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Arkes, Hal, Hirshleifer, David, Jiang, Danling and Lim, Sonya

09. July 2007

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Hal R. Arkes[a]
David Hirshleifer[h]
Danling Jiang[j]
Sonya Lim[l]

July 9, 2007

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a. Hal R. Arkes, Professor of Psychology, Department of Psychology and College of Public Health, The Ohio State University. arkes.1@osu.edu. http://faculty.psy.ohio-state.edu/arkes/

h. David Hirshleifer, Professor of Finance & Merage Chair in Business Growth, The Paul Merage School of Business, University of California – Irvine. david.h@uci.edu. http://web.merage.uci.edu/~Hirshleifer/

j. Danling Jiang, Assistant Professor of Finance, The College of Business, Florida State University. djiang@cob.fsu.edu. http://mailer.fsu.edu/~djiang/

l. Sonya Lim, Assistant Professor of Finance,The Kellstadt Graduate School of Business, DePaul University. slim1@depaul.edu. http://mozart.depaul.edu/~slim/

We appreciate the helpful comments from participants at the Society for Judgment and Decision Making annual conference in Houston, Texas in November of 2006, the Carnegie-Mellon Department of Social and Decision Science colloquium, and the Ohio State University SBIG colloquium in the Department of Psychology. We thank Michelle Qu and McKay Price for helpful research assistance and Jin Wan Cho, Joon Ho Hwang, Dong Wook Lee, Hyunhan Shin, Shujun Zhang, and Wei Zhao for their coordination in recruiting subjects. We are grateful for the financial support from the Program in Decision, Risk, and Management Science at the National Science Foundation (0339178 and 0339052). The order of the authors is alphabetical.

Abstract

We examined prospect theory and reference point adaptation following gains or losses using participants from China, Korea, and the US. Supporting prospect theory, we found in Studies 1 and 2 that subjects from all three countries generally exhibited loss aversion and a greater propensity for risk seeking in the loss domain than in the gain domain. In Study 3 we used the Becker, DeGroot, and Marschak (1964) procedure to ascertain the valuation subjects placed on a gamble after either a prior gain or a prior loss on a stock. After inferring the shift in each subject's reference point following this prior gain or loss, we found that reference point adaptation following a gain exceeded that following a loss in all three countries. In our third study we also had subjects sell and then immediately repurchase a stock that had experienced a prior gain or loss, which was designed to "punctuate" or close the mental account containing the prior gain or loss. This manipulation caused an increase in reference point adaptation among the Americans but a decrease among the Asians.

Keywords: prospect theory; cross-cultural differences; reference point adaptation; mental accounting

1. Introduction

Although prospect theory (Kahneman and Tversky 1979) is one of—if not the—most prominent descriptive theories of decision making under uncertainty, there has been very little research done to test it in non-Western cultures. For this reason a primary purpose of this manuscript was to ascertain to what extent some important features and implications of prospect theory apply in Eastern cultures, specifically Chinese and Korean.

We chose to examine several predictions of prospect theory. First, subjects should generally manifest risk-seeking behavior in the domain of losses and risk-averse behavior in the domain of gains. Second, a loss should have more impact than a gain of identical absolute value (e.g., Kahneman and Tversky 1979; Kahneman and Lovallo 1993). These two features of prospect theory pertain to what we will call the static model.

Recent research, however, has examined what happens to the reference point following a gain or loss. A natural hypothesis is that the reference point adapts in response to past outcomes, shifting upward following a gain and downward following a loss. These shifts comprise dynamic features of prospect theory. Using subjects from the US, Arkes, Hirshleifer, Jiang, and Lim (2007) discovered asymmetry in reference point adaptation: such adaptation was significantly larger following a gain than following a loss.[1] They also found that when realization of the initial gain or loss was emphasized, adaptation both to losses and gains appears to be enhanced. These two dynamic aspects of prospect theory will also be examined in our cross-cultural comparisons.

[1] In a somewhat similar spirit, Strahilevitz & Loewenstein (1998) conjectured that " . . . adaptation to losses takes longer than adaptation to gains and would therefore require a greater time interval to observe."

We suggest that cross-cultural study of prospect theory and reference point adaptation carry important implications in the area of judgment and decision making and in its applications in areas such as economics, management, and finance. Recent studies have documented systematic differences in judgment and decision making across countries, such as overconfidence (Yates, Lee, and Shinotsuka 1998), the attribution error (Morris and Peng 1994), and risk preferences (Weber and Hsee 1999). The results of these studies suggest that previous findings mostly generated in the United States may not generalize completely to other countries. To the extent that businesspersons and negotiators have different risk perceptions, for example, they may not be able to reach mutually beneficial outcomes (Weber and Hsee 1998).

Researchers have used prospect theory to understand a number of anomalous stock market phenomena, including excess volatility, the equity premium puzzle, the value effect, and the disposition effect (e.g., Shefrin and Statman 1985; Bernartzi and Thaler 1995; Barberis and Huang 2001, Barberis, Huang, and Santos 2001). There is evidence that the high equity premium, the value effect, and the disposition effect are present outside the United States but sometimes to different extents (e.g., Dimson, Marsh, and Staunton 2006; Fama and French 1998; Grinblatt and Keloharju 2001; Feng and Seasholes 2005). Understanding the extent to which prospect theory holds in other countries, and cross-cultural differences in the adaptation of reference points may help explain these variations in market behavior across countries.

1.1. Prospect Theory

Kahneman and Tversky (1979) proposed prospect theory as an alternative to the normative theory of expected utility maximization. Three main elements of prospect theory are most relevant to our research. First, people derive utility from gains and losses relative to a reference point, while traditional utility theory assumes that people derive utility from total

wealth or consumption. Although the reference point is generally one's current wealth (Kahneman and Tversky, 1979), aspiration levels or norms can also serve this function (Kahneman and Tversky, 1979, p. 286; Heath, Larrick, and Wu, 1999). Second, the value function is concave in the domain of gains and convex in the domain of losses with a steeper slope in the loss domain. The shape of the function captures "dual risk attitudes": individuals tend to be risk averse in the gain domain but risk seeking in the loss domain. Third, the effect of a loss on utility is much larger than that of a gain of the same size ("loss aversion").

