ABSTRACT

HAFER, JULIA GREER. Age Differences in the Impact of Affect on Risk Taking (Under the direction of Thomas M. Hess.)

This study addresses the role of affect in decision making and the role age might play in moderating the impact of affect on decision making, in particular the willingness to take risks. The literature on decision making is unclear with respect to the impact of affect on risk taking in later life. Based on emotion regulation theory, I hypothesized that affect associated with two different mechanisms might affect older adults' risk decisions: feedback regarding the consequences of their decision and current emotional state According to socioemotional selectivity theory (SST: Carstensen, 1995; Carstensen et al., 1999), avoiding sadness is a more important goal for older adults than for younger adults. If risk taking provides an affective boost, sad older adults might therefore take greater risks than sad younger adults. Similarly, if experiencing feedback about loss during a decision making task lowers mood, older adults might take greater risks in immediate feedback conditions compared to delayed feedback conditions. An alternative perspective suggests older adults manage negative affective states more efficiently than younger adults (Carstensen, Isaacowitz, & Charles, 1999). If this is true, sad older adults might engage in the same level of risk taking as sad younger adults, and immediate versus delayed feedback should not significantly impact older adults' performance.

Age Differences in the Impact of Affect on Risk Taking

by

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INTRODUCTION

Risk taking at different stages of life can confer benefits or disadvantages depending upon the cognitive and emotional resources of the risk taker. Negative outcomes following risky decisions may be particularly consequential in later life, when resources and time to recover from bad decisions may be more limited than in younger adulthood. Prior research focusing on whether older adults are more or less risk seeking compared to younger adults paints a mixed picture, with different tasks and scenarios leading to different risk patterns. In a widely-cited study by Heckhausen (1997), older adults reported greater risk aversion in hypothetical scenarios compared to younger adults. Yet, older adults have sometimes been found to take the same or greater risks than younger adults (Mata, Josef, Samanez-Larkin & Hertwig, 2011) in gambling tasks such as Blackjack, the Iowa Gambling task (IGT, Bechara et al., 1994), the Balloon Analogue Risk Task (BART; Lejuez, Read, & Kahler, 2002), and the Columbia Card Task (CCT; Figner, Mackinlay, Wilkening, & Weber, 2009; Figner & Weber, 2011).

One factor that might explain the nature of observed age differences has to do with responses to affective information associated with the decision-making task (Peters, Hess, Västfjäll, & Auman, 2007). Differential sensitivity to affective information across age groups may result in different patterns of risk taking, and differences in affective content across task contexts may account for some of the variability in age differences observed across studies. In order to provide more information about the potential affective mechanisms associated with aging and risk taking, the current study examines two potential sources of affective influence: feedback from specific responses (i.e., loss and gain outcomes) and pre-existing mood.(e.g., sadness).

Feedback and Risk Taking

Feedback during risky decision making has been shown to create greater affective engagement and arousal (Figner et al., 2009; Huang et al., 2013), which in turn might influence how risk information is processed. Heightened arousal has been found to impair processing of non-emotional information about risk (Phelps, 2006) and result in greater risk avoidance, perhaps due to increased processing of loss information (Clark et al., 2012). Delayed feedback, on the other hand, is assumed to be relatively less arousing, and result in lower affective engagement in a task compared to immediate feedback. Few studies have directly compared older and younger adults' risky behavior. A recent meta-analysis found there was little consistency in how age impacted risk taking except when task characteristics were taken into consideration. Older and younger adults appear to take similar risks when betting is primarily based on probability information with no feedback (i.e., decision by description). In contrast, when responses are based primarily on feedback (i.e., decision by experience), older adults tend to take more risks than younger adults when learning rewards caution, but fewer risks when learning rewards risk seeking (Mata et al., 2011). Older adults' mixed responses across different types of risky betting tasks might be explained in part by age-related differences in the reaction to the feedback delivered during a task.

In order to directly compare the impact of immediate versus delayed feedback, Figner and colleagues (2009) created two version of the Columbia Card Task (CCT). In this task, participants must decide how many cards—some of which indicate gains and others losses—to turn over to gain maximum points without turning over a loss card. In the "Warm" version of the CCT, participants are provided with immediate feedback about wins or losses after each round. In the "Cold" version, this information is only provided after all rounds have been played. Through self-reports and skin conductivity measurements of arousal, both younger and older Warm CCT participants experience significantly higher levels of arousal than Cold CCT participants (Figner et al., 2009; Huang et al., 2013). Two studies have compared younger and older adults' performance on the CCT, and both found older adults took greater risks in the Cold (no immediate feedback) condition than younger adults, but similar risks in the Warm condition (Chou et al., 2007; Huang et al., 2013). Through modeling analysis of performance on the BART, in which participants must decide how many pumps will inflate a balloon to its largest size before it pops, Rolison, Hanoch and Wood (2012) found that older adults were more risk-seeking than younger adults at the beginning of the task, but more cautious as they begin to experience loss. One way to interpret these findings is that older adults are initially more attracted to risk than younger adults, but less interested in taking risks when the likelihood of loss increases in salience (i.e., once a loss has been experienced). Older adults' performance could be more negatively impacted by immediate feedback than that of younger adults, particularly given theorizing that aging is associated with less effective cognitive functioning in high arousal situations (Labouvie-Vief, 2009). Thus, feedback and the arousal associated with feedback could be more disruptive to older adults' performance on tasks involving risk taking.

Mood and Risk Taking

Another affective factor that might influence age differences in risk taking has to do with pre-existing mood (or incidental affect). In research with younger adults, the low-arousal, negatively valenced emotion of sadness has been associated with increased risk taking. Sadness is theorized to increase a person's sense of urgency to act upon, and prefer, high-risk, high-reward options (Raghunathan & Pham, 1999; Ellsworth & Scherer, 2003). Lerner, Small, and Loewenstein (2004) found that young adults induced into a sad mood were willing to spend significantly more money on a set of highlighter pens than were participants in a neutral mood. The authors interpreted this finding as evidence that sadness triggers a goal to change one's circumstances, supporting the position that risk taking can improve mood by providing an opportunity for a quick gain. When given the opportunity, sad younger people may take risks in order to achieve a mood-boosting higher state of arousal.

If negative mood states impact older adults differently than younger adults, age may act as a potential moderator of mood on risk taking. Although older adults generally report better internal control of sadness than younger adults (Gross et al., 1997), older adults have been shown to judge negative images as more negative in valence and higher in arousal than younger adults (Grühn & Scheibe, 2008) and to react to sadness to a greater degree than younger adults (Kunzmann & Grühn, 2005). Physiological responses to sadness may differ in older and younger adults. Levenson and colleagues (1991) found older adults' emotion self-reports and patterns of ANS activity during sadness inductions did not differ significantly from those of younger adults. Yet, sadness experienced by older adults was associated with greater sympathetic nervous system activation relative to other negative emotions; this pattern was not found in younger adults, suggesting sadness is a more upsetting emotion in older adulthood than in younger adulthood.

