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Individual differences in a switch from risk-averse preferences for gains to risk-seeking preferences for losses: can personality variables predict the risk preferences?

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Individual differences on a framing problem and a reflection problem were examined in light of the Myers–Briggs type Indicator. The predictions on information processing style, derived from Jungian personality type theory, were tested for the much-discussed framing effect in the Asian Disease Problem (Tversky and Kahneman 1981) and for the reflection effect on which the framing effect presumably depends. As anticipated, the results revealed that business students with higher iNtuition/Extraversion scores and lower Judging score were more likely to be consistently risk-seeking. Conversely, those with higher Sensing/Judging scores were more likely to be consistently risk-averse. Both framing and reflection effects were displayed by those with higher Sensing/Judging scores. However, the second expected result was not supported. Rather, a so-called 'gray hair/clouds' effect (effect name inspired by Medin and Shoben's research in 1988), questioning the validity of risk propensity, was observed and analyzed. The somewhat surprising results and their theoretical and practical implications are discussed.

Keywords: reflection effect; framing effect; Myers–Briggs type indicator; gray hair/clouds effect

Introduction

Measure of risky choice: two-fold pattern of risk attitudes

The concept of risk propensity has been the subject of both theoretical and empirical investigation, but with little consensus about its definition and measurement (Nicholson et al. 2005). In economic theories, risk attitudes are usually measured by revealed lottery preferences and characterized by a known probability distribution (Mellers, Schwartz, and Cooke 1998). According to Kahneman and Tversky (1982, p. 136), a choice is 'risk-averse' if a sure thing is preferred to a gamble with an equal or greater monetary expectation. A choice is 'risk-seeking', on the other hand, if a sure thing is rejected in favor of a gamble with an equal or lower monetary expectation. In particular, Kahneman and Tversky (1979, p. 268) described a *reflection effect* in which the signs of the outcomes were reversed, with gains replaced by losses and *vice versa*. Under these conditions, they observed that preference orders would be reversed to be risk-averse in the gain domain and risk-seeking in the loss domain. They concluded that a 'reflection of prospects around 0 reverses the preference order'.

Such an observable switch from risk-averse preferences for gains to risk-seeking preferences for losses has provided grist for the theoretical mills and been the subject

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of much contention. For example, prospect theory (Kahneman and Tversky 1979) provided the main theoretical framework for explaining the reflection effect: the observed pattern of the reflection effect (risk aversion for gains and risk seeking for losses) could be accounted for by the theory's S-shaped value function alone. As Kahneman and Tversky (1979, p. 268) claimed, 'in prospect theory, the over-weighting of small probabilities favors both gambling and insurance, while the S-shaped value function tends to inhibit both behaviors'. An alternative approach, the equate-to-differentiate theory (Li 2004a, b), postulates that the reflection effect on the two-fold pattern of risk attitude is mediated by an individual's judged value difference between the possible outcome and the certain outcome (Li 1998, 2005; Li and Adams 1995; Li and Xie 2006). The reflection effect is produced if, and only if, reflection of prospects around 0 changes the perceived value difference between the possible outcome and the certain outcome across different domains.

The reflection effect presumably forms the basis for the framing effect in which the perceived domain is influenced by changes in the problem wording (Fagley and Miller 1997). Framing effect on decision-making was much discussed by the Asian Disease Problem (Tversky and Kahneman 1981), which demonstrated behavior in contradiction to the invariance axiom of expected utility theory:

> **Problem 1**. Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:
> If Program A is adopted, 200 people will be saved.
> If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no one will be saved.
> Which of the two programs would you favor?
> **Problem 2**. Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:
> If Program A is adopted, 400 people will die.
> If Program B is adopted, there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.
> Which of the two programs would you favor?

According to Tversky and Kahneman (1981), Problem 2's programs are loss-oriented, complementary versions of Problem 1's programs. The normative principle of descriptive invariance states that the manner in which prospects are formulated should not influence their preference order (Kahneman and Tversky 1984). Consequently, if Program A from Problem 1 is favored over Program B from Problem 1, then Program A from Problem 2 should be favored over Program B from Problem 2. Framing effect is demonstrated when respondents choose Program A from Problem 1 and Program B from Problem 2 (framing), or choose Program B from Problem 1 and Program A from Problem 2 (reverse framing). Tversky and Kahneman (1981) found that when alternative outcomes were phrased positively in terms of lives saved, the majority (72%) preferred the certain option (Program A, Problem 1). When outcomes were phrased negatively in terms of lives lost, the risky option (Program B, Problem 2) was preferred (78%). Tversky and Kahneman's findings show that people systematically violate the invariance principle and that such preference instability can be elicited by trivial variations in wording.