Kahneman and Tversky (1979) showed that prospect theory described the behavior of subjects in the US as well as in European countries such as Sweden, and in Israel. Past studies suggested that losses have an effect approximately 2 to 2.5 times that of a gain of the same size (e.g. Tversky and Kahneman, 1992). However, we are aware of very little existing research that assesses the robustness of prospect theory and the magnitude of the loss aversion among east-Asians, who tend to differ from westerners in several aspects of judgment and decision making (e.g., Levinson and Peng 2006; Weber and Hsee 1998; Wright and Phillips 1980; Yates, Zhu, Ronis, Wang, Shinotsuka, and Toda 1989).

There are two prior studies somewhat related to ours. One study, by Kachelmeier and Shehata (1992), documented evidence consistent with the probability weighting function in prospect theory, using high monetary incentives for Chinese subjects. However our research has a somewhat different emphasis, since it pertains to the value function rather than the probability weighting function. The other, by Hsee and Weber (1999), is more closely related. These researchers examined choices over sure versus risky outcomes in both gain and loss domains. They constructed a risk-preference index based on these choices, which could be transformed into a binary variable to determine whether a given subject is risk-seeking or risk-

averse in each domain. However, Hsee and Weber (1999) report their results in a manner which does not make it possible to determine if each subject is risk-seeking in the domain of losses and risk-averse in the domain of gains, that is, whether a subject manifests dual risk attitudes. Making this determination is one of the goals of our studies.

1.2. Reference Point Adaptation in Prospect Theory

Prospect theory has most commonly been applied to static decision environments. When one applies this model to more realistic dynamic settings such as stock trading, repeated bargaining and negotiation, and firm investments, it is important to understand how reference points are updated after such individuals experience outcomes over time.

Consider the prospect theory value function depicted in Figure 1. If a loss has occurred, the decision maker is at point L in Figure 1a. If a subsequent decision is to be made and the reference point has not adapted to the initial loss, the decision maker will likely be risk seeking, in that a further loss will cause only a small decrease on the y-axis, whereas a further gain will result in a larger increase. However if the decision maker adapts fully to the initial loss, then Figure 1b depicts this situation. Now the decision maker will be less risk seeking, because the "re-centering" of the origin of the graph on the current state of affairs causes a loss to be more painful than it would have been in Figure 1a. Thus, if the reference point does not budge following a loss, then the decision maker is likely to become risk seeking and to try to make back the loss, leading to such phenomena as the sunk cost effect (Arkes and Blumer 1985) or the disposition effect (Shefrin and Statman 1985). On the other hand, if the reference point adapts downward following a loss, the decision maker is able to "make peace" with this loss and will be less likely to "throw good money after bad" in this fashion.