There are two ways in which age differences in responses to sadness might influence risk taking and performance on the CCT. First, sad mood might impact younger adults' decision making to a greater degree relative to that of older adults' due to their comparatively lower emotion regulation efficiency. Specifically, some studies have found that exposure to negative stimuli has more impact on cognitive outcomes in younger than in older adults (Emery & Hess, 2011; Scheibe & Blanchard-Fields, 2009). This appears consistent with research suggesting that emotion regulation skills may be enhanced in later life (Carstensen, Isaacowitz, & Charles, 1999). Indeed, Bruyneel, Dewitte, Franses, and Dekimpe (2009) found that emotion regulation in response to sad mood resulted in depletion of cognitive resources in younger adults, which in turn led to greater risk taking. Lerner, Li and Weber (2013) found young adults in sad moods were more likely to exhibit "present bias," an impatience for immediate reward over delayed rewards, than when they were in neutral moods. Thus, sad younger adults might be expected to take greater risks and be less sensitive to loss contingencies compared to older adults due to the greater disruptive effect of sad mood on younger adults' cognition. Reduced deliberative processing of information has been associated with increased risk taking under sad mood conditions, perhaps because cognitive resources are being diverted to mood regulation attempts (Bruyneel, 2009). Inefficient emotion regulation could result in greater risk taking at inappropriate times, which would negatively impact a player's score. In contrast, older adults in sad moods should efficiently regulate out of their mood and retain their ability to consider changing risk information. They would therefore be expected to perform as well as and take risks similar to older adults in neutral moods.

Alternatively, other research suggests sad mood may differentially impact older adults' cognition to a greater degree than younger adults, and worsen their ability to make effective risk decisions. Phillips, Smith and Gilhooly (2002) found sad older adults exhibited reduced problem-solving ability, but sad younger adults did not. Chronically held emotional goals in older adulthood may offer an explanation if sad older adults show reduced performance on the task. According to Socioemotional Selectivity Theory (SST; Carstensen, 1995), the perception of limited future time is thought to lead to a shift in motivation in older adulthood away from knowledge-focused goals to emotionally gratifying goals and a selective focus on positive information. The "myopic-misery hypothesis" predicts sadness increases impatience in decision making due the association of sadness with loss. Gain seeking behavior in the form of risk taking should result when a person seeks to correct this feeling of imbalance (Lerner et al., 2004). If older adults are highly motivated to avoid feelings of sadness, they may exhibit increased impatience and reduced performance. Given these hypothesized changes in emotional goals in later life, it may be the case that sadness will differentially impact decision making across age groups. Sad older adults, whose decisions may be more affected by negative moods compared to younger adults, might engage a larger share of cognitive resources for mood regulation. As a consequence, older adults might process less information about risk, leading in turn to greater—or perhaps less effective--risk taking, and this could result in a lower overall score for sad older adults.

In summary, the just-reviewed research suggests that mood may play an important role in risk taking in older adults. Evidence would suggest older adults are quicker emotion regulators and may be less impacted by sadness, taking similar levels of risk in sad moods compared to neutral moods. If the emotion regulation hypothesis is supported, older adults' performance should not be significantly affected by sad mood or immediate feedback about their losses during the game. From the perspective of socioemotional selectivity, sad moods and feedback about loss should impair older adults' deliberative capacity, thereby negatively impacting their performance on the task. Both perspectives can be and have been supported in hypothetical scenarios of risk taking preference. Because past research has not sufficiently addressed this conflict, the current study seeks to find evidence for the aforementioned positions theorized to underlie older adults' risk preference in sad moods by examining their actual risk taking behavior.

The Present Study

This study explored differences in risk behavior in older versus younger adults, and the extent to which feedback and mood moderate such differences. In order to examine these questions, I used a risky decision-making task—the CCT—to compare risk taking and performance with feedback (hot version) and without feedback (cold version). I also compared risk taking and performance in sad versus neutral mood. Risk taking was operationalized as the number of cards turned over in each round of the game. The Cold version of the task was used as a baseline measure of risk taking without affective arousal due to feedback, whereas the Warm version was used as a measure of risk taking with affective arousal. Age comparisons in the neutral mood condition across the Cold and Warm versions of the CCT allowed a test of the extent to which affective feedback moderated young and older adults' risk taking. Comparisons across mood conditions in the Warm version then provided information about how a sad mood state impacted responses to the affective information, and whether there were age differences in this response.

Hypotheses

For conceptual simplicity, I divided my hypotheses into two sets. The first set was based on age differences across the Cold and Warm CCT conditions in the neutral mood condition, which would provide some information about normative age differences in risk-taking in relation to whether or not participants receive feedback regarding the outcomes of their bets. In keeping with previous studies, older adults were expected to exhibit greater levels of risk taking without feedback, and while both groups were expected to exhibit a significant decrease in risk-taking in the warm condition compared to the cold, older adults were expected to decrease their risk taking to a greater degree than younger adults.

The second set of hypotheses dealt with the impact of mood and age on risk taking. Focusing solely on performance in the Warm condition, I predicted an Age X Mood interaction in risk taking, with this interaction taking one of two potential forms based on two theoretical positions which support age differences in the effect of mood on risk taking. From the age differences in emotion regulation (ER) perspective, the sad mood induction was expected to result in greater risk taking in the young than in the old. Specifically, due to poorer emotion regulation abilities, sad mood in younger adults was expected to accentuate the impact of loss and result in an attempt to restore balance through gain seeking (i.e., greater risk taking). In contrast, older adults' relatively more efficient sad mood regulation was expected to minimize the impact of mood on performance, resulting in little difference across mood conditions in the old group.

Alternatively, the SST perspective argues older adults are more motivated than younger adults to eliminate their sad mood; if this is true, older adults would be more likely than younger adults to use the betting task to regulate their emotions. In this case, older adults would show increased risk-taking in the sad condition compared to the neutral condition, and the difference between conditions would be greater than the difference for younger adults. If sad mood increases the salience of rewards, older adults would exhibit greater willingness to make riskier bets in order to quickly escape sad mood. From the SST perspective, sad older adults would be expected to exhibit greater, but less optimal, risk taking than sad younger adults, resulting in worse scores.

Method

Participants

The initial sample included 74 younger adults and 67 older adults. The sample size, based on a power analysis using the Gpower computer program (Faul & Erdfelder, 1998) was chosen to permit the identification of medium-sized effects at $\alpha = .05$ with power of .80. Young adult participants were students recruited from Introductory Psychology classes who were fulfilling a course option through participation. Older adult participants were recruited from the Adult Development Lab participant pool and received a $25 honorarium. The testing materials included a number of test instruments constructed in English, therefore participants were required to have English as their primary reported language to ensure validity of the tests. Because one of the aims of the proposed study was to examine the effect of sad mood on decision making, answers on the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986) were used to assess possible depression, with data from subjects scoring 10 or above (as recommended by Lezak, Howieson, & Loring, 2004) being excluded from the analyses. No participants were excluded for depression. I excluded from analysis data of participants (a) with limited English (N = 3 young), (b) whose choices on the CCT indicated they did not understand the instructions (i.e., if more than once they chose to turn over all 32 cards in the array, which would guarantee a loss (N = 4 young, 5 old), (c) who quit in frustration (N = 1 old), (d) whose session was interrupted due to computer malfunction (N =1 old), and (e) whose Cold CCT risk taking was identified as a high outlier on SPSS boxplot analysis (N =1 old).[1] All subsequent analyses were conducted using this new sample, which included 59 older adults (aged 65-84, 29 female) and 67 younger adults (aged 18-21, 34 female), with 62 participants in the Neutral condition (29 old, 31 female) and 64 (31 old, 32 female) in the Sad condition.