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Over the past two decades, a variety of studies have demonstrated that risk preferences are remarkably sensitive to the way a decision is framed and to the mode of response used to express the preference (Fischhoff, Slovic, and Lichtenstein 1980, see also Slovic 1995). Such studies have explored the framing effect based on the Asian Disease Problem and its variants, including those in applied settings. For example, McNeil et al. (1982) found that not only laypeople but also physicians were susceptible to this framing effect. However, Kühberger (1998) found that diverse operational, methodological and task-specific features made it impossible to speak of a single framing effect. He reviewed the influence of framing on risky decisions based on data from 136 framing experiments involving nearly 30,000 participants. Kühberger showed that the overall framing effect between conditions was of small to moderate size, depending on research design. Obviously, not all study participants exhibit the framing effect – there is a considerable population that gives the standard normative response on each of these tasks (Stanovich and West 1998). The outcome for the two problems, each with two program choices, thus leads to four observable combinations:

- consistent risk-aversers – those who always choose a sure thing
- consistent risk-seekers – those who always choose a risky option
- framing exhibiters – those who exhibit framing effect
- reverse framing exhibiters – those exhibiting reverse framing effect.

While there have been many concerns about the interpretation, assessment and prediction of the above four combinations, relatively little attention has been paid to individual differences on risk preference. As Stanovich and West (1998) noted, individual differences are usually ignored when interpreting the descriptive/normative gap. Thus, the purpose of this study is to investigate and understand the relationship between information processing style – as measured by the Myers–Briggs type indicator (MBTI), and the two-fold pattern of risk attitude.

Information processing style and two-fold pattern of risk attitudes

Information processing style, often termed cognitive style, is defined as the way in which people process and organize information and arrive at judgments or conclusions based on their observations (Hunt et al. 1989). It is considered as an individual characteristic linked to differences in decision-making behavior (Leonard, Scholl, and Kowalski 1999).

Some research has explored the relationship between preferences on risk and personality type in terms of information processing type. For instance, the dual-process approach of thinking assumes that there are two completely different kinds of processing style, and one kind of processing style is relatively automatic and holistic and leads to an automatic contextualization of problems, whereas the other involves a more controlled and analytic processing style and serves to decontextualize and depersonalize problems (Stanovich and West 2000). In the field of risk preference, sensibility to contextual cues such as the framing effect has become one differential factor for the two kinds of processing style. McElroy and Seta (2003), for instance, found that the responses of analytic style thinkers were more likely to conform to predictions derived from expected utility theory than those of holistic style thinkers. In addition, it is interesting to note that Lichtenstein and Slovic (1971)

also claimed the importance of an individual's information processing mechanism when making choices.

A more comprehensive elaboration on information processing has been proposed in Jung's (1964/1968) theory of psychological types which confirms that individuals have psychological preferences for performing certain tasks. The MBTI, developed by Myers (1962) as an operationalization of Jungian theory, serves as a useful tool for understanding important functions of applied settings (Sample 2004). The MBTI broadens Jung's interested cognitive style into four dimensions, and seeks to identify an individual's status on either one or the other two opposite personality categories (Myers et al. 1998), namely, Extraversion versus Introversion (EI), Sensing versus iNtuition (SN), Thinking versus Feeling (TF) and Judging versus Perceiving (JP). Two of the four MBTI dimensions, SN and JP, seem to be most related to risk preference. They also offer some overlap as well as some differences with the dual-process approach of holistic-analytic thinking style. On the SN dimension, the *Sensor* prefers the immediate, real, practical facts of life – his or her experiences are grounded in the here-and-now. By contrast, the *iNtuitor* prefers possibilities, relationships and meanings of experience and is fascinated by the future. On the JP dimension, the *Judger* prefers to live in a decisive, planned, orderly way and aims to regulate and control events. The *Perceiver*, on the other hand, prefers to live in a spontaneous, flexible way and aims to understand life and adapt to it.