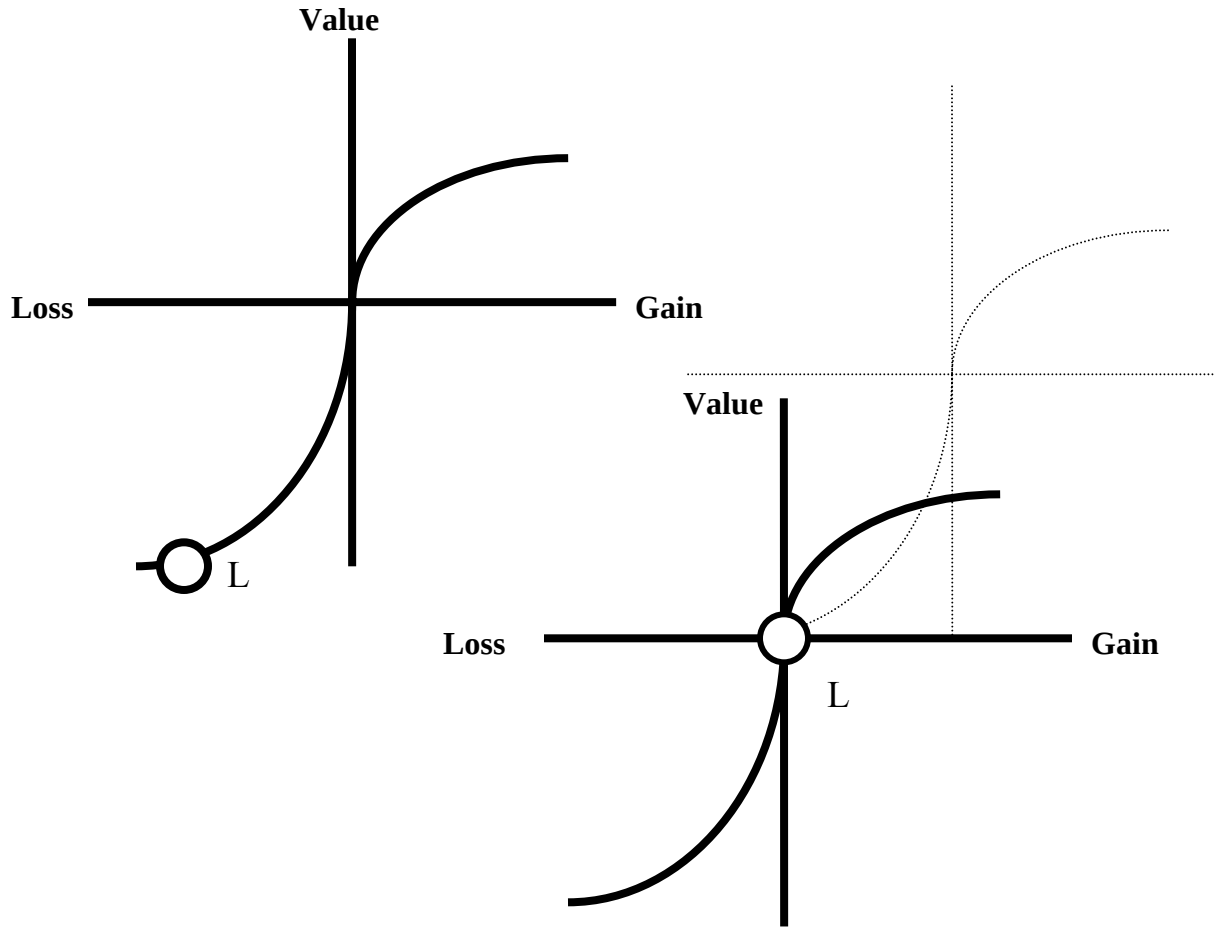

Figure 1a (left): No adaptation to the loss that has occurred at point L.
Figure 1b (right): Full adaptation to the loss that has occurred at point L.

Although there are a very few cross-cultural studies pertaining to the static aspects of prospect theory, we know of no cross-cultural research on its dynamic aspects. However there are a very few studies testing dynamic aspects using US subjects. Chen and Rao (2002) found that the order in which two opposite events (gain/loss) occurred affected the subject's final affective state, suggesting that a shift in the reference point occurred after the first event. Gneezy (2002) showed that assuming a stock's peak price to be the reference point best explained subjects' willingness to sell that stock. Arkes et al. (2007) estimated the changes in reference

point location following stock trading gains and losses using both questionnaires and real money incentives. They found that the reference point adapts to prior gains to a greater extent than to prior losses.

In Experiment 6 of Arkes et al. (2007) subjects purchased a stock at a certain price and experienced either price appreciation or depreciation. Then subjects were informed of the possible stock prices in the next trading period and offered a chance to sell the stock by stating their minimum selling price. Using the Becker, DeGroot, and Marschak procedure (1964), Arkes et al. obtained each subject's minimum selling price—the certainty equivalent of the gamble—and then solved for the implied new reference point using the prospect theory value function. They then measured the reference point adaptation by comparing the distance between the new reference point and the initial reference point, which was assumed to be the purchase price.

There were two primary results. First, reference point adaptation was asymmetric; adaptation following a gain was significantly greater than following a loss. The second result pertained to a manipulation Arkes et al. employed to influence the "mental accounting" (Thaler 1999) for the initial gain or loss. After an initial gain or loss in the stock, approximately half the time the experiment imposed sale of that stock and then a repurchase of it at the same price at which it had been sold. Arkes et al. (2007) hypothesized that this sale/repurchase intervention would emphasize the new price, because a sale and repurchase took place at that new price following the original gain or loss. Hence this intervention would cause the person holding that stock to "close" the mental account containing the gain or loss. This would, in turn, cause more adaptation to the outcome, whether it was a gain or loss. Indeed, the second main result was that this sale/repurchase intervention increased adaptation to both gains and losses.

In this manuscript, the third experiment to be reported employed the methodology used in Arkes et al. (2007) to quantify the magnitude of reference point adaptation in response to trading outcomes. We wanted to ascertain whether these two principal results also occurred among Korean and Chinese participants as well as to replicate this result among new American subjects. First, we compared reference point adaptation across the three countries to ascertain if the greater adaptation to gains than losses was present in the two Asian cultures, as was documented among US participants in Arkes et al. (2007). Second we ascertained whether the intervention of the sale and repurchase of a stock accelerated reference point adaptation in the two Asian cultures, as was previously demonstrated in the American sample.

1.2. Cross-Cultural Differences in Decision Making

Weber and Hsee (1998) and Hsee and Weber (1999) showed that Chinese are less risk-averse than Americans in their financial decisions, but not in other domains such as medical and academic decisions. Weber and Hsee (1998) 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.

Weber and Hsee (1999) advanced the "cushion hypothesis" to account for cross-cultural differences in risk perception in the financial domain. In collectivist cultures such as present in China, the members of one's social network can provide assistance to cushion financial losses. Thus Chinese participants in this research might understandably perceive financial risks to be less than would Americans due to this safety net. However members of one's family or social network cannot provide the same magnitude of assistance in medical or educational domains, so differences in risk perception between Chinese and Americans were neither predicted nor found

in these areas. In support of the cushion hypothesis, Hsee and Weber (1999) found that when they controlled for social network variables such as the number of people an individual could rely on for financial assistance, the cross-cultural difference between the Chinese and Americans became non-significant.

To gain further insight into the sources of cross-cultural differences in risk-taking, Weber, Hsee, and Sokolowska (1998) examined risk advice contained in national proverbs. They found that Chinese proverbs seem to provide more risk-seeking advice than American proverbs, and that Chinese perceived their proverbs to advocate greater risk-seeking than Americans perceived in their proverbs, but only for financial and not for social risks.

Nisbett and his colleagues (e.g., Ji, Nisbett, and Su 2001) documented an important difference between Asians' and Americans' attitudes toward change. In five studies they showed that Chinese students were more likely to predict change from an initial state than were Americans. In one of their experiments (Study 2) some questions asked of students were economic, such as the following: "The global economy growth rates (annual percentage change in real GDP) were 3.2%, 2.8%, and 2.0% for 1995, 1997, and 1999, respectively, as indicated on the graph below." Subjects were asked to predict the probability of the trend remaining the same, going up, and going down. Chinese subjects in this study and others were more likely than Americans to predict that the current trend would reverse. Thus compared to Americans, Chinese subjects—or Asian subjects in general—might be more likely to predict that gains would be followed by losses, and conversely. Any such difference would have important implications for the valuation and willingness to continue holding a stock following an initial price movement.