Materials

Columbia Card Task. This study used the Columbia Card Task (CCT; Figner & Weber, 2011) to assess risk taking. The CCT is a gambling task that gives researchers insight into how players use information about probability, loss, and gain to guide their decisions. Two versions of the task were used. In the Cold CCT (see Appendix A for the on-screen

[1] Analyses on the Cold CCT showed some significant age differences in risk taking without feedback; excluding the data of participants who appear to have misunderstood or whose data were not valid eliminated the age effects.

instructions shown to participants), a participant sees a 4 X 8 display of 32 cards on the computer screen. Arrayed along the top are three pieces of information relating to risk: (a) the number of Loss cards in the 32-card array (1 or 3 cards); (b) the value of a Loss card (-250 or -750 points); and (c) the value of a Gain card (+10 or +30 points). The participant decides the number of cards they would like to "turn over" based on this information by clicking their choice from a row of 33 numbered button ranging from 0 to 32. The Cold CCT consists of 24 rounds of choices—three repetitions of each possible combination of the three earlier described risk components. In the Cold CCT, cards are not actually turned over, however; a player only learns of the outcome of their betting at the end of the game. In each round, participants simply click the number of cards they would turn over out of 32 based on the Loss Amount, Gain Amount and Loss Probability they are given, then move on to the next round. In this way, the Cold CCT provides a hypothetical betting scenario, and participants choose how much risk to take without experiencing feedback from round to round.

In the Warm version of the CCT (see Appendix B to see the different Practice Questions given for this version of the task), the display format and the instructions of the task are the same except in this version, participants choose how many cards to turn over by clicking on them one by one (they also have the option of clickly "No Card" and moving on to the next round). As participants click, they do not see the result of their choice, only the number of cards they are choosing (i.e., the first card they click shows a 1, then the second a 2, et cetera). After they have finished choosing how many cards they would like to turn over, they click a button that says STOP/Turn Over to reveal their results. A Gain card is indicated bya yellow smiley face, whereas a Loss card is indicated by a green frowning face. Encountering a Loss card results in an immediate end to the trial and subtraction of the loss amount for that trial from the running total of winnings. If no Loss card is encountered, the number of Gain cards turned over multiplied by their point value is added to the winnings. Thus, in the Warm CCT, participants experience feedback about whether they have won or lost points in a given round. Participants are not shown their cumulative score, only the outcome for each round. For both versions of the CCT, two performance measures are derived: (a) “risk taking” is determined by the number of cards turned over in each of the 24 trials; and (b) “choice outcome score” is indicated by the amount won (or lost) on each trial, The amount won or lost is determined by adding all gain cards turned over before a loss card is encountered, at which point the gain cards stop being added, the loss card deduction is immediately applied to the score, and the round stops. If a loss card is not encountered, a round total would be positive. If a loss card is encountered, the resulting round score could be negative (especially in rounds with low gain amount and high loss amount). The same scoring applies in the Cold, no-feedback version of the task, except the loss cards are not visually encountered, they are randomly chosen to by the computer to affect participants' score (or not), just as if they had been actively turned over.

Self-Assessment-Manikin. Current mood was assessed at five different times during the experiment on a 9-point scale using self-assessment manikins (SAM; Lang, 1980, see Appendix D).

Film clips. The experiment used a sad film clip as a mood induction. Participants in the experimental condition viewed a sad scene from the animated film *Up*, in which a couple is depicted meeting as children, marrying as young adults, and experiencing life milestones, including the disappointments of being unable to have children and not having the money to pursue their life's dream to travel to South America. In the final scene of the clip, the wife dies of an unnamed illness and the husband is shown grieving after her funeral. Participants in the control group viewed scenes from the film *Searching for Bobby Fischer* in which a father slowly comes to the realization his son is a chess prodigy. Both clips were chosen to contain stories that might be similarly relevant to both older and younger adults. I pilot tested 16 young and 10 older adults, with 13 participants in the Sad condition and 13 in the Neutral condition. I examined their mood ratings (SAM scale of 1 [negative] to 9 [positive]) using a 2 X 2 X 2 (Age Group [young v.s old] X Film Clip [sad vs. neutral] X Time [before vs. after viewing film]) analysis of variance (ANOVA). There was a significant Time X Condition effect: $F(22) = 15.92$, $p < .01$ effect size. Age did not moderate this effect. As can be seen in Table 1, both young and older adults exhibited significant decreases in affect following viewing of the sad film clip, whereas there were no significant changes in mood associated with the neutral clip. Based on these data, I assumed that these two film clips would be able to elicit similar mood states for both young and older adults.

Table 1

Effects of mood manipulation on young and old pilot participants

	Time 1		Time 2	
Age Group	*M*	*SD*	*M*	*SD*
		Sad Film		
Young (N=8)	7.38	0.48	4.00	0.71
Old (N=5)	7.40	0.61	3.00	0.89
		Neutral Film		
Young (N=8)	7.50	0.48	7.75	0.71
Old (N=5)	7.60	0.61	6.00	0.90

Note. Values are mean scores on a 9-point scale (1=negative mood, 9=positive from the self-assessment-manikins (SAM; Lang, 1980).

Procedure

Prior to testing sessions, half of the participants from each age group were assigned to the neutral mood condition and the other half to the sad mood condition. Participants were randomly assigned to condition within age and gender groups. Pre-arrival packets were mailed to older adult participants and an online version of the questionnaire was emailed to younger adults who agreed to participate. These packets provided basic demographic information, as well as answers to the SF-36 Health Questionnaire (Ware, 1993), the NEO Five-Factor Inventory (NEO-FFI), the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), and the Geriatric Depression scale (GDS; Sheikh & Yesavage,1986). Participants were instructed to fill them out upon receipt, and older adults were instructed to bring their packet with them to their session. The Short Blessed Orientation-Memory-Concentration test (Katzman, 1983) was administered by phone to older adults in order to screen for cognitive impairment (indicated by a score of 7 or higher); no participants were excluded for depression or cognitive impairment.

Upon arrival, participants were greeted and older adults were asked to turn in their completed questionnaire packet. After checking the packet to ensure all questions had been answered, experimenters thanked participants for agreeing to be a part of the study and briefly introduced to the study. They were told they would be engaging in different activities and at different points be asked to rate how they were feeling. After participants read and signed an informed consent form, the experimenter gave the participant the first SAM (self-assessment manikin, see Appendix D) sheet to rate their current mood by identifying the manikin character that most accurately represented their level of happiness versus unhappiness and excitement versus calmness, both on a 1-9 scale. These ratings were used to establish participants' baseline mood. Next, the experimenter turned on the computer monitor to administer the Cold CCT. Instructions for the game appeared on the screen and subjects proceeded through the instructions and practice rounds at their own pace, clicking the Continue button with the mouse to move from one screen to the next. The CCT instructions include a page which requires participants to demonstrate their understanding of how the game is scored by adding and subtracting points in a hypothetical round (see Appendix C). Once participants had correctly answered the questions on this page (as many chances as needed were given), they were allowed to move on to the game. The Cold CCT, including instructions, took participants about 10 minutes to complete. The experimenter then administered the second SAM, followed by the Digit Symbol Substitution task, which took 2 min, followed by a third SAM. These data were collected in order to provide additional data about the sample as well as to provide spacing between the Cold and Warm CCT.