The present exploration of a switch from risk-averse preferences for gains to risk-seeking preferences for losses focuses on only one particular pattern of choice problem related to the framing effect, or even the reflection effect, namely, choices between two options where one is risky and the other is a sure thing. This is because Kahneman and Tversky do not claim that their framing effect can be produced with all the reflection patterns listed in their 1979 paper (Table 1), nor with other related patterns not listed there. It is commonly acknowledged that it is only in one of the patterns that a sure thing is involved and it is only with this pattern (involving risk aversion for gains and risk-seeking for losses) that the classical framing effect has been found (see Li 1998 for more detailed argument). These two options can be identified and distinguished from each other by crossing two factors: outcome versus controllability, as shown in Table 1. A close look at Table 1 and the descriptions of the two types that comprise the four broader classes indicates that the SN and JP cognitive styles are most likely to affect a choice between two options where one is risky and the other is a sure thing.

The existing empirical evidence (e.g. McElroy and Seta 2003) implies that the iNtuitor is more risk-seeking than the Sensor when faced with a choice between a

Table 1. A classification of the two options employed in the present study.

		Outcome	
		Fixed and riskless	Probabilistic
Controllability	Controllable	A sure thing option	n.a.
	Uncontrollable	n.a.	A risky option

risky and a sure things; whereas the Judger is more risk averse than the Perceiver. In light of the above observations, we proposed the following hypothesis:

H1: consistent risk-aversers will have higher mean Sensing (SN dichotomy) and/or Judging (JP dichotomy) score(s) than consistent risk-seekers.

The framing effect exhibits an asymmetrical preference on risk. For example, faced with different contexts in the Asian Disease Problem, participants will exhibit one of the four combinations mentioned earlier. Soane and Chmiel (2005, p. 1782) distinguished domain-specific preferences, which refer to 'the decision-making and risk preferences within a particular choice domain' with cross-domain consistency, which refers to 'the degree of variation that an individual shows for the same decision-making variable, e.g. risk preference, across each of the decision domains'. Their evidence for cross-domain (e.g. gain or loss domain in this case) consistency encourages our proposition that the relatively stable risk propensity is personality-based, specifically information processing type as measured in this study. Research has also shown that personality traits become increasingly stable over the life course (Roberts and DelVecchio 2000). Gosling, Kwan, and John (2003) even suggested that personality differences exist and are measurable in animals other than humans. If personality traits exhibit stability, we would expect the information processing style for risk-aversers for gains and risk-seekers for losses (or *vice versa*) to fall somewhere between that of consistent risk-averser and consistent risk-seeker. Accordingly, the following hypothesis was formulated:

H2: SN and/or JP mean score(s) by inconsistent decision-makers (those who are risk averse for gains and risk seeking for losses, or vice versa) are expected to compare to the average of the scores of consistent risk-aversers and consistent risk-seekers combined.

Method

Participants

The participants in this experiment were 200 first-year undergraduates (81 males and 119 females) undergoing the organizational behaviour module in Nanyang Technological University. The average age for males was 21 years while the average age for the females was 19 years. All the participants paid $2 each to undertake the MBTI test, which was conducted by the Nanyang Business School as a course requirement.

Measurement

Myers–Briggs type indicator

The version of MBTI used was Step II Expanded, and Form K. MBTI Step II (Form K) provides information about individual differences and nuances within each type. The MBTI preference clarity index (PCI) indicates how clearly and surely a respondent prefers one pole of a dichotomy over its opposite. As such, the numerical PCI on the MBTI reflects the degree of confidence in the accuracy of placement of a respondent into a particular type category (Myers et al. 1998). A higher PCI means that the respondent is clearer about what he or she wants when compelled to make a choice. For example, a respondent scoring T 30 more clearly prefers Thinking as compared to Feeling, than a respondent scoring T 15 when faced with the same

questions. A low PCI results from almost equal votes for each opposite pair in a dichotomy. A *very clear preference* is demonstrated when a respondent scores a PCI of 26–30. A PCI of 16–25 indicates *clear preference*, 6–15 indicates *moderate* and 1–5 indicates *slight preference* (Myers et al. 1998). The MBTI reported reliabilities are adequate (Myers et al. 1998).