2. Study 1

Since the existing literature has not examined some of the key implications of prospect theory using east-Asian subjects, we began our research by testing whether prospect theory holds for an average east-Asian subject. In Study 1, we focused on the "dual risk attitudes," which denotes risk aversion in the gain domain but risk seeking in the loss domain. In Study 2, we concentrated on the specific degree of loss aversion. Our questionnaires followed Kahneman and Tversky (1979) and Tversky and Kahneman (1992). In our first two studies we used the same range of hypothetical payoffs as the range of the real monetary payoffs used in our Study 3.

2.1. Research Participants

The participants were undergraduate students at Florida State University in the United States (81 subjects), Nanjing University in China (89 subjects), and Korea University in Korea (81 subjects). The subjects answered brief questionnaires in a classroom setting. All students voluntarily filled out the questionnaires for a raffle prize within each class. The raffle prizes were adjusted to ensure a similar monetary incentive across three countries from the perspective of an average subject. In the US, the prize was $20. According to official exchange rates when the experiment was conducted, this amount was equivalent to 20,000 KRW (Korean Won), which was the prize for our Korean subjects. The prize for our Chinese participants was ¥80, which is the equivalent of $10 according to the official exchange rate. However the three countries' prizes were chosen to be equal in purchasing power, because the raffle prize could pay for approximate 3-4 equivalent McDonalds meals in each country.[2]

[2] The exchange rate between the US dollar and Korea Won is close to the ratio of the purchasing powers of two currencies. However, there is a discrepancy between the exchange rate and the purchasing power ratio for the US dollars and China ¥. For instance, an equivalent McDonald meal or an hour of math

2.2. Questionnaires and Procedure

We conducted a questionnaire study to assess the presence of risk aversion in the domain of gains and risk-seeking in the domain of losses in China, Korea, and the US. To ensure that original meanings were preserved during translation, the questionnaire was first translated into Chinese or Korean by one person and then back-translated into English by a different person, and we made minor corrections when there were discrepancies (Brislin 1986).

There were two questions asked in the survey. One concerned the choice between a risky outcome and a sure outcome when both were framed in the gain domain. The other posed a similar choice except that both options were framed in the loss domain. The US payoff numbers were multiplied by 1,000 in Korea and by 10 in China, because one US dollar was about 1000 KRW in Korea and approximately ¥8 in China. The closest multiple of 10 was chosen to mitigate the difficulty of the task introduced by odd numbers. [3]

Problem 1:

Option A: win $40 with probability 0.8 and win nothing with probability 0.2.

Option B: win $30 for sure.

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tutoring costs roughly 2-3 times more in the US than in China. Therefore, for the Chinese subjects we made an adjustment to their prize based on the relative price of a McDonald meal or payment for tutoring services in the two markets. This strategy ensured similar incentives from the perspective of an average subject across all countries.

[3] Due to the discrepancy between the exchange rate and the purchasing power of China and the US, these relatively low hypothetical payoffs in the US will tend to be relatively high in China when multiplied by 10. For this reason, in both Studies 1 and 2 we also asked Chinese subjects a set of questions in which the numbers of the hypothetical payoffs are the same as in the US (e.g., $40 ➔ ¥40). The results are qualitatively similar, which will be reported in the subsequent footnotes.

Circle the option that is more attractive to you: A or B

Problem 2:

Option A: lose $40 with probability 0.8 and lose nothing with probability 0.2.

Option B: lose $30 for sure.

Circle the option that is more attractive to you: A or B

2.3 Results and Discussion

We report in Table 1 the proportion of subjects that chose the gamble over the sure outcome in both problems. In all three countries, we observed the reflection effect: a minority of the subjects in the gain domain but a majority of the subjects in the loss domain chose the gamble over the sure outcome.

Table 1. Proportion of subjects that choose the gamble over the sure outcome in the gain (G) and the loss (L) domains

	N	Gain	t(G < 0.50)	Loss	t(L > 0.50)	Loss − Gain	*p-value*
China	89	0.44	*1.17*	0.76	*4.98*	0.33	*<0.01*
Korea	81	0.25	*4.56*	0.79	*5.22*	0.54	*<0.01*
US	81	0.44	*1.00*	0.75	*4.56*	0.31	*<0.01*
All	251	0.38	*3.85*	0.77	*8.52*	0.39	*<0.01*

Note. Gain (G) refers to the proportion of subjects that choose the gamble over the sure outcome when the outcomes are framed in the gain domain. Loss (L) refers to the proportion of subjects that face the same set of choices when the outcomes are framed in the loss domain. The *t*-statistics are based on one-sample proportion tests. Loss – Gain (L – G) refers to the difference in proportions of subjects that favor the gamble over the sure outcomes in the loss domain and in the gain domain. The *p*-values for the significance of the difference in proportions are calculated using a McNemar test.

On average, 38% of the subjects were risk seeking in the gain domain, but 77% of the subjects were risk seeking in the loss domain. In the loss domain, the risk-seeking proportions are all significantly greater than 0.50. However, in the gain domain, we can only reject risk neutrality in favor of risk aversion in the gain domain in Korea (25% risk seeking, $t = 4.56$) but not in China (44% risk seeking) or the US (44% risk seeking).[4] Nevertheless, in all three countries there is a significantly greater fraction of subjects who exhibit risk seeking in the loss domain than in the gain domain. We used a McNemar test (Siegel, 1956, p. 63) to calculate the significance of the difference between the two proportions, since each subject answered both the gain and loss domain questions. Specifically, the difference in these proportions is 33% in China [$\chi^2(1) = 13.29$, $p < 0.01$], 54% in Korea [$\chi^2(1) = 29.82$, $p < 0.01$], and 31% in the US [$\chi^2(1) = 9.76$, $p < 0.01$]. Based on these findings, we conclude that easterners, like westerners, exhibit prospect theory's dual risk attitudes toward gains and losses.

We also tested cross-country differences in the change in risk attitudes when the framing of the questions switched from the gain domain to the loss domain. Using the two-sample McNemar test (Feuer and Kessler, 1989), we found that Koreans significantly differed from the Americans [$Z = 2.01$, $p = 0.04$] and from the Chinese [$Z = 1.98$, $p = 0.04$]. As the domain changed from gain to loss, the Koreans exhibited a greater change toward risk seeking compared to the Chinese and the Americans. The difference between the latter two was insignificant [$p = 0.88$].