Prior to administration of the Warm CCT, subjects in both conditions were given a headset and told they would be watching a video alone in the room. They were asked to watch the video and experience it as they would a movie at home, then immediately rate their mood using the fourth SAM next to the computer once the clip had ended. They would then open the door to the testing room so their experimenter would know they had finished viewing the clip and rating their mood. Participants in the neutral condition viewed the film clip from *Searching for Bobby Fischer*. Participants in the sad condition viewed the clip from the film *Up*. Both videos were approximately 6 minutes in length, after which the experimenter returned to the testing room to immediately administer the Warm CCT so the mood induced by the film clip would be still active for this version of the task. Upon completion of the Warm CCT, participants completed a fifth and final SAM. Participants in the sad condition then were shown a happy film clip from the movie *Up* to counteract any lingering negative affect from the mood induction. Last, the experimenter administered three final tasks: the WAIS Vocabulary test, the Letter-Number Sequencing subtests and the Stroop task. Participants were then informed of the true nature of the study, thanked for their participation and compensated.

Results

Affective response was expected to moderate age differences in performance on the CCT, and analyses were performed to help determine whether and how this moderation might occur. First, analyses were performed comparing participants' baseline (no-feedback, low affective engagement) Cold CCT performance. Next, the Cold CCT performance of participants in the Neutral condition were compared to their with-feedback (increased affective engagement) Warm CCT performance. Finally, the role of mood was examined by comparing sad versus neutral mood groups in their performance on the Warm CCT.

Performance was analyzed using two measures: risk taking and choice outcome score. Risk taking was measured by the number of cards a participant turned over in 24 rounds of the CCT. Participant choice outcome score was analyzed as a dependent variable of interest in order to further understand how age and mood might have impacted task performance. This was done because even a statistically non-significant increase or decrease in risk taking on this task could potentially have large effects on a participant's score on the CCT. A Loss card in a high loss potential trial stops the round and subtracts 750 points from total score. Even in a high gain potential trial in which each Gain card adds 30 points, a loss of 750 would be difficult to overcome in terms of final score, especially if a high loss outcome occurs more than once (most final outcome scores for all participants in both conditions were negative). Thus, final outcome score is an interesting measure to examine because it could indicate performance differences even when overall risk taking (number of cards turned over) does not appear to differ between age groups or mood conditions. Loss Amount, Gain Amount and Loss Probability are included as variables in reported analyses in order to examine how changes in task contingencies might have impacted strategy differently across age group and mood condition. Choice outcome score as a performance measure should also reflect whether participants have accurately assessed risk, meaning they have determined when it is appropriate to take risk and when it is not based on these contingencies and have adjusted their strategies accordingly.

Participants

Sample characteristics are presented in Table 2. To determine if random assignment resulted in any inadvertent differences across conditions, Age Group X Mood Condition analyses of variance were conducted on each of the measures presented in this table prior to the main analyses. The results of these analyses revealed no significant effects due to condition.

Table 2

Participant characteristics

	Age*		Education*		Vocabulary*		DSS*		LNS*	
Age Group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Young (N=67)	19.17	0.85	12.81	1.06	46.58	9.67	79.88	12.51	10.84	2.05
Old (N=59)	74.51	5.53	16.83	2.24	52.05	11.59	67.28	13.92	9.98	1.98

**Significant difference (p < .05) between age groups*

Cold CCT Performance

Prior to analyzing Cold CCT risk taking, an examination of the data showed some participants (3 older, 5 younger) chose 32 cards once during their trials, which may have been a temporary lapse in memory of the task parameters. For these participants, their 32 choice was replaced by the mean number of cards turned over for their age group for that particular trial type and condition, and all subsequent analyses were conducted using these imputed data. A 2 (age) X 2 (loss probability) X 2 (gain amount) X 2 (loss amount) mixed ANOVA was then conducted on risk taking on the Cold CCT as the dependent measure. A significant main effect for loss probability was obtained, F (1, 124)= *198.62,* $p < .01$, $\eta^2_p = .62$, with participants taking fewer risks when probability was high (M = 8.58, SD = *3.92*) than when it was low (M = 12.78, SD = 4.87). A significant effect due to gain amount was also obtained, F (1, 124) = *33.36,* $p < .01$, $\eta^2_p = .21$, with participants taking more risk when gain amount was high (M = 11.24, SD = 4.40) than when it was low (M = 10.12, SD = 4.06). Finally, a significant effect of loss amount was also obtained, F (1, 124) = *51.61,* $p < .01$, $\eta^2_p = .29$, with participants taking fewer risks when loss amount was high (M = 9.73, SD =*4.25*) than when it was low (M = 11.63, SD = 4.44). No other effects were significant. Based on the obtained effect sizes, loss probability appears to be the most important factor participants considered in their risk taking, followed by loss amount, then gain amount.

I next examined choice outcome scores on the Cold CCT using an 2 (age) X 2 (loss probability) X 2 (gain amount) X 2 (loss amount) mixed ANOVA. As in the previous analysis, significant main effects for the three task variables were obtained. Specifically, participants scored significantly lower: (a) when loss probability was high (M = -175.47, SD

= 102.90) than when it was low (*M* = -13.95, *SD* = 99.22), *F* (1, 124) = 170.03, *p* < .01, η^2_p = .58; (b) when gain amount was low (*M* = -158.95, *SD* = 97.25) than when it was high (*M* = -30.47, *SD* = 98.01), *F* (1, 124) = 126.70, *p* < .01, η^2_p = .51; and (c) when loss amount was high (*M* = -206.87, *SD* = 135.85) than when loss amount was low (*M* = 17.45, *SD* = 48.84), *F* (1, 124) = 323.22, *p* < .01, η^2_p = .72. There was also a significant Loss Probability X Gain Amount interaction, *F* (1, 124) = 10.70, *p* < .01, η^2_p = .08 . The impact on outcome score of gain amount was higher when loss probability was low than when loss probability was high (see Figure 1).