Framing tasks

The Asian Disease Problem (Tversky and Kahneman 1981) was presented as described earlier. The investment problem was borrowed from Hodgkinson et al. (1999) (see Appendix). Both problems are framed either as gain or loss, which include the risk-averse and risk-seeking options.

Procedure

Participants were first asked to indicate their MBTI scores for the four individual spectrums on a demographics sheet through a computer scoring system. Participants, in an in-class setting (limited to 20 students), were then asked to complete the framing problem pairs (that is, framing was a within-participant variable) and the investment problem pairs, in which they also completed some other tasks not part of the present investigation. The problems were interspersed among other unrelated tasks and presented in questionnaire form. The positively and negatively framed items were all presented adjacently in the questionnaire. After completion, participants were thanked and debriefed.

Results

Patterns of participants

For both problems, the participants had to choose a safe alternative (e.g. a safe proposition of investing locally for the Investment Problem) or a 'riskier' alternative (e.g. a 'riskier' alternative of investing overseas for the Investment Problem) in each pair of problems. Both problems were phrased such that Problem 1 was positively framed, whereas Problem 2 was negatively framed. Consistently risk-averse participants chose A for both problems, while consistently risk-seeking participants chose B for both problems. Positive framing or reflection effect participants chose A for Problem 1 and B for Problem 2. Reverse framing or reflection effect participants chose B for Problem 1 and A for Problem 2.

For the disease problem, a total of 118 of the 200 participants were consistent on both trials (73 were consistently risk-averse and 45 were consistently risk-seeking). That 59% of the participants responded consistently in a within-participant administration of this problem is consistent with the 63.6% figure obtained by Frisch (1993). The proportions consistently risk-averse (36.5%) and consistently risk-seeking (22.5%) were similar to those obtained in the Frisch study (30.3 and 33.3%, respectively). Thirty-three percent of the sample (66 participants) displayed a framing effect (the figure was 29.3% in Frisch's sample). Finally, 8% of the sample (16 participants) displayed reverse framing effects (risk-averse responses in the negative frame and risk-seeking responses in the positive frame). This again is similar to the 7.1% figure in Frisch's (1993) study.

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For the investment problem, a total of 112 of the 200 participants were consistent in their choices – 52 participants were consistently risk-averse (26% of the total sample) while 60 participants were consistently risk-seeking (30%). Eighty-eight participants exhibited framing effect – 74 participants exhibited reflection effect (37%) while 14 participants exhibited reverse reflection effect (7%).

Information processing style for four patterns

Table 2 presented the four mean MBTI scores as a function of the pattern of responding on the Disease Problem and the Investment Problem, and the corresponding MANOVA results.

As we were most interested in the opposite SN and JP personality categories, we gave priority to examine the difference of risk preference for these two categories. For the SN dichotomy, MANOVA analysis revealed a significant effect of response pattern on PCI scores in the Disease Problem, $F(3,196)=6.584$, $p<0.001$. Further *post hoc* Bonferroni tests found a significant difference between the consistent risk-seeker and the consistent risk-averser, and between the consistent risk-seeker and the framing exhibiter. A roughly similar pattern of risk preference for the SN dichotomy was found in the Investment Problem. The consistent risk-seeker scored lower on the SN dichotomy than either the consistent risk-averser or the framing exhibiter.

Within the JP dichotomy, the mean positive PCI scores in the Disease Problem were observed for all four patterns, with the framing exhibiter the highest ($M=14.76$) and the consistent risk-seeker the lowest ($M=1.07$). MANOVA analysis revealed a significant effect of response pattern on PCI scores, $F(3,196)=3.958$, $p<0.001$. Further *post hoc* Bonferroni tests found a significant difference between consistent risk-seekers and framing exhibiters. The risk preference pattern is similar with both Investment and Disease Problems. The consistent risk-seeker scored lower on JP dichotomy than the framing exhibiter ($p<0.05$), and also lower than the consistent risk-averser, although failed to reach statistical significance at 0.05 level. Thus, hypothesis 1 was supported.

Our data also showed a noteworthy risk-preference/personality-category correlation other than SN and JP dichotomies. MANOVA analysis revealed a significant effect of response pattern on PCI scores in the Disease Problem for the EI dichotomy, $F(3,196)=3.667$, $p<0.05$. Further *post hoc* Bonferroni tests found a significant difference between the consistent risk-seeker and the reverse framing exhibiter. However, there was no significant effect between the two opposite patterns in the Investment Problem, $F(3,196)=0.887$, *ns*. As for the TF dichotomy, the resulting findings were very clear-cut – there was no significant effect of response pattern on PCI scores in either the Disease [$F(3,196)=0.635$, *ns*] or Investment [$F(3,196)=1.651$, *ns*] Problems.

