	40%	20%	50%	30%	10%	0%	
Outcome (plus \$5,000)	\$6,000	\$8,000	\$7,000	\$4,000	\$4,000	\$2,000	-\$2,000	-\$7,000	-\$12,000

**Table 3.3. The illustration of the Card Playing Game for larger stake (\$5,000)**

Whether the DD or CPG task was completed first, whether the order of the standard amounts was \$50 - \$5,000 or vice versa, and whether \$475 or \$525 was used first for the DD contrast amount, were all counterbalanced producing eight different task orders. The questionnaires were completed between DD or CPG blocks (see Table 3.4).

Subjects	DD	Q-I	DD	Q-II	CPG	Q-III	CPG	Q-IV
1	DD <sub>1</sub>	DS	DD <sub>2</sub>	GRCS	CPG <sub>1</sub>	BIS-11	CPG <sub>2</sub>	SOGS
2	DD <sub>2</sub>		DD <sub>1</sub>		CPG <sub>2</sub>		CPG <sub>1</sub>	
3	DD <sub>3</sub>		DD <sub>4</sub>		CPG <sub>1</sub>		CPG <sub>2</sub>	
4	DD <sub>4</sub>		DD <sub>3</sub>		CPG <sub>2</sub>		CPG <sub>1</sub>	
5	CPG <sub>1</sub>		CPG <sub>2</sub>		DD <sub>1</sub>		DD <sub>2</sub>	
6	CPG <sub>2</sub>		CPG <sub>1</sub>		DD <sub>2</sub>		DD <sub>1</sub>	
7	CPG <sub>1</sub>		CPG <sub>2</sub>		DD <sub>3</sub>		DD <sub>4</sub>	
8	CPG <sub>2</sub>		CPG <sub>1</sub>		DD <sub>4</sub>		DD <sub>3</sub>	

**Table 3.4. The counterbalancing scheme used for the experimental tasks**

Note: CPG = Card Playing Game; Q = Questionnaire; DS = Demographic Sheet; BIS-11 = Barratt Impulsiveness Scale 11th Version; GRCS = Gambling Related Cognition Scale; SOGS = South Oaks Gambling Screen; DD = Delay Discounting Task; PD = Probability Discounting Task; CPG<sub>1</sub> = \$50 → \$500; CPG<sub>2</sub> = \$5,000 → \$500; DD<sub>1</sub> = \$50 → \$475; DD<sub>2</sub> = \$5,000 → \$525; DD<sub>3</sub> = \$5,000 → \$475; DD<sub>4</sub> = \$50 → \$525.

The questionnaires were arranged between pairs of DD and CPG blocks to minimize unintended interactions between tasks (see Liberman, Forster, & Higgins, 2007; Martin, 1986; Martin et al., 1990).

*Debriefing Sheet.* In addition to a brief description of the rationale and aims of this experiment, the debriefing sheet provided to participants after the experiment contained information of problem gambling services available in Christchurch (such as the Problem Gambling Foundation, the Gambling Helpline and the Salvation Army – Oasis Centre), in case participation in the experiment raised concern about these issues.

### 3.2.3 Procedure

Participants first completed the computer-based delay discounting (DD) task. The procedure was the same as Experiment 2 with both \$50 and \$5,000 as standard amounts, and \$475/\$525 as the contrast amount (counterbalanced).

After the DD tasks and two questionnaires in the middle and after the tasks, he or she began to do the CPG. In the instruction sheet, participants were informed that the task does not involve a standard deck of playing cards so they were unable to predict how many of each card would appear. The goal of the playing was to win as much hypothetical money in the game, and the participant who won the largest amount of money in the CPG received a prize (valued at \$70 in grocery vouchers).

Participants played with four different card decks. The stakes (i.e., the amount that participants began each deck with) were \$50, \$500, \$5,000, and \$500; or \$5,000, \$500, \$50, and \$500 (counterbalanced). To play the game, participants used the mouse to position the cursor over the deck of cards, and clicked to turn over a card. After each card was turned over, “You won \$xx!” or “You lost \$xx!” was displayed above the card, depending on its color, where \$xx was 10% of the initial stake. As they progressed through the trials, the current sum of money (reflecting cumulative wins and losses) was displayed below the deck of cards. There was a “Quit” button that always appeared in the lower left corner of the screen. When the participant wished to quit, he or she would click the button and go on to the next game with a different stake. If all blocks were completed (i.e., all 70 or 80 cards are turned and the participant did not click ‘quit’), the computer indicated “Game is over! You lost \$xx!”. After each block of 10 cards was completed, computer prompted, “Do you want to continue?”, and the participant had to respond affirmatively to continue.

In every round, cards were shuffled randomly by the computer according to their predefined win/loss ratios. The whole game took approximately 5-10 minutes to complete.

### 3.3 Results

Card Playing Game	Mean	Minimum	Maximum	SD
\$50	14.40	-70.00	85.00	63.57
\$500 after \$5,000	502.38	-200.00	800.00	308.02
\$5,000	3,892.86	-7,000.00	9,000.00	5,381.29
\$500 after \$5,000	478.57	-200.00	800.00	341.62
Total Money	4,888.21	-7,470.00	9,680.00	5,663.23
Normalized \$50	0.29	-1.40	1.70	1.27
Normalized \$500 after \$50	1.00	-0.40	1.60	0.62
Normalized \$5,000	0.78	-1.40	1.80	1.08
Normalized \$500 after \$5,000	0.96	-0.40	1.60	0.68
Total Normalized Amount	3.03	-3.60	6.40	2.52
Total Cards Played	118.63	0.00	300.00	82.63

**Table 3.5. Descriptive statistics for the Card Playing Game**

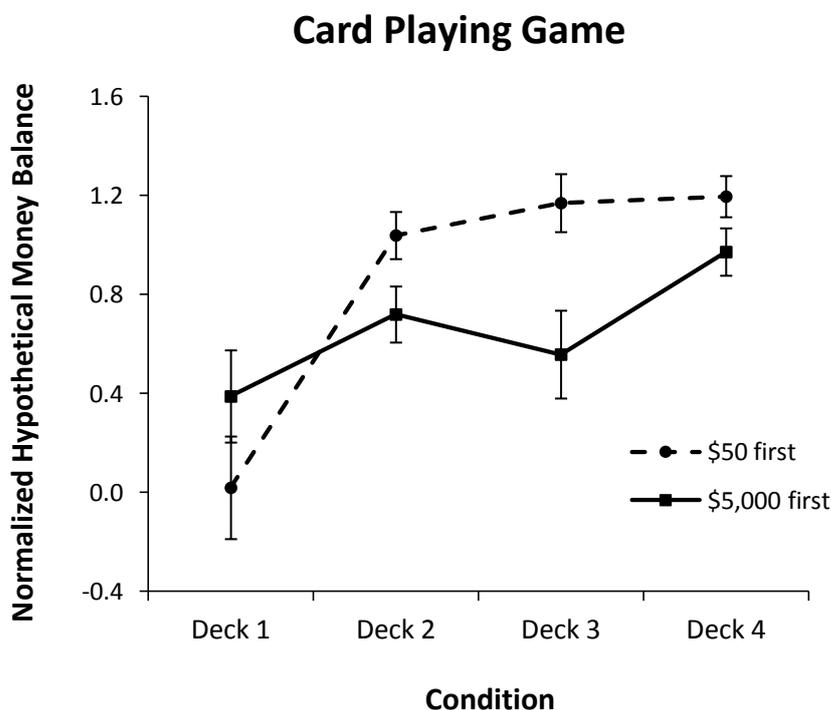
Scales	Mean	Minimum	Maximum	SD
<b>SOGS</b>	1.04	0	9	1.67
<b>GRCS overall score</b>	46.12	23	141	18.81
Gambling expectancies	7.86	4	22	3.94
Illusion of control	6.93	4	28	3.92
Predictive control	13.69	6	36	6.31
Inability to stop gambling	6.95	5	35	4.38
Interpretive bias	10.69	4	22	5.19
<b>BIS-11 overall score</b>	67.88	46	98	9.70
(1) Attention	11.71	6	20	2.88
(1) Motor	16.17	10	23	2.96
(1) Self-Control	13.49	6	21	3.16
(1) Cognitive Complexity	11.63	6	18	2.76
(1) Perseverance	7.87	4	13	1.81
(1) Cognitive Instability	7.01	3	12	1.54
(2) Attentional Impulsiveness	18.73	10	32	3.78
(2) Motor Impulsiveness	24.04	16	33	3.51
(2) Nonplanning Impulsiveness	25.12	13	39	5.10

**Table 3.6. Descriptive statistics for the SOGS, GRCS and BIS-11 and their subscales, respectively**

Note: (1) and (2) represent the first- and second-order subscales of the BIS-11

Table 3.5 shows descriptive statistics for participants in the CPG. Overall, participants tended to lose money even though they would have won had they stopped after the second block. The average total money at the end of the four decks was \$4,888.21, which was less than the cumulative initial stake of \$6,050. Overall performance varied widely across participants, ranging from a maximum of \$9,680 to a minimum of -\$7,470.

Table 3.6 shows descriptive statistics for the gambling-related questionnaires (SOGS and GRCS) and the BIS-11. SOGS scores were overall low, with only 21.4% (18/84) having scores > 1, indicating an interest in gambling. We used the same procedure as Raylu and Oei (2004) to compare GRCS scores for two groups based on SOGS scores (SOGS = 0 and SOGS  $\geq$  4). The average total GRCS scores for the two SOGS groups were 41.95 ( $n = 41$ ) and 58.00 ( $n = 5$ ), which were not significantly different ( $p > .05$ ).



**Figure 3.1.** Normalized monetary balance (Final Balance / Initial Stake) for the four decks of the Card Playing Game. Results are shown separately for participants with \$50 or \$5000 initial stakes for Deck 1. Bars indicate +/- 1 SE.

To examine CPG performance in more detail, Figure 3.1 shows the normalized amount of money won (or lost) after each of the four CPG decks (i.e., the amount won or lost divided by the initial stake). Results are shown separately for participants whose stakes were \$50 - \$500 - \$5,000 - \$500 and \$5,000 - \$500 - \$50 - \$500 across decks. Participants generally improved across the four decks, and results appeared to depend on condition order. A repeated-measures ANOVA with order as a between-subjects factor (\$50-\$5,000 or \$5,000-\$50) and condition as a within-subjects factor found a significant effect of condition,  $F(3, 246) = 12.29, p < .001$ , and a significant condition  $\times$  order interaction,  $F(3, 246) = 5.91, p < .001$ , but the effect of condition was not significant,  $F(1, 82) = 2.07, p > .15$ . Participants that had a \$50 stake for the first deck improved markedly for the second deck (with \$500 stake), whereas those with a \$5,000 stake in the first deck improved less for the second deck. Results for the third and fourth decks also showed an effect of order, with participants with stakes of \$5,000 and \$500 performing better than those with stakes of \$50 and \$500.

Averaged across groups, the normalized amount of money was 0.20, 0.88, 0.86 and 1.08 of the initial stake across the four decks. Thus for the first deck participants lost on average 80% of the initial stake, whereas by the fourth deck they increased their stake on average by 8%.

The improvement over successive decks, combined with the order effect, complicates our plan to measure contrast effects within-subjects in the CPG. However, a between-subjects test of contrast is possible by comparing results for the second deck, which had the same \$500 stake but differed depending on the stake for the first deck. Participants that had a \$50 stake in the first deck had better results in the second deck ( $M = \$519.05$ ), compared to participants who had a \$5,000 stake in the first deck,  $M = \$359.52$ ,  $t(82) = 2.16, p < .05$ . This is consistent with predictions of a contrast effect on the stake for the second deck: Given the assumption that participants would show more loss aversion with larger amounts, the subjective value of the

\$500 stake in the second deck was greater for participants who had \$50 stakes in the first deck than for participants who had \$5,000 stakes in the first deck.

Figure 3.2 shows the results from the delay-discounting (DD) task. The present value of the \$50 reward decreased more rapidly than the present value of the \$5,000 reward, consistent with the magnitude effect. Discounting rate, measured as the area under the receiver-operating characteristic curve (AUC), was significantly greater for the \$5,000 reward ( $M = .52$ ) than \$50 reward ( $M = .33$ ),  $t(83) = 7.59, p < .001$ , indicating that the present value of the \$50 reward decreased more rapidly with delay.

Figure 3.2 also shows the present value of the intermediate amount (\$475 or \$525) at a one-year delay for test trials following the \$50 or \$5,000 reward blocks. The present value of the delayed intermediate amount was greater when the test trial followed \$50 than when it followed \$5,000 ( $M_s = .69$  and  $.59$ , respectively),  $t(83) = 3.37, p < .01$ . This result confirms a contrast effect in the DD task, and suggests that the subjective value of the intermediate amount was greater following \$50 than following \$5,000.

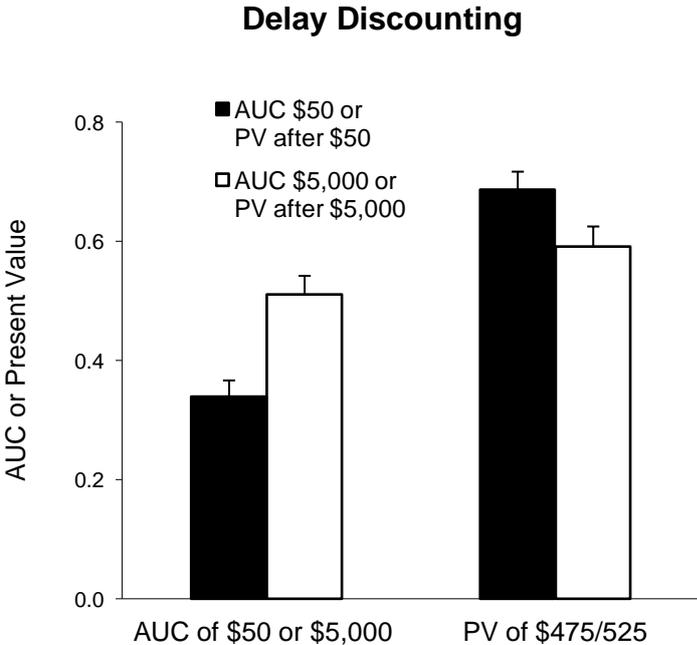


Figure 3.2. Bar graph for contrast effect illustration. Bars indicate +/- 1 SE.

	Total Cards	Avg Norm\$	Total Money	AUC \$50	AUC \$5,000	AUC\$5,000 - AUC\$50	PV\$475/525 (1)-(2)	GRCS	BIS-11
<b>AvgNorm\$</b>	-.88***								
<b>Total Money</b>	-.67***	.75***							
<b>AUC\$50</b>	-.24*	.23*	.12						
<b>AUC\$5,000</b>	-.20†	.19†	.18	.61***					
<b>AUC\$5,000 - AUC\$50</b>	-.20	-.00	.06	-.25*	.58***				
<b>PV\$475/525 (1)-(2)</b>	.25*	-.30**	-.34**	-.09	-.38***	-.41***			
<b>GRCS</b>	-.06	.00	.02	-.05	-.16	-.17	.15		
<b>BIS-11</b>	.13	-.12	-.04	-.02	-.07	-.04	.07	.07	
<b>SOGS</b>	.05	-.15	-.07	.00	-.15	-.14	-.07	.27*	.14

**Table 3.7. Correlation table**

Note: Total Cards = Total number of cards played, AvgNorm\$ = Average normalized amount of money per deck, Total Money = Money won or lost in the CPG

†  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

A major question of the present study was whether performance in the CPG would be related to DD measures and gambling-related psychometric variables. Table 3.7 shows correlations between three summary measures for the CPG: Total number of cards played (Total Cards), Average normalized amount of money per deck (AvgNorm\$), Total Money (won/lost), and DD and psychometric variables. The three measures of CPG performance were strongly correlated: Participants who played more cards tended to perform poorly on each deck and ended the game with greater losses. AUC\$50 was significantly correlated with total cards and averaged normalized money per deck,  $r_s = -.24$  and  $.23$ , both  $p_s < .05$ . This suggests that participants who were less impulsive in terms of having lower rates of delay discounting performed better on the CPG. Corresponding correlations with AUC\$5,000 were similar but failed to reach significance ( $p < .10$ ) The magnitude of DD contrast, measured as the difference between the present value of the intermediate amount after \$50 and after \$5,000, was significantly correlated with all CPG measures,  $r_s = .25$ ,  $-.30$ , and  $-.34$  for Total Cards, AvgNorm\$ and Total Money, respectively,  $p_s < .05$ ,  $.01$ , and  $.01$ . This shows that participants who had a greater degree of contrast in the DD task – that is, for whom the subjective value of the intermediate amount changed more

depending on the amount in the prior block, were more likely to persist (and thus lose more money) in the CPG.

The SOGS was significantly correlated with the GRCS,  $r = .27, p < .05$ , but none of the correlations of psychometric variables with CPG performance were significant. The correlations between the BIS-11 and GRCS, and between the BIS-11 and SOGS, also failed to reach significance,  $r_s = .06$  and  $.14$ , respectively,  $ps > .20$ .

### **3.4 Discussion**

The primary goal of the present experiment was to evaluate performance in a simulated gambling task, a computerized version of the Card Playing Game (CPG) developed initially by Newman, Patterson, and Kosson (1987), using a convenience sample (young adults recruited from the University community). Participants played the CPG with four decks, in which the initial stakes were \$50, \$500, or \$5,000. The stake was \$500 for two decks following both \$50 and \$5,000. In addition, participants completed the same delay discounting task as Experiment 2, and self-reported gambling measures (SOGS; Lesieur & Bloom, 1987; GRCS; Raylu & Oei, 2004) and the Barratt Impulsivity Scale (BIS-11; Patton et al., 1995).

The original plan was to obtain a within-subjects measure of reward contrast in the CPG by comparing results for the two decks with \$500 stakes. However, there was a unanticipated order effect: Performance improved across the four decks, especially for participants that had a \$50 stake for the first deck and \$5,000 for the third rather than vice versa. This suggests that with repeated exposure to the CPG, participants learned the association between playing more cards and losing money, and were able to limit their losses. Because of the improvement across decks, we were unable to obtain a valid measure of contrast within-subjects. However, results from the second deck provided a between-subjects test of contrast, and showed that participants who had a \$50 stake in the first deck had significantly more money at the end of the second deck ( $M =$

\$519.05) than participants who had a \$5,000 stake in the first block ( $M = \$359.52$ ). If we assume that participants should be more likely to stop playing if they are losing (or potentially losing) larger amounts of money, this result is consistent with predictions of reward contrast. Thus CPG results support our prediction that responding in a simulated gambling task would be influenced by reward contrast.

Did the CPG have ecological validity as a simulated gambling task? We failed to observe significant correlations between the gambling-related measures (GRCS and SOGS) and CPG performance. BIS-11 scores were also unrelated to CPG performance. However, it is possible that the overall prevalence of problem gambling was too low in the present sample for significant correlations to emerge. Only 6% (5/84) of the sample had a SOGS score greater than 4. This is comparable to the percentage of SOGS > 4 scores in the large community sample obtained by Raylu and Oei (7%; 71/968) to develop the GRCS. However, the low base rate of problem gambling in the present sample would make it more difficult to obtain significant correlations with CPG performance. Thus the lack of significant correlations with SOGS and GRCS scores should not be taken as evidence against the validity of the CPG task. We plan to reassess the validity of the CPG as a simulated gambling task in Experiment 4, using a sample with a higher base rate of gambling behavior.

Results from the delay-discounting (DD) task showed evidence of reward contrast. The present value of an intermediate amount (\$475/\$525) varied inversely with the amount from the prior block, thus successfully replicating the results from Experiment 2 with a different (and larger) sample. More importantly, reward contrast in the DD task was significantly correlated with CPG performance, showing that participants for whom the present value of the intermediate amount changed relatively more depending on the prior amount performed more poorly in the CPG. Delay-discounting rates were also negatively correlated with CPG performance, especially for small (\$50) amounts. The correlation with reward contrast is consistent with one of the

guiding hypotheses for our research: That susceptibility to reward contrast could contribute to problem gambling. However, reward contrast in the DD task was not significantly correlated with self-reported measures of gambling-related cognitions and behavior (GRCS and SOGS).

An unexpected result was that the magnitude effect in delay discounting (defined as the difference between AUC\$5,000 and AUC\$50) was negatively correlated ( $r = -.41$ ) with reward contrast (PV \$475/\$525 after \$50 – PV \$475/\$525 after \$5,000). As the magnitude effect is negatively associated with impulsivity (i.e., increased magnitude effect indicates lower rates of delay discounting for large amounts), it is interesting that participants who showed relatively larger magnitude effects were less likely for the PV of the intermediate reward to depend on the prior amount. These correlations were not reported in Experiment 2 so we computed them. For participants that had the delay discounting task, the correlation between the magnitude and contrast effects was negative but failed to reach significance,  $r = -.21$ ,  $p = .26$ . However, for participants with the probability discounting task, the correlation between the magnitude and contrast effects was significantly positive,  $r = .49$ ,  $p < .01$ . Because the magnitude effect is opposite for probability discounting, this correlation also suggests that increased impulsivity is associated with a larger reward contrast effect.

Overall, results of Experiment 3 provide some encouragement for the use of the CPG as a task that realistically models some aspects of gambling-related behavior. CPG performance was related to delay discounting measures in the manner which suggested that greater impulsivity (i.e., higher rates of delay discounting, higher reward contrast) was associated with greater persistence (and losing more money) on the CPG. In Experiment 4, we use the CPG and measures of delay and probability discounting to compare performance of both Chinese and Caucasian (New Zealand European) participants, while including a higher percentage of individuals who are likely to have gambling-related problems.

## **Chapter 4 Experiment 4 – A Cross-Cultural Comparison of Delay and Probability Discounting and a Performance on a Simulated Gambling Task by Gamblers and Non-Gamblers**

### **4.1 Introduction**

Results of Experiments 1-3 have confirmed that reward contrast effects are obtained in delay and probability discounting, and shown that the Card Playing Game (CPG) has potential as a task which captures some of the realistic elements of a gambling situation. In Experiment 4 we used the delay and probability discounting procedures – shown in previous experiments to provide sensitive measures of discounting as well as reward contrast – and the CPG to compare performance across two factors: Cultural group (Chinese vs. Caucasian), and gambling status (gambler/non-gambler). Based on previous research, we predicted that Chinese participants would have lower rates of probability discounting (i.e., be less risk averse) than Caucasians (New Zealand European), and that similar results would be obtained for gamblers. We were interested to test whether Caucasians and Chinese would differ in terms of reward contrast, and whether reward contrast and measures of delay and probability discounting would predict performance on the CPG.

### **4.2 Method**

#### **4.2.1 Participant Recruitment**

Participants were recruited from the University of Canterbury (UC) and the surrounding urban community through advertisements in newspapers, e-mails, flyers posted on campus and the community, and by contacting local community organizations. In order to attract a reasonable amount of participants to get involved in the experiment, some different recruiting techniques

were taken. Controls were targeted first. In addition to using the participant pool of the Psychology Department, flyers written in English (advertised to native English speakers only) and Chinese (advertised to native Chinese speakers only) were posted in libraries, cafeterias on campus of UC. Flyers contained some basic information of the experiment. For example, a simulated card game will be played and a \$5 valued grocery voucher was offered for their participation (or alternative course credit for those who needed participant pool course points). In addition, a prize of \$70 grocery voucher for winner(s) in the CPG was offered as an incentive also the simulation as a comparatively real-life gambling environment. After obtaining enough control participants, recruiting of gamblers began.

New advertisements (in English and Chinese) emphasized the gambling experience, for example, “if you like gambling”. Ads were posted on websites which provide free advertising service (such as <http://christchurch.gumtree.co.nz>, [www.te.co.nz](http://www.te.co.nz), <http://christchurch.locanto.co.nz>, etc.), supermarkets close to campus (also there is a TAB<sup>11</sup> outlet close to them), the most influential local mainstream newspaper – The Press, the most influential local Chinese newspaper – Messengers, and the most popular local Chinese website in NZ – [www.skykiwi.com](http://www.skykiwi.com), some Chinese restaurants/takeaways, shops. There were also some participants recruited by word of mouth from friends or personal networks. In order to attract participants from communities, in the new advertisement, incentives were increased. A \$15 valued grocery voucher for participation and a prize of \$100 (also in vouchers) were promised for the one(s) who win the largest amount of the hypothetical money in the Card Playing Game compared to other participants (after all data were collected, a prize of \$70 and \$100 in vouchers were collected by or posted to the two winners of the control and gambler groups, respectively). In total, 163 participants were recruited. In the native English speakers group, four were from Asia (non-Chinese), Pacific islands or indigenous (i.e., Maori). Because this research focus was on Chinese and New Zealand Europeans, only the data from the two ethnic groups were

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<sup>11</sup> TAB = Totalisator Agency Board, off-course betting system in NZ.

subjected to analysis (75 Caucasians and 77 Chinese). Among them, one participant who failed to complete the discounting tasks, three participants who self-reported as drug users were excluded<sup>12</sup>. A few participants who self-reported as mix-ethnic (European-Maori or European-Asia) were included in the Caucasian group<sup>13</sup>. In addition, 30 Caucasian participants from a collaborative study (see Harrow, 2010) were also included. These participants completed only a single deck of the CPG so their results from this task were not included.