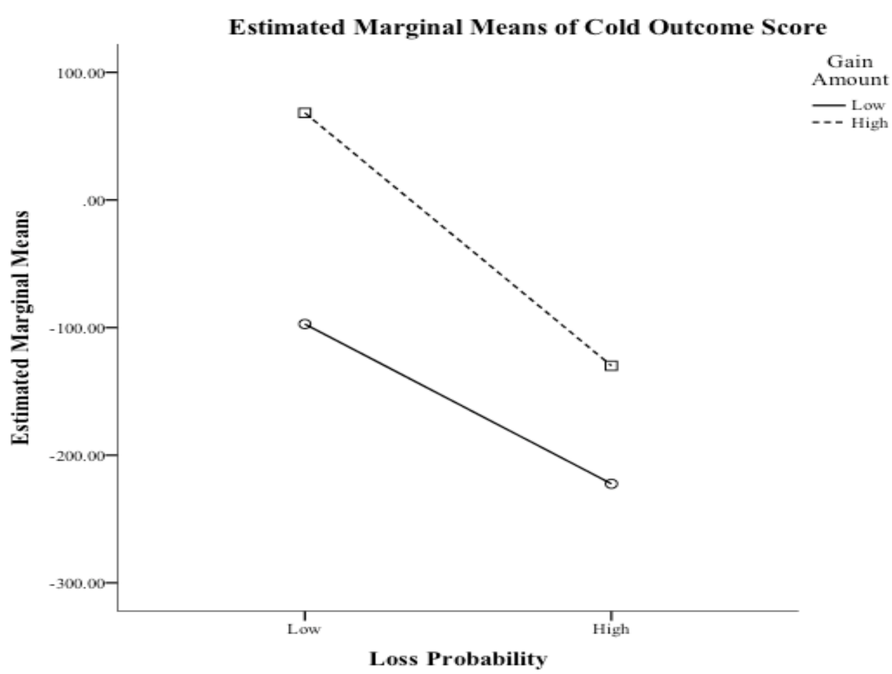


Figure 1. Impact on outcome score of gain amount by loss probability

A significant Age X Loss Probability X Gain Amount X Loss Amount interaction was also obtained, F (1, 124) = 12.49, $p < .01$, $\eta^2_p = .09$. Follow-up analyses within age groups showed significant Loss Probability X Gain Amount, F (1, 124) = 10.60, $p < .01$, $\eta^2_p = .16$, and Loss Probability X Loss Amount, F (1, 124) = 4.43, $p = .04$, $\eta^2_p = .07$, interactions for older adults, but not for younger adults. In contrast, the Loss Probability X Gain Amount X Loss Amount interaction was significant for young adults, F (1, 124) = 12.44, $p < .01$, $\eta^2_p = .16$. These interactions suggest that outcomes in both groups were affected by the three task variables, and the data (Figure 2) indicate that the general patterns of performance were similar across age groups, with the 4-way interaction reflecting slight variations in scores. The age effect appears to be associated with older adults' worse performance relative to younger adults in low gain, high loss trials and high gain, high loss trials suggesting older adults were somewhat less sensitive than younger adults to high loss amount.

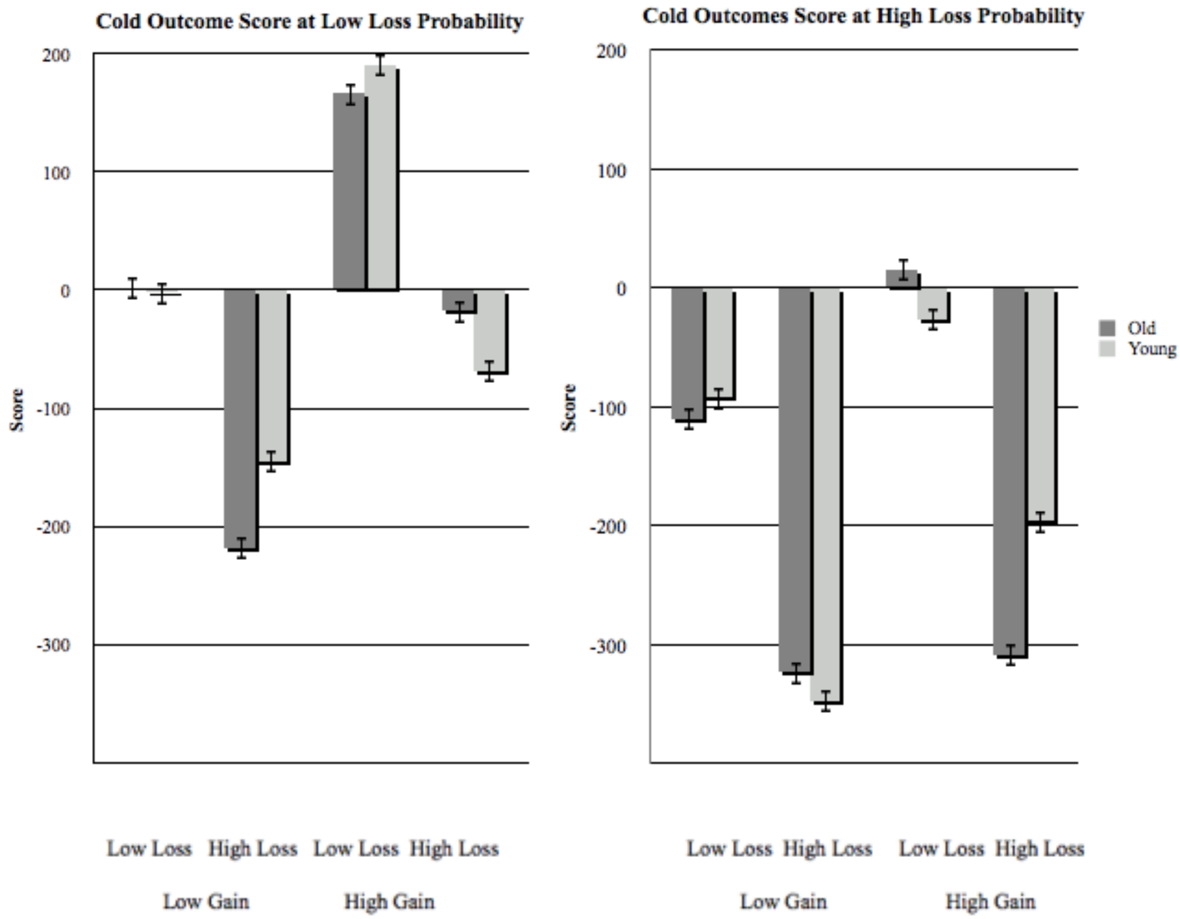


Figure 2. Cold CCT scores at low and high loss probability for young and older adults.

Although mood was not manipulated prior to performance in this task, I examined whether there were any differences across participants assigned to the two mood conditions since later analyses will focus on only a subset of the sample. Specifically, a 2(Age) X 2 (Mood) X (Loss Probability) X 2 (Gain Amount) X 2 (Loss Amount) mixed ANOVA was performed with risk taking in the Cold CCT as the dependent measure. There was a significant Age X Mood X Gain Amount X Loss Amount interaction, F (1, 122) = 6.37, p = .01, η^2_p = .05; and a significant Age X Mood X Loss Probability X Gain Amount X Loss Amount interaction, F (1, 122) = 7.02, p <.01, η^2_p = .05. These mood effects suggest some differences across conditions in the old group. To control for this, subsquent analyses examining mood effects will use cold CCT risk scores as a covariate.