To further investigate cross-country differences we performed a logistic regression in which the dependent variable was 1 when an individual chose the sure outcome in the gain

[4] Based on the set of questions that used the same number as the dollar payoffs in the US, 47% of the Chinese subjects exhibited risk seeking in the gain domain, and 82% showed risk seeking in the loss domain. Thus, smaller hypothetical payoffs induced a slight increase in risk seeking.

domain but the risky outcome in the loss domain, and zero otherwise. The independent variable was the three countries. The logarithmic odds ratio estimate of China relative to the US is 0.908 with the 95% Wald confidence interval [0.497, 1.658]. In a logistic regression, a zero logarithmic odds ratio means that the odds ratios of two countries are equal while a positive one means that the former country has a greater odds ratio than the latter one. Thus, these results suggest that the Chinese are significantly more likely to exhibit prospect theory's dual-risk attitudes than are the Americans. The odds ratio estimates of Korea relative to the US is 1.758 with the confidence interval [0.934, 3.307], suggesting an even stronger difference. Considering all of the statistical tests, we find that Koreans have stronger dual-risk attitudes than the residents of the other two countries. There is some evidence that Chinese exhibit stronger dual-risk attitudes than Americans using a logistic regression with three countries, but the evidence is weaker using the two-sample McNemar test.

3. Study 2: Estimating the Coefficient of Loss Aversion.

A fundamental principle of prospect theory is that losses have a greater affective impact than gains of the same magnitude. In American samples losses have been found to have an impact varying between 2.0 and 2.5 times that of gains (Kahneman and Lovallo 1993). To the best of our knowledge, the magnitude of the loss aversion coefficient has never been ascertained in Asian participants. A second reason to estimate the loss aversion coefficient in each country is to have more precise estimates of reference point movements among the participants from the three countries in Study 3.

3.1. Research Participants

Study 2 was run together with Study 1. Thus, the participants and procedures were the same as described in Study 1. The only difference is that, in our Korea subjects, three persons did not

provide answers to the loss aversion questions. Thus, we had 78 observations (81 – 3) from Korea in this study.

3.2. Questionnaires and Procedure

We again used questionnaires, this time to measure country-specific loss aversion coefficients. Again, back-translation was employed to ensure translation accuracy.

There were three questions asking for the size of the gain prospect of a gamble that would make a participant indifferent between a sure outcome of zero and the gamble. The three questions differed in the magnitude of the loss prospect; the numbers were converted into a local currency of equivalent amounts by an approximate ratio based on the exchange rates, as described in Study 1. The three questions were adapted directly from Tversky and Kahneman (1992), and the loss aversion coefficient of an individual was measured by the indicated gain prospect, X, divided by the corresponding loss prospect.

Option A: no gain or loss;

Option B: Win $X or lose $25/$50/$100 with equal probability of 50%

Indicate the dollar value of X that will make you indifferent between Options A and B:

$_____

3.3 Results and Discussion

The data from one US subject were deleted due to a preposterous value provided by that individual. Table 2 contains the mean and median loss aversion coefficients for the remaining 248 people. The mean loss aversion coefficient across the three loss prospects is 1.78 for China, 1.61 for Korea, and 1.86 for the US while the median coefficient is 1.5, 1.2, and 2.0,

respectively.[5] Both the mean and median indicate that the US subjects are more loss averse than the Asians.

A 3 (country: US, China, Korea) x 3 (loss amount: 25, 50, 100) ANOVA with the loss amount being a within-subjects factor revealed that the country effect was not significant [F(2,244) = 1.73, $p = 0.179$].[6] We later used these mean point estimates for the country-specific loss aversion coefficients in order to analyze the data from our final study. The median loss aversion coefficient 2.0 for the Americans is similar to what were reported by prior researchers (e.g., Kahneman and Lovallo 1993). Although not of central interest, the interaction was significant, [$F(3.03,244) = 2.92$, $p < .05$, Greenhouse-Geisser df correction]. The interaction was due to the fact that the Koreans' loss coefficient was further below the mean of the other two countries at the lowest loss level (1.51 vs. 1.86) and at the intermediate loss level (1.57 vs. 1.77) but less so at the highest loss level (1.76 vs. 1.83).

Table 2. Mean and Median Loss Aversion Coefficients from Study 2

	Mean				Median			
	$25	$50	$100	All	$25	$50	$100	All
China	1.82	1.77	1.75	1.78	1.5	1.5	1.5	1.5
Korea	1.51	1.57	1.76	1.61	1.2	1.2	1.2	1.2
US	1.89	1.78	1.91	1.86	2.0	2.0	2.0	2.0

[5] When the questions are displayed with the same dollar numbers in local currency, Chinese participants have a loss coefficient of 1.69, slightly lower than using the equivalent dollar payoff as displayed in Table 2.

[6] If we use for Chinese subjects the answers to the questions displayed with the same dollar numbers in local currency to compute their loss aversion coefficient,, the country main effect remains non-significant [$F(2,244) = 1.72$, $p = 0.182$]. The interaction becomes non-significant, and the loss amount becomes significant due to a greater loss coefficient at the highest loss level.

Note. The loss aversion coefficient is defined as the reported amount of the gain prospect divided by the pre-specified loss prospect ($25, $50, or $100) in a 50:50 gamble such that a subject is indifferent between the gamble and a sure outcome of zero.

4. Study 3: Stock Trading Game [Becker, DeGroot, and Marschak (1964) Procedure]

Based on findings in Studies 1 and 2, we concluded that, consistent with prospect theory, subjects from all of the three countries exhibit dual risk attitudes and loss aversion. We then proceeded to test reference point adaptation to outcome payoffs. As discussed previously, we employed the experimental design of Arkes et al. (2007) to test whether (a) reference points adapt faster to gains than to losses, and (b) a forced sale/repurchase event helps foster adaptation. Furthermore, we looked for possible cultural differences in these adaptation patterns.