## 4.2.2 Measures

### 4.2.2.1 The SOGS and its Chinese Version

Apart from its original English version (see Experiment 3), the SOGS has been translated into more than 20 languages, such as French, Spanish, German, Dutch, Italian, Swedish and Chinese (see Lesieur & Blume, 1993).

The SOGS has been used with Chinese migrants in developed countries of Canada, Australia, and the United States as well as with Chinese residing in Chinese societies with either English (Arthur et al., 2008) or Chinese version SOGS (e.g., Blaszczynski et al., 1998; Tang & Wu, 2009).

Arthur et al. (2008) employed an English version of the SOGS to 148 undergraduate students in Singapore and majority of them were Chinese (82%). The SOGS was found to be internally consistent with an alpha value of 0.83. Three factors were identified that accounted for

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<sup>12</sup> A large number of studies have shown that individuals diagnosed with substance use disorders discount delayed outcomes significantly more steeply than matched controls (Bickel & Marsch, 2001; Bickel et al., 2007; Madden, Petry, Badger, & Bickel, 1997b; Petry, 2001b, 2003). In order to rule out possible confounds due to co-morbidity, the self-report drug users were excluded for further analysis.

<sup>13</sup> Studies (Briley & Wyer, 2002; Chen et al., 2009., 2005; Hong, Morris, Chiu, & Benet-Martinez, 2000; Wong & Hong, 2005) found that bicultural people with Western influences display more Western cognitions when primed with Western cultural cues, and language cues can also prime a particular culture (Tavassoli & Lee, 2003). As the mixed ethnics in this study were all born and brought up in NZ, and the experiment was conducted in English (priming) for them, their cultural identities were deemed as Caucasians and their data were included in the Caucasian group.

46% of the total variance. The SOGS also had high correlations with other gambling measures such as the Gamblers Anonymous 20 ( $r = 0.74$ ), the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001) ( $r = 0.79$ ), and the DSM-IV criteria for pathological gambling ( $r = 0.60$ ). In another study, Tang and Wu (2009) investigated the reliability and validity of the Chinese SOGS when used with 979 Chinese college students in Hong Kong and Macao. Results of likelihood ratios and receiver operating characteristic curve supported the Chinese SOGS as a valid screening instrument for probable pathological gambling. Using the DSM-IV criteria for pathological gambling, the conventional cutoff score of 5 on the Chinese SOGS showed satisfactory sensitivity, specificity and false negative rates, and identified 85% of the true positives and 95% of the true negatives (Tang & Wu, 2009). Additional research with community and treatment-seeking gamblers has confirmed the reliability and validity of the Chinese version of SOGS (Tang et al., 2010).

Another investigation of Chinese versions of SOGS and DSM-IV was conducted in Hong Kong (Cheng et al., 2006) on more than 500 Chinese treatment samples for each screen. However, their findings indicated that the Chinese SOGS did not demonstrate either satisfactory reliability or validity, whereas the Chinese DSM-IV questionnaire was verified to be valid but not reliable. Reasons for this result remain unclear.

Overall, most of the limited available studies which have used the Chinese version of the SOGS have found that it has reasonable reliability and validity, and thus is potentially useful for investigations of problem gambling in the Chinese community.

#### **4.2.2.2 The Chinese SOGS Employed in the Current Research**

With regard to the translation of SOGS for Chinese participants, Mandarin was chosen as this dialect is the national language of China and has become the common language for all

Chinese (Tseng, Lin, & Yeh, 1995). However, for a few items, alternative definitions in Cantonese were also provided considering that they may be used differently in South China. For example, “*loan shark*” is called “*gao-li-dai*” in mainland China but “*gui-li*” or “*da-er-long*” in Canton and Hong Kong when referencing with some other Chinese versions SOGS available on Internet (e.g., Caritas Addicted Gamblers Counselling Centre, n.d.). Either simplified or traditional Chinese SOGS was provided on request of participants. The SOGS was translated from English to Chinese and back translated into English by an English qualified Chinese (who holds Masters Degree in English and used to teach English at a Chinese university in China). When discrepancies occurred, careful discussions were made to establish semantic integrity (Kinzie & Manson, 1987) and to check for consistency of words (Pernice, 1994) until reaching eventual agreement between the author and translator.

#### **4.2.2.3 The Gambling Related Cognitions Scale and its Chinese Version**

Apart from their English version of the GRCS (see Experiment 3), Oei, Lin and Raylu (2007a) also validated the Chinese translation of the GRCS (via back-translation) with Chinese participants. The Cronbach’s alpha coefficient for the overall scale of Chinese version was .95. Although originally developed for the general population, the results reported in their study confirmed the psychometric structure, reliability and validity of the scale, establishing it as a suitable instrument for measuring gambling cognitions both among Caucasian and Chinese.

Both the English and Chinese version GRCS were obtained from one of the original authors of the instrument (Professor Tian Po Oei, University of Queensland).

#### 4.2.2.4 BIS-11 and its Chinese Version

While originally developed and normed in English (see Experiment 3), the BIS-11 has been translated into at least 11 other languages, such as Chinese, Dutch, French, German, and Japanese (see Stanford et al., 2009). The internal consistencies (Cronbach's  $\alpha$ ) reported for the BIS-11 total score from these translations all fall within an acceptable range (0.71-0.83) suggesting that the scale is reliable across these diverse cultures.

Li, Su and Geng (2006) found that the parent-evaluated Chinese version BIS-11 has adequate reliability, validity, and is applicable to assess impulsivity of Chinese children. Yao et al. (2007) achieved the similar results in a sample of Chinese adolescents. Furthermore, in their study of the school students, females reported higher BIS-11 total scores than males as well as higher scores on the motor impulsiveness, self-control, and cognitive instability subscales. The BIS-11 was significantly associated in the predicted direction with a wide variety of self-reported problem behaviors including alcohol use, gambling, and academic misconduct. Zhou et al. (2006) and Yang et al. (2007) also demonstrated that the Chinese version of the BIS-11 has good psychometrics properties when administrated to a sample consisting of college students and community residents. As reported, all of Chinese BIS-11 versions used a back-translation method. The reliability and validity of the Chinese BIS-11 versions has also been supported with Taiwan Chinese (e.g., Li & Chen, 2007; Wu et al., 2009).

The Chinese version BIS-11 used in our present research was obtained from Professor Shuqiao Yao (see Yao et al., 2007) at the Central South University, China.

#### 4.2.2.5 Other Measures

The computerized DD and PD tasks, Card Playing Game and the printed *debriefing sheet* were also used in the present study, and they were all the same as in Experiment 3. The only

difference was that for the Chinese participants, all these tasks and sheets (including the instruction sheet before the experiment) were Chinese versions obtained by back-translation method.

### 4.2.3 Procedure

Different from the design of Experiment 3 which counterbalanced the order of discounting task and CPG, in Experiment 4, participants did each two paired decks (i.e., \$50 or \$5,000 then \$500) of CPG before the discounting tasks.

Counterbalancing produced groups of 8 participants was produced. To illustrate, experiment procedure flow charts of Participant 1 to 8 are provided below (Table 4.1). The whole experiment took about 40 to 60 minutes. The participants from Harrow (2010) did not complete the full decks of the CPG and BIS-11.

No	CPG	DD/PD	Q-I	DD/PD	Q-II	CPG	DD/PD	Q-III	DD/PD	Q-IV
1	CPG <sub>1</sub>	DD <sub>1</sub>	DS	DD <sub>2</sub>	BIS-11	CPG <sub>2</sub>	PD <sub>1</sub>	GRCS	PD <sub>2</sub>	SOGS
2	CPG <sub>2</sub>	DD <sub>3</sub>		DD <sub>4</sub>		CPG <sub>1</sub>	PD <sub>3</sub>		PD <sub>4</sub>	
3	CPG <sub>1</sub>	PD <sub>1</sub>		PD <sub>2</sub>		CPG <sub>2</sub>	DD <sub>1</sub>		DD <sub>2</sub>	
4	CPG <sub>2</sub>	PD <sub>3</sub>		PD <sub>4</sub>		CPG <sub>1</sub>	DD <sub>3</sub>		DD <sub>4</sub>	
5	CPG <sub>1</sub>	DD <sub>4</sub>		DD <sub>3</sub>		CPG <sub>2</sub>	PD <sub>4</sub>		PD <sub>3</sub>	
6	CPG <sub>2</sub>	DD <sub>2</sub>		DD <sub>1</sub>		CPG <sub>1</sub>	PD <sub>2</sub>		PD <sub>1</sub>	
7	CPG <sub>1</sub>	PD <sub>4</sub>		PD <sub>3</sub>		CPG <sub>2</sub>	DD <sub>4</sub>		DD <sub>3</sub>	
8	CPG <sub>2</sub>	PD <sub>2</sub>		PD <sub>1</sub>		CPG <sub>1</sub>	DD <sub>2</sub>		DD <sub>1</sub>	

**Table 4.1. The counterbalancing scheme used for the experimental tasks**

Note: CPG = Card Playing Game; Q = Questionnaire; DS = Demographic Sheet; BIS-11 = Barratt Impulsiveness Scale 11th Version; GRCS = Gambling Related Cognition Scale; SOGS = South Oaks Gambling Screen; DD = Delay Discounting Task; PD = Probability Discounting Task; CPG<sub>1</sub> = \$50 → \$500; CPG<sub>2</sub> = \$5,000 → \$500; DD<sub>1</sub> = \$50 → \$475; DD<sub>2</sub> = \$5,000 → \$525; DD<sub>3</sub> = \$5,000 → \$475; DD<sub>4</sub> = \$50 → \$525; PD<sub>1</sub> = \$50 → \$475; PD<sub>2</sub> = \$5,000 → \$525; PD<sub>3</sub> = \$5,000 → \$475; PD<sub>4</sub> = \$50 → \$525.

### 4.3 Results

The final sample consisted of 181 participants (104 Caucasians and 77 Chinese).

Demographic information for these participants is shown in Table 4.2.

Number ( <i>n</i> ) and Percent (%)	Caucasian	Chinese
<b>Total</b>	104	77
<b>Age (years) <sup>a</sup></b>	25.2 (10.0)	31.2 (11.0)
<b>Sex</b>		
Male	50 (48.1)	36 (46.8)
Female	54 (51.9)	41 (53.2)
<b>SOGS</b>		
= 0	60 (57.7)	24 (31.2)
= 1~4	41 (39.4)	37 (48.1)
= 5+	3 (2.9)	16 (20.8)
≤ 1	81 (77.9)	37 (48.1)
>1	23 (22.1)	40 (51.9)
<b>Education</b>		
No school qualifications	2 (1.9)	0
School qualifications	16 (15.4)	12 (15.6)
Sixth form certificate or university entrance	55 (52.9)	16 (20.8)
Post- secondary	12 (11.5)	14 (18.2)
University undergraduate degree	14 (13.5)	23 (29.9)
University postgraduate degree	5 (4.8)	12 (15.6)
<b>Marriage Status</b>		
Never married	74 (71.2)	31 (40.3)
Currently married/De facto	14 (13.5)	33 (42.9)
Living with partner	9 (8.7)	4 (5.2)
Separated/Divorced	6 (5.8)	7 (9.1)
Widowed	0	0

## Employment

Student	78 (75.0)	38 (49.4)
Homemaker	0	7 (9.1)
Unskilled/manual work	6 (5.8)	10 (13.0)
Work supervisor, clerical and skilled crafts	13 (12.5)	7 (9.1)
Managerial/professional	1 (1.0)	14 (18.2)
Pensioner/Superannuation	1 (1.0)	0
Unemployed/Welfare	3 (2.9)	1 (1.3)
Disability compensation	0	0

## Personal Income

< \$20,000	79 (76.0)	39 (50.6)
\$20,000-\$30,000	7 (6.7)	11 (14.3)
\$30,000-\$40,000	3 (2.9)	4 (5.2)
\$40,000-\$50,000	1 (1.0)	4 (5.2)
\$50,000-\$60,000	5 (4.8)	3 (3.9)
\$60,000-\$70,000	6 (5.8)	4 (5.2)
> \$70,000	6 (5.8)	2 (2.6)

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**Table 4.2. Demographic table**

*Note:* <sup>a</sup> Means and standard deviations.

Overall, 48.1% of the Caucasians (50/104) were male compared to 46.8% of the Chinese participants, which was not significantly different,  $\chi^2(1) = 0.03$ , *ns*. On average, the Chinese participants were older than the Caucasian participants,  $M_s = 31.22$  and 25.17 years, respectively,  $t(179) = 3.85$ ,  $p < .001$ . Consistent with this age difference, the Chinese participants were more likely to have completed post-secondary or University education (64%; 49/77) than Caucasians (29.8%; 31/104),  $\chi^2(1) = 20.53$ ,  $p < .001$ , and less likely never to have married or lived with a partner, 40% (31/77) versus 71% (74/104),  $\chi^2(1) = 17.34$ ,  $p < .001$ . Implications of this age difference are considered in the Discussion.

We conducted an analysis of variance (ANOVA) with age as the dependent variable and ethnicity, gambling status (SOGS > 1 = gamblers) and gender as factors. There was a significant effect of ethnicity,  $F(1,173) = 12.62, p < .001$ , but none of the main effects or interactions involving the other factors were significant (all  $ps > .34$ ). We also compared SOGS scores for those to be included in the gambling groups (SOGS > 1). Overall, SOGS scores were higher for the Chinese gamblers ( $M = 4.83$ ) than the Caucasian gamblers ( $M = 3.22$ ),  $t(61) = 2.22, p < .05$ .

#### 4.3.1 DD and PD Results by Conventional Analyses

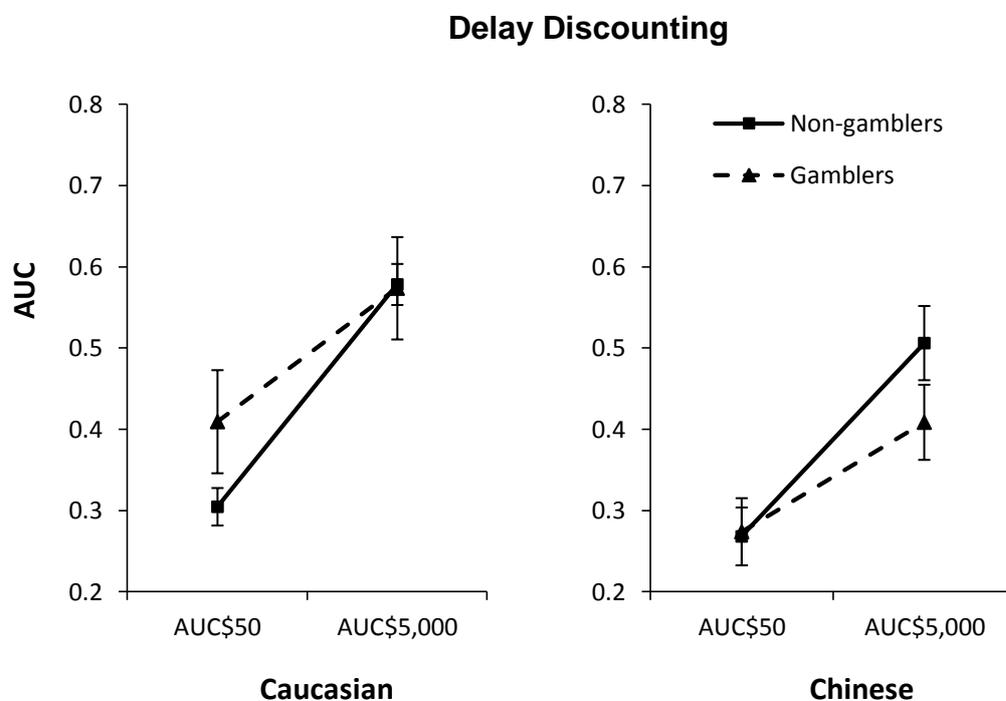
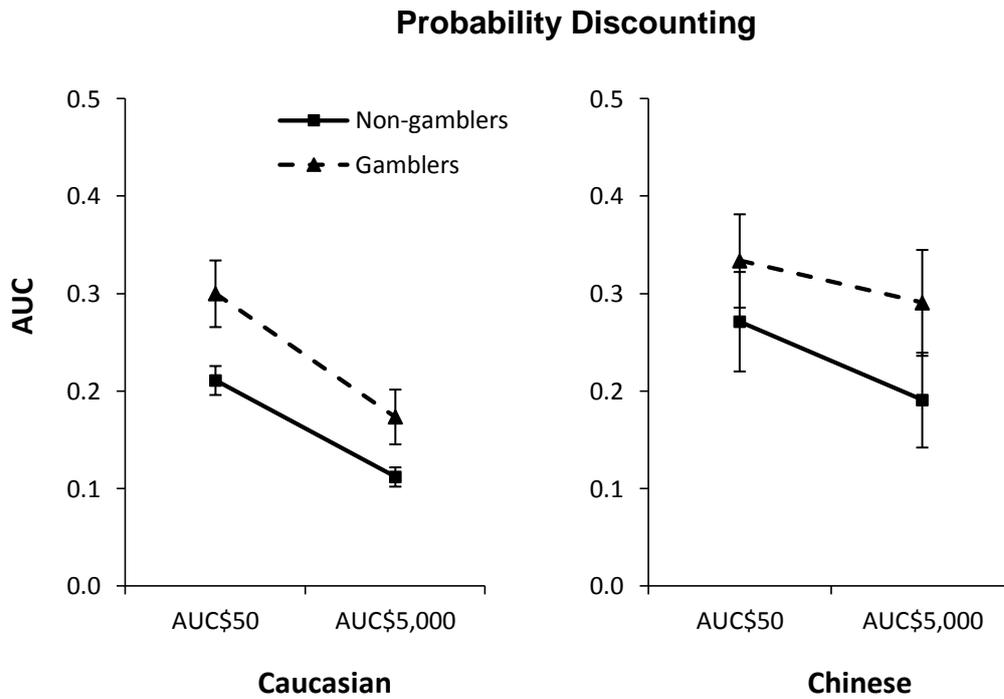


Figure 4.1. Delay discounting. Bars indicate +/- 1 SE.

Figure 4.1 shows the results from the delay-discounting task. The left and right panels show the average area under the discounting curve (AUC; Myerson et al., 2001) for the \$50 and \$5,000 standard amounts for the gamblers and non-gamblers, respectively. Results for Chinese and Caucasian participants are shown by filled and unfilled symbols, respectively. Data were entered into a repeated-measures ANOVA with amount (\$50/\$5,000) as a within-subjects factor, and gambling status and ethnicity as between-subjects factors. There was a significant main

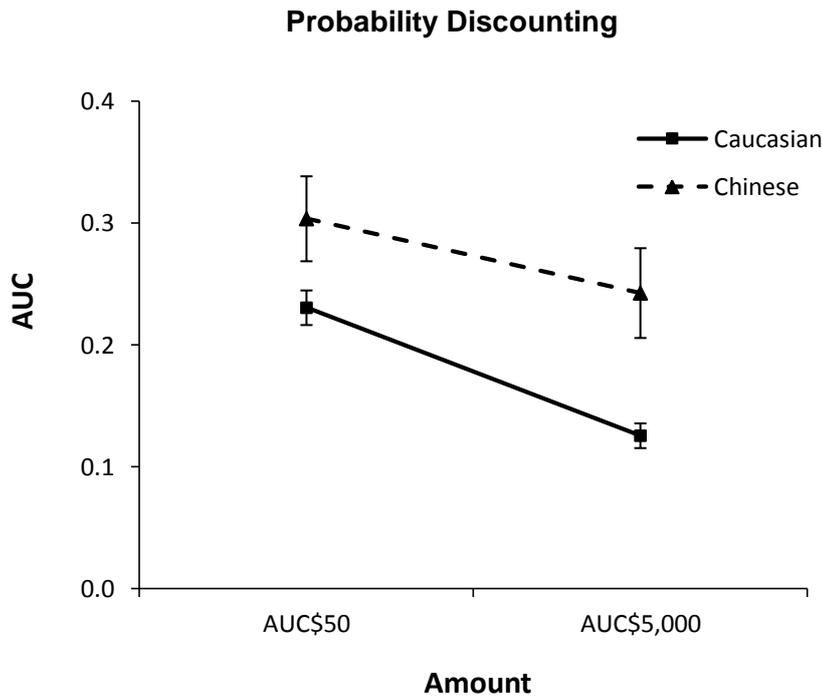
effect of ethnicity,  $F(1, 177) = 7.37, p < .01$ , partial  $\eta^2 = .04$ , indicating that Chinese participants had higher discounting rates (lower AUC values) than Caucasians,  $M_s = .36$  and  $.47$ , respectively. As expected, the main effect of amount was significant,  $F(1, 177) = 155.93, p < .001$ , partial  $\eta^2 = .47$ , confirming that discount rates were greater for \$50 than \$5,000, consistent with the magnitude effect in delay discounting. There also was a significant amount x gambling status interaction,  $F(1, 177) = 10.74, p < .01$ , partial  $\eta^2 = .06$ . Post-hoc comparisons showed that the interaction was due to the gamblers showing a smaller magnitude effect overall than non-gamblers: The difference between  $AUC_{\$5,000}$  and  $AUC_{\$50}$  was 0.15 for gamblers but 0.26 for non-gamblers ( $p < .001$ ). Thus although gamblers and non-gamblers did not differ in terms of overall levels of delay discounting, the gamblers were less sensitive to changes in reward amount. The effect of age was not significant, and none of the other main effects or interactions were significant.

Thus, results from the delay-discounting task showed that there was an effect of ethnicity such that Chinese discounted delayed rewards at a higher rate than Caucasians. A magnitude effect was obtained such that larger rewards were discounted less steeply than smaller rewards, but this effect was smaller for gamblers than non-gamblers.



**Figure 4.2. Probability discounting. Bars indicate +/- 1 SE.**

Figure 4.2 shows the results from the probability-discounting task. The left and right panels show the average AUC for the \$50 and \$5,000 standard amounts for the gamblers and non-gamblers, respectively. Results for Chinese and Caucasian participants are shown by filled and unfilled symbols, respectively. Data were entered into a repeated-measures ANOVA with amount (\$50/\$5,000) as a within-subjects factor, gambling status and ethnicity as between-subjects factors. There was a significant effect of ethnicity,  $F(1, 177) = 4.27, p < .05$ , partial  $\eta^2 = .02$ , indicating that Chinese participants had lower probability discounting rates (higher AUC values) than Caucasians,  $M_s = 0.27$  and  $0.20$ , respectively. There was also a significant effect of gambling status,  $F(1,176) = 5.33, p < .05$ , partial  $\eta^2 = .03$ , which indicated that gamblers had lower rates of probability discounting rates than non-gamblers, adjusted  $M_s = .27$  and  $.20$ , respectively. As expected, there was a significant effect of amount,  $F(1, 177) = 58.39, p < .001$ , partial  $\eta^2 = .25$ , which confirmed that discounting rates were greater for the larger amount, consistent with the magnitude effect in probability discounting ( $M_s = .28$  and  $.19$  for  $AUC_{\$50}$  and  $AUC_{\$5,000}$ , respectively).



**Figure 4.3.** Probability discounting of all Caucasian and Chinese. Bars indicate +/- 1 SE.

There was a significant interaction between amount and ethnicity,  $F(1, 177) = 4.98, p < .05$ , partial  $\eta^2 = .03$ . As Figure 4.3 shows, the magnitude effect (i.e., the difference between  $AUC_{\$5,000}$  and  $AUC_{\$50}$ ) was greater (in absolute value) for Caucasians than Chinese,  $M_s = -0.11$  and  $-0.06$  ( $p < .01$ ). None of the other main effects or interactions were significant.

Thus, results from the probability discounting task showed that Chinese participants were less risk-averse than Caucasians, and gamblers were less risk-averse than non-gamblers. A magnitude effect was obtained such that larger rewards were discounted at a higher rate, but this effect depended on ethnicity and was more pronounced for Caucasians.

### 4.3.2 Contrast Effects in DD and PD Tasks

Similar to Experiments 2 and 3, we calculated contrast effects for both delay and probability discounting as the difference between the present value (PV) for the \$475/525 reward after \$50 and after \$5,000 had been the standard reward. Thus the contrast effect was predicted

to be positive for delay discounting and negative for probability discounting. Averaged across all participants, the contrast effect for delay discounting was positive ( $M = 0.03$ ) and significant,  $t(151) = 1.64, p = .051$  (one-tailed). However, the contrast effect for probability discounting was not significantly different from zero ( $M = -0.01$ ),  $t(151) = -0.70$ .

Figure 4.4 shows the average contrast effect for delay and probability discounting separately by ethnicity and gambling status. A repeated-measures ANOVA with type of discounting as a within-subjects factor and gambling status and ethnicity as between-subjects factors found no significant main effect or interactions (all  $ps > .20$ ). Thus results suggested that the contrast effect in delay discounting but not probability discounting was replicated, and that neither effect varied with ethnicity or gambling status.