Feedback effects

In order to determine the impact of feedback on risk taking in older versus younger adults, a 2 (Age Group) X 2 (CCT Version) X 2 (Loss Probability) X 2 (Gain Amount) X 2 (Loss Amount) mixed ANOVA was conducted on participants in the neutral group. (Only effects involving task version will be discussed here and in the following analysis of choice outcome.) There was a main effect of CCT Version, $F(1, 60) = 30.60$, $p < .01$, $\eta^2_p = .34$, with participants taking significantly greater risks on the Cold CCT rounds (*M* = 10.79, *SD* = *4.08*) compared to the Warm CCT rounds (*M* = 8.01, *SD* = 3.35). This is consistent with the hypothesis that feedback about losses would decrease risk taking. The following significant interactions were also obtained: Age X CCT Version X Loss Probability, $F\ (1, 60) = 4.15$, $p < .05$, $\eta^2_p = .07$; Age X CCT Version X Gain Amount, $F\ (1, 60) = 4.49$, $p = .04$, $\eta^2_p = .07$; and Age X CCT Version X Loss Probability x Gain Amount x Loss Amount, $F\ (1, 60) = 4.28$, $p = .04$, $\eta^2_p = .07$.

Follow-up analyses within the older adult group showed a significant main effect for CCT Version, with older adults significantly decreasing their risk taking from Cold (*M* = *11.81*, *SD* = 4.11) to Warm Version (*M* = 8.00, *SD* = 3.45), $F\ (1, 28) = 26.66$, $p < .01$, $\eta^2_p = .49$. There was also a significant CCT Version X Loss Probability interaction, $F\ (1, 28) = 5.27$, $p = .03$, $\eta^2_p = .16$. The means indicate older participants became more risk-averse with both low and high probability bets with feedback, but that the shift was somewhat stronger for low probability bets (*Ms* = 13.78 vs 9.38; *SDs* =4.92 vs 4.06, from Cold to Warm CCT) than for high probability bets (*Ms* = 9.83 vs. 6.62; *SDs* =5.28 vs 3.18 from Cold to Warm CCT). There was also a significant CCT Version X Gain Amount X Loss Amount interaction, F (1, 28) = 4.63, p = .04, η^2_p = .14. Again, older adults seem to have become more risk-averse in the Warm Version on all types of trials, but the shift was stronger for low loss amounts coupled with high gain (see Figure 3). These results would suggest that older adults were reducing risk taking in all situations with feedback, but that the increase in risk aversion is—surprisingly—in conditions under which the probability of success is highest (low loss amount, high gain amount).

In the younger adult group, participants became more risk averse with feedback, F(1, 32) = 6.91, p = .01, η^2_p = .18, but the absence of significant interactions indicates that this effect was relatively constant across task conditions.

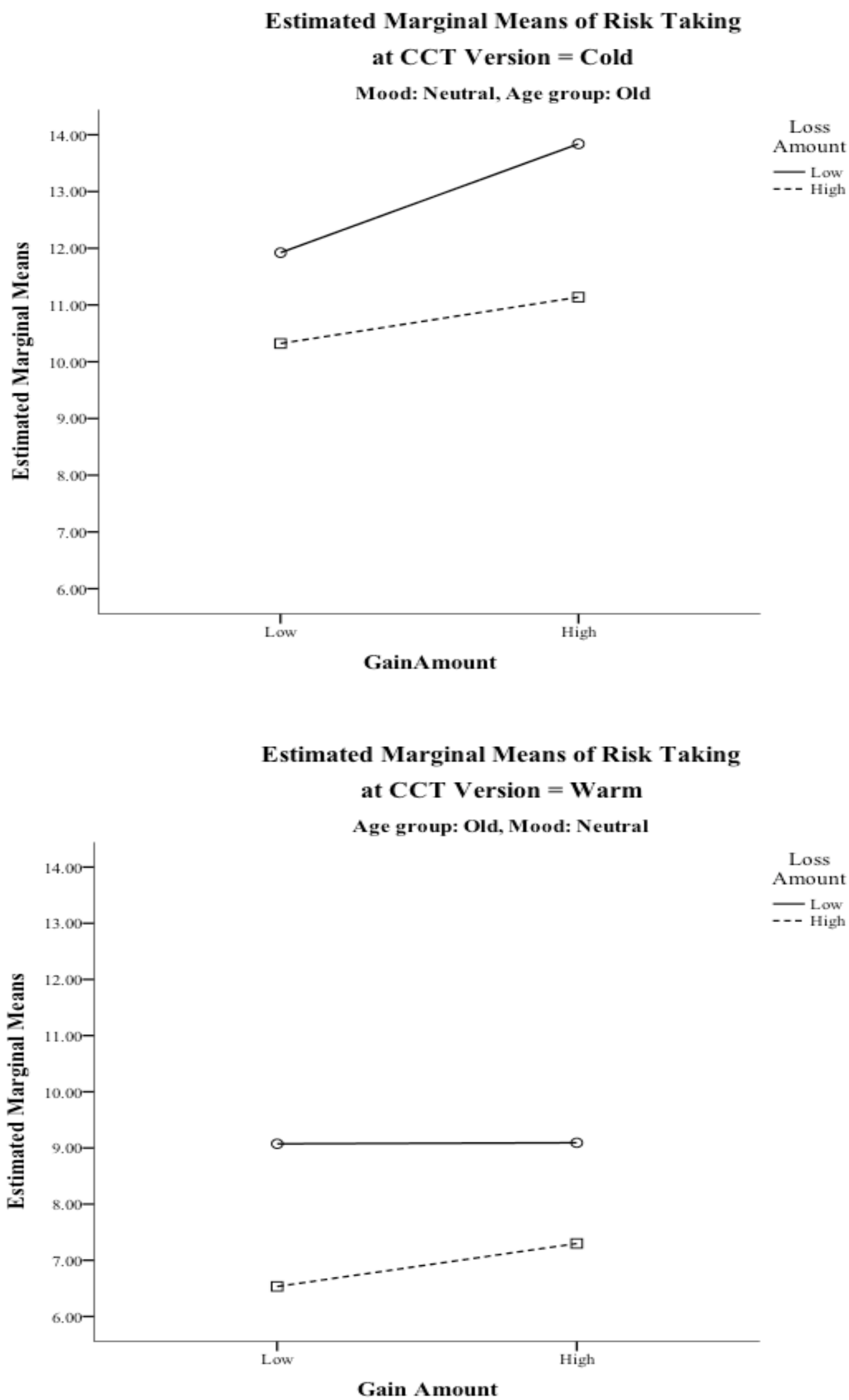


Figure 3. Cold vs. Warm CCT risk in older adults by loss and gain amount.