4.1. Research Participants

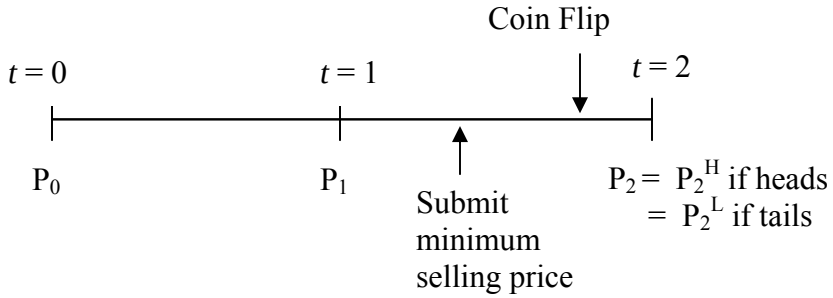
The participants were 76 subjects from Florida State University in the US, 94 subjects from Sun Yat-Sen University in China, and 116 subjects from Yonsei University in Korea. We recruited undergraduate business majors through e-mails, fliers, and in-class announcements. The study occurred outside of class time.

4.2. Procedure

We used the stock trading game procedure of Arkes et al. (2007, Experiment 6) that is based on the Becker, DeGroot, and Marschak (1964) procedure. The same procedure was used with our participants in China, Korea, and the US.

Subjects traded one stock in each of 4 trading rounds. Each round consisted of three dates and two periods. At the beginning of the trading round, subjects were told that they had purchased a stock at a certain price (P_0) and had held the stock for a week. They were then informed of the current price P_1, which was either higher or lower than their purchase price P_0.

Also, they were informed of the two future possible prices of the stock in the next trading period (P_2). Before the realization of the second period price P_2, subjects had a chance to sell the stock to the experimenter by stating their minimum selling price. Following the Becker, DeGroot, and Marschak (1964) procedure (BDM), a buying price was drawn from a uniform distribution of prices at 10-cent intervals between the two possible future prices P_2^H and P_2^L, which correspond to the high and low future price possibilities, respectively. If the randomly drawn buying price exceeded or equaled the subject's minimum selling price, the subject sold the stock at the randomly drawn buying price. If the buying price was less than the minimum selling price, the subject held the stock and sold it at the next trading period's price P_2 which was to be determined by a coin flip.



Under the BDM procedure, it is optimal for the subjects to set their minimum selling price equal to their valuation of the gamble. Thus, the BDM procedure reveals through subjects' minimum selling prices their certainty equivalents of risky gambles, given their new reference point. By obtaining the certainty equivalent, the implied new reference point is solved for using the prospect theory value function.

Among the four stocks, two were winners and two were losers. The price paths used in the US experiments were as follow: The winner stocks, which were purchased at $20, went up to $26 after the first period. The subjects were informed that the stocks would have to be sold at

either \$30 or \$22 with equal probability in the next trading period. The loser stocks were purchased at \$20 and dropped to \$14 with a future price of either \$18 or \$10 with equal probability. The BDM valuation procedure was used to solicit subjects' minimum selling prices after we informed the subjects of the next trading period stock prices.

One winner and one loser stock had the intervention of a sale and repurchase of that stock, following Arkes et al. (2007). After subjects were informed of the first period price movement, they had to sell the stock and repurchase it for the same price after a time delay. During the time delay, the subjects traded other stocks that were not involved in this experiment. This time delay ranged between 20 and 30 minutes, and was designed to help subjects segregate the prior outcome—a gain or a loss—from the upcoming BDM procedure. We hypothesized that this forced sale and repurchase would help close the mental account occasioned by the prior price movement ($P_1 - P_0$). After subjects repurchased a stock, they learned the possible future prices of the stock and submitted their minimum selling prices.

Following Arkes et al. (2007), we explicitly instructed subjects about why it was optimal for subjects to ask their true valuation of the stock. We included illustrative examples showing how asking above or below one's true valuation causes suboptimal outcomes. All subjects in each session had a chance to gain experience in two practice rounds. Arkes et al (2007) reported that the subjects showed good understanding of the procedure and the optimal strategy.[7]

In China, the stock prices presented to subjects were the same as the numbers used in the US. Most stock prices range from ¥5 to ¥50 in Chinese stock markets. Therefore the purchase price of ¥20 and possible future prices of ¥30/¥22 or ¥10/¥18 sound more realistic than the US

[7] Subjects gave an average 5.3/6 rating to their understanding of the experimental procedure, and an average rating of 3.8/5 to their acceptance of the optimal strategy under the BDM mechanism in Arkes et al (2007).

prices multiplied by the exchange rate. In Korea the numbers presented to subjects were the US prices multiplied by 1,000. This conversion reflects the exchange rate between Korea and the US, and the converted numbers are close to typical stock prices in Korean stock markets. The reference points inferred from Korean subjects' minimum selling prices were divided by 1,000 so that we could compare the results across countries.

Like Studies 1 and 2, we adjusted the range of the possible final payoff to ensure similar monetary incentive from the perspective of a college student. The subjects were promised a $20 base payment in the US, ¥60 in China, and 20,000 KRW in Korea for their participation. In addition, subjects were told that their trading profit or loss would be added to the participation fee to yield their final payment. Specifically, we told them that two stocks out of all stocks they had traded would be randomly drawn and their trading profits would count toward their final payoff. This created a pecuniary incentive for the participants to follow the optimal strategy in each round of trading. Further, since trading profits were not cumulative across rounds, their decision on each round should not have been influenced by their decisions from prior outcomes. The final payoffs ranged from $15 – $25 in the US, ¥40 – ¥ 80 in China, and 15,000 – 25,000 KRW in Korea, all equivalent to about 2-3 hours of math tutoring services or 2-4 McDonald's meals in local markets.