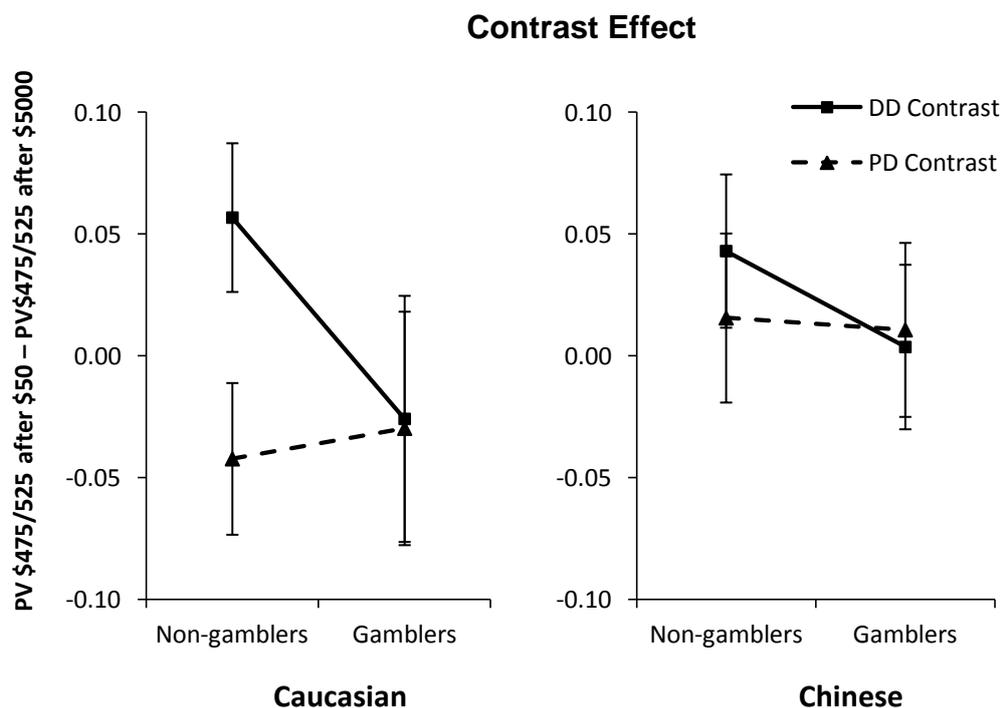


Figure 4.4. Contrast effect. Bars indicate +/- 1 SE.

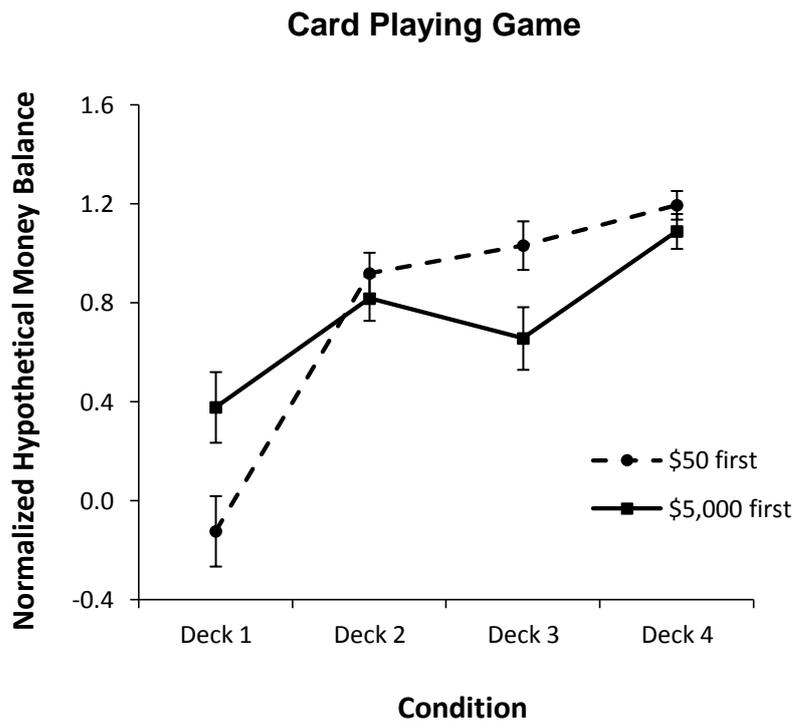


Figure 4.5. Card Playing Game results of all participants. Bars indicate +/- 1 SE.

### 4.3.3 Card Playing Game and Other Psychometric Measures

Results from the Card Playing Game were analyzed similarly to Experiment 3: Normalized amounts of money won/lost were computed for each deck. Results are shown in Figure 4.5. Data were entered into a repeated-measures ANOVA with deck (1 through 4) as a within-subjects factor, gambling status, ethnicity, and order (\$50-\$5,000 or \$5,000-\$50 stakes in Decks 1 and 3, respectively) as between-subjects factors. There was a significant main effect of deck,  $F(3, 432) = 44.28, p < .001$ , partial  $\eta^2 = .24$ , and a significant deck x order interaction,  $F(3, 429) = 5.61, p < .001$ , partial  $\eta^2 = .045$ . Figure 4.6 shows results separately for participants who had stakes of \$50-\$500-\$5,000-\$500 and \$5,000-\$500-\$50-\$500 across the four decks. The deck x order interaction was similar to that obtained in Experiment 3, and showed that performance depended on the amount of the initial stake: Participants with a \$50 stake for the first deck improved markedly in the second deck, whereas those with a \$5,000 stake improved less. The main effect of deck confirmed that performance improved with training: The average normalized money

(i.e., amount at the end of the deck divided by the initial stake) was 0.12, 0.87, 0.85, and 1.14 across the four decks. These results were quite similar in quantitative terms to those from Experiment 3 (which were 0.20, 0.88, 0.86 and 1.08).

Unlike Experiment 3, there was no significant contrast effect when analyzed between-subjects: The average performance for the second deck, with \$500 stake, was not significantly different for participants who had \$50 stake in the first block ( $M = 0.92$ ; \$459.62) and participants who had a \$5,000 stake ( $M = 0.83$ ; \$415.00),  $t(150) = 0.83$ , *ns*.

## Card Playing Game

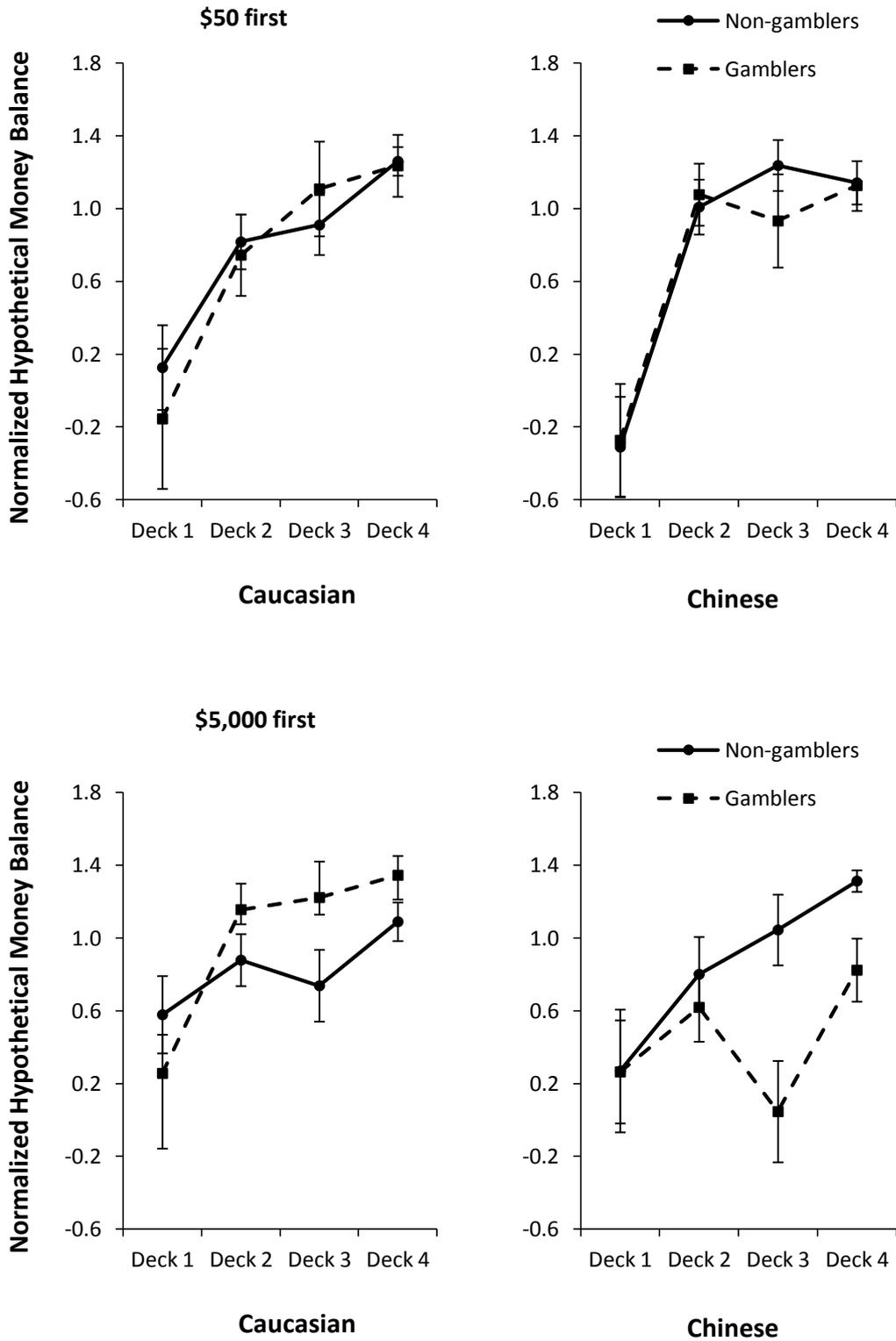
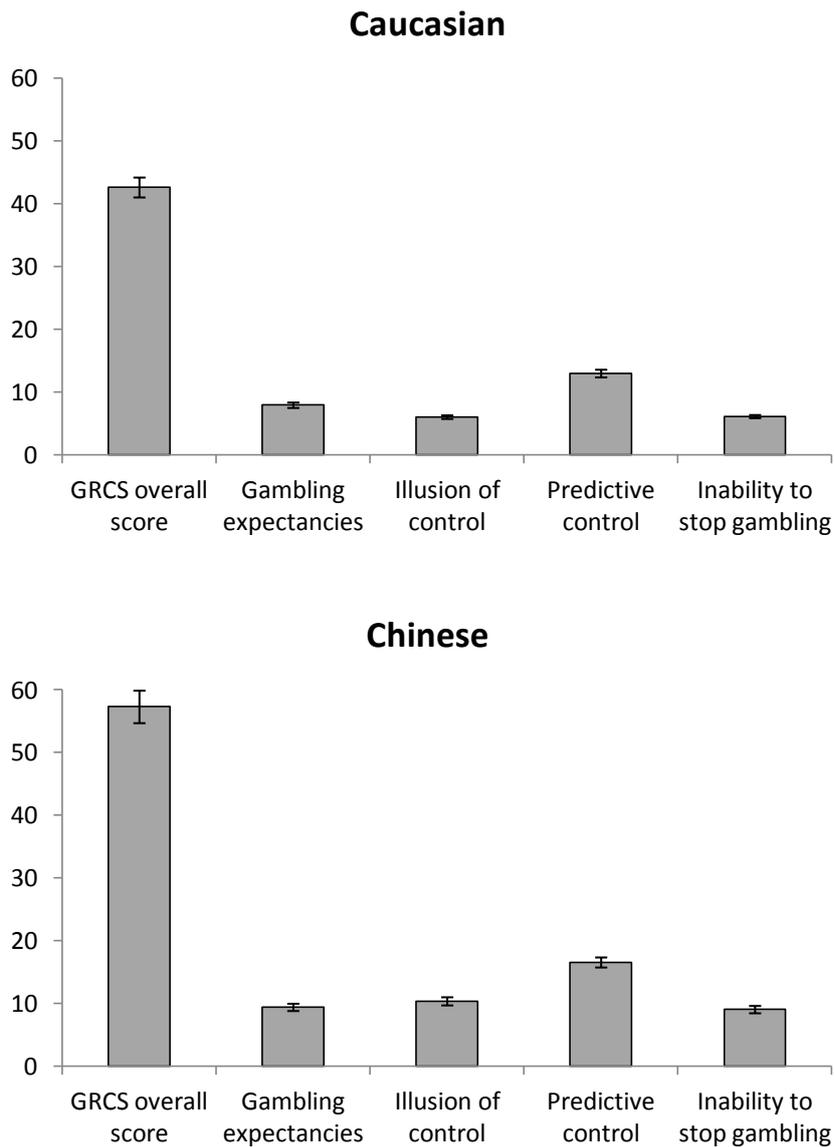


Figure 4.6. Card Playing Game results of Caucasian and Chinese. Bars indicate +/- 1 SE.

The ANOVA also revealed a significant three-way interaction between deck, gambling status, and ethnicity,  $F(3, 432) = 3.80, p < .05$ , partial  $\eta^2 = .03$ . Figure 4.6 shows results of this interaction. Post-hoc comparisons (Tukey HSD) showed that Chinese gamblers performed worse than Chinese non-gamblers in the third deck, and for the third and fourth decks overall, whereas there were no significant differences between the Caucasian gamblers and non-gamblers.



**Figure 4.7. Bar graphs of GRCS and its subscale scores of Caucasian and Chinese. Bars indicate +/- 1 SE.**

Scores on the Gambling Related Cognitions Scale (GRCS; overall scores and subscales) are shown in Figure 4.7. Data were entered into a multivariate analysis of covariance (MANCOVA) with gambling status (SOGS > 1) and ethnicity as between-subjects factors.

Because Chinese gamblers had higher SOGS scores overall than Caucasian gamblers, SOGS was included as a covariate. As expected, SOGS scores were significantly correlated with GRCS scores,  $r = .58, p < .001$ . There was a significant effect of ethnicity, Wilks'  $\lambda = 0.82, p < .001$ . The effect of gambling status and the interaction were not significant. Univariate analyses confirmed that scores for Chinese were significantly higher than Caucasians for the Illusion of Control and Inability to Stop Gambling subscales. Scores on Gambling Expectancies, Predictive Control, and Interpretive Bias subscales were not significantly different for Chinese and Caucasians.

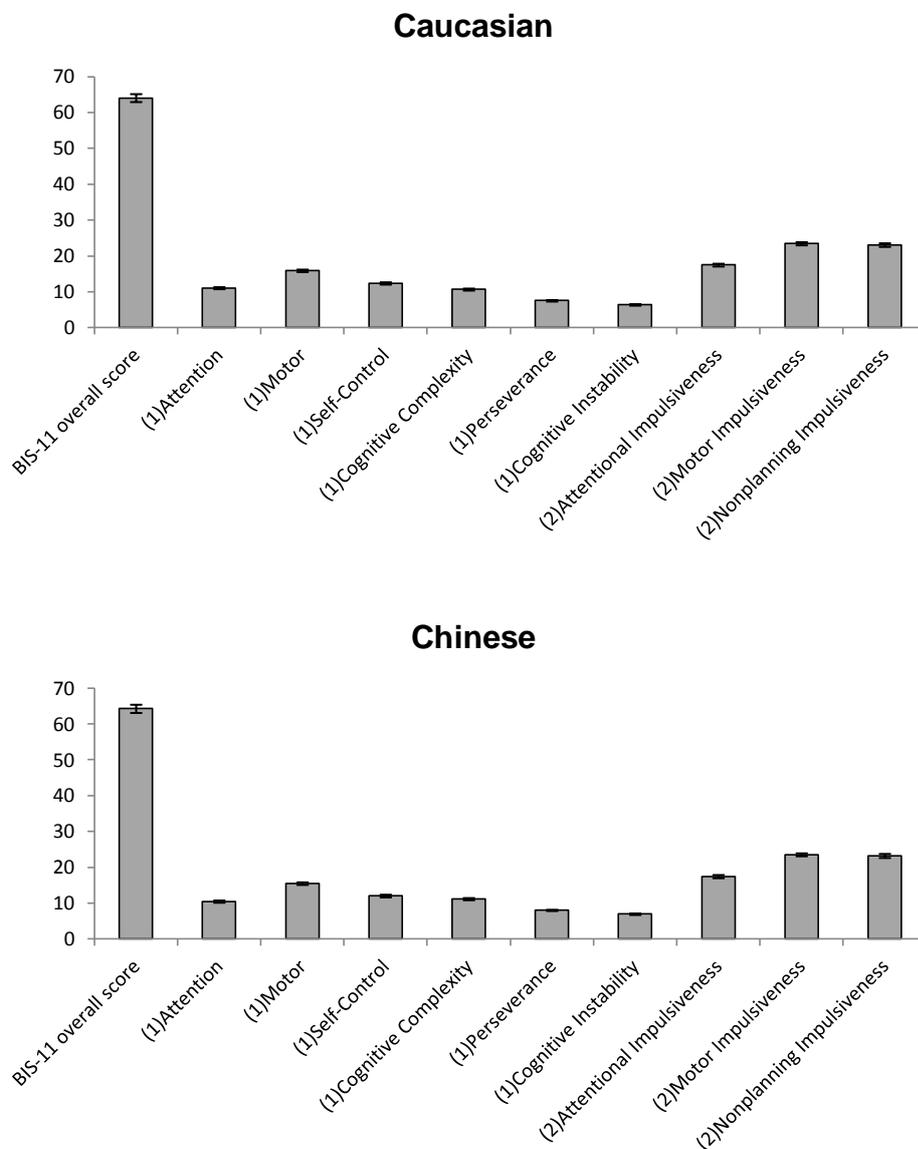


Figure 4.8. BIS-11 and its subscale scores of Caucasian and Chinese. Bars indicate +/- 1 SE..

Results for the BIS-11 are shown in Figure 4.8. A MANCOVA similar to that performed on the GRCS found no significant results. Thus BIS-11 scores did not vary with gambling status or ethnicity.

	PD- Contrast	DD- AUC\$50	DD - AUC\$5,000	DD-ME	PD- AUC\$50	PD- AUC\$5,000	PD-ME	GRCS	BIS-11	AvgNorm\$	Total Cards	Total Money
DD-AUC\$50	-.10											
DD- AUC\$5,000	-.05	.68***										
DD-ME	.06	-.26**	.52***									
PD-AUC\$50	-.01	.25**	.18*	-.04								
PD- AUC\$5,000	-.11	.20**	.13†	-.05	.82***							
PD-ME	-.17*	-.08	-.08	-.01	-.29***	.31***						
GRCS	-.04	.09	-.12	-.26***	.25**	.28***	.06					
BIS-11	-.06	.02	.02	.01	-.01	.06	.11	.07				
AvgNorm\$	-.05	-.11	-.01	.11	-.11	-.22**	-.18*	-.13	-.06			
Total Cards	.04	.05	-.03	-.10	.18*	.26**	.15†	.12	.12	-.90***		
Total Money	-.08	-.11	.07	.21**	-.13†	-.18*	-.08	-.13†	-.04	.72***	-.63***	
SOGS	-.03	.05	-.12	-.22**	.22**	.27***	.08	.58***	.16†	-.28**	.23**	-.21*
DD- Contrast	.07	-.08	-.09	-.03	-.02	-.04	-.04	-.10	-.00	-.02	.08	.01

**Table 4.3. Correlation table**

Note: Total Cards = Total number of cards played, AvgNorm\$ = Average normalized amount of money per deck, Total Money = Money won or lost in the CPG, ME = Magnitude effect, Contrast = Contrast effect

†  $p < .10$ , \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

Finally, we examined correlations between overall performance on the CPG (measured as the average normalized money across the four decks) and other variables. Average normalized money and Total Money were negatively correlated with SOGS scores,  $r_s = -.28$  and  $-.21$ ,  $p < .01$  and  $.05$ , respectively, while Total Cards was positively correlated with SOGS,  $r = .23$ ,  $p < .01$ , showing that gamblers tended to perform overall more poorly on the CPG. Correlations between average normalized money and probability discounting rates ( $AUC_{\$5,000}$ , and the magnitude effect for probability discounting  $AUC_{\$5,000} - AUC_{\$50}$ ) were both negative and statistically significant,  $r_s = -.22$ ,  $p < .01$  and  $-.18$ ,  $p < .05$ , respectively. This shows that participants who were less risk-averse tended to perform more poorly on the CPG. However, correlations between contrast measures in delay and probability discounting and CPG performance were not significant.

#### **4.3.4 Delay Discounting – Analysis of Indifference Points**

We conducted an analysis of the individual indifference points for a more detailed understanding of the discounting data. The indifference points for the delay discounting (DD) task were entered into a repeated-measures ANOVA with ethnicity and gambling status as between-subjects factors and amount and delay as within-subjects factors. Figure 4.9 shows the average indifference points from the delay-discounting task for gamblers (left panels), non-gamblers (right panels), Chinese (upper panels), and Caucasians (lower panels). There was a significant effect of ethnicity,  $F(1, 177) = 6.75$ ,  $p < .05$ , partial  $\eta^2 = .04$ , confirming that indifference points were overall greater for Caucasians than Chinese,  $M_s = 0.56$  and  $0.47$ , respectively. This indicates that delay-discounting rates were greater for Chinese participants, consistent with the analysis of AUC data reported above. The main effects of delay and amount were significant,  $F(5, 885) = 292.31$ ,  $p < .001$ , partial  $\eta^2 = .62$  and  $F(1, 177) = 193.09$ ,  $p < .001$ , partial  $\eta^2 = .52$ , as was their interaction,  $F(5, 885) = 13.33$ ,  $p < .001$ , partial  $\eta^2 = .07$ . The main

effects confirmed that indifference points decreased with delay and magnitude of reward, and the interaction showed that the magnitude effect (i.e., the difference between indifference points for \$5,000 and \$50 at a given delay) was reduced for the shortest and longest delays compared to mid-range delays.

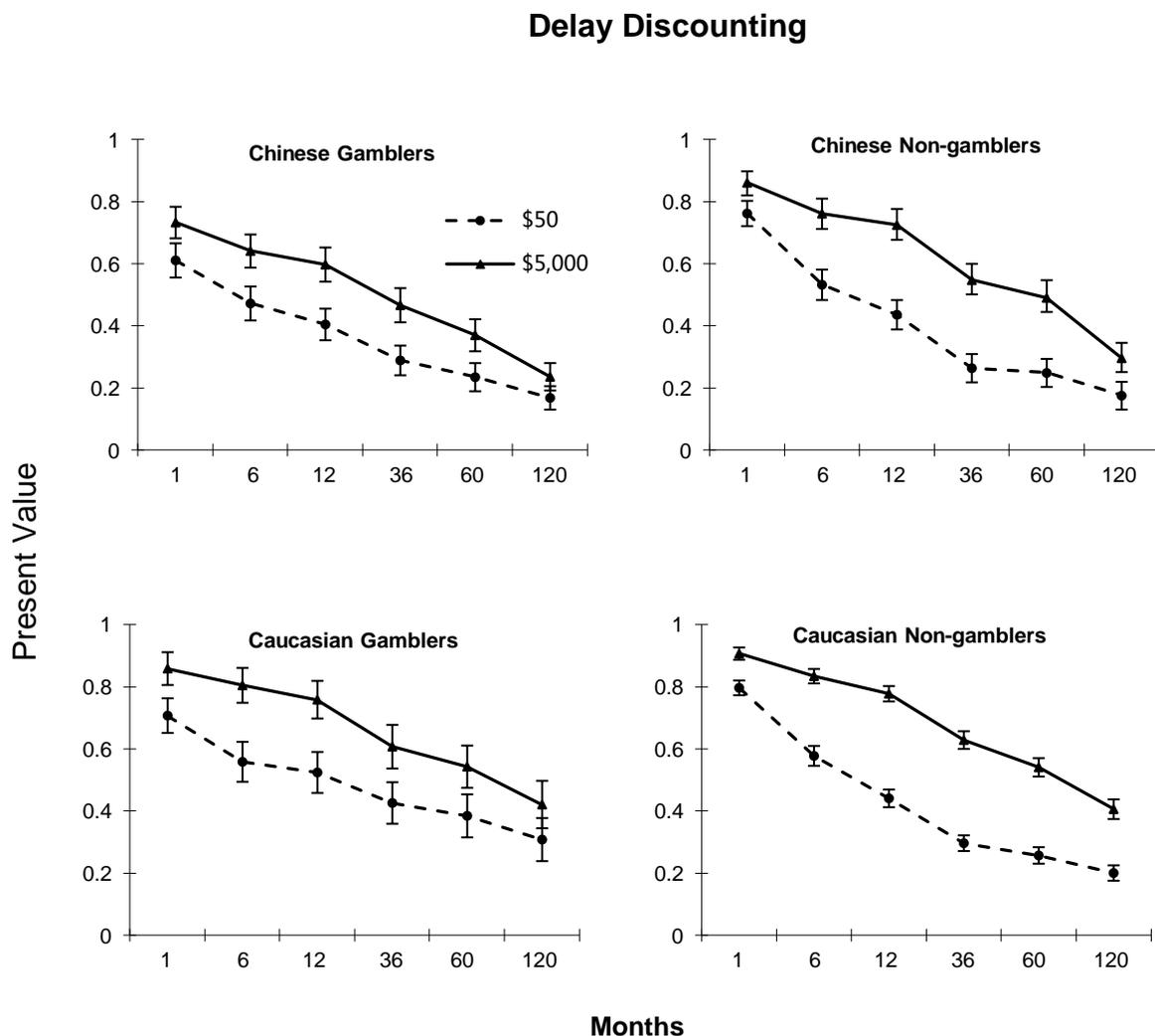


Figure 4.9. Average indifference points from delay discounting task in Experiment 4. Bars indicate +/- 1 SE.