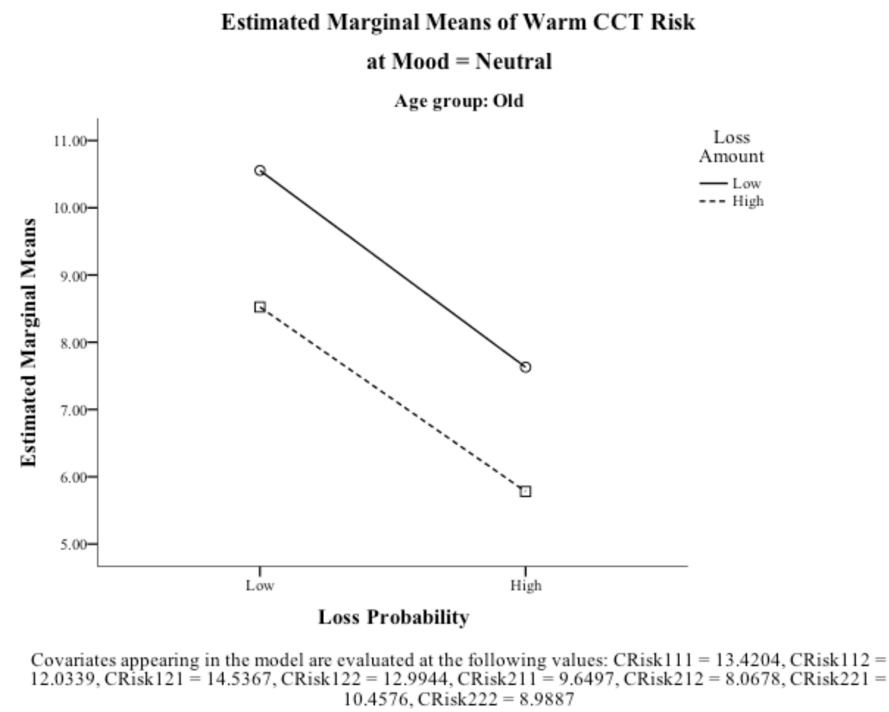
A 2 (age group) X 2 (CCT version) X 2 (loss probability) X 2 (gain amount) X 2 (loss amount) mixed ANOVA was then conducted on the choice outcome scores of participants in the neutral condition. There was a main effect of CCT Version, F (1, 60) = 17.32, p < .01, η^2_p = .22. Participants' average choice outcome scores were significantly higher on the Warm Version (M = -51.06, SD = 76.48) compared to the Cold Version of the task (M = -94.86, SD = 71.83)**,** presumably reflecting the fact that participants took fewer risks in the Warm CCT than in the Cold CCT. I also obtained the following significant interactions: Age X CCT Version interaction, F (1, 60) = 10.67, p < .01, η^2_p = .15; CCT Version X Loss Amount interaction, F (1, 60) = 10.21, p < .01, η^2_p = .15; and Age X CCT Version X Loss Amount, F (1, 60) = 5.27, p = .03, η^2_p = .08. Older adult average outcome scores improved more from the Cold to the Warm CCT (*Ms* = -121.34 vs. -37.01; *SDs* =72.90 vs 68.47, respectively) than younger adults' average outcomes scores (*Ms* = -71.01 vs. -60.83; *SDs* =72.03 vs 62.04, respectively), presumably reflecting older adults' greater change in risk taking. Follow up analyses within age groups showed that, for older adults, there was greater change from Cold to Warm CCT for bets involving high loss amounts (*Ms* = -250.80 vs. -104.28 ; *SDs* =138.77 vs 131.08, respectively) than for those involving low loss amounts (*Ms* = 8.12 vs. 30.26; *SDs* =60.08 vs 53.87, respectively), which may reflect random error associated with loss cards. For younger adults, choice outcome scores did not significantly differ from Cold to Warm CCT.

Mood effects

Prior to analyzing the effect of mood on CCT performance, I conducted a 2 (Age Group X 2 (Mood Condition) X 5 (Time) ANOVA on the mood ratings as a mood manipulation check. This analysis revealed a significant Condition X Time interaction, *F* (1, 122) = 19.28, $p < .01$, $\eta^2_p = .14$. Specifically, participant mood at time 4 changed in a manner consistent with the film clip viewed. That is, those viewing the sad mood film exhibited a significant decline in mood ratings at Time 4 (*M* = 4.36, *SD* = 2.07) relative to Time 1 (*M* = 6.81, *SD* =1.48), 2 (*M* = 6.25, *SD* = 1.63) and 3 (*M* = 6.30, *SD* = 1.57), whereas those in the neutral mood condition exhibited relatively stability. All participants showed mood recovery to near baseline by time 5 (*M* = 6.02, *SD = 1.65*), and there were no age differences in the effectiveness of the mood manipulations. Thus, the mood manipulation appears to have been successful in inducing sad and neutral incidental affective states in participants prior to their playing the Warm version of the CCT.

To examine the impact of mood on risk taking, a 2 (age Group) X 2 (mood condition) X 2 (loss probability) X 2 (Gain Amount) X 2 (loss amount) mixed ANCOVA was conducted on number of cards turned over in the Warm CCT as the dependent measure and risk taking on the Cold CCT as a covariate. Inconsistent with expectation, no significant effects involving mood condition were obtained (*p*s > .10). Given that mood effects were a primary focus of my study, I decided to explore mood effects separately within each group, recognizing that any obtained effects would need to be viewed with caution. Within the older adult group, a Mood X Loss Probability X Loss Amount interaction approached significance, *F* (1, 49)= 3.17, $p = .08$, $\eta^2_p = .06$. The data suggest that older participants became more risk-averse with both low and high loss amount when loss probability shifted from low to high, but that the shift was somewhat stronger for low loss amount bets when participants were in a sad mood compared to when they were in a neutral mood (see Figure

4). This suggests sad mood somewhat increased risk aversion in older adults, even in the condition in which the likelihood of success was higher. This is somewhat consistent with the effects found for feedback. Within the younger adult group there were no mood effects that approached significance.



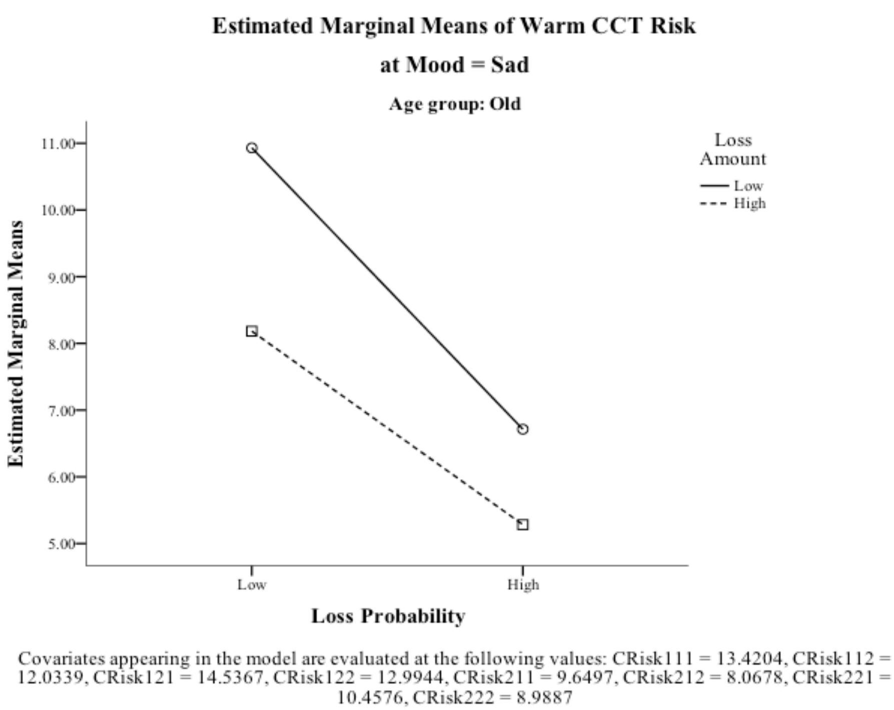


Figure 4. Neutral vs. Sad Warm CCT risk in older adults by loss probability and loss amount.