4.3. Results

The reference point at time 1 is the value R^* that equates the utility from selling the stock for $P^{\min}$ to the expected utility from retaining the stock and bearing the risk of an up or down movement:

$$V(P^{\min} - R^*) = 0.5V(P_2^H - R^*) + 0.5V(P_2^L - R^*), \quad (1)$$

where P^{min} is the dollar amount a subject indicates for the minimum selling price, and R^* is the implicit reference point. The value function is the cumulative prospect theory value function (Tversky and Kahneman, 1992). The coefficient of loss aversion is □, which was ascertained in Study 1.

$$V(x) = \begin{cases} x^{\alpha}. & x \geq 0 \\ -\lambda(-x)^{\alpha}. & x < 0 \end{cases} \quad (2)$$

After solving Equation (1) for the reference point, the adaptation is defined as the deviation of the new reference point from the original reference point, which is the purchase price.

After obtaining the minimum selling price (P^{min}) for each of the four stocks, we inferred each subject's reference point at time 1 (R^*) using Equation (1). For the value function in Equation (2), we used the average loss coefficient for each country estimated in Experiment 1; 1.78 for China, 1.61 for Korea, and 2.08 for the US. We used □ □ □because it maximized the number of solvable observations, following Arkes et al. (2007). We defined the amount of reference point adaptation as $R^* - P_0$ when there was a prior gain and $P_0 - R^*$ when there was a prior loss.

We performed a 3 (country: US, Korea, China) x 2 (outcome: win, loss) x 2 (sale/repurchase intervention: yes, no) analysis of variance (ANOVA) on the magnitude of reference point adaptation. Country was the only between-subjects factor. For very high or low minimum selling prices, we were not able to solve for reference points, so we ended up with 92 subjects from China, 108 subjects from Korea, and 76 subjects from the US with usable data.

Table 3 reports the average reference point adaptation for the four stocks. We found greater adaptation to gains than losses in all three countries. Thus the outcome main effect was significant [$F(1,273) = 37.09$, $p < 0.001$]. This evidence replicates the US findings of Arkes et

al. (2007) and extends this conclusion to other cultures as well. However the magnitude of this asymmetry differed across countries, as the country × outcome interaction term was significant [F(2,273) = 3.85, p = 0.023]. Among the Chinese participants the magnitude of adaptation following gains was 1.16 greater than that following losses. This was twice the asymmetry among Koreans (0.57), and approximately three times greater than that of the Americans (0.39).

Table 3. Mean Reference Point Adaptation to $6 Gain/Loss

	Winner (Base)	Loser (Base)	Winner (Intervention)	Loser (Intervention)
China (n=92)	6.64	5.53	6.34	5.14
Korea (n=108)	6.18	5.69	6.01	5.35
US (n=76)	6.04	5.58	6.10	5.77

Note. These mean reference point adaptations are calculated using the mean loss aversion coefficients for each country (1.78 for China, 1.61 for Korea, and 1.86 for the US; See Table 1).

The sale/repurchase intervention main effect was also significant [F(1,273) = 6.35, p = 0.012], but this was qualified by the intervention × country interaction [F(2,273) = 4.65, p = 0.01]. Whereas the sale/repurchase intervention caused a small increase in adaptation among the Americans, replicating Arkes et al. (2007), it caused a *decrease* in adaptation among the two Asian groups. Figure 2 depicts this interaction. In Figure 2, for all three cultures the mean following a loss is always less than the mean of the corresponding gain, illustrating the outcome main effect. For the Americans the sale/repurchase intervention resulted in a higher mean adaptation following both gains and losses, but for the two Asian cultures, the intervention

resulted in a lower mean adaptation following both gains and losses, illustrating the intervention × country interaction.[8]

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[8] The outcome main effect and the intervention × country interaction are insensitive to the choice of the loss aversion coefficient or □. in each of the three countries. The country x outcome interaction effect is sensitive to the choice of □ or the loss aversion coefficient.

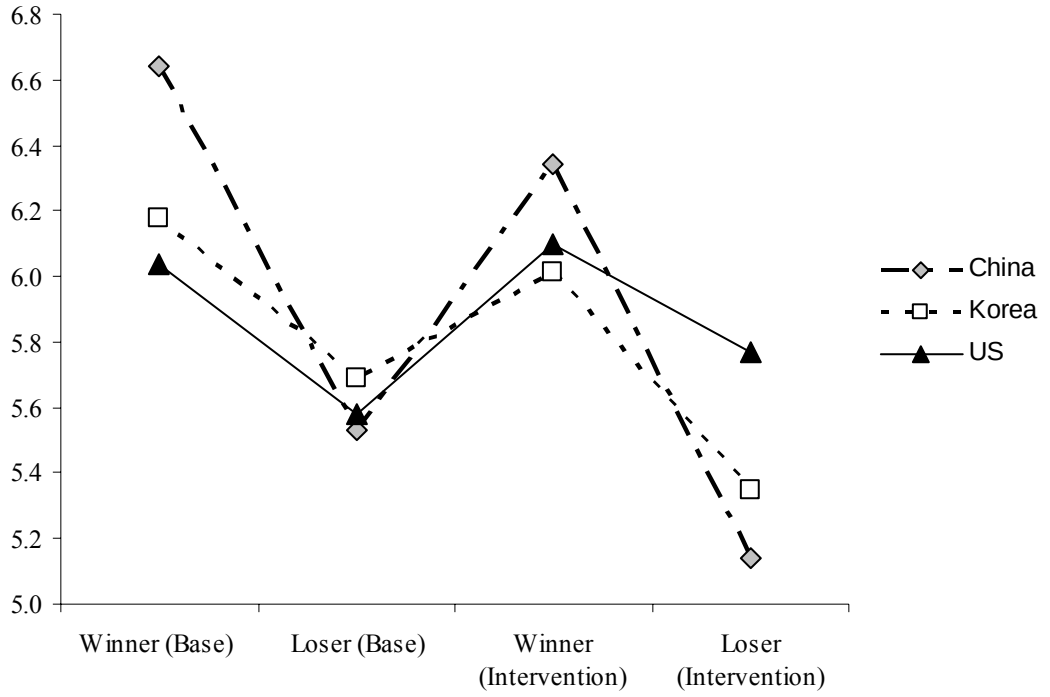

Figure 2: Reference point adaptation of all groups in Study 3.