There was a significant interaction between amount and gambling status,  $F(1, 177) = 6.05$ ,  $p < .05$ , partial  $\eta^2 = .03$ . The interaction was due to gamblers having indifference points for \$50 rewards that were not significantly different from non-gamblers ( $M_s = .42$  and  $.41$ , respectively), whereas gambler's indifference points for \$5,000 rewards were significantly lower than non-gamblers' ( $M_s = .57$  and  $.66$ ; Fisher LSD,  $p < .01$ ). Thus the magnitude effect – that is, the

decrease in discounting rate as amount increases – was reduced for gamblers compared to non-gamblers. The interaction between delay and gambling status was also significant,  $F(5, 885) = 4.61, p < .001$ , partial  $\eta^2 = .03$ . Post-hoc tests (Fisher LSD) showed that this interaction resulted because indifference points for gamblers were significantly lower ( $p < .05$ ) for the shortest delays (1 month and 6 months) but not from delays from 1 year to 10 years. Finally, there was a significant interaction between amount, delay, and gambling status,  $F(5, 885) = 3.30, p < .01$ , partial  $\eta^2 = .02$ . Post-hoc tests (Fisher LSD) showed that indifference points for gamblers and non-gamblers were significantly different for the three shortest delays for \$5,000 rewards, but only for the shortest delay for \$50 rewards. None of the remaining interactions were significant.

These results are consistent with the AUC analysis reported above: Chinese participants had overall higher rates of delay discounting, and the magnitude effect was reduced for gamblers. In addition, the molecular analysis showed that although the main effect of gambling status was not significant, gamblers had higher discounting rates for \$5,000 rewards over short delays. This is important because it suggests that gamblers may have a tendency to make impulsive choices when relatively large, short-term rewards are at stake.

#### **4.3.5 Probability Discounting – Analysis of Indifference Points**

The indifference points from the probability discounting were entered into a repeated-measures ANOVA with ethnicity and gambling status as between-subjects factors and amount and probability as within-subjects factors. Figure 4.10 shows the average indifference points from the probability-discounting task for gamblers (left panels), non-gamblers (right panels), Chinese (upper panels), and Caucasians (lower panels). There were significant effects of amount and probability,  $F(1, 177) = 34.33, p < .001$ , partial  $\eta^2 = .16$  and  $F(5, 885) = 435.81, p < .001$ , partial  $\eta^2 = .71$ , showing that indifference points decreased for larger (\$5,000) amounts and as the likelihood of receipt became more unlikely. The interaction between amount and probability

was significant,  $F(5, 885) = 2.38, p < .05$ , partial  $\eta^2 = .01$ . Post-hoc tests (Fisher LSD) showed that the indifference points for \$5,000 and \$50 rewards were significantly different ( $p < .001$ ) for all reward probabilities except 95%. The interaction between amount and gambling status was also significant,  $F(1, 177) = 4.00, p < .05$ , partial  $\eta^2 = .02$ . Post-hoc tests showed that this interaction was due to gamblers having less of a difference between the mean indifference points for \$50 and \$5,000 rewards ( $M_s = .43$  and  $.39$ , respectively) than non-gamblers ( $M_s = .39$  and  $.31$ ). Thus gamblers showed a reduced magnitude effect. This effect can also be seen in terms of the greater separation between the \$50 and \$5,000 data points for non-gamblers in Figure 4.10. Indifference points were also overall greater for gamblers than non-gamblers, indicating that gamblers were less risk averse, but the main effect of gambling status only approached significance,  $F(1, 177) = 3.53, p = .06$ , partial  $\eta^2 = .02$ .

## Probability Discounting

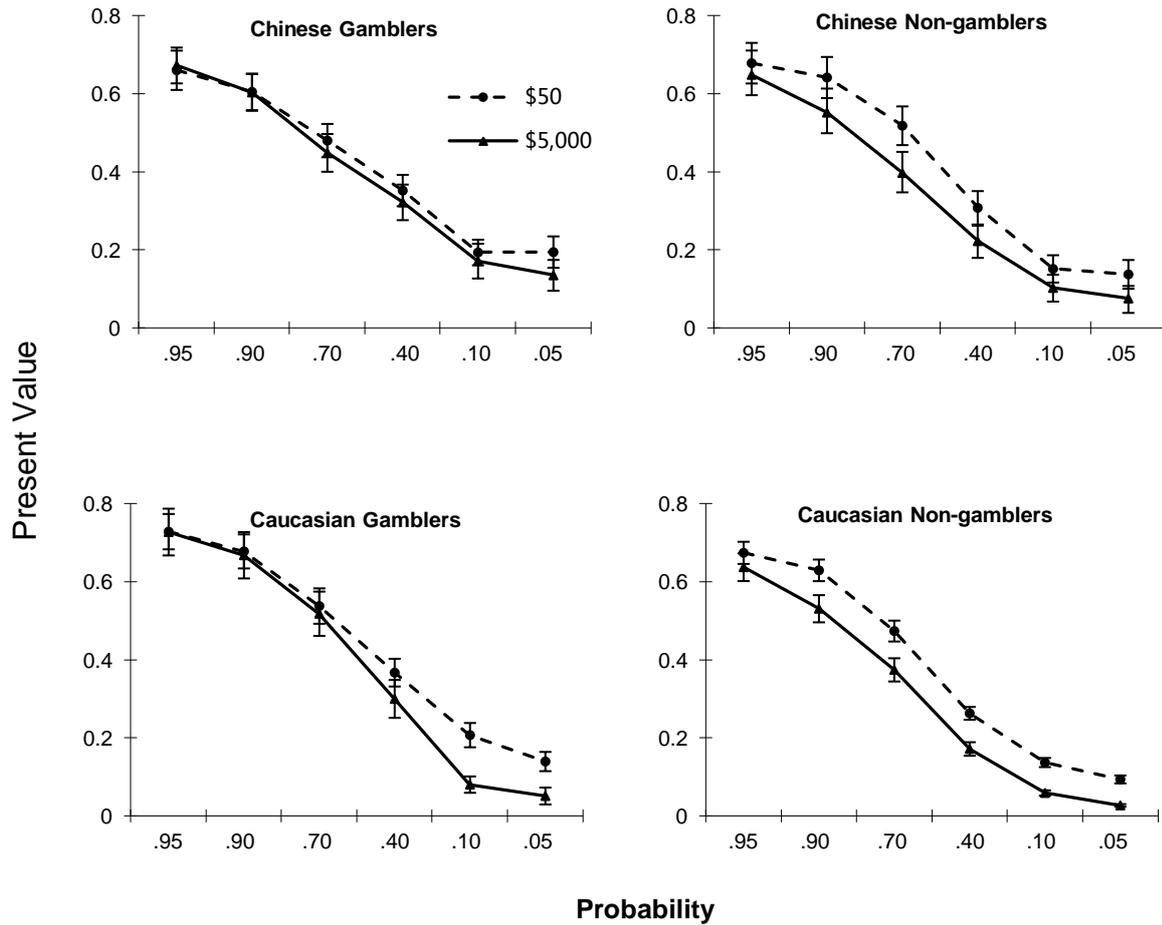
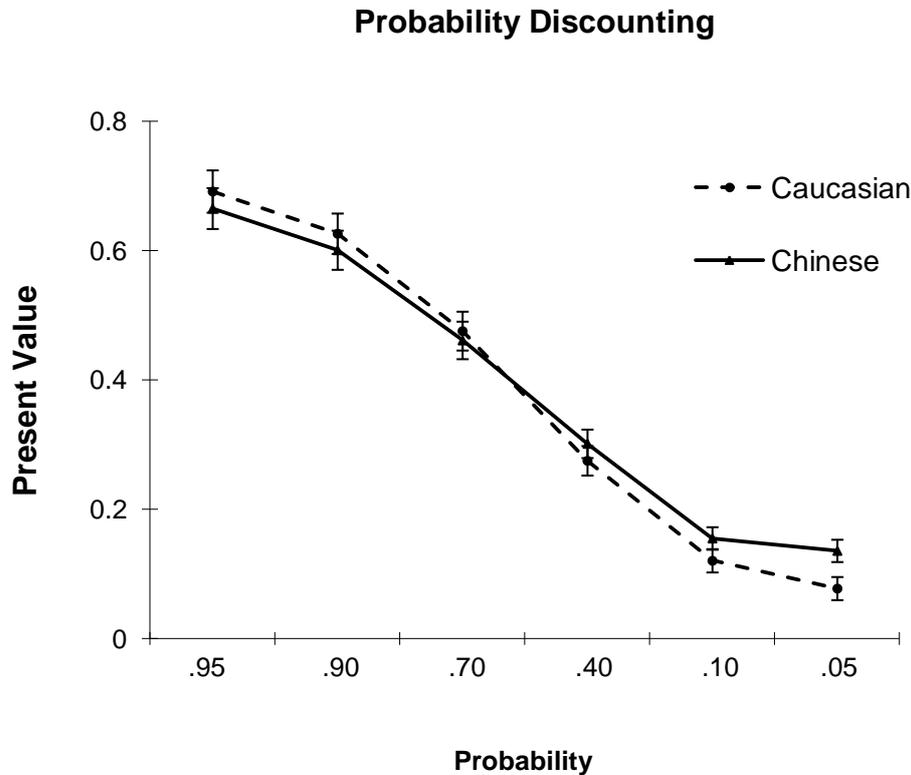


Figure 4.10. Average indifference points from probability discounting task in Experiment 4. Bars indicate +/- 1 SE.

The three-way interaction between amount, probability, and gambling status was significant,  $F(5, 885) = 2.29, p < .05$ , partial  $\eta^2 = .01$ . Post-hoc tests showed that the difference between gamblers and non-gamblers was not significant for \$50 rewards at any probability, but gamblers had significantly higher indifference points for \$5,000 rewards for mid-range probability values (90%, 70%, and 40%). This suggests that gamblers were more likely to make risky choices than non-gamblers with large amounts and when the uncertainty of reward outcome was relatively high.



**Figure 4.11. Crossover effect between Caucasian and Chinese in probability discounting. Bars indicate +/- 1 SE.**

There was a significant interaction between probability and ethnicity,  $F(5, 885) = 2.36, p < .05$ , partial  $\eta^2 = .04$ . Figure 4.11 shows indifference points averaged across amount and gambling status by probability, separately for Chinese and Caucasians. There was a crossover such that Chinese had lower indifference points at high probabilities but higher indifference points at lower probabilities. Post-hoc tests (Fisher LSD) showed that although the indifference points were only significantly different for the 5% probability ( $p < .05$ ), the decrease in indifference points from 95% to 5% probability was greater for Chinese than Caucasians ( $p = .05$ ). The main effect of ethnicity was not significant,  $F(1, 177) = 0.09, p > .75$ . None of the other interactions were significant.

Overall, these analyses are consistent with expectations based on previous research on probability discounting, but also reveal some differences with the AUC analyses reported above. As expected, indifference points varied directly with reward probability and inversely with

reward amount. Whereas the AUC analyses suggested that gamblers overall had higher rates of probability discounting than non-gamblers and Chinese had lower rates of probability discounting than Caucasians, these results were more nuanced: Gamblers showed a reduced magnitude effect compared with non-gamblers, and were less risk-averse with large amounts than non-gamblers when the likelihood of reward receipt was high (i.e., for mid-range probability values). Similarly, the AUC analyses suggested that Chinese participants had lower overall rates of probability discounting than Caucasians, but analysis of indifference points revealed a crossover interaction (Figure 4.11) such that Chinese had significantly greater indifference points for low-probability rewards.

#### **4.4 Discussion**

The major goal of Experiment 4 was to investigate the relationship between gambling-related behavior and delay and probability discounting for both Chinese and Caucasian (NZ European) samples. Gambling-related measures included both self-report questionnaires (SOGS and GRCS) and performance on a Card Playing Game (CPG), while delay and probability discounting were measured using a computer-based task. Of particular interest was whether reward contrast effects in delay and probability discounting would differ between Chinese and Caucasian participants and predict gambling behavior.

Results showed that Chinese participants had higher rates of delay discounting and lower rates of probability discounting than Caucasians, when data were analyzed according to the area under the discounting function (AUC). Gamblers had lower rates of probability discounting than non-gamblers, indicating that they were less risk-averse. Although delay-discounting rates were not significantly different overall for gamblers and non-gamblers, the magnitude effect in delay discounting (i.e., the difference between discounting rates for large and small amounts) was lower for gamblers than non-gamblers. The magnitude effect in probability discounting (i.e. the

tendency for participants to become more risk averse as amounts increased) was lower for Chinese than Caucasians. However, when probability discounting data were analyzed at a more molecular level (in terms of individual indifference points rather than as the AUC value), there was no main effect of ethnicity but significant interaction between ethnicity and probability due to a crossover effect such that Chinese were more risk-averse at high probabilities and less risk-averse at low probabilities than Caucasians. The contrast effect for delay discounting (in which the value of a standard \$475/\$525 reward appeared larger or smaller, respectively, when it followed a \$50 or \$5,000 reward) was replicated, but the corresponding effect for probability discounting was not significant. Performance on the Card Playing Game (CPG) was significantly correlated with both SOGS scores and probability discounting rates, such that those who reported more problems with gambling and were less risk averse were likely to perform more poorly on the CPG. We discuss each of these results in turn.

#### **4.4.1 Differences in Delay Discounting between Caucasians and Chinese**

The finding of a significant difference in delay discounting (DD) such that Chinese discounted future rewards more rapidly than Caucasians is inconsistent with Du, Green Myerson (2002). In their study, they found no difference of discounting rate of delay rewards between American and Chinese (but the two ethnic groups discounted more steeply than the Japanese). However, in Du et al.'s (2002) study, they used English versions of DD and PD tasks on all participants (i.e., for American, Chinese and Japanese). By contrast, in our Experiment 4, all tasks and questionnaires were conducted for Chinese in their native language. Research has shown that bilinguals respond differently when they make decisions and describe their self-concepts depending on which language they are speaking (Briley, Morris, & Simonson, 2005; Kimmelmeier & Cheng, 2004). Ji, Zhang, and Nisbett (2004) proposed that testing in native languages may make any cultural differences look larger than they are. They found that

bicultural Chinese demonstrated enhanced cultural effect when they were tested in Chinese rather than in English. It is likely that language (also visual or auditory cues) (Chen et al., 2005; Hong et al., 2000; Tavassoli & Lee, 2003; Wong & Hong, 2005) can prime a particular culture. Thus the use of Chinese-language DD tasks may have contributed to the significant difference that we observed.

Our result that Chinese show greater delay discounting rates than Caucasians may seem to contradict common perceptions of Asian cultures as being more patient than Western ones. For example, Asians-Americans value education attainments, have a higher savings rate, and are less likely to use credit cards in comparison with Caucasian Americans (Chen et al., 2005; Katzner, 2002; Springstead & Wilson, 2000). Studies have suggested that impulse buying may at least partially account for the high levels of consumer debt in the U.S. (Vohs & Faber, 2007), and correlational evidence indicates that impulsive buying is more strongly related to self-reported consumption (e.g., beer) for those with an independent or Caucasian cultural self-construal than for those with an interdependent or Asian cultural self-construal (Benjamin, Choi, & Strickland, 2010; Kacen & Lee, 2002; Zhang & Shrum, 2009).

The finding that Chinese had greater delay discounting rates than Caucasians also appears to contradict Hofstede's (2001) cultural dimensions. His dimension of Long-/Short-Term Orientation (LTO) was derived from Chinese values and has sometimes been called Confucian Dynamism. LTO reflects Confucius's teachings on the importance of thrift and respect for tradition. A high score on LTO is believed to be consistent with "a dynamic, future-oriented mentality" (Hofstede & Bond, 1988). According to the LTO Index (Hofstede, 2001, p. 356), countries/regions that are populated largely by Chinese ranked as the top three (i.e., mainland China, Hong Kong and Taiwan) and followed by the other two East Asian countries (i.e., Japan and South Korea). By contrast, most Western countries' scores are much lower than East Asian (also see a new ranking in Hofstede and Minkov (2010, p. 499)).

However, because “*thrift*” and “*respect for tradition*” are the only two items depicted in Hofstede’s questionnaire (VSM 94) to measure LTO (2001, p. 495), how much the LTO and delay discounting rates (as measured in the present study) might overlap should be questioned. According to the two items, the LTO seems to emphasize more of a past than future orientation. Hofstede wrote that, “Long-term-oriented cultures teach virtues directed at the future, such as education, frugality, and persistence. Short-term-oriented cultures teach virtues directed at the past and present, such as respecting traditions, social spending, and maintaining face” (p. 363), but these descriptions conflict the definition of LTO itself. For example, on the first hand, Hofstede includes the item “respect for tradition” as one of the two indicators for long-term-oriented cultures. That is, the lower a culture scores on this perspective should indicate a short-term-orientation. Another conflicting aspect of LTO is *face* culture. Chinese culture is assumed to place a strong emphasis on not ‘losing face’ (Ho, 1976; Jia, 1998) but “maintaining face” is included as one of the characteristics of a short-term cultural orientation, and Hofstede even acknowledges that there is no such equivalent word in English (but interestingly, not for other collectivist cultures in the West, e.g., Greece) (see Hofstede, 2001, p. 230).

Despite these apparent inconsistencies in relating Hofstede’s LTO construct to delay discounting, the future-oriented mentality associated with LTO has been frequently interpreted as the one of the core features of Chinese culture. However the two questions depict that the LTO measures would seem to refer more to “past” rather than “future” orientation (also see Lee & Semin, 2009; Lee, Lee, & Kern, 2011).

#### **4.4.2 Differences in Probability Discounting between Caucasians and Chinese**

When data were analyzed in terms of AUC values, we found that Chinese participants had lower rates of probability discounting than Caucasians, that is, they were less risk averse, similar to results of Du et al. (2002). However, analysis of individual indifference points showed that the

difference between Caucasians and Chinese was more nuanced: There was a crossover interaction such that Chinese were more risk averse for likely gains but less risk averse for unlikely gains. We consider possible reasons for this interaction in the General Discussion. Here we review previous research on risky decision making that is relevant to the question of whether Chinese are different from Westerners in terms of their attitudes toward risk.

Perception and judgment of risk have been shown to differ across cultures (Weber & Morris, 2010). The Cultural Theory of Risk proposed by Douglas and Wildavsky (1982) argues that in an independent-oriented society, individuals appreciate uncertainties as market driven opportunities and fostering more risk-taking. By contrast, in a hierarchical- and interdependent-oriented society, people tend to be more obedient to the status quo, and defer to experts and authorities, suggesting risk aversion. Studies have found that Caucasians and Chinese do perceive each other as corresponding to these stereotypes (Hsee & Weber, 1999; Li & Fang, 2004). That is, Caucasians perceive Chinese as more risk-averse and vice versa. However, most recent studies in the last decade suggest that Chinese maybe actually more risk seeking than Caucasians, especially in the financial domain and those that suffer more from the gambling problems (see Literature Review). Our results are consistent with these recent studies and suggest that Chinese show less risk aversion in decision making about uncertain monetary rewards than Caucasians.

In the first study which compared preferences for risk between Chinese and Americans, Hsee and Weber (1999) found that Chinese exhibit more willingness to choose a larger amount of money with uncertainty than a smaller amount with certainty, whereas Americans show the opposite propensity. In other words, in Hsee and Weber's (1999) experiment, Chinese demonstrated more risk tolerance than Americans. Bruhin et al. (2010) found that Chinese are much more optimistic on the lotteries of small and medium-sized probabilities than the Swiss. Sensitivity to changes in probabilities was also generally lower for the Chinese participants than

for Swiss. Mandel (2003) reported that American university students without a prominent ethnic identification, when primed with an interdependent (rather than independent) self-construal, were more likely to make a risky choice when making decisions about a lottery or parking ticket (i.e., financial gains or losses).

However, Hsee and Weber (1999), Mandel (2003) also reported that the American and Chinese participants when primed with an interdependent or independent self-construal, did not show differences in decision making for academic (the task was to choose whether to write a term paper on a conservative topic with a predictable grade, or a provocative topic with a risky grade), medical (to choose whether to take a pain reliever with a moderate but sure effectiveness or one with a high variance of effectiveness) and social domains (choosing which type of shirt to wear to a family gathering). Chinese have also been reported to prefer the risky choices with larger outcomes among the first two options of the classic Allais paradox (Li, 1993; Li, 2001; Wu, 2009) (see also Chapter 5) and Asian Disease Problem (Brumagim & Wu, 2005; Zhang et al., 2008), unlike Caucasians.

The only previous study which has compared performance of different cultural groups in delay and probability tasks similar to those used in the present research was reported by Du, Green, and Myerson (2002). They compared American, Chinese, and Japanese graduate students in the United States on both delay and probability discounting. For probability discounting, their results showed that Americans discounted probabilistic rewards the most, followed by Japanese, and the Chinese discounted probabilistic rewards the least. Thus the present results are consistent with Du et al. (2002) in terms of Chinese showing less risk aversion in decision making about uncertain monetary rewards than Caucasians, as well as previous studies using different decision-making paradigms (e.g., Hsee & Weber, 1999).

However, it should be noted that some previous studies have found that when individuals were given an interdependent (as opposed to independent) prime, risk aversion in decision

making increased. Briley and Wyer (2002) found that when participants (both European-Americans and Chinese) were primed with interdependent icons (e.g., Chinese dragon, the Great Wall) versus independent icons (e.g., American flag, the Superman), they were more likely to choose a compromise alternative (i.e., an option with medium values on two different attributes) over the extreme options (i.e., options with a high value on one attribute and a low value on another) when choosing between such products as candy, cameras, stereo sets, or computers. When asked to pick two pieces of candy, interdependent-primed participants were more likely to choose two different candies than two pieces of the same candy. To the extent that choosing the compromise alternative reduces the risk of social embarrassment and post-choice regrets, it arguably demonstrates prevention focus (Higgins, 1997, 1998), or loss aversion (Kahneman & Tversky, 1979). Thus, these results suggest that individuals who are with an interdependent mindset are more risk averse.

Hamilton and Biehal (2005) also found that American students who were primed with an independent self-construal (by reading text: “Remember, enjoying your life is what it is really all about”) were more likely to make a risky investment choice (i.e., a more volatile investment that can offer higher payoffs but also with higher risks) compared to participants who had an interdependent self-construal prime (by reading text: “Remember, relationships are what it is really all about”).

However, we suggest that results of research using primes to activate independent or interdependent self-construals need to be interpreted cautiously. For example, the American culture is perceived to be adventurous and risk seeking by Asians, but also Americans tend to see Asian culture in a similar way (Hsee & Weber, 1999; Li & Fang, 2004). One possibility is that when participants are primed with construals that are different from their culture, they might respond in ways consistent with their stereotyping of that culture. This kind of stereotyping also exists for both genders in terms of time and risk preference, however, experiments found the

opposite results (e.g., Weber et al., 2002) (also see identity salience effects in Benjamin et al., 2010). In other words, using priming to elicit other-culture self-construal might activate an individual's thinking how a person from a non-predominant culture should think, rather than their predicted object's real thinking.

On the other hand, some indirect evidence also suggests that Caucasians might be more tolerant of risk than Chinese. For example, an early study (Hong, 1978) showed that, when compared with Chinese, Americans were more likely to recommend that others should choose a risky option (e.g. an insecure job whose future can be very prosperous) over a safer alternative (e.g. a job with a secure but undistinguished future). In contrast, deliberation helped Chinese become significantly less risk-seeking to make decisions, especially when required to produce consensus risk-taking advice in groups.

In a series of studies, a group of psychologists (Bontempo et al., 1997; Hsee & Weber, 1999; Weber & Hsee, 1998; Weber et al., 1998) found that Chinese are significantly more risk tolerant in financial decision making than Americans, which finding is contrary to the lay image. To account for this counterintuitive finding, they argued that members of collectivist cultures like Chinese may be able to take greater financial risks because their interdependent social network serves as a 'cushion' that protects them from financial troubles. They propose that in collectivistic societies, family or other in-group members will step in to help a group member who suffers a large loss. In other words, interdependents have a larger support system or safety net than members of individualist cultures. Because of this cushion, Chinese would be more likely to choose risky options than members of more individualist cultures.

The "cushion theory" has been supported by some research (e.g., Agarwal, Chomsisengphet, & Liu, 2011; Fan & Xiao, 2006; Mandel, 2003). However, there are also studies which have failed to support its predictions. Some studies did not find that Chinese or other collectivistic ethnics (e.g., Israeli Arabs) had a larger network to protect against financial

risk (Li, Bi, & Zhang, 2009; Li & Fang, 2004; Mahajna, Benzion, Bogaire, & Shavit, 2008). Lau and Ranyard (2005) challenged the view that Chinese preferred risky options because they had more social support, arguing that it was not credible. In Chinese society, serious involvement in gambling activities is a social stigma, and being able to get financial support from social networks is thus doubtful. Li et al. (2009), Li and Fang (2004) also suggested that Chinese social networks could be viewed not only positively as a cushion, but also negatively as a potential burden in that decision makers would know that they could harm their family and friends if they failed, increasing the magnitude of potential losses. Thus, it is uncertain whether an interdependent social network can unambiguously provide a ‘cushion’ that increases the likelihood of risky decisions. In any case, cultural differences about the perception of risk and its role in decision making should be further investigated in future research.

#### **4.4.3 Differences in Delay Discounting between Gamblers and Non-Gamblers**

Results showed that although there was no significant overall difference in delay discounting between gamblers and non-gamblers, there was a significant interaction between amount and gambling status. Compared to non-gamblers, the gamblers showed a reduced magnitude effect. Delay discounting rates (as measured by AUC) were lower for small (\$50) rewards but higher for large (\$5,000) rewards compared to non-gamblers, leading to a smaller magnitude effect.