Risk dispositions of inconsistent decision-maker

To analyze the stability of individual difference in risk preference, we defined framing exhibiter and reverse framing exhibiter as inconsistent decision-makers. We depicted our findings by crossing three combinations: consistent risk-averser, consistent risk-seeker and inconsistent decision-maker (see Figures 1 and 2 respectively for both problems). In line with H1 proposed in this paper, consistent

Table 2. Mean MBTI scores and MANOVAs for both problems.

MBTI dichotomies	Problems	Response patterns				MANOVA	
		Consistent (risk-averse)	Consistent (risk-seeking)	Risk aversion for gains and risk seeking for losses	Risk seeking for gains and risk aversion for losses	F	*p*
EI	Disease	−6.64 (73)*	4.51 (45)[a]	−5.05 (66)	−14.63 (16)[a]	3.667	0.013
	Investment	−6.96 (52)	−0.59 (60)	−5.70 (74)	−2.36 (14)	0.887	0.449
SN	Disease	7.33 (73)[b]	−6.13 (45)[b,c]	9.26 (66)[c]	7.13 (16)	6.584	0.000
	Investment	9.15 (52)[d]	−3.07 (60)[d,e]	8.82 (74)[e]	2.79 (14)	5.316	0.002
TF	Disease	6.96 (73)	3.02 (45)	8.24 (66)	10.81 (16)	0.635	0.594
	Investment	5.13 (52)	6.85 (60)	5.47 (74)	19.86 (14)	1.651	0.179
JP	Disease	9.96 (73)	1.07 (45)[f]	14.76 (66)[f]	1.88 (16)	3.958	0.009
	Investment	10.08 (52)	2.17 (60)[g]	12.46 (74)[g]	14.50 (14)	2.749	0.044

*Mean MBTI scores (equal votes for each opposite pair in a dichotomy have a score of 0; positive scores denote PCI of E, S, T or J; negative scores denote PCI of I, N, F or P) are indicated with the number of participants in parentheses.
The same letter indicates significant relationship ($p<0.05$); no or different letters indicate non-significance.

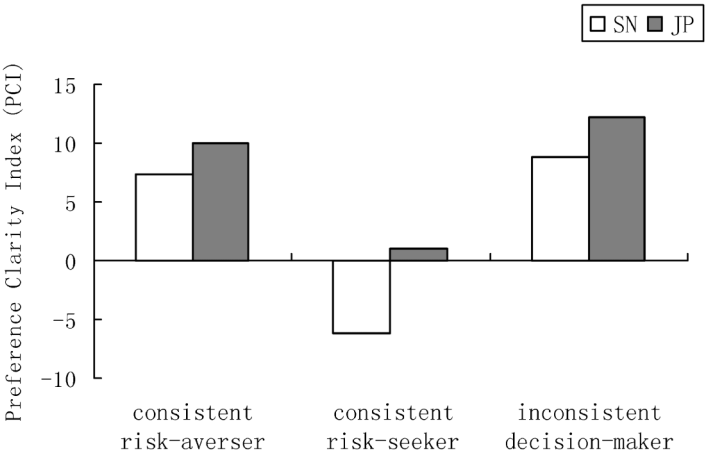

Figure 1. The cognitive style and the risk preference in Asian Disease Problem. Equal votes for each opposite pair in a dichotomy have a value of 0; positive values denote PCI of S or J, negative values denote PCI of N or P.