4. Discussion

There were two main results in Study 3. First, the asymmetric adaptation found in American students by Arkes et al. (2007) was also found in the Korean and Chinese participants as well as further US subjects. Thus this result appears to generalize across cultures. If valid, the

explanation offered by Arkes et al. (2007) would apply in every culture, because it is based on fundamental hedonic processes. This explanation is as follows.

Arkes et al. hypothesized that faster adaptation to gains than to losses is a consequence of mental accounting (Thaler 1999) and hedonic maximization (Thaler 1985). In particular, asymmetric adaptation results from hedonic benefits of segregating intertemporal gains and integrating intertemporal losses. After experiencing a gain, a person who closes that account and adapts the reference point upward experiences two benefits. The first is the immediate hedonic benefit of closing a mental account to realize a gain. The second is that any subsequent gain includes the steep portion of the value function just to the right of the new origin of the updated graph. In addition, when the update is incomplete, the remaining part of the gain can be used to cushion a possible subsequent loss. Therefore, a partial adaptation to a gain is preferred to no updating of the reference point.

On the other hand, adaptation of the reference point following a loss has two disadvantages. The first is that closing a mental account "in the red" results in a negative hedonic experience. The second is that as a result, a subsequent loss will occur in the steep portion of the value function to the left of the new origin of the graph, and one also forgoes the prospect of negating the prior loss with a possible subsequent gain. Hence, less updating is preferred to more updating.

The goal of such "affective engineering" is hedonic maximization. We hypothesize that culture would have a minimal role to play in the adoption of this goal. Thus we expect to observe asymmetric adaptation to gains and losses in all countries.

The second main finding from Study 3 was the intervention × country interaction. Although the insertion of the sale/repurchase intervention caused greater adaptation in the

Americans—again replicating Arkes et al. (2007)—it had the opposite effect in both Asian samples. We hypothesize that two factors are responsible for this result.

The first factor is the one that motivated the use of this intervention. Arkes et al. hypothesized that by having the subject sell and repurchase the stock, its time 1 price would be emphasized. This heightened salience created by the transaction is hypothesized to encourage adaptation toward the new price. Indeed, that is what happened in the American sample in Arkes et al. (2007) and in this manuscript.

The second factor is discussed by Ji et al. (2001). These investigators demonstrated in a very wide variety of assessment tasks that Chinese persons, to a significantly greater extent than Americans, anticipated that circumstances would change. For example, Chinese subjects, more than Americans, expected a chess champion to lose the next match, bickering children to eventually become lovers, and dating couples to break up. Although most of the demonstrations of this difference were in non-business contexts, the same result was manifested in the domains of economic growth and personal financial trends.

Within the BDM procedure we used in Study 3, this contrarian tendency would cause less adaptation among Chinese than among Americans. For example, if the first price change is a positive one and this gain is emphasized by the sale/repurchase intervention, Chinese participants are likely to place a lower value on the outcomes of the subsequent coin flip compared to Americans, because they have a somewhat greater expectation of an adverse outcome. Placing a lower value than the Americans would be interpreted in the BDM framework as a smaller movement from the original reference point. This low amount of adaptation would be more likely to occur with the sale/repurchase intervention, because in that situation the original positive price movement is emphasized. To the extent that the Korean participants shared many

of the same cultural characteristics of the Chinese, we might expect the two groups to behave similarly, which is the result we obtained.

5. General Discussion

It has been three decades that prospect theory came into existence. Surprisingly, our knowledge of cross-cultural patterns in the static and dynamic properties of prospect theory is rather limited. Indeed, prior research on prospect theory is mainly confined to Westerners. Our studies explored these issues and found both cross-cultural similarity and differences in several such properties.

We showed that prospect theory in general holds among Chinese and Koreans, two examples of eastern cultures. In those countries, individuals also exhibited loss aversion and dual risk attitudes. Interestingly, we found that east Asians tend to be less loss averse than the Americans, although not significantly so. (The median loss coefficients in the three countries differed much more than the means did, however.) Weber and Hsee (1998, 2001) found that Chinese tend to be more risk-seeking than Americans in the financial domains. Our result suggests that the tendency to seek risk among east-Asians might be fostered to some extent by their smaller degree of loss aversion.

Extending the findings of Arkes et al. (2007) from western to eastern cultures, we showed that, in the dynamic setting of security trading, reference points adapt to prior gains to a greater degree than to prior losses. Thus, asymmetric adaptation to outcome payoffs can be applied across the three countries we sampled. We suggest that asymmetric adaptation has profound implications for the sunk cost effect (Arkes and Blumer 1985), the disposition effect (Odean 1998, Shefrin and Statman 1985), investor trading decisions (Arkes et al. 2007), and the decision making in general. For example, to the extent people do not adapt to their losses, they will be

more likely to “throw good money after bad” in an attempt to rescue the failing course of action. To the extent people do adapt substantially to gains, these gains will soon become less satisfying (Staw 1976). Our results therefore suggest that asymmetric adaptation may be important for the international arenas of finance, management, marketing, and negotiation.

One puzzle that we documented, and for which we offered a hypothesized explanation, pertains to cross-cultural differences in the impact of the sale and repurchase event. When stocks are sold but repurchased at the same price, we found that east-Asians tend to decrease their reference point adaptation while Americans tend to increase it. This finding suggests a potentially very interesting cultural difference in the exogenous closing and opening of a mental account. We leave the definitive explanation for this phenomenon for future research.

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