These results are consistent with several previous studies which have found that gamblers discount delayed rewards more steeply than controls, showing impulsivity (Dixon, Marley, et al., 2003; MacKillop, Anderson, Castelda, Mattson, & Donovan, 2006; Petry, 2001a; Petry & Casarella, 1999). However, Holt et al. (2003) compared delay discounting between college undergraduate students categorized as gamblers ( $\text{SOGS} \geq 4$ ,  $M = 6.5$ ) and non-gamblers ( $\text{SOGS} \leq 1$ ,  $M = 0.3$ ). In Holt et al.’s study, delay discounting rates for gamblers were lower than those

for non-gamblers, although the difference was not statistically significant. Madden et al. (2009) found that delay discounting rate was higher for treatment-seeking pathological gamblers (mean of SOGS = 13.3) than a control group (mean of SOGS = 0.8) (both  $Ns = 19$ ), but the difference was not statistically significant. Overall, results of prior studies are somewhat mixed, but the present results suggest that for relatively large amounts, gamblers have higher rates of delay discounting than non-gamblers.

There is a consensus that problem gambling (PG) is associated with increased impulsiveness as evidenced by higher rates of delay discounting and scores on impulsivity questionnaires (Alessi & Ptery, 2003; Dixon & Holton, 2009; Dixon, Marley, et al., 2003; MacKillop et al., 2006; Petry, 2001b; Petry & Casarella, 1999; or see Holst et al., 2010; Petry & Madden, 2010, for reviews). Pathological gambling is included in the diagnostic group of impulse-control disorders not elsewhere classified in DSM-IV (APA, 1994), and a number of studies have reported that pathological gamblers' impulsivity scores are higher than those of controls using measures such as the Eysenck Impulsivity scale (Alessi & Ptery, 2003; Blaszczynski, Steel, & McConaghy, 1997; Madden et al., 2009), BIS-11 (Castellani & Rugle, 1995; Fuentes, Tavares, Artes, & Gorenstein, 2006; Sáez-Abad & Bertolín-Guillén, 2008; Skitch & Hodgins, 2001), or both scales (Myrseth, Pallesen, Molde, Johnsen, & Lorvik, 2009). In the present study, we found that gamblers (as defined according to SOGS scores) reported more gambling-related cognitions than non-gamblers (i.e., had higher GRCS scores), but did not report higher levels of impulsivity according to the BIS-11.

A primary motivation for Experiment 4 was to test whether individual differences in contrast effects in delay and probability discounting might have contributed to problem gambling. Although we did find a significant contrast effect in delay discounting, indicating that the present value of an intermediate reward (\$475/525) varied inversely with the reward amount in the preceding block, similar to Experiments 1-3, this effect did not vary with ethnicity or

gambling status. Thus there is no evidence that gamblers differed from non-gamblers in terms of their propensity to show reward contrast effects, as measured by the intermediate reward tests.

However, our finding that gamblers had an overall reduced magnitude effect in delay discounting may be related to reward contrast because the magnitude effect, which is based on differences in delay discounting for large and small amounts, might be affected by interactions between those amounts within the session. For example, if an individual perceives \$5,000 to be ‘relatively large’ compared with \$50, their preferences might change more substantially, leading to an increased magnitude effect. Our results suggest that gamblers were less sensitive to within-session differences in reward magnitude than non-gamblers, and treated large and small rewards more similarly. A reduction in sensitivity to changes in reward amount could contribute to problem gambling in the following way. Assume that a large stake (i.e., a large number of gambling chips) is similar to a delayed reward, in that it must be later converted to money. An individual with a reduced delay-discounting magnitude effect who has just won a substantial number of chips may be more likely to stake them on an additional bet, in contrast with an individual with a larger magnitude effect who would be more likely to ‘quit while you’re ahead’. Thus, a reduced sensitivity of intertemporal choice to changes in reward amount could contribute to problem gambling by making it less likely for an individual to stop during a gambling session.

#### **4.4.4 Differences in Probability Discounting between Gamblers and Non-Gamblers**

Results of the present study showed that gamblers were overall less risk averse than non-gamblers in the probability discounting task. This finding is generally consistent with those of previous studies. Holt et al. (2003) reported that college student gamblers had significantly more shallow probability discounting functions than a matched group of nongamblers, implying lower rates of probability discounting. The probabilities they applied in the PD task were 95, 90, 75, 55, 30, 10, and 5%. Madden et al. (2009) varied reward probability over a wider range (4 to

97%) and reported that male pathological gamblers discounted probabilistic rewards significantly less steeply than matched controls. Higher SOGS scores were significantly negatively correlated with probability discounting rates. However, Shead et al. (2008) failed to find a significant correlation between degree of probability discounting and college student gamblers' scores on the Canadian Problem Gambling Index (Ferris & Wynne, 2001). Apart from that the majority of their samples (81.4%) were low- to moderate-risk gamblers whose gambling problem might not be severe enough to show difference in PD, the probabilities they used were 95, 90, 75, 50, 25, and 5% – somewhat skewed to medium and high probabilities. The above three studies all used the odds against to transform data and used either AUC or  $k$  values from fits of hyperbolic models to estimate discounting rates. The present study confirms that gamblers are overall more risk-seeking than non-gamblers.

Although the AUC results for probability discounting showed no evidence that the magnitude effect differed for gamblers and non-gamblers, analysis of indifference points found that gamblers were less risk averse for large amounts (\$5,000) when the reward uncertainty was high. This suggests that the magnitude effect in probability discounting depends on the level of uncertainty for gamblers, and could contribute to problem gambling in terms of encouraging risky decision making with large stakes.

#### **4.4.5 The Card Playing Game (CPG)**

Results from the CPG were similar to Experiment 3 in terms of showing improvement over successive decks and depended on order with which the \$50 and \$5,000 stakes were encountered. Thus, like Experiment 3, we were unable to measure reward contrast effects within participants. In addition, although the performance in the second block with \$500 stake was greater for participants who had \$50 in the first block, similar to Experiment 3, the difference was not significant. However there were some findings which suggested that the CPG is

potentially useful as a test of gambling-related behavior. Chinese gamblers performed significantly more poorly than Chinese non-gamblers in the third and fourth decks, and overall, SOGS scores were correlated with CPG performance such that individuals with higher SOGS scores played more cards and had less money at the end of the fourth deck. The lack of a significant difference between Caucasian gamblers and non-gamblers may have been due to the fact that overall SOGS scores for the Caucasian gamblers were lower than for the Chinese. In addition, CPG performance was correlated with probability discounting rates such that individuals who were less risk averse performed more poorly on the CPG. This suggests that the CPG, as implemented here as a computer-based task, has some ecological validity as a simulation of gambling behavior.

#### **4.5 BIS-11 Scores Were not Different between Caucasian and Chinese**

It has been frequently reported that BIS-11 is a reliable and valid tool to measure impulsivity of disordered behaviors (e.g., problem gambling) (e.g., Castellani & Rugle, 1995; Fuentes et al., 2006; Sáez-Abad & Bertolín-Guillén, 2008; Skitch & Hodgins, 2001), so is the delay discounting task (e.g., Bickel & Marsch, 2001; Green & Myerson, 1993; Rachlin, 1995).

BIS-11 scores were not different between Caucasian and Chinese although the Chinese delay discounting rates of \$50 and \$5,000 were lower than Caucasian. In Baumann Neves' (2008) thesis, she also reported that while Latinos had higher delay discounting rate, their scores did not differ from the European Americans on the BIS-11. The results of Baumann Neves (2008) and present study indicate that the BIS-11 might not be an appropriate instrument for measuring differences in impulsivity across different national groups. This further suggests that in decision making of time preference, there would be cultural factors involved.

#### 4.6 Age Difference between Caucasians and Chinese

Finally, one potential limitation of the present study needs to be acknowledged. Despite our attempts to recruit Chinese and Caucasian gamblers and non-gamblers that would be similar in terms of other demographic variables, overall the Chinese participants were older than the Caucasians. As a result, they were also more likely to have completed post-secondary education and less likely never to have been married or lived with a partner. The difference in overall age was not large ( $M_s = 31.22$  and  $25.17$  years for Chinese and Caucasians, respectively) but is a potential confound. However, there are several reasons to believe this difference does not challenge our conclusions. First, previous studies which have reported effects of age on delay discounting rates (e.g., Green, Fry & Myerson, 1994) have compared individuals across the lifespan, from childhood to older adults. The general finding from research using the delay discounting paradigm has been that discounting rates decrease across the lifespan, and were lowest for older adults ( $M = 67.9$  years in Green et al.'s study; see also Green et al., 1996). But other studies have found a curvilinear relationship between age and discounting, with middle-aged people having a lower rate than either younger or older adults (Read & Read, 2004). In Experiment 4, we found that delay discounting rates were higher for Chinese participants than Caucasians. Thus based on results of prior studies, any impact of age in Experiment 4 should have mitigated against the effect we observed.

We are not aware of any previous study which has compared rates of probability discounting for older and younger adults. However, Scheres et al. (2006) compared both delay and probability discounting for children and adolescents and found that although delay discounting rates were lower for adolescents (consistent with Green et al., 1994), rates of probability discounting did not vary with age. Similar results were obtained by Olson et al. (2007). Thus there is no reason to expect, based on previous studies, that the age difference

between Caucasian and Chinese participants represents a major threat to the validity of our conclusions.

## Chapter 5 General Discussion

Understanding how people make decisions when rewards are delayed or uncertain is an important goal for research. Through a series of experiments, this thesis aimed to make contributions to the study of decision making under risk and of time, especially from a cross-cultural perspective and in an attempt to understand factors which might contribute to problem gambling. In this section we will provide a more detailed and integrating discussion of what our experimental results have demonstrated.

### 5.1 Reward Contrast

Our starting point was to investigate a potential effect of reward contrast in delay and probability discounting. Experiments 1 and 2 confirmed that a reward contrast effect was obtained for delayed and probabilistic rewards (hypothetical amounts of money) using both a between-subjects (Experiment 1) and within-subjects (Experiment 2) design, suggesting that the subjective value of an intermediate reward was perceived as relatively larger or smaller, respectively, if it followed choices involving a smaller or larger reward. In Experiment 3 we tested whether similar reward contrast effects could be observed in a simulated gambling task (Card Playing Game; CPG). Experiment 3 also successfully replicated the within-subjects reward contrast effect for delay discounting with a different participant sample. Although participants improved across repeated CPG blocks, confounding our attempt to measure reward contrast within-subjects, we did observe a contrast effect between-subjects: Participants who had a \$50 stake in the first block performed better in the second block, with a \$500 stake, than participants who had a \$5,000 stake in the first block. Moreover, we found that reward contrast, measured within-subjects in a delay-discounting task, was negatively correlated with CPG performance, suggesting that participants who were more susceptible to reward contrast performed more poorly on the CPG task. Experiment 4 replicated the reward contrast effect for

delay discounting but not probability discounting, and also failed to find a significant between-subjects contrast effect in the CPG task (although results were in the predicted direction). Experiment 4 also failed to observe significant correlations between reward contrast (delay discounting) and CPG performance. In addition, there were no significant differences in reward contrast depending on ethnicity or gambling status.

Overall, the present results suggest that reward contrast is a reliable phenomenon, particularly for delay discounting. In addition there was some evidence of reward contrast in the CPG. However, the failure to find significant correlations between reward contrast and CPG performance in Experiment 4, as well as significant differences based on gambling status and ethnicity, suggests that individual differences in reward contrast, as measured by our within-subjects delay-discounting procedure (Experiment 2) are not a major contributor to problem gambling.

Why we observed significant correlations between reward contrast in Experiment 3 but not Experiment 4 is unclear. One possibility is that participants may have been fatigued by the greater number of tasks to be completed in Experiment 4, which required between 40 – 60 minutes to complete. Future research might use a more limited testing protocol, or assess participants over multiple sessions. Another possibility might be that our contrast test – in which an intermediate reward was assessed at a 1-year delay or 70% probability – may have been too limited because it did not examine a range of delays or probabilities. Finally, the reward contrast effects may have been too small, particularly in Experiment 4, to have reliable correlations with other variables, given the sample sizes used in the present research. In Experiment 2, the present value (PV) of the intermediate reward changed by 11% and 7%, respectively, in the delay and probability tasks depending on the magnitude of the prior reward. In Experiment 3, the PV changed by 10% for delay discounting, and in Experiment 4, by 3% and 1% (not significant) for delay and probability discounting, respectively. Thus the magnitude of the contrast effect was

smaller in Experiment 4 compared with the previous experiments, which likely contributed to the reduced correlations.

However, one notable result from Experiment 4 is that the magnitude effect in delay discounting (defined as the difference in AUC values for standard rewards of \$5,000 and \$50) was smaller for gamblers than non-gamblers, and was correlated with poorer CPG performance. Arguably, the magnitude effect may be related to reward contrast because both effects may depend on the degree of interaction between amounts over successive choices. A reduced magnitude effect suggests that gamblers may be less sensitive to variation in reward amount across choices. As previously discussed, this reduction in sensitivity might contribute to problem gambling to the extent that it encourages impulsive decisions when relatively large amounts are involved. Thus, results of the present study suggest that not only do we need to consider whether gamblers differ from non-gamblers in terms of their overall rates of delay and probability discounting, but also whether they show differential sensitivity to changes in amounts over a series of choices. Given that real-life gambling involves a stream of betting decisions, elucidating how different amounts involved in successive choices interact, whether in terms of reward contrast or magnitude effects, may contribute to an understanding of the factors which contribute to problem gambling.

## **5.2 Differences in Delay Discounting between Chinese and Caucasians**

Experiment 4 showed that Chinese participants had overall higher rates of delay discounting than Caucasians. For the \$5,000 rewards, the average AUC for Caucasians was 0.58 compared to 0.46 for Chinese, which was a medium effect size, Cohen's  $d = 0.46$ . Here we consider some possible reasons for this cross-cultural difference.

Regulatory Focus Theory posits two separate and independent self-regulatory orientations – promotion and prevention (Higgins, 1997, 1998; Pennington & Roese, 2003). In comparison

with Caucasians who focus more on the anticipated positive experience of a decision (i.e., gains achieved), Chinese (or broadly speaking, interdependent cultures) are more concerned with avoiding negative consequences than attaining positive ones (i.e., losses avoided), and thus often behave in ways that attempt to minimize the likelihood of negative consequences (Aaker & Lee, 2001; Briley & Wyer, 2002; Fong & Wyer, 2003; Lee et al., 2000; Lee & Semin, 2009). In terms of Prospect Theory (Kahneman & Tversky, 1979), the prevention-focused orientation can be seen as *loss aversion* and a strong degree of loss aversion typifies Chinese culture.

For example, Lee et al. (2000) described a conversation that was overheard between a Chinese immigrant mother in a Western country and another parent as the two waited to pick up their children from school:

“My daughter thinks going to school here is just wonderful! In Hong Kong, if my daughter were to score 9 out of 10 in her dictation, her teacher would reprimand her for missing the one word. But here, the teacher compliments her on knowing the 9. The system here is so different—they focus on what you do well, not on what you don’t” (p. 1122).

The cultural differences implied in this conversation suggests that Western culture places more emphasis on achievements and positive information and tends to ignore negative evaluations (e.g., Frey & Stahlberg, 1986). In contrast, under the influence of the doctrines of Confucianism, East Asian culture focuses more on fulfilling obligations, obeying social roles, maintaining connections with others to fit in harmony and avoiding mistakes, which might contribute to a prevention-focussed orientation (e.g., Lee et al., 2000).

A possible resolution of the apparent contradiction between the greater delay discounting rates for Chinese in the present study and the ranking of Chinese at the top of long-term orientation (LTO) in Hofstede’s (2001) cultural dimensions may be found in a study by Lee, Lee and Kern (2011). In their Study 2, students with culture identities of East Asian (Chinese, Korean and Japanese – all East Asian countries score the highest of LTO in Hofstede (2001) and European Americans responded to a series of questions in an online survey. Participants were

asked to imagine a scenario to work for an incoming project to help in a Children's Festival with an organization. After reading the descriptions of the scenario, participants were asked to predict when the festival would happen (a week to one year from now), their feeling about the project (the extent of happiness and disappointment), and how long the positive consequences of the festival (e.g., community enthusiasm) would last (2 weeks to 2 years). Their results showed that East Asians predicted the festival to take place sooner but also expected the community's enthusiasm to last longer in comparison to their European American counterparts. In other words, East Asian culture is associated with a proximal temporal distance (i.e., coming sooner), meanwhile more long-term oriented (i.e., lasting longer) than Western culture. Lee et al.'s (2011) study confirmed that the LTO scores in Hofstede (2001) do measure a long-term dimension. However, the interpretation of East Asian scores of LTO as more "forward looking" or "patient" in comparison to Westerners should be made with caution.

Another integrating explanation for the lower delay discounting rate of future gains for Chinese would be the 'temporal asymmetry effect', that is, the differential weighting of the value of past and future events. Studies conducted in Western societies have demonstrated that people report having more intense emotions when they imagine a future event than when reflecting on that same event in the past (e.g., D'Argembeau & Van der Linden, 2004; Van Boven & Ashworth, 2007). This leads people to value future events more intensely than past ones. For example, European Americans are found to expect more payment for a job done in the future than for an equivalent job that has been done in the past (Caruso, Gilbert, & Wilson, 2008). Similarly, judgement of future moral violations (e.g., fairness and unfairness) is more negative than past ones (Caruso, 2010). Because European North Americans generally assign greater value and emotions to future events, they may be more willing to pay for innovations and upgraded products, whereas Chinese tend to attach more emotions and values to past events than to similar future ones (Guo, 2008; Ji, Guo, Zhang, & Messervey, 2009). For example, Levinson

and Peng (2007) found that the 'value estimation ratio' (i.e., the ratio of estimated current value to past value) of an antique chair for Chinese was much greater than that for Americans.

In terms of consumer decision making, Chinese exhibit more brand loyalty than Caucasians (e.g., Lowe & Corkindale, 1998; Yau, 1988). Chinese commercial advertisements are more likely to contain historical, time-honored cues, an elderly person or symbolic icons/models (e.g., Cheng & Schweitzer, 1996; Lowe & Corkindale, 1998). More generally, people in more interdependent societies may be less likely to buy new and different products, and are more likely to repeat their previous choices and consumption patterns (Steenkamp, Hofstede, & Wedel, 1999; Yaveroglu & Donthu, 2002; Yenyurt & Townsend, 2003).

This cultural difference of assigning relatively more (or less) value to the past versus present may be understood in terms of Chinese education. Traditionally, education in China emphasized the memorization of good exemplars from the past and application of those exemplars to present situations, rather than the development of new thoughts and ideas. According to this view, the most effective way to learn is not to have a debate over competing ideas but to find well-established truth and to internalize it. Rather than treating a problem as a new question, Chinese rely more on following good examples from the past (Gardner, 1989; Seok, 2007). Indeed, Ji et al. (2009) found that Chinese attended to a greater range of past information and remembered it in more details than did European Canadians. In their study, participants read a description of a theft case with clues that occurred in the remote past, recent past, or present. They found that Chinese participants rated behaviors that occurred in the remote and recent past as more relevant to the case, and remembered more of the past cues in a subsequent recall task, compared to the European Canadians.

Guo (2008) and Ji et al. (2009) attributed the Chinese weighting more on the past to their cyclical notion of time. According to the cyclical notion of time, past events are repeated in the future, and so the future will be similar to the past (Zuo, 2001). This repetition leads to expected

similarities between past, present, and future. Consequently, problems in the present or future can be resolved by focussing on the past and respecting tradition. If practices in the past have worked for countless generations, it is wise to respect tradition and follow the past (Brislin & Kim, 2003; Yau, 1988; Zuo, 2001). Because the future is less certain and more changeable than the past, it should therefore be valued less. In contrast, the strong future orientation of Western cultures may be rooted in a more linear notion of time, such that time is assumed to go ceaselessly forward and never return to a previous state (Zuo, 2001).

Some research also suggests that that Caucasian and Chinese have different conceptions of time. For example, Mandarin speakers are more likely than English speakers to conceive and talk about time more vertically (i.e., with earlier time-points above and later time-points below) and moving, while Europeans have been shown to construct representations of time that are horizontal and stationary (Boroditsky, Fuhrman, & McCormick, 2011; Ji et al., 2009).

As Leu et al. (2010) noted, “While ‘finding the good in the bad’ is a cross-culturally shared attitude towards negative situations, ‘finding the bad in the good’ in positive situations is only meaningful from a dialectical perspective” (p. 8). Cultural differences in emotional complexity remain when different potential biases (e.g., response styles, modesty bias, social desirability) are included as covariates in statistical analyses (Bagozzi et al., 1999; Hui, Fok, & Bond, 2009; Schimmack, Oishi, & Diener, 2002), and are also observed with open-ended questionnaires (e.g., Leu et al., 2010). Maddux and Yuki (2006) referred to the expectation of change among East Asians as a “ripple effect,” referring to their tendency to include more causes and consider more consequences when explaining events, compared to Americans.

The above accounts seem to provide an explanation for Chinese placing more value on the past than Caucasians, as the name of the ‘temporal asymmetry effect’ itself would suggest. However, we propose that this effect could also reflect a tendency for *dialectical thinking* (e.g., Peng & Nisbett, 1999) among Chinese. According to this view, when facing future gains,

Chinese would be concerned about the potential unachievability of the rewards, and thus try to obtain them as soon as possible, or value the proximal rewards more than the distant rewards. Results which are consistent with a long-term orientation – for example, the greater emphasis on educational attainment, high savings rate, and reduced use of credit cards for Chinese compared with Caucasians, might be explained in terms of Chinese having a stronger loss aversion, rather than differences in temporal perspective. For example, Chinese might be concerned more about losing in the future competition of a labor market, and thus invest more in education. Investment in education (Hartog & Bajdechi, 2007) could also be explained by the Chinese focus on family's reputation and concern with losing face. Holding a higher savings rate, and less likely to use credit cards would have more direct explanation from loss aversion, that is, concern about financial danger. These cultural differences may be understood in the framework of Prospect Theory, and will be discussed in a later section.

### **5.3 Differences in Probability Discounting between Chinese and Caucasians**

Results of Experiment 4 showed that Chinese were less risk-averse than Caucasians overall when making decisions about probabilistic rewards when data were analyzed in terms of the area under the discounting function (AUC). This result is consistent with previous studies (e.g., Du et al., 2002; Hsee & Weber, 1998). However, analyses of individual indifference points revealed an interaction between ethnicity and probability, but no significant main effect: Compared to Caucasians, Chinese were more risk averse for rewards with high probability but less risk averse for rewards with low probability. Du et al. (2002) is the only prior study that has used a comparable methodology (i.e., obtaining indifference points for a range of reward probabilities) to compare probability discounting of Chinese and Westerners (Americans). They only reported ethnic differences in terms of AUC values. Our results confirmed the overall difference between Chinese and Caucasians in terms of AUC values, but when the data were examined at a more

disaggregated level a more nuanced picture emerged, in which Chinese were less risk averse for low probability outcomes.

In the following sections, we attempt to provide an explanation for this result. First, we consider some alternative explanations for a difference in risk perception between Chinese and Westerners. Then we consider some methodological reasons why different results might have been obtained in Experiment 4 when PD data were analyzed in terms of AUC or indifference points. Next we review literature which suggests that Chinese may differ from Westerners in terms of dialectical thinking and emotional responses to risk. We then propose a framework for the cross-cultural study of decision making under risk. We begin by reviewing philosophical arguments related to the intellectual history of China, which support our claim that Chinese may have a different cognitive and emotional style which affects their worldview and may contribute to the empirical differences observed in Experiment 4.

#### **5.4 Alternative Explanations of Differences in Attitudes toward Risk between Chinese and Caucasians**

From an anthropological perspective, the history of the mathematics of probability theory is much more recent than the linguistic expression of uncertainty, and individuals cannot grasp the abstract conception of the probabilities at early age (e.g., Budescu, Weinberg, & Wallsten, 1988). On the other hand, in many traditional non-Western cultures, the mathematical understanding of probability is absent; phenomena governed by chance are often believed to be controlled by supernatural beings or manifestations of fate (Levy-Bruhl, 1924). The mathematical theory of probability was first translated and introduced into China at the end of 19<sup>th</sup> century, more than three hundred years later after its origin in the West (Guo, 1989). This might contribute to the reduced accuracy and calibration of probabilistic thinking in Chinese (or Asians in general) compared to Westerners (e.g. Harrison, Lau, et al., 2005; Lau & Ranyard,

1999, 2005; Wright et al., 1978; Wright, Phillips, & Wisudha, 1983; Yates et al., 1989), particularly because Chinese has a lesser range of phrases than English to express probabilities and Chinese speakers use them less precisely (Lau & Ranyard, 1999; Xu & Li, 2007). Lau and Ranyard (2005) found that Chinese exhibited both less probabilistic thinking and riskier gambling decisions than English speakers. It is possible that their Chinese participants interpreted the probabilities differently from the English speakers, resulting in different choices. However, studies have found that improved knowledge and skills of probability theory are not associated with actual gambling behavior (Williams & Connolly, 2006), and gamblers and non-gamblers are not different in their knowledge of gambling odds or numerical ability (Delfabbro, Lahn, & Grabosky, 2006; Lambos & Delfabbro, 2007), although educational messages of irrational beliefs before gaming were found to reduce risky gambling behavior (Floyd, Whelan, & Meyers, 2006). Gamblers were also found to endorse rational beliefs about causality both before and after playing a videogame, even though they were likely to show irrational behavior during the game (S é vigny & Ladouceur, 2003). Thus it is unclear whether potentially inaccurate understanding of probability due to language, could explain the prevalence of problem gambling among Chinese and East Asians.