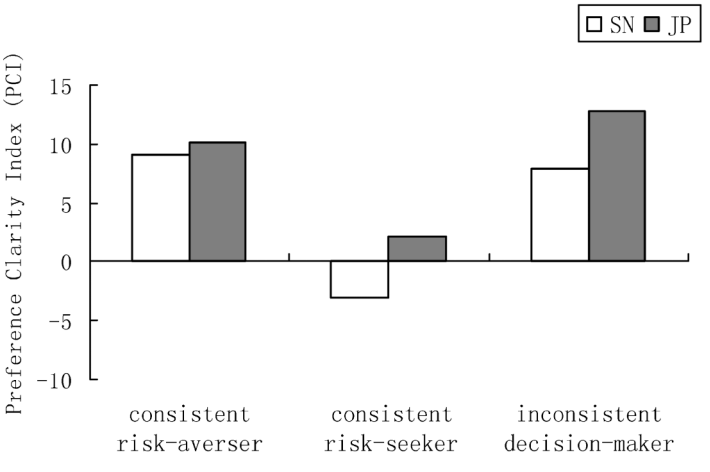

Figure 2. The cognitive style and the risk preference in Investment Problem. Equal votes for each opposite pair in a dichotomy have a value of 0; positive values denote PCI of S or J, negative values denote PCI of N or P.

risk-aversers could be categorized into the Sensing/Judging group, whereas consistent risk-seekers could be categorized into the iNtuitive/Perceiving group.

Mean MBTI PCI for the Asian Disease Problem indicated that the mean SN score of inconsistent decision-makers ($M=8.84$) was well beyond the average of the mean SN scores of both consistent risk-aversers ($M=7.33$) and consistent risk-seekers ($M=-6.13$). A test of within-participants contrast (Helmert contrast) showed a significant difference between inconsistent decision-makers' mean SN score and the average of the mean SN scores of both consistent risk-aversers and consistent risk-seekers, $F(2,197)=9.84$, $p<0.001$. Further analysis revealed a significant difference between inconsistent decision-makers' mean JP score

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(M=12.24) and the average of the mean JP scores of both consistent risk-aversers (M=9.96) and consistent risk-seekers (M=1.07), $F(2,197)=3.72$, $p<0.05$.

As for the Investment Problem, we found the same pattern we had with the Asian Disease Problem. A test of within-participants contrast (Helmert contrast) showed that there was a significant difference between inconsistent decision-maker's mean SN score (M=7.86) and the average of the mean SN scores of both consistent risk-aversers (M=9.15) and consistent risk-seekers (M=−3.07), $F(2,197)=7.39$, $p<0.001$. In addition, there was a significant difference between inconsistent decision-maker s' mean JP score (M=12.78) and the average of the mean JP scores of both consistent risk-aversers (M=10.08) and consistent risk-seekers (M=2.17), $F(2,197)=4.09$, $p<0.05$. On the whole, H2 is not supported by our results.

Discussion and conclusion

In the present study, we examined the relationship between risk preference and cognitive style operationalized by the Myers–Briggs type indicator. In general, a similar pattern of risk preference was found for both the SN and JP dichotomies across both Disease and Investment Problems. In the Disease Problem, we also found a significant EI PCI-score difference between the consistent risk-seeker and the reverse framing exhibiter. Overall, participants with a higher iNtuition PCI, a lower Judging PCI and a higher Extraversion PCI were more likely to be consistently risk-seeking. Further, those with higher Sensing and Judging PCI's were more likely to be consistently risk-averse, although there were no significant differences between the consistent risk-averse pattern and any of the other three patterns on the JP dichotomy. In addition, those with higher Sensing and/or Judging PCI's displayed the framing effect. Those with higher Introversion PCI's, however, exhibited the reverse framing effect. Our data supported previous studies by observing that risk propensity is rooted in personality in terms of information processing style.

It should not be surprising that there is a significant relationship between the EI dichotomy and risk preference. According to Jung's (1964/1968) theory of psychological types, the EI dichotomy is referred to as attitudes, that is, people differ in the degree to which they are oriented toward the external world or the internal world. In addition, studies have demonstrated that the four dichotomic dimensions of MBTI are related to the *big five personalities* (e.g. McCrae and Costa 1988; Furnham 1996). Overall, the personality measures show that NEO-PI Extraversion is correlated with MBTI EI, Openness is correlated with SN, Agreeableness with TF and Conscientiousness with JP (Furnham, Moutafi, and Crump 2003). Moreover, studies on personality difference in risk preference reveal that risk taking in different decision domains is associated positively with extraversion and openness, and negatively with neuroticism, agreeableness and conscientiousness (Nicholson et al. 2005; Kowert and Hermann 1997). Therefore, our result reinforces existing findings that the Extravert tends to be more risk-seeking than the Introvert.