Some words with meanings related to uncertainty may correspond to different probabilities in English and Chinese. Xu and Li (2007) raised an interesting example: When an American leader said, “It’s possible that the nuclear warfare will break out”, the psychological probability of “possible” may be “38%” according to a Western mindset (Budescu et al., 1988). However, when it is directly translated into a matched Chinese word “*ke-neng*” (可能), the Chinese leader may perceive it as “54.99%” (Xu & Li, 2007). Viewed in the context of the finding that Chinese are overall more risk-seeking than Americans, such a misunderstanding could have unexpected and severe consequences.

Based on the collectivist culture, Chinese who are fond of gambling also like to play social games (GAMECS Project, 1999; Kwan, 1997; Latour et al., 2009; Loo et al., 2008), which may be influenced by Confucianism. Overall, Chinese show a preference for social games (such as table games like baccarat and mahjong) than individual games (like slot machines) (e.g., Loi & Kim, 2010; Wang & Eadington, 2008). Lam (2007a) observed that Chinese baccarat players liked the exchange of ideas and discussion of betting strategies that occurred during game play; these aspects are similar to those of mahjong (Zheng, Walker, et al., 2010). Players also enjoy collaborating with each other by betting on the same side to beat the house (Lam, 2007a).

### **5.5 Problems with the Analysis of Probability Discounting Data with Odds Against and the Area Under the Discounting Curve**

The likelihood of the occurrence of an uncertain outcome can be interchangeably expressed in terms of probability or odds. For example, if the winning chance of a bet is 20%, the *probability* of winning is  $p = 20\%$  or 0.2, and the probability of losing is therefore  $1 - p = 1 - 0.2 = 0.8$ . In contrast, *odds* is expressed as the ratio of the probability that the event occurs to the probability that it does not, and *odds against* is the reciprocal of the odds. Specifically, odds is  $p:(1 - p)$  or  $\frac{p}{1 - p}$ , and the odds against is  $\frac{1 - p}{p}$ . For the bet mentioned above, the odds is  $2:8 = 0.25$  and the odds against is  $8:2 = 4$ .

The technique of odds against was first introduced in the study of probability discounting by Rachlin, Raineri, and Cross (1991). The primary advantage of odds against is that it provides a measure analogous to delay that can vary from zero to infinity, and the value of a probabilistic reward decreases as the odds against increases. Rachlin et al. (1991) showed that probability discounting data plotted as a function of odds against were well described by a hyperbola, similar to delay discounting. Thus use of odds against allows for the potential integration of delay and probability discounting in terms of a common functional relationship.

However, odds against has some disadvantages because it is a ratio. As illustrated in Figure 5.1, probabilities  $\geq 50\%$  are mapped to the range from 0-1, and probabilities  $< 50\%$  are mapped from the range 1 to infinity. Thus a greater portion of the range of odds against is associated with small probabilities ( $< 50\%$ ), and the resulting distribution is skewed toward small probabilities (high odds against). Therefore low probabilities will have relatively more influence on estimating discount rates if using overall AUC. If estimates of  $k$  from fits of a hyperbolic function are used, then discount rates for both low and high probabilities will be biased.

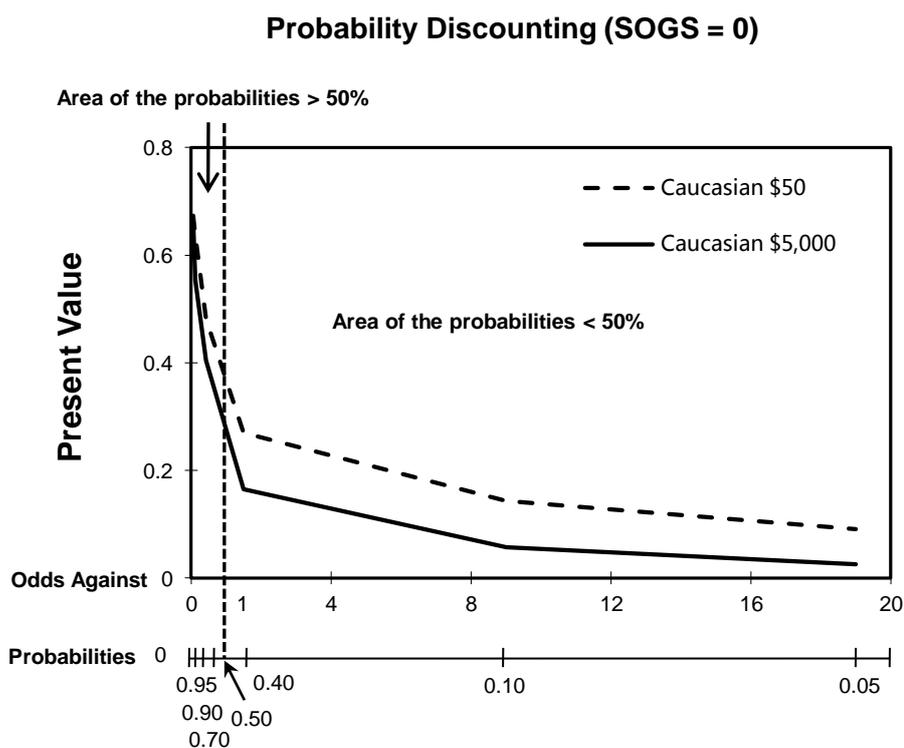


Figure 5.1. An illustration of the problem with odds against as a transformation of probability (data from Experiment 4)

The skew induced by the use of odds against explains why there was a significant main effect of ethnicity when the PD data were analyzed in terms of odds against, but only a significant interaction between ethnicity and probability when indifference points were analyzed separately for each probability. The interaction indicated that Chinese had higher indifference points (indicating lower PD rates) for low probabilities than Caucasians, but lower indifference points (indicating higher PD rates) for high probabilities. However when AUC was used, only

the main effect was significant because the low probabilities (for which the Chinese had lower PD rates) dominated. Thus, use of AUC values obscured a more nuanced relationship between ethnic differences and reward probability.

## **5.6 Dialectical Thinking and Chinese Emotional Complexity**

In many ways, Chinese and Western worldviews appear to be philosophically distinct. From the times of ancient Greece, Western thinking has been characterized by its analytic, atomistic and linear view, which focuses on salient objects and their categories or attributes. According to this view, objects are seen as distinct, discrete, and separate from their environmental context. By contrast, Chinese (or arguably East Asians in general) have a holistic, contextual and cyclic view, which emphasizes continuity over time and relationships between objects and their environment (see Nisbett, 2003; Schneider, 1990).

Chinese (or East Asian) culture has been greatly affected by three philosophical traditions: Confucianism, Taoism, and much later, Buddhism (Cheung & Chow, 1999; Child & Warner, 2003; Fan, 2000; Nisbett, 2003). In terms of their cultural influences, Confucianism focuses heavily on the concept of relationship, Taoism seeks to promote the inner peace of individuals and harmony with their surroundings, and Buddhism deals with people's immortal world, including beliefs about spiritual transformation, karmic cycles and reincarnation. Confucianism and Taoism are both indigenous Chinese philosophies and are the foundation of Chinese thought. Buddhism was imported to China from India around approximately 100 A.D. The Buddhist doctrine of "rebirth" has enabled many Chinese to endure hardship and suffering while looking forward to a better future – if not in the present life, then the next. Most Chinese (especially Han Chinese) practice a syncretistic combination of Confucianism, Taoism, and Buddhism as a practical guide for living. The important influence of Confucianism on Chinese culture has been

long recognized, however, the influence of the other two doctrines, especially Taoism, has just received extensive attention in the last decade or so.



**Figure 5.2.** *Yin-yang* symbol (From: Spencer-Rodgers, Williams, & Peng, 2010)

Tao can be translated into English as “the way” or “the path” (e.g., Peng, Spencer-Rodgers, & Zhong, 2006), indicating “the way it is” or “the natural or reasonable law or rule” (Lee, 2000). Taoism was developed by the philosopher Lao-Tse during the 6th or 4th century B.C. He tried to articulate a philosophy that would help to avoid the feudal warfare and other conflicts that consistently disrupted society during his lifetime (Kwan & Ofori, 2001). The basic doctrines of Taoism emphasize the notions of change, connection, compromise, covariation, context, and contradiction (Peng et al., 2006). Thus Taoism encourages an individual to view the world from multiple perspectives, and thus dialectical thinking. Another view of the origin of Chinese paradoxical logic or thinking is much earlier than Lao-Tse’s Tao. Tao is well illustrated in the yin-yang symbol (Figure 5.2) which is rooted in the *I-Ching* or “The Book of Changes” formed 5,000 years ago. Lao-Tse, Confucius and even almost all ancient Chinese scholars were greatly influenced by it (see Lee, 2000). The yin-yang image is known as the symbol of Taoism, a cosmic symbol of primordial unity and harmony, graphically representing the balance of

opposites in the universe in contrast to the Western view of paradox as exclusive opposites. The yin-yang image is illustrated in a circle being equally divided by a curved line forming the black and white areas. Yin represents feminine, dark and passive, whereas yang represents masculine and light and active elements (Chen, 2002; Child & Warner, 2003; Nisbett, 2003; Peng & Nisbett, 1999; Spencer-Rodgers, Williams, et al., 2010). Spencer-Rodgers, Williams, et al. (2010) concluded six fundamental elements that the yin-yang symbol depicts: Holism – the outer circle represents the concept of context which emphasizes the holistic view rather than the focal object; duality – reflected in the symmetry of the black and white areas; interconnection – the inner elements of the circle are inextricably linked to one another, representing the holistic thinker’s view that all aspects of the world are interconnected; contradiction – the black dot and the white dot represent the “seeds of their opposite” and together form a dynamic unity; change – the swirl symbol reflects continual movement, indicating that the universe is in a state of flux and that objects, events, and states of being in the world are forever alternating between two extremes or opposites; and cycle – the white dot will become the black dot over time (and vice versa), in a never-ending cycle of change and renewal.

The yin-yang philosophy offers Chinese a dialectic worldview, a paradoxical yet balanced approach to life. Influenced by Taoism, Chinese believe that in a universe that is perceived as context dependent, inextricably interconnected, constantly changing, and inevitably contradictory, individuals are more inclined to anticipate change and adopt a compromise rather than an extreme approach. All these elements contribute to the Chinese dialectical thinking style (Peng & Nisbett, 1999; Peng et al., 2006)<sup>14</sup>. The Tao is considered to be the highest goal of intellectual life and the defining motivation for Chinese thinking and behavior (Peng et al., 2006). In combination, the cognitive tendencies to expect change and tolerate contradiction are

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<sup>14</sup> It’s noteworthy that some principles in Confucianism and Buddhism also contribute to the dialectical thinking (Nisbett, 2003). The phenomena of tolerance for contradiction and the expectation of change have been documented in other cultures, for example, in India (Lee, McCauley, & Draguns, 1999; Ramanujan, 1989; Shweder, 1991). For another instance, Bagozzi et al. (1999) found that Koreans who are under deep influence of Confucianism and Buddhism share similar emotional complexity as Chinese (for the dialectical thinking in other cultures, see more in Chapter 6).

known as *na ĩve dialecticism* (Peng & Nisbett, 1999). Thus, an important aspect of *na ĩve* dialecticism is the concept of change, which asserts that the universe is in a state of flux and that objects, events, and states of being in the world are forever alternating between two extremes or opposites (Peng & Nisbett, 1999).

The Chinese word “*wei-ji*” (危机) might be one of the best examples to illustrate the Chinese concept of paradox. “*wei-ji*”, literally meaning “crisis” in English, is a combination of the characters for “danger” and “opportunity.” *wei-ji* expresses the Chinese view of the dynamic, interchangeable relationship between adversity and opportunity (Chen, 2002; Xie & Wang, 2003). “Crisis is seen not as an insurmountable problem but as a function of transformation, a process in which paradoxical thinking can lead to opportune action” (Chen, 2002, p. 186). In *The Art of War* (550 B.C.), Sun-Tzu writes: “The thinking of the wisest individuals lies in considering both pluses and minuses. Think positively of yourself when in difficulty or in crisis; consider your weaknesses when in a strong position” (cited in Lee, 2000).

In contrast to the Chinese emphasis on a dialectical approach that embraces change, contradiction, relationships and harmony, Western folk beliefs are derived from the ancient Greek philosophers. Western beliefs are rooted in Aristotelian philosophy, which emphasizes identity (constancy), synthesis (reconciliation of contradiction) and extremes (no middle ground) (e.g., Peng et al., 2006). Under the influence of the philosophies from the ancient Greek, Caucasians more tend to take extreme stands, such as attributing good results to themselves and bad events to others. Caucasians are also prone to perceive good events as stable and global, bad events as unstable and specific (Lee & Seligman, 1997). The Greek philosophers made a distinction between an external, objective world and an internal, subjective one. This distinction had been refined through their tradition of debate and curiosity (see Nisbett, 2003). The pre-Socratic philosophy of Democritus (460-360 B.C.) emphasized an analytical view, breaking reality down into smaller, independent objects of study. The Greek word for analysis

(‘ανάλυση’) indicates a ‘loosening’ or ‘breaking apart’. Consistent with this approach, Western philosophy has tended to consider opposing ideas such as self and other, life and death, good and evil, as separate categories that are irreconcilable and therefore paradoxical (Chen, 2002; Schneider, 1990). As Lewis (2000) wrote, “Grounded in the philosophies of Aristotle, Descartes, and Newton, formal logic requires parsing phenomena into ever smaller and more disparate pieces. Yet, formal logic is based on either/or thinking, incapable of comprehending the intricacies of paradox” (p. 761-762).

Moreover, evidence shows that members of East Asian cultures demonstrate a greater preference than Caucasians for proverbs which imply paradoxical expressions, such as, “a wise person can be victim of his own wisdom”, “who knows that a horse is lost is miserable or fortunate” (Fang, 2006; Nisbett, 2003; Peng & Nisbett, 1999; Peng et al., 2006). Scholars have claimed that close to 20% in Chinese proverbs are Taoist in nature (Peng, 1997), and proverbs can be seen as expressions of folk wisdom and cultural heritage (Leung, 1996; Peng et al., 2006; Weber et al., 1998). Research has shown that dialectical lay-beliefs have broad implications for self-view, cognition, emotion, behavior and psychological well-being, attitudes and evaluations, social categorization and perception, and judgment and decision making (see Spencer-Rodgers, Williams, et al., 2010, for a review). Of most direct relevance to the present research, Lun, Fischer, and Ward (2010) found that Asian students tended to rely more on dialectical thinking to solve critical thinking problems than their New Zealand European counterparts.

An emerging body of research has specifically investigated dialectical emotions, that is, the relationship between positive and negative affects, across cultures (Bagozzi et al., 1999; Falk, Dunn, & Norenzayan, 2010; Goetz, Spencer-Rodgers, & Peng, 2008; Hui et al., 2009; Perunovic, Heller, & Rafaeli, 2007; Schimmack et al., 2002; Spencer-Rodgers, Peng, & Wang, 2010; Spencer-Rodgers, Peng, Wang, & Hou, 2004). The major finding of these studies is that among Western societies, people typically report experiencing uniformly positive or negative emotions,

and there is a strong negative association between them. This association holds both within and across individuals, so for someone who reports being happy is unlikely also to report being unhappy; and individuals who are more likely to report being happy are less likely to report being unhappy (e.g., Zelenski & Larsen, 2000). In contrast, there is weaker, null, or even positive relationship between the intensity and occurrence of the two polarized emotions for East Asians. In other words, positive emotions are fully compatible with expressing negative emotions, suggesting a dialectical or paradoxical emotional state. For example, when highly positive events occur for East Asians, there is a tendency not to celebrate the good fortune too strongly, but to acknowledge that things could turn out badly next time; conversely, when negative events occur, the despair is counterbalanced by the self-instruction that things could turn out better next time (Bagozzi et al., 1999). A recent study (Spencer-Rodgers, Peng, et al., 2010) provided direct experimental evidence for that the lay dialecticism among East Asians accounts for cultural differences in emotional complexity (Goetz et al., 2008) in comparison with Westerners. For an instance in decision making, Xie and Wang (2003) set up managerial scenarios to investigate risk-perception and risk-choice patterns of Chinese in the framework of Prospect Theory (gain-loss), along with factors related to information (opportunity-threat framing) and disposition (achievement motive-avoidance motive). Results showed that in some cases Chinese participants violated the reflection and framing effects predicted by Prospect Theory. Furthermore, they found that for Chinese, motivation for achievement seemed to be stronger in the face of adversity, whereas caution was more likely in face of prosperity. Although the primary focus of their study was to better understand risk-taking behavior by Chinese rather than cross-cultural comparisons, their results suggest that predictions of Prospect Theory may also depend on cultural factors, particularly for Chinese, emotional complexity.

In brief, in comparison with Caucasians, Chinese (or East Asians in general) are more likely to expect emotions to undergo a change from the status quo (Spencer-Rodgers, Williams, et al., 2010), and that the direction of change will be the reverse of the current polarity. Cross-

cultural studies (Arkes, Hirshleifer, Jiang, & Lim, 2010; Chen, Kim, Nofsinger, & Rui, 2007; Ji, Nisbett, & Su, 2001; Ji, Zhang, & Guo, 2008) which compared the attitudes of Caucasian and Chinese in stock market decisions support the robustness of this conclusion. These studies have found that Caucasians are strongly influenced by market trends: They tend to predict that recent and current trends will persist, whereas Chinese participants are likely to make decisions based on historical patterns. While Caucasians predict that positive trends will continue, Chinese are more likely to predict a market reversal. Chinese investors are more likely than Caucasians to sell stocks that had appreciated in price (positive framing), but also were less likely to sell stocks that had depreciated in price, showing a disposition effect (i.e., a tendency for investors to hold on to their losing stocks longer than the winning ones). Ji and colleagues (Ji et al., 2001; Ji et al., 2008) proposed that, in financial markets, Chinese would show the gambler's fallacy – that is, the belief that a small-sample trend will reverse itself to correspond to what would be expected over the long run – to a greater extent than North Americans due to Chinese persons' greater belief in change and reversals.

## **5.7 Dialectical Emotions and the Present Results**

The crossover of probability discounting (PD) curves (for collapsed means of \$50 and \$5,000) of Caucasian and Chinese participants at the middle probability range indicates that Chinese showed more risk seeking at low-probability, meanwhile more risk averse at high-probability than Caucasians. As described earlier in Chapter 1 (Literature Review), previous studies have found Chinese to be either more risk seeking or risk averse than Caucasians. The present results are the first demonstration of an interaction between ethnicity and sensitivity to risk, that is, the difference between Chinese and Caucasians in terms of risk aversion depends on whether the reward probabilities are high or low.

Brandstätter et al. (2002) and Li (2011) provided empirical support for the view that both Caucasian and Chinese should show a similar relation between positive/negative emotions and probabilities in the context of risky decision making. That is, attitudes toward risk are influenced by emotions, high-probability events tend to elicit negative emotions (e.g., *fear* of losing to avoid disappointment) and low-probability events tend to activate positive emotions (e.g., *hope* of winning to expect surprise). However, there is a lack of direct cross-cultural comparison in past research. Based on the previous studies reviewed here, in particular the evidence that Chinese have a characteristic dialectical emotion mode (i.e., expecting emotions to reverse) (Goetz et al., 2008), we propose that the cross-cultural differences between Chinese and Caucasians in terms of attitudes toward risk would originate from different emotional perceptions of high- and low-probability rewards.

## **5.8 A Framework for the Cross-Cultural Study of Risky Decision Making**

Weber and Hsee (1998) might be the first who found that the perception of the riskiness of financial investment options is lower among Chinese than Americans, and argue that this difference in risk perception can explain cross-cultural differences in risk preferences. However, our results show that even when the probabilities were given equally and explicitly to them, Chinese still display more risk seeking propensity, however, show more risk averse at high-p than Caucasians.

Kahneman and Tversky (1979) argued that, “In prospect theory, the overweighing of small probabilities favours both gambling and insurance, while the S-shaped value function tends to inhibit both behaviors” (p. 286). Tversky and Kahneman (1992) further proposed a fourfold pattern of risk attitude: Risk seeking for gains and risk aversion for losses of low probability (both overweighing); coupled with risk aversion for gains and risk seeking for losses of medium and high probability (both underweighing). However, these accounts cannot explain the

observation that Chinese tend to weigh more on small-p of gains (i.e., overweighting) and consequently are inclined towards gambling, but meanwhile, weigh less on small-p of losses (i.e., underweighting) and show a reluctance to buy insurance (e.g., Chan, 2009; Wang & Fischbeck, 2004b).

We propose that individuals from different cultures may have characteristic differences in terms of their emotional responses to prospects (i.e., potential choice outcomes) that are relatively likely or unlikely. We refer to such choice outcomes as *relatively-anticipatory-positive-prospects* (RAPPs) and *relatively-anticipatory-negative-prospects* (RANPs). As we have illustrated in Figure 4.11, gains with specified uncertainties would not be universal positive prospects. Prospects with a probability greater than a cutoff criterion are assumed to be RAPP of gains, whereas prospects with a probability less than the cutoff are RANP of gains. Here for simplicity we assume that the cutoff criterion is 50%, although there could be individual differences in its location. Thus, gains of above 50% (or high-p) can be seen as RAPP as those are relatively more likely to happen, whereas gains of below 50% (or low-p) can be seen as RANP as those are relatively less likely to happen. As Goetz et al. (2008) proposed, positive emotions promote approach and appetitive behavior, whereas negative emotions promote escape and avoidance behavior. We suggest that in a decision making context with gains, a RAPP, although likely to occur, could still evoke some fear of loss and encourage a relatively risk-avoiding attitude, whereas RANP, although unlikely, could evoke hope and expectation of surprise, and encourage a relatively risk-seeking attitude.

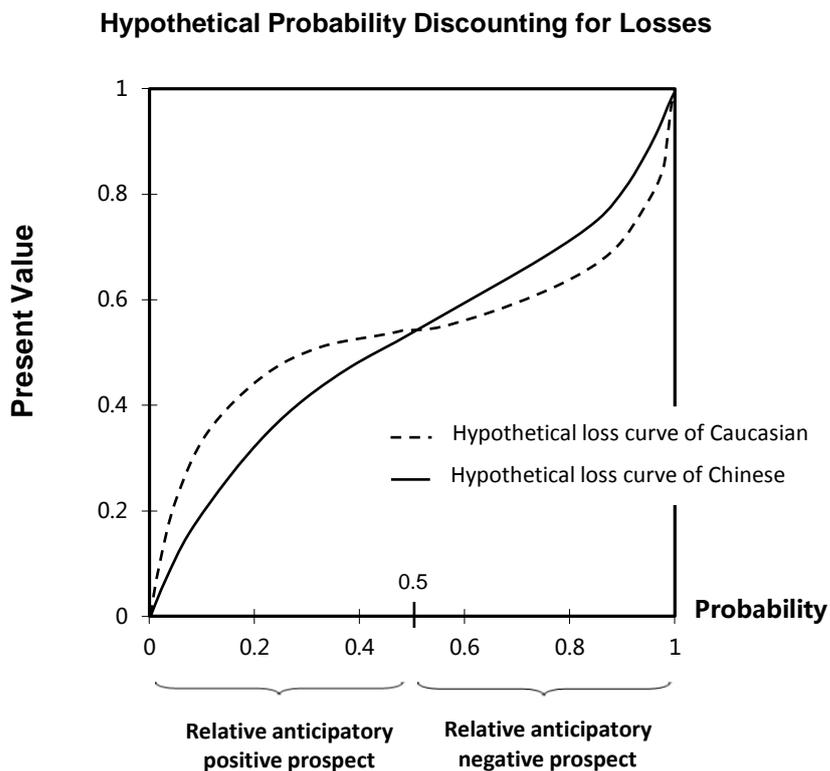
Because of the Chinese tradition of dialectical thinking, they hold more positive attitude on negative events and more negative attitude on positive events. For gains under risk, in comparison with Caucasians, as found in Experiment 4, Chinese showed more risk seeking on RANP (suggesting greater hope on low-p prospects), and more risk averse on RAPP (suggesting greater fear on high-p prospects). Chinese tend to be more risk seeking than Caucasian at low-p

which might contribute to the greater prevalence of problem gambling in the Chinese population. On the other hand, Chinese are prone to be risk averse than Caucasian at high-p which might be able to explain their stronger loss aversion. In a gambling context, Chinese may be more likely to overestimate their chances of winning when the objective probability is low. The present results do not suggest that Chinese are more risk-seeking in general, given that they have a tendency to be less risk seeking for high probability outcomes. However, a tendency to overestimate low probabilities of winning, rooted in dialectical thinking, could provide an alternative explanation of the likely higher prevalence rate of problem gambling in the Chinese community, in addition to accounts such as the “cushion hypothesis” (Hsee & Weber, 1999; Weber & Hsee, 1998). In gambling, the probabilities of winning are typically low given the “house edge” in casinos (Pingle, 2010; Thorp, 1984), but Chinese gamblers may show more optimism to beat and win the “house”.