Although our current findings match those of most individual difference studies on risk decision-making, we also found the unexpected but interesting result that framing effect exhibitors are more sensing and judging. Thorne and Gough (1991) found a conceptual overlap between SN and JP and reasoned that both scales tapped a stability versus change dimension. That is, the Sensor and Judger were seen as

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conservative, while the iNtuitor and Perceiver were seen as changeable and nonconforming (Gardner and Martinko 1996).

Nevertheless, a closer look at the data reveals that such a finding will pose considerable difficulty for the theoretical framework of personality approach. First, base framing results on the concept of risk propensity will inevitably engender difficulty in enabling the personality account to be interpreted unambiguously. Given that both consistent risk-aversers and inconsistent decision-makers share the same SN and JP scores, knowledge of personality type will not permit prediction of risk preference.

Second, the data do not logically anchor and explain the risk dispositions of inconsistent decision-makers. Our finding showed that consistent risk-aversers were more likely to be Sensors/Judgers and consistent risk-seekers were more likely to be iNtuitors/Perceivers. Therefore, if risk preference is shaped by personality, the inconsistent decision-makers should not have a strong propensity either to always take or avoid risks – their risk dispositions should lie somewhere between these two extremes. Our findings contradict such an expectation, that is, inconsistent decision-makers *did not* have lower SN and/or JP PCI scores. Their high PCI scores showed much more clarity and strength in preferences and accordingly, information processing style.

We labeled the surprising out-of-points (oops) result as a 'gray hair/clouds' effect. This metaphor was inspired by Medin and Shoben's (1988) finding that gray clouds were judged to be more similar to black clouds than to white clouds, but gray hair was perceived as more similar to white hair than to black hair. Logically, white hair falls into the white category, black hair falls into the black category, and therefore, half black and half white hair should fall into the gray category – mid-way between the extremes. The so-called 'gray hair/clouds' effect is an anomaly suggesting that, the young/old can be definitely characterized by their black/white hair, but there is no way to characterize the middle-aged by their gray hair. The same applies to the clouds case. Medin and Shoben's (1988) finding was applied to our observations: the SN and JP scores of inconsistent decision-makers are more similar to consistent risk-aversers than to consistent risk-seekers.

To further appreciate the significance of the points involved, let us take a look at another striking effect demonstrated by Tversky and Shafir (1992). In their study, students reported their preferences about buying a nonrefundable Hawaiian vacation after a tough examination. One-third of 200 participants were told one of the following: (1) they had passed the exam; (2) they had failed the exam; (3) they did not know if they had passed or failed. Fifty-four percent of participants in the 'pass' group and 57% of participants in the 'fail' group purchased the vacation. However, only 32% of participants in the 'don't know' group purchased the vacation. Participants who knew their passing or failing exam results were more likely to buy the vacation, whereas those who did not know were less likely to buy. Contrary to consequential reasoning, the proportion of buyers in the 'don't know' group does not fall between that of the 'pass' and 'fail' groups, i.e. between 54 and 57%.

In summary, our findings, on the one hand, present supporting evidence that information processing style is significantly related to stable risk propensity. On the other hand, when looking at the surprising result, analogous to the disjunction effect (Tversky and Shafir 1992), we found that the observed SN and JP personality

characteristics of inconsistent decision-makers are beyond rational expectation. It seems that knowledge of personality alone will not logically permit prediction of risk preferences. We hope that such an unexpected finding will stimulate research into the fundamental mechanisms that underlie the so-called 'gray hair/clouds' effect.

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Appendix

Investment problem

Problem 1

Imagine that you have to choose between two alternative investments:

A. Developing a new marketing effort within the domestic market and not attempting to export overseas. Market research indicates that this option would certainly lead to profits of $1 million.
B. Halting new developments within the domestic market but a commitment to the export market overseas. Market research indicates that this initiative would lead to profits of $3 million with probability one-third, and no profits with probability two-thirds.

Which is the one you would choose? (please circle the preferred choice).

Problem 2

Imagine that you have to choose between two investments:

A. Developing a new marketing effort within the domestic market and not attempting to export overseas. Market research indicates that this option would certainly lead to profits $2 million below target.
B. Halting new developments within the domestic market but a commitment to the export market overseas. Market research indicates that this initiative would lead to profits at target level with probability one-third, and profits $3 million below target level with probability two-thirds.

Which is the one you would choose? (please circle the preferred choice).