The opposite risk preference at high and low probabilities between Caucasian and Chinese is supported by other research in behavioral economics conducted in China. In Ma and Shi’s (2002) study, Chinese university students were divided into two groups and assigned high and low value expectancy, respectively. Subjects were asked to make rank order of lottery schemas with various sources and levels of risk based on their risk preference. When they compared their results with another one (MacCrimmon, Stanbury, & Wehrung, 1980) conducted in the America with similar experiment design (the American participants were managers and the incentives were real money), Ma and Shi concluded that when high probabilities involved to receive rewards, Chinese displayed more risk aversion than the Americans. However, when the choice became very risky (i.e., low probability of reward), Chinese were more risk seeking than the Americans. These results resemble the crossover interaction between ethnicity and probability that we observed in Experiment 4.

In the above section, we have observed and interpreted the cross-cultural differences of risk attitudes for gains between Caucasian and Chinese. In the next section, we will make some predictions about cross-cultural differences in situations involving uncertain losses. Our presumption is that overall gains would elicit positive emotions and overall losses would elicit negative emotions. As a result, the emotions attached to the RAPP/RANP should be reversed accordingly. In other words, for gains, RAPP (above 50%) elicits fear to not to gain and RANP (below 50%) elicits hope for surprise. For losses, RAPP (below 50%) elicits fear for losing more and RANP (above 50%) elicits relative hope, or a kind of ‘fluky mentality’, to lose less. For cross-cultural differences of risk attitudes for losses, we predict that Chinese would be more risk averse on RANP and more risk averse on RAPP than Caucasian, actually consistent with their risk attitude for gains, but the emotions involved in the RAPP and RANP for gains and losses are the opposite. That is, Chinese should show consistently more risk-seeking attitudes at low-p for both gains (RANP) and losses (RAPP) than Caucasians, but more risk-averse attitudes at high-p for both gains (RAPP) and losses (RANP), due to influence of dialectical thinking among Chinese.

## 5.9 The Prediction of the Crossover Effect for Losses in PD between Caucasian and Chinese



**Figure 6.1.** Prediction of the crossover effect for losses in PD between Caucasian and Chinese

We have proposed a framework for the analysis of risky decision making in which the high-p and low-p of gains are described in terms of relative anticipatory positive and negative prospects (RAPP/RANP). The emotional response of decision makers to each type of prospect involves both positive and negative emotions. Cultural differences may then be understood in terms of the mixture of emotions evoked by these prospects. In this section, we describe how this framework can apply to decision making about uncertain losses as well.

Losses are assumed to activate the fear emotion (i.e., loss aversion). We propose that when a loss will occur with a low probability it is a RAPP (i.e., a relatively positive prospect) and will elicit fear (i.e., fear of increasing the likelihood of losing), whereas a prospect with a high probability of loss is a RANP and thus will elicit hope (i.e., hope that the likelihood of losing

might be decreased). An individual who experiences hope in the face of a high probability of a loss might be described as expecting a ‘fluke’ or believing in miracles.

Because of dialectical thinking, we predict that Chinese would show more emotional complexity in probabilistic decisions involving losses. Compared with Caucasians, for low-p losses (i.e., RAPP), Chinese should show more risk-seeking (less fear – contrary to the RAPP of gains eliciting more fear for Chinese); whereas for high-p losses (i.e., RANP), Chinese should show more risk aversion (less relative hope – contrary to the RANP of gains eliciting more hope for Chinese). Thus RAPP/RANP show reverse emotional effects for losses and gains. We predict that a crossover effect for losses should occur for Caucasians and Chinese, as shown in Figure 6.1. This prediction could be tested in future research.

The tendency of Chinese to be more risk seeking at low-p of losses can account for their reluctance to buy insurance (e.g., Chan, 2009; Wang & Fischbeck, 2004b), whereas greater risk aversion at high-p of losses indicates an increased loss aversion (Aaker & Lee, 2001; Briley & Wyer, 2002; Fong & Wyer, 2003; Lee et al., 2000; Lee & Semin, 2009). The latter effect may also encourage Chinese problem gamblers to chase their losses (less-p to win, more-p to lose). For example, when asked how much money to pay for a 5% chance of losing \$5,000 (RAPP; the expected value is the loss of \$25), Chinese might be willing to pay \$20, showing risk seeking, but Caucasian might pay \$30, showing risk aversion (similar to purchasing insurance). When asked how much money to pay for 90% of losing \$5,000 (RANP; expected loss of \$4,500), Chinese might like to pay \$4,600, showing risk aversion; but Caucasians might pay \$4,400, showing risk seeking. Pingle (2010) posits that “the thrill obtained from uncertainty may be what motivates the gambler to gamble, and the discomfort of uncertainty may be what motivates the buying of insurance” (p. 8). A greater willingness to buy insurance indicates risk aversion, whereas an unwillingness to buy insurance is risk seeking (also see Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). The finding that Chinese are reluctant to buy insurance is

consistent with their tendency towards risk seeking at low-p losses. In other words, Chinese might believe that low-p events of gains are more likely to happen to them, meanwhile low-p events losses are less likely to occur for them. We will discuss some results from previous studies which may support our hypothesis.

Chan (2009) observed that Chinese often do not believe that misfortunes would occur to them and show little interest to buy insurance. Although the life insurance market has been steadily developing in China, currently it serves more as financial management rather than risk management. Several other studies have found that Chinese are less loss averse than Caucasians in lotteries (Arkes et al., 2010; Hsee & Weber, 1999). Specifically, Wang and Fischbeck (2008) found that Americans are more risk-averse than Chinese on losses with probability = 0.01 in a lottery experiment, showing more risk seeking of Chinese at small-probability of losses. Results of He's (1996) study also suggests that Chinese are more risk seeking at small-probability of losses, although a cross-cultural comparison was not included. He (1996) asked Chinese students to indicate their willingness-to-pay to simulated lotteries and insurances with probabilities of 10, 50 and 90%, and payoffs were varied. The ratio of risk premium to expected value (i.e., how much more than expected value the individual was willing to pay divided by the expected value) was used as a measure of risk attitude. For the same probabilities, the Chinese participants showed greater willingness to pay for the lottery than the insurance. They also rated losses at 10% as significantly less risky than the corresponding gains, showing risk seeking at low-probability of losses in comparison to gains.

Other research has also found that Chinese can show greater loss aversion than Westerners. Levinson and Peng (2007) found that Chinese placed a much higher value on objects that had been lost than those which had been found, compared with Americans. Wang and Fischbeck (2008) reported that Chinese had higher levels of concern for risks with catastrophic potential (i.e., the greatest number of deaths in a single episode), showing risk

aversion when the magnitude of losses was high. Other observations which are consistent with strong loss aversion among Chinese are special beliefs in fate and lucky/unlucky icons (words, numbers and colors etc.) (Chien & Hsu, 2006; Papineau, 2005), fear of losing face (Ho, 1976; Jia, 1998), and emphasis on education (to avoid loss in future competition of labor market and family's reputation). In terms of education, a popular saying between Chinese parents illustrates their concern for potential loss: "Don't let children lose at the starting line!"

The estimation of the more loss aversion under overall negative priming of Chinese than Caucasian also has support from their performance of future gains in DD. The delayed rewards involve uncertainty and Chinese may be more worried about the possible losses of the outcomes, then discount the future gains more (also termed as prevention-focused found in interdependent culture) (Chen et al., 2005; Lee et al., 2000; Lee & Semin, 2009).

#### **5.10 The RAPP/RANP Framework Applied to Intertemporal Choice: Does the Cross-Cultural Difference in Delay Discounting Depend on Proximal versus Distal Delays?**

As previously noted, results of Experiment 4 showed that Chinese had higher rates of delay discounting than Caucasians. There was a main effect of ethnicity when data were analyzed either as AUC or individual indifference points, indicating that the effect was consistent across the range of delays studied (1 month to 10 years). Here we consider the possibility that given a suitably broad range including very short delays, a crossover interaction similar to that observed with the probability discounting data might be obtained. Our reasoning is based on the functional equivalence that has been proposed between delay and probability (i.e., increased delays correspond to decreased likelihood of receiving reward; Rachlin et al., 1986). Thus here we extend the RAPP/RANP framework to make predictions about cross-cultural differences in delay discounting depending on delay magnitude.

There is some evidence from previous studies that symbols of Chinese culture are associated with decreased impatience among bilingual Chinese. Chen, Ng, and Rao (2005) tested the cross-cultural difference of attitude for expedited consumption of merchandise by bicultural Singaporean students under different conditions. They primed the participants with characteristic icons to invoke a particular culture embedded associated with East and Western thinking (e.g., Singapore Airlines model and The Lion Head Statue for Singaporean culture vs. Coca-Cola logo and the Statue of Liberty for American culture). In their Study 1, to measure impatience, participants stated how much they were willing to pay to expedite delivery of a book (novel) by one day rather than wait a standard five-day shipping period. They found that American-primed participants were willing to pay a higher premium and thus valued immediate consumption more than did Singaporean-primed participants. In their Study 2, they measured the impatience directly with two questions: “Right now, I would like to get a copy of the novel as quickly as possible,” and “‘Buy now, get it instantly’ describes how I feel about the novel at this moment.” These two questions can be treated as making a choice between within more extreme short-term delays (e.g., immediately vs. a few hours). They measured the time that participants spent reading the description of the outcome and goal manipulation as a proxy for the amount of attention participants allocated to processing the information. Results of their Study 2 again showed that participants in the U.S.-primed conditions were more impatient than those in the Singapore-primed conditions, confirming their finding in Study 1.

Benjamin, Choi, and Strickland (2010) reported that Asian-Americans showed more patience in real delayed payments (varied from \$3 to \$15) than White Americans when the Asians were asked to respond some ethnicity-related questions (i.e., family languages and immigration history ) as a prime for cultural identity. The time delays they used were one and two weeks. Benjamin et al. (2010) also found that the two ethnic groups had no difference in risk preference, and the probability of winning they used was 58% which might be consistent with

our findings in PD. That is, Caucasian and Chinese had no risk preference difference at medium probabilities in Experiment 4.

On the surface and despite the procedural differences, results of Chen et al. (2005) and Benjamin et al.'s (2010) finding that U.S.-primed Asian or White Americans showed more impatient than Asian-primed participants appears to be contrary to our results in Experiment 4 in which we found that Chinese delay discounting rates of both hypothetical \$50 and \$5,000 were significantly higher than Caucasians as measured by both AUC and individual indifference points. However, it notable that the delays in Chen et al.'s (2005) and Benjamin et al.'s (2010) studies were very proximal, such as immediately, a few days or weeks, whereas delays in Experiment 4 were longer (i.e., 1 month, 6 months, 1 year, 3 years, 5 years and 10 years). Had we included very short term delays (e.g., a couple of hours or days) in the delay-discounting task, Chinese participants may have shown more patience (i.e., lower discounting rates) than Caucasians. Time attitude preference switch between Caucasian and Chinese would be supported by the construal level theory (CLT; Trope & Liberman, 2003, 2010) which posits that people construe different psychological distances to the proximal and distant future.

The results of these studies, together with our probability discounting results from Experiment 4, lead us to suggest that for a sufficiently wide range of delays, a similar crossover effect would be observed in the indifference points for Caucasians and Chinese. That is, some certain proximal delay may serve as the similar function as 50% in PD for which participants' time preference would switch from patient to impatient, similar to the switch for probability discounting at approximately 50%, and the RAPP/RANP framework might be applied to intertemporal choice.

Specifically, Chinese would treat the events in the very near future as more likely to happen (i.e., RAPP) and display a tendency for patience (similar to their elevated risk aversion in probability discounting for high-p gains). By contrast, more distant delays are similar to low-p

gains (i.e., RANP) and would evoke impatience (similar to their risk-seeking in probability discounting for low-p gains). However, this hypothesis is speculative and needs to be explored in future research.

### **5.11 Rethinking the Allais Paradox**

Expected Utility Theory requires that a change in a common consequence does not alter risk preference. However, Maurice Allais (1953) argued that under certain conditions individuals will systematically violate the independence axiom of EUT (see Chapter 1, Literature Review).

Among alternative explanations (see Fox & Poldrack, 2009) of the Allais paradox, the certainty effect and weighting function (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) are probably the most famous. The certainty effect can be also seen as an instance of loss aversion. In the Allais paradox and related decision problems, the role of loss aversion is most evident in the choice between A and B. In this choice, participants are able to avoid the possibility of zero gain. Moreover, the difference between the 0% and 1% probabilities of winning nothing in A vs. B may be perceived as a greater difference than between the 89% and 90% chance of winning nothing in D vs. C. Thus, Prospect Theory provides an explanation for why people may prefer A to B (i.e., prefer a certain reward because of loss aversion) but D to C (because D causes less loss aversion compared to B) (see Oliver, 2003).

The Allais paradox has been replicated in numerous studies (see Fox & Poldrack, 2009; Oliver, 2003), predominantly those conducted in Western countries and for which most of the participants were likely to be Caucasians. However, several studies conducted in Singapore, Hong Kong and mainland China (Li, 1993; Li, 2001; Wu, 2009) reported that Chinese university students responded differently in the Allais Paradox for the A vs. B question compared to results for Caucasians (Note: Some of the studies altered the amount of the small and large amounts proportionally but remained the ratios of probabilities). In the first pair of questions, most Asians

prefer the risky option (i.e., Option B, involving a larger amount with low obtaining probabilities, plus a smaller amount with high obtaining probabilities and a tiny probability of loss) rather than the certain choice (i.e., Option A, smaller amount with certainty of obtaining), although the Caucasians and Chinese had no significant difference to choose option D for the second pair of questions. Based on the results of present study, the Chinese preference for B over A may be due to their risk-seeking propensity (having more hope) at low-probability of gains, and might be meanwhile having less fear at the small probabilities of losses, such as neglecting the 1% of loss in Option B. Chinese respond similarly in the second pair as Caucasians, choosing D over C. In other words, the “preference reversal” based on the “common consequence” in Allais paradox might not be a culturally-universal effect. A detailed discussion is provided below.

We propose that the choosing between A/B and C/D does not involve the same weighting of expected values and that could result in the inconsistency of decision making, also the cross-cultural difference for the A/B choice. Compared to Chinese, Caucasian would give less weight to the “10% chance of \$5 million”, more weight to both of the “89% chance of \$1 million” and the “1% chance of nothing (low-p loss)”. In contrast, Chinese would give more weight to the “10% chance of \$5 million” and less weight to both of the “89% chance of \$1 million” and the “1% chance of nothing (i.e., less averse of low-p losses)”. Thus, Chinese would be more likely to choose B rather than A.

For option C/D, the Russian roulette example given by Kahneman and Tversky (1979) illustrates that the difference in subjective value for probabilities close to certainty is much higher than more uncertain probabilities. As they described, “Most people feel that they would be willing to pay much more for a reduction of the probability of death from 1/6 to zero than for a reduction from 4/6 to 3/6” (p. 283). The probability weighting function is steep near the endpoints (0.0 and 1.0), but more flat in the middle which means that the marginal sensitivity (i.e., slope of the weighting function) is greater near extreme probabilities and decreases as the

probability approaches 0.50. Therefore, the change in psychological magnitude between 10% and 11% chance of receiving, also 89% and 90% chance of losing would be much lower than 99% to 100% chance of a desirable outcome, and 0% to 1% chance of an undesirable outcome. Thus, the preference of D to C might be caused less by the difference of probabilities; rather it would be overwhelmed by the magnitude difference between \$1 million and \$5 million, and so most people (either Caucasian or Chinese) prefer Option D to C. In contrast, people might choose C if the \$5 million in D is reduced to \$1.1 million. This explanation might be able to address the findings that the Allais paradox is greatly reduced or eliminated for small outcomes (e.g., Camerer, 1989; Chew & Waller, 1986; Fan, 2002). Because when the magnitude decreases, the preference between C and D would be less salient. Moreover, the worst outcome for both C and D is to lose \$1 million (rather than \$5 million for D if the two Options appear to the decision maker together) but with 89% for C and 90% for D for losses. Thus the loss difference is just the probability difference. Due to the marginal diminishing sensitivity of the non-endpoint probabilities, the magnitude difference between \$1 million and \$5 million should dominate the probability difference. In summary, loss aversion would be the deciding factor for Caucasians to choose A than B, whereas, the difference in magnitude lead to a preference for D over C.

Petry (2005, p. 201) gives a relevant example: “gamblers would not place \$100 bets if the maximal payout were only \$200. However, when a jackpot exceeds \$30 million, people stand in lines for hours to purchase tickets.” Researchers have also noted that even risk-averse persons are likely to place bets in lotteries and horse races when the prize distributions are skewed toward large winnings (Garrett & Sobel, 1999; Golec & Tamarkin, 1998). Their findings provide insight as to why risk-averse individuals also gamble—due to people’s attraction for large rewards rather than a preference for risk.

In summary, we propose that the attitude towards risk influences the choice between Option A and B of the Allais paradox. Chinese prefer B because they are risk seeking at low-p of

gains and presumably less loss averse at low- $p$  of losses too; Caucasians prefer A because they are risk averse at low- $p$  of both gains and losses (more loss averse for low- $p$ ). In contrast, both the weighting function and reward magnitude determine the choice for D over C. The differences between Chinese and Westerners in terms of their responses to the Allais Paradox are similar to the crossover interaction that we observed in Experiment 4: Both results can be explained by assuming that Chinese are relatively more risk-seeking at low probabilities than Caucasians, but relatively less risk-seeking at high probabilities.

### **5.12 Limitations and Future Research**

It is important to acknowledge some of the limitations of the present research. We used convenience samples and recruited participants from the University and wider community in Christchurch. Most of the Chinese students would have come from big cities in China, rather than rural areas. It is also important to note that gambling is legal in New Zealand, but not in China (except for state-owned lotteries and small-stake recreational gambling activities). In terms of the cross-cultural comparisons in Experiment 4, the Chinese participants were to some degree bi-cultural as they were living in New Zealand and might differ from, for example, mainland Chinese without overseas experience. Evidence suggests that such people do not merely have values and beliefs that are intermediate between two cultures, but that their cognitive processes can also be intermediate – or at least, that they can alternate between forms of reasoning characteristic of one culture versus another (Child & Warner, 2003; Fan, 2000; Fang, 2006; Ji et al., 2004). Thus, our sample was restricted to Chinese-speaking persons who have chosen to live overseas. It would be interesting to attempt a similar comparison with mainland Chinese. It is possible that the cultural differences would be stronger and there would be a greater difference in terms of risk sensitivity depending on low or high reward probabilities.

We also determined gambling status entirely in terms of self-reports, without external verification of their gambling behavior. Although this is common practice in research on gambling, the information from participants might be subject to recall and social desirability bias (e.g., Kuentzel, Henderson, & Melville, 2008). Additionally, we used a Chinese version of the SOGS, obtained by a back-translation method by qualified English-Chinese bilinguals, but were not able to test its psychometric properties.

Another limitation of the present research is that we used hypothetical and not real rewards in the delay and probability discounting tasks. Use of hypothetical rewards has been a common practice in research on delay and probability discounting, but overall, results have been mixed in terms of whether results are similar with real and hypothetical rewards. Research by psychologists has generally found similar results with real and hypothetical rewards in delay-discounting tasks (e.g., Kirby, 1997; Kirby & Maraković, 1995, 1996; Lagorio & Madden, 2005; Madden et al., 2003; Rodriguez & Logue, 1988). But there is evidence from research in economics that real payments improve participants' performance (see Hertwig & Ortmann, 2001). It is unknown whether the differences observed here between gamblers and non-gamblers and ethnic groups in terms of delay and probability discounting would have changed if real rewards had been used. Thus for our conclusions to generalize to real rewards, we would need effectively to assume that there is no interaction between ethnicity or gambling status and real versus hypothetical rewards.

The ecological validity of the computerized Card Playing Game (CPG) that we used in Experiments 3 and 4 as a simulated gambling task can also be questioned. Although the money won (or lost) in the CPG was hypothetical, we attempted to create an additional incentive by rewarding the participant with the best overall performance with a grocery voucher. There was some evidence for the validity of the task, as gamblers performed overall more poorly than non-gamblers in Experiment 4. However, participants showed evidence of learning across successive

decks, and it may be that the CPG is not suitable for repeated testing. This compromised our attempt to measure contrast effects within-subjects in the CPG. It might be worthwhile in future research to change the payoff structure of the CPG to be less predictable.

As previously noted, it would be interesting to compare delay discounting by Chinese and Caucasians with a wider range of delays that included very short delays, perhaps days or weeks. Although results indicated that Chinese had higher discounting rates for delays from 1 month to 10 years, we expect that the opposite result might be obtained for very short delays. If confirmed, this prediction would considerably strengthen our proposal that the tendency for dialectical thinking among Chinese is the cause of the cross-cultural differences observed here.

## Chapter 6 Broader Implications

In this thesis, we have argued that cultural factors need to be considered in the study of risky decision making, and made specific proposals about how dialectical thinking might affect valuation of probabilistic outcomes by Chinese persons. However, might the tendency towards (or against) dialectical thinking be relevant for understanding risk attitudes of other cultures? And what are the broader implications of this view?

### 6.1 Dialectical Thinking/Emotions in Western Culture

Dialectical thinking is generally viewed as a higher cognitive process that develops in adulthood, and is related to an individual's overall intellectual capacity and even wisdom (e.g., Baltes & Staudinger, 1993; Basseches, 1980, 1984; Chandler & Boutilier, 1992; Kramer & Woodruff, 1986). Dialectical thinking is not only prevalent in Chinese (or East Asian) cultures (Peng & Nisbett, 1999) but is also important in Western cultures and serves a similar psychological function (English & Chen, 2007; Lee, 2000; Spencer-Rodgers et al., 2004; Wong, 2006). There is a classic tradition of dialectical thinking and reasoning about contradiction in the West, particularly among European philosophers. For example, Nietzsche wrote (as cited in Lee, 2000), "The wisest man would be the one richest in contradiction" and "Virtue is under certain circumstances merely an honorable form of stupidity". Examples from Heraclitus: "The attunement of the world is of opposite tension, as is that of the harp or bow"; "good and bad are the same"; "goodness and badness are one"; and 'couples are wholes and not wholes, what agrees disagrees, the concordant is discordant". Similar examples of dialectical reasoning are found in the works of Immanuel Kant, G. W. F. Hegel, Karl Marx, Frederick Engels, and in Aristotle's formal logic (see Lee, 2000). Examples of dialectical thinking can be found in other cultures. For example, in ancient Indian philosophy, Brahmanic thinking emphasized the importance of unity or harmony based on two opposites

(Lee et al., 1999; Ramanujan, 1989; Shweder, 1991). According to the dialectical view, opposition is a category of the mind, and is not itself an element of reality (Lee, 2000).

## 6.2 Dialectical Thinking/Emotions in Other Cultures

As previously noted, Chinese and Western worldviews have been frequently claimed to be philosophically distinct (or even opposite) in many different ways (see Nisbett, 2003; Schneider, 1990). Based on the above accounts, the evaluation of time and risk may be influenced by dialectical thinking and associated emotional complexity. However, could this assumption also predict other countries/cultures' risk and time attitude differences?

Minkov (2009) re-examined a Pew Research Center survey which measured life appraisals and assessment of domestic social issues in 47 countries in 2007. He observed that responses from nations whose individuals were less likely to dissociate positive and negative emotions were likely to have highly polarized quality judgments of domestic social issues (i.e., very good vs. very bad). In contrast to *dialecticism* which refers to the co-occurrence of pleasant and unpleasant emotions (Spencer-Rodgers, Peng, et al., 2010), Minkov (2009) described an alternative orientation as *absolutism*, which refers to a high polarization of judgment and dissociation of pleasant and unpleasant emotions. While his observation confirms that most East and South East Asian societies are dialectical, Middle Eastern Arab and Islamic societies are at the opposite extreme (absolutist), and most Western countries locate (except for Spain, Italy and some East European countries) somewhat in the middle but skew to the absolutist. Indonesia and Malaysia are two countries which have embraced Islam as their predominant religion for centuries yet show a strong tendency towards dialectical thinking, which would refute any assertion of a strong correlation between Islamic societies and absolutism. However, absolutists who hold inflexible views about religion, such as dogmatic atheists (e.g., fanatic communists) and rigid religionists (e.g., Christian or Islamic fundamentalists) have been suggested to be

associated with irrational beliefs and emotional problems (Ellis, 1983), and prejudice and discrimination (Hunsberger, Alisat, Pancer, & Pratt, 1996). Another attribute associated with absolutism is a cultural history of *pastoralism* (e.g., Minkov, 2009; Nisbett, 2003). Edgerton (1974) found that pastoralist life style traditions (e.g., nomadic farming; East and North Africa, Middle East, and Central Asia etc. (Haviland, 1990; Oswalt, 1986)) were more conflict oriented. Historically (and contrary to the modern associations of tranquillity and escape from an urban dystopia), life in a pastoralist society required forceful action to defend against attack and encouraged an ‘us versus them’ mindset. Thus, pastoralism may have promoted strong communication styles, resulting in greater polarization in terms of social and emotional judgments. In contrast, rice farming (e.g., historically the predominant lifestyle in East Asia) requires people to cultivate the land in concert with neighbours and maintenance of complex irrigation systems. This encouraged the development of more centralized control (e.g., regional magistrates, despots), which required obedience, constraint, and compromise from ordinary citizens to be effective, and thus the emphasis in East Asian societies on cooperation, harmony, avoidance of conflict, and sensitivity to social relations (Nisbett, 2003). By contrast, European civilization was derived from a hunting, herding, fishing, and trading lifestyle, which required less cooperation with others than rice farming but rewarded competition. For example, the ancient Greeks would habitually argue with each other in the marketplace, as well as in the political assembly (Nisbett, 2003). Anglo and European societies that experienced a shift from agriculture became more commercialized (in comparison with East Asian societies), which encouraged competition and assertiveness and led to more polarized cultures (Minkov, 2009; Nisbett, 2003). Arguably, these different historical life styles led to distinct cultural influences on mental and cognitive processes (such as attention and perception), thinking habits (such as attribution, expression and problem solving), and even attitudes to science (Minkov, 2009; Nisbett, 2003).

Large-scale multicountry studies have shown that dialecticism along with other cultural syndromes (e.g., Hofstede's cultural dimensions of collectivism-individualism, power distance, uncertainty avoidance, masculinity and long-term orientation, and indulgence/restraint (Hofstede, 2001; Hofstede, Hofstede, & Minkov, 2010)) are found to different degrees in various national and ethnic subgroups (Minkov, 2009). For example, Chileans and Mexicans have a strong collectivist orientation but are not dialectical, whereas Israeli Jews value dialectical thinking but also individualism (Peng et al., 2006; Schimmack et al., 2002).

Based on the findings in the present research and the distinction between dialectical and absolutist cultures, we suggest that individuals in absolutist cultures would exhibit more strongly polarized emotional responses to risky choice situations and more extreme attitudes toward risk when compared with individuals from dialectical cultures. In other words, persons from absolutist cultures would tend to be more risk-averse for low-p of gains, and more risk-seeking at high-p of gains. They might experience less positive emotion in a RANP situation, which reduces the attraction of gambling. On the other hand, they might experience less fear in a RAPP situation and take more risks in situations with an already high probability of a positive outcome. Potentially, this increased tendency toward risk-taking, when coupled with an absolutist ideology (e.g., religious fanaticism) could lead to negative outcomes such as irrational competition, conflict, war, and even terrorism in extreme cases (Minkov, 2009).

### **6.3 Dialectical Thinking, Relativism, and Globalization**

A major dispute in recent decades, particularly with widespread immigration in Western societies and moves toward multiculturalism, has been the question of cultural relativism. Is morality relative to culture or does "right and wrong vary with cultural norms" (Tilley, 2000)? As Sinha (2007) noted, "Relativism is therefore as dangerous an idea for liberals, who believe in

universal human rights, as it is for conservatives, who believe in an eternal and divinely ordained social and moral order. Indeed, in our own times, we see authoritarian rulers and governments appeal to the supposed particularities of their own cultural traditions in rejecting calls for democratic reform: liberal democracy, they say, is incompatible with their cultures (Confucian, Koranic, “Asian” and so forth)” (p. 1289).

Cognitive relativism has been defined as the view that what is true or false, valid or invalid, can vary from society to society and there are no cross-cultural universals in terms of values or standards for resolving conflicts between conflicting norms and practices (Baghramian, 2004). Although results of Experiment 4 suggest that attitudes toward risk are not culturally invariant, we would not favour the term ‘relativism’, especially ‘cultural relativism’. For example, although due to dialectical thinking, Chinese may be adept at ‘seeking opportunity from crisis’ and recover soon from financial or psychological adversities, their dialectical thinking may also contribute to placing more value on low-p events (i.e., RANP) which could increase susceptibility to problem gambling. On the other hand, Chinese risk-taking propensity when faced with a RANP may also explain the fast economic growth of China in recent decades. For example, Liu (2008) found that those Chinese farmers who overweighed small probabilities in a lottery task tended to be less risk-averse with adopting an innovative technology and more likely to accumulate more wealth. Western cultures may suffer less from problem gambling in comparison with Chinese due to their relative lack of dialectical thinking and reduced value given to low-p events. However, because Western cultures may not have a foundation concept like ‘wei-ji’ (i.e., there are opportunities in crises, meanwhile crises in opportunities) and thus place more value on high-p events (i.e., RAPP), they are susceptible to over-enjoyment, and lack of thrift resulting in overconsumption, overspending and debts, which may have contributed to the global financial and environmental crises (Dauvergne, 2008; Hofstede & Minkov, 2010). For extreme cases, holy war, as ‘crusade’ in Christian society or ‘jihad’ in Islamic culture, may be a consequence of their risk-taking behavior for what they

believe morally positive causes (i.e., RAPP) and justify the engagement in violence or war (e.g., Flori, 2002; Johnson, 1997).

In terms of time perspective, the respect for the past and traditions among Chinese may contribute to their cyclical notion of time which states that the same events are repeated according to cyclical patterns, and the future will be similar to the past. Greater respect for the past may pose a hindrance for the development of science, as Chinese may believe that problems and difficulties people face in the present are best solved by focus on past traditions rather than coming up with novel solutions (Guo, 2008; Ji et al., 2009; Zuo, 2001). By contrast, in Western culture the past is not given such importance. The lack of retrospection may result in neglecting lessons or mistakes from history. Western linear thinking may also discourage viewing problems in a broad context. Overall, each culture has its own '*cognitive blind spot*' which can contribute to irrational or suboptimal behavior.

Superficially, it may seem as if we have endorsed a straightforward form of cultural relativism. But 'relativism' can be studied, measured and analyzed, for example through the sort of cross-cultural comparisons reported in this thesis. 'Relativism' also suggests that no culture is superior to another in terms of cognitive features. "There are no scientific standards for considering one group as intrinsically superior or inferior to another" (Hofstede, 1991, p. 7). In many respects, the principles of Taoism (e.g., middle way, holism, change and contradiction) may seem at odds with the fundamental tenets of Aristotelian ethics (e.g., the law of identity, non-contradiction, and the excluded middle), which have featured prominently in the history of Western philosophy (Nisbett, 2003; Peng & Nisbett, 1999; Peng et al., 2006). The Chinese way of dealing with contradictions is derived from Taoism, and is characteristically a dialectical or compromising approach; that is, a tendency to keep core elements of opposing perspectives by finding a 'middle way'. In contrast, the Western approach, deriving from Aristotle, tends to formulate sharply different perspectives in an effort to determine which is correct (Peng &

Nisbett, 1999; Peng et al., 2006). We propose that each culture has its advantages and disadvantages, in cognitive terms, and would call for increased awareness of other cultures which could help to mitigate the disadvantages. Civilizations belong to humankind in general, and we should be able to utilize them well and enhance our awareness and appreciation of others' perspectives. More directly and specifically, Western and Islamic cultures may benefit from more dialectical thinking/emotions, whereas Chinese culture may need to alleviate some dialectical thinking.

The shortcomings of one culture may seem to be good examples for another, but this conclusion is too simple. There is a Chinese word, '*shi du*' (适度), which can be translated into English as 'moderate degree' or 'appropriate boundary'. A Chinese idiom '*guo you bu ji*' (过犹不及) illustrates the consequence of the two sides of not '*shi du*', which means 'going too far is as bad as not going enough'. For example, Chinese culture tends to value the past too much but Western culture may make the opposite mistake. Perhaps the wise course for both cultures would be to move away from their cognitive extremes. This may seem like an endorsement of Taoism – the 'middle way' – but this term is too vague and universal. We would suggest utilizing the 'middle way' for specific domains, when it is clear that a series of behaviors or culturally-specific cognitions are leading to potentially irredeemable consequences, it may be wise to think the opposite or withdraw a bit. For example, with the development of science and technology which are especially led and driven by the West, people's life span and quality have been improved to the best level in human's history. On the other hand, we should not neglect that the endless pursuing of the enhancement of subjective well-being has taken us to the point of exhausting the natural resources on the earth and climate change, and promoted more regional conflicts after the Cold War which was mainly about ideological discrepancies. However, these crises seem to have not been better alleviated with increased globalization.

In *The Clash of Civilizations*, Huntington (1996) sees the West joined in an unavoidable collision with two other major civilizations – Islamic and Confucian – due to irreconcilable differences in values and worldviews. We propose that if a ‘clash’ occurs, it would be much likely a result of different cognitive styles, and more importantly, ignorance of these differences within and between cultures.

With the advent of globalization in recent decades, through innovation of technology in transportation and communication (e.g., Internet), immigration across borders, the whole world has more opportunities than ever to interact in various domains. However, although Westernization is predominant, globalization is influenced from other cultures as well. As Nisbett (2003, p. 226) commented: “I firmly believe that the entry of East Asians into the social sciences is going to transform how we think about human thought and behavior across the board”.

Lee, Yang, and Wang (2009) point out that Taoism’s harmonic perspectives, such as yin-yang oneness, nonintervention, peace loving, and tolerance and appreciation of differences, are meaningful in the modern globalization world. Following the doctrines of Taoism may help to tackle human challenges such as ethnic conflicts, discrimination, domestic violence, inequality and oppression, as well as ecological problems such as pollution, destruction of the natural environment. However, the downside of Oriental traditions has been expressed by Chen (2002): “The desire for harmony in the workplace often results in compromise, a tradeoff that often means obedience to authority takes precedence over reevaluation of the status quo. Nor are the Confucian principles of harmony and holism always democratic, rather, they often are applied only to those segments of society to which the individual has strong attachments, such as the family, the village, or the family business. Egocentricity is a prominent feature of the Chinese makeup, but in contrast with the Western conceptualization, it centers around family and clan as opposed to the individual” (p. 187).

## **6.4 Proposal of a New Research Domain – Cultural Behavioral Psychology or Cultural Finance**

The study of risk and time which used to be in the domain of economics and finance has benefited from research in the past several decades from research in psychology, based on cognitive, affective, behavioral and social developmental perspectives (see Boyer, 2006, for a multi-perspective review), but little emphasis has been placed on cross-cultural factors. The traditional assumption of economists and decision theorists was to discover a set of principles which were universal in terms of their applicability to human behavior regardless of cultures and populations (Levinson & Peng, 2007; Weber & Morris, 2010). However, in recent years there is emerging evidence which shows that the way in which people perceive the most basic types of events and stimuli can be affected by culture. Findings of differences between cultures in terms of cognitive and affective processing may illuminate how culture can shape how people perceive economic and financial concepts, for example the difference in dialectical thinking/emotions between East Asians and Westerners which has been mainly elaborated in the present thesis (e.g., Bagozzi et al., 1999; Minkov, 2009; Peng & Nisbett, 1999), as well as other perspectives such as holistic/contextual vs. analytic/discrete (e.g., Morris & Peng, 1994; Nisbett & Miyamoto, 2005; Nisbett, Peng, Choi, & Norenzayan, 2001), and cyclic vs. linear time perspective (Ji et al., 2009; Zuo, 2008). These cognitive differences across cultures have been also demonstrated in neuroimaging studies and helped to establish a new research domain – cultural neuroscience (see Ambady & Bharucha, 2009; Ames & Fiske, 2010; Chiao et al., 2010). The emerging discipline of cultural neuroscience uses imaging methods (e.g., fMRI) to map changes in blood flow in the brain that occur during different mental operations, and has confirmed that even when Caucasians and East Asians are presented with the same objective stimulus, their brains may activate differently. Cultural differences in neural activation have also been found in the areas of emotion, self-representation, and attention (e.g., Blais et al., 2008; Chiao & Blizinsky, 2010;

Chiao et al., 2008; Han et al., 2010; Park & Huang, 2010; Tang et al., 2006; Zhu, Zhang, Fan, & Han, 2007).

As frequently noted in this thesis, emotions play a critical role in decision making under risk. For example, positive emotions (e.g., hope) promote approach behavior such as risk-taking, whereas some negative emotions (e.g., fear) promote escape and avoidance behavior such as risk-aversion (Brandstätter et al., 2002; Li, 2011). In terms of time perspective, proximal and distant future delays may also involve different emotions or construals (Fishbach et al., 2010; McClure et al., 2004; Trope & Liberman, 2010). The fundamental emotions may be universal across cultures, but cultures may differ in terms of the complexity or nuance of different emotions, for example the degree of polarization of positive and negative emotions (e.g. see Bagozzi et al., 1999; Minkov, 2009; Peng & Nisbett, 1999). These differences in emotional complexity have implications for our understanding of risky and intertemporal choice.

However, as Hens and Wang (2007) point out:

“To what extent, do emotions contribute to cross-cultural difference in risk-taking behavior and financial decision making? How to construct financial products that are appealing to different cultures? For example, are high-risk products more attractive to Asian countries? Does experience with financial products change risk preferences over time? With the rapid process of globalization, different cultures inevitably confront and interact with each other. This makes cross-cultural studies in finance and financial market more necessary and at the same time more feasible. We believe deeper understanding of the impacts of cultural backgrounds will help us gain more insights of the development of financial markets, and facilitate higher efficiency.”

One goal of the present thesis is to make a contribution to this emerging field of research.

## Concluding Remarks

The personality and cultural traits of a nation can be very lasting (Hofstede & McCrae, 2004). Simply changing to a new type of economy (e.g., from socialist to market-oriented) does not remove what has been ingrained in a culture over millennia (Minkov, 2009). On the other hand, the emerging *dynamic constructivist theory* (e.g., Briley & Wyer, 2002; Hong & Chiu, 2001; Hong et al., 2000; Weber & Morris, 2010) suggests that multiple cultures, to some extent, may operate within any single individual. Is it possible on the one hand to utilize practical advantages derived from awareness of other cultures to counter one's own 'cognitive blind spot', on the other hand, and not be affected by their downside? We suggest that at least it is worth trying, and awareness of one's own and others' cultures and their differences, especially in terms of cognitive pros and cons, can be the first step.

In our personal view, to be able to study better on our own, willing to learn from each other, and to build up a more habitable, sustainable, harmonious and peaceful society on the earth for all humankind, is our most pressing goal today.

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## Appendix

### A: Demographic Sheet

Your Subject No.: \_\_\_\_\_

Date: \_\_\_\_\_

1. Name \_\_\_\_\_
2. Sex  Male  Female
3. Your contact information:  
Landline/Mobile \_\_\_\_\_  
Email \_\_\_\_\_
4. Ethnicity (please tick only one)  
 NZ European  
 Maori.  
 Pacific Islander (specify) \_\_\_\_\_  
 Asian (specify) \_\_\_\_\_  
 Mix (specify) \_\_\_\_\_  
 Other (specify) \_\_\_\_\_
5. Date of Birth \_\_\_\_ (mm) \_\_\_\_\_ (yyyy)
6. Born Place (country)  
\_\_\_\_\_
7. Have been living \_\_\_\_ years in NZ.
8. The highest educational qualification:  
 No school qualifications  
 School qualifications  
 Sixth form certificate or university entrance (including current undergraduate study)  
 Post- secondary (e.g. Trade certificate, professional certificate or diploma)  
 NZ University undergraduate degree (e.g. bachelor's degree)  
 NZ University postgraduate degree (e.g. Master's, Ph.D.)  
 Overseas University qualification (specify)  
\_\_\_\_\_  
 Other qualifications (specify)  
\_\_\_\_\_
9. Marital Status  
 Never married  Currently married /De facto  
 Living with partner  
 Separated/Divorced  Widowed
10. Religion  
 No Religion  Christianity  Islam  
 Buddhism  Hinduism  Taoism  
 Other (specify) \_\_\_\_\_
11. Personal income (tick in the left square) and family income (tick in the right square) per annum (before tax)

Personal	Familial
<input type="checkbox"/> Less than \$20,000	<input type="checkbox"/>
<input type="checkbox"/> \$20,001 to \$30,000	<input type="checkbox"/>
<input type="checkbox"/> \$30,001 to \$40,000	<input type="checkbox"/>
<input type="checkbox"/> \$40,001 to \$50,000	<input type="checkbox"/>
<input type="checkbox"/> \$50,001 to \$60,000	<input type="checkbox"/>
<input type="checkbox"/> \$60,001 to \$70,000	<input type="checkbox"/>
<input type="checkbox"/> Over \$70,000 (specify) _____	<input type="checkbox"/> _____
12. Usual occupation for living  
 Full-time  Part-time  
 Student  
 Homemaker  
 Unskilled/manual work (e.g. labourer, driver, waiter, shop assistant), specify \_\_\_\_\_  
 Work supervisor, clerical and skilled crafts (e.g., secretarial, artisan, foreman, shopkeeper), specify \_\_\_\_\_  
 Managerial/professional, specify \_\_\_\_\_  
 Pensioner / Superannuation  
 Unemployed / Welfare  
 Disability compensation  
 Other (specify) \_\_\_\_\_

## B: Demographic Sheet (Simplified Chinese Version)

### 信息统计单

实验编号: \_\_\_\_\_

实验日期: \_\_\_\_\_ 年 \_\_\_\_ 月 \_\_\_\_ 日

1. 姓名 \_\_\_\_\_

2. 性别  男  女

3. 联系方式:

固定电话/手机 \_\_\_\_\_

电子邮件 \_\_\_\_\_

4. 所说语言 (可多选)

英语流利  英语一般

基本不会说英语

普通话

汉语中的方言(具体指) \_\_\_\_\_

会说其他语言(具体指) \_\_\_\_\_

5. 出生日期 \_\_\_\_\_ 年 \_\_\_\_ 月

6. 出生地 (若中国大陆请具体到省份) \_\_\_\_\_

7. 已经在新西兰生活了 \_\_\_\_\_ 年.

8. 最高学历:

未受过正规学历教育

中学教育

六级证书或大学入学水平 (含在读本专科生)

中学以后的学历 (如贸易证书、专业证书或大专)

新西兰大学本科生学位 (如学士学位)

新西兰大学研究生学位 (如 硕士、博士学位)

海外大学的学历 (具体指) \_\_\_\_\_

其他学历 (具体指) \_\_\_\_\_

9. 婚姻状况

从未结过婚  已婚/订婚  同居

分居/离异  丧偶

10. 宗教信仰

没有宗教信仰  基督教  伊斯兰教

佛教  印度教  道教

其他宗教 (具体指) \_\_\_\_\_

11. 税前个人年收入 (在左侧方框内划勾) 和家庭年收入 (在右侧方框内划勾)

个人

家庭

少于 \$20,000

\$20,001 至 \$30,000

\$30,001 至 \$40,000

\$40,001 至 \$50,000

\$50,001 至 \$60,000

\$60,001 至 \$70,000

超过 \$70,000 (具体指) \_\_\_\_\_  \_\_\_\_\_

12. 职业/谋生情况 ( 全职  兼职)

学生

在家照顾家庭

非技术性/人力工作 (如, 劳力、司机、服务员、售货员等), 具体指 \_\_\_\_\_

中层管理人员、文书和技术性工作 (如, 秘书、技工、领班、店主等), 具体指 \_\_\_\_\_

高级管理人员/专业人员, 具体指 \_\_\_\_\_

领取退休、养老金人员

失业 / 领取福利  残障补偿

其它 (具体指) \_\_\_\_\_

## C: The South Oaks Gambling Screen (Simplified Chinese Version)

实验编号: \_\_\_\_\_

实验日期: \_\_\_\_\_ 年 \_\_\_\_ 月 \_\_\_\_ 日

请阅读以下问题, 并将你的答案填写在相应的括号内:

I. 请指出在你一生中曾经涉足下列哪种赌博类型。对每种类型标示一个答案:  
(A) “一次也没有”, (B) “一周少于一次”, (C) “一周一次或更多”

- ( ) I-1. 赌牌
- ( ) I-2. 赌马, 赌狗或其他动物 (在场外, 跑场, 或通过赌注经纪人下注)
- ( ) I-3. 赌运动输赢 (如玩固定赔率美式复式投注卡, 通过赌注经纪人下注, 在回力球娱乐场下注)
- ( ) I-4. 赌骰子 (包括双骰, 大小, 或其他骰子游戏)
- ( ) I-5. 在合法或非合法的赌场赌博
- ( ) I-6. 赌数字或彩票
- ( ) I-7. 赌宾果 (BINGO)
- ( ) I-8. 买卖股票, 期权及/或期货
- ( ) I-9. 赌投币机 (角子机/老虎机), 扑克牌机或其他赌博机
- ( ) I-10. 保龄球, 桌球, 高尔夫球或其他技巧性的赌钱竞赛
- ( ) I-11. 除彩票外的其他抽签赌博
- ( ) I-12. 打麻将
- ( ) I-13. 上述未列出之其他赌博形式 (请列举) \_\_\_\_\_

( ) II. 请指出以下哪些人有 (或曾经有) 赌博问题

- A. 父亲
- B. 母亲
- C. 兄弟或姊妹
- D. 配偶或伴侣
- E. 子女
- F. 曾祖父母
- G. 其他亲戚
- H. 我的家人或亲属中没有人有 (或曾经有) 赌博问题

以下是关于你赌博情况的询问。请将你的回答填写在问题前面的括号中：

- ( ) III. 你在一天中曾经有过的最大赌额是多少？
- A. 从未赌博
  - B. \$1 或以下
  - C. 超过 \$1 但少于 \$10
  - D. 超过 \$10 但少于 \$100
  - E. 超过 \$100 但少于 \$1,000
  - F. 超过 \$1,000 但少于 \$10,000
  - G. 超过 \$10,000 以上 (请列出具体数额 \$ \_\_\_\_\_)
- ( ) 1. 当你赌输了钱，改天再次前往想将赌输了的钱赢回来的次数有多少？
- A. 从不
  - B. 有时会 (少于一半赌输的时间)
  - C. 大多数输了钱之后会
  - D. 每次输了钱之后
- ( ) 2. 你是否曾经声称你赌赢了钱，但事实上你却是赌输了钱？
- A. 从不
  - B. 有时会 (少于一半赌输的时间)
  - C. 是的，大多数输了钱之后会
- ( ) 3. 你是否觉得你曾经有嗜赌的问题？
- A. 没有
  - B. 有过，在以前而非现在
  - C. 是，我觉得目前的确存在嗜赌问题

请用“√=是”或“X=否”回答下列问题：

- ( ) 4. 你是否曾经赌博超出你原来的预算呢？
- ( ) 5. 是否曾有人批评你的赌博问题？
- ( ) 6. 你曾否为你的赌博方式或因其引至的后果感到内疚？
- ( ) 7. 你曾否希望能停止赌博，但又自觉无能为力？
- ( ) 8. 你曾否对你的配偶/伴侣，儿女或其他生命中重要的人隐藏赌注单据，彩票根，赌本或其它与赌博有关的证据呢？
- ( ) 9. 你曾否和你同住的人士有关你的理财方法争执过？
- ( ) 10. (若你在 9 题的答案是“是”)那是否因为金钱上的争执集中在你的赌博问题上？
- ( ) 11. 你曾否向别人借钱但因赌博而未归还？
- ( ) 12. 你曾否因赌博而旷工 (或旷课) ？

如果你曾经借过钱用以赌博或偿还赌债,那么你向谁或从何处借钱? (在选中的答案前划勾)

- 13. 家庭生活用钱
- 14. 你的配偶
- 15. 其他亲戚或姻亲
- 16. 银行、借贷公司、或信用机构
- 17. 信用卡
- 18. 放高利贷者(或称“贵利”、“大耳窿”)
- 19. 变卖股票, 债券, 或其他证券
- 20. 变卖个人或家庭的财产
- 21. 从支票帐户借钱(使用空头支票)
- 22. 与赌注登记经纪人有(或曾经有)信贷额度
- 23. 与赌场有(或曾经有)信贷额度

24. 请根据自己的情况填空回答下列询问

在过去的30天里有 \_\_\_\_\_ 天饮用了酒类。

赌博问题存在了 \_\_\_\_\_ 年。

在过去的3个月中有 \_\_\_\_\_ 天有赌博行为。

在过去3个月的赌博中, 赢了\$ \_\_\_\_\_, 输了\$ \_\_\_\_\_。

目前因赌博负债 \$ \_\_\_\_\_。

您是毒品依赖者吗? 是 \_\_\_\_\_。否 \_\_\_\_\_。

您有吸烟的习惯吗? 是 \_\_\_\_\_。否 \_\_\_\_\_。

25. 请在下面与赌博相关的行为和认知的描述中选择符合自己情况(单选或多选, 划勾)

- 赌博替代了其他的活动。
- 赌博是逃避问题的一种方式。
- 赌博是解决财务问题的方式。
- 曾为了资助赌博从事过非法的活动。
- 数额大的奖金总能影响我去下更多的赌注。
- 用赢钱来给别人留下印象。
- 喜欢赌博的行动和刺激。
- 容易找到能玩赌博的场所。
- 赌博是融入社会的一种方式。
- 其他要说明的情况 \_\_\_\_\_
- 曾经接受过赌博成瘾的治疗/咨询  
(地点 \_\_\_\_\_ 时间 \_\_\_\_\_)
- 我根本就不喜欢赌博。

26. 如果需要，你会通过下列那种方式寻求对于问题赌博的帮助（单选或多选）

- 问题赌博基金会 Problem Gambling Foundation [329 Durham Street, Christchurch]
- 救世军 The Salvation Army – Oasis Centre for Problem Gambling [126 Bealey Ave, Christchurch]
- 赌博问题帮助热线 [免费中文服务热线 0800 862 342]
- 注册心理咨询师  教堂
- 家庭  朋友  自己
- 医生 [西医]  中医
- 其他（具体说明） \_\_\_\_\_
- 我没有任何的赌博问题。

请复查你是否回答了以上所有的问题。如是请在此处签名 \_\_\_\_\_