2 (age Group) X 2 (mood condition) X 2 (loss probability) X 2 (Gain Amount) X 2 (loss amount) mixed ANCOVA conducted on choice outcome scores in the Warm CCT as the dependent measure and risk taking on the Cold CCT as a covariate revealed no significant mood interactions. Exploratory follow-up analyses within age groups revealed no significant mood interactions.

Discussion

In this study I examined the impact of affect on younger and older adults' risk taking, and consider the role affect regulation might play with regard to changes in risk taking. The Columbia Card Task (CCT) was chosen to examine risk taking because it allows insight into particular factors that might be influencing risk taking: loss probability, gain amount and loss amount. Another advantage to this particular task was that there were two versions, a no-feeedback (Cold) version and an immediate-feedback (Warm) version, allowing me to compare participants' performance when affective engagement in the task was relatively low to when it was heightened.

Two conceptual frameworks were used to examine the prediction that age would interact with mood and impact participants' level of risk taking. The first related to emotion regulation (ER) abilities. There is evidence in the literature suggesting older adults' emotion regulation skills are more efficient than those of younger adults. This would lead to the expectation that older adults would be more efficient at regulating their emotions compared to younger adults, and therefore be less likely to be affected by feedback and sad mood induction. The second related to age differences in the salience of chronic emotional goals. I assumed that both younger and older adults would be motivated to avoid sad moods, but according to SST, older adults should have been even more motivated to do so and thus more likely to engage in specific regulation activities designed to deal with sad moods.

When examining performance in the Cold CCT—in which affective influences are presumably minimally associated with performance—I found no significant age differences. Other researchers have found older adults took greater risk in the Cold version of the task (Chou et al., 2007; Huang et al., 2013), but my finding of no age differences was in keeping with findings from a meta-analysis about risk taking in which older and younger adults were found to take similar risks when they did not receive feedback and betting was based on probabililty information (Mata et al., 2011). Thus, in the absence of strong affective responses, young and older adults appear to act similarly in terms of their propensity for taking risks.

When affect was introduced into the task in the form of feedback associated with participants' choices (i.e., outcomes associated with cards turned over), I observed that younger adults decreased their risk taking across all levels of gain-card values, loss-card values, and loss probability. Older adults also reduced their risk taking following feedback, but the effects were strongest in rounds in which it would have been more beneficial to take greater risks. Specifically, even when gain amount was higher and loss probability and loss amount were both lower, older adults were decreasing their risks in the Warm CCT. This result is consistent with the findings of the Mata et al. meta-analysis, which found older adults took fewer risks when learning rewarded risk seeking. The results of this study were inconsistent with the meta-analysis finding that older adults tended to take more risks than younger adults when learning rewarded caution; both age groups reduced their risk taking in similar ways when loss probability and loss amount increased and when gain amount decreased. In contrast to the meta-analysis, the present study was able to examine the effects of feedback using the same basic task, thereby controlling for other task-related factors that could have influenced performance.

The greater reduction in risk taking in the older adults that was observed in my study did not provide strong support for the emotion regulation hypothesis. Specifically, had older adults been more efficient at regulating their emotions compared to younger adults, they should have not have reduced their risk taking to a greater degree than younger adults when they received feedback or when they were in a sad mood. However, the results do appear to be consistent with expectations derived from Socioemotional Selectivity Theory, whereby older adults were expected to be more motivated to avoid negative affective states (e.g., losses) than younger adults. Indeed, the greater reduction in risk taking by older adults was associated with a reduction in negative outcomes, as evidenced by the significant increase in performance outcomes.

When the impact of incidental mood associated with my mood manipulation was examined, the impact was minimal on risking taking in both age groups. I did observe a marginally significant reduction in risk taking for older adults in sad mood compared to the neutral mood condition, with little evidence of a similar effect for younger adults. This lends some support to the idea that mood regulation attempts might differentially impact older adults‘ information processing (Bruyneel, 2009). The data from this study provide some evidence that, like feedback, sad mood tended to reduce risk taking specifically in trials in which older adults would have been expected to take greater risks.

In summary, the significant reduction in risk taking by older adults when they received performance feedback supported my hypothesis that affective influences would be stronger for older adults than for younger adults. When older adults received feedback, and to some extent when they were a sad mood, older adults decreased rather than increased risk taking. Feedback also resulted in reduced risk taking in younger adults, but the shift in risk taking from Cold to Warm CCT was greater in the older adult group, suggesting feedback was affecting older adults to a greater extent. Additionally, no mood effects approached significance in the younger adult group. The position that sad mood would be associated with increased gain seeking in the young adult group (Raghunathan & Pham, 1999; Ellsworth & Scherer, 2003; Lerner et al., 2004) was not supported.

This study had several important limitations. First, whereas the sad mood induction was effective in terms of significantly changing participants' mood ratings, it may not have created enduring mood effects that would significantly alter strategy on the subsequent task. The movie clips shown to participants in this study may have been too obvious emotional manipulation, and thus less effective at producing an enduring mood effect. It is also possible the sad mood participants felt following the movie was not difficult to move past given how clearly unrelated the subsequent task was to the sadness they may have felt. A more accurate description of the sad mood induced in this study might be "sad emotion," which would indicate the feeling of sadness was actually fleeting, and did not endure as a mood would have. This is an important distinction given the assumptions of the study.

Perhaps a better "mood" manipulation would have been music, which could have lasted throughout the game, and perhaps been more effective at changing participants' strategies. While not a limitation, it should be noted that the sample of older adults from the community who participate in our lab have generally high education and are high functioning in terms of cognitive ability. Perhaps with a more diverse sample and a more effective mood manipulation, significant differences in risk taking would have been found.

Another limitation in this study was that a fairly large number of participants appear to have either not understood or to have chosen to ignore task instructions, despite indicating inititially they had understood them. Turning over 32 cards guarantees a loss in the CCT, and this should not have occurred as often as it did. More followup questions to participants following instructions reinforcing the rules of the game would have likely prevented this problem. Some participants said in their post-task questionnaire they believed the array of cards had a pattern they needed to understand in order to avoid loss cards, which would also explain their decision to turn over all of the cards in the array. Clearer pre-task instruction could have reiterated the randomness of the game.

The computer task and lab setting clearly limit the ecological validity of the findings, but if the impact of feedback and affective state on risk taking in older adults were to be applied to real world scenarios, one might expect that older adults might take less optimal risks when receiving continual feedback or when in a sad affective state. For example, day trading might be riskier for older adults than for younger adults, and incidental affect might differentially impact older adults' financial decisions.

In this study, the sadness induced was incidental and non-task-related; it would be interesting to examine the role of potentially more self-relevant influences on risk taking on the same task. For example, some mood manipulations involve participants writing about sad personal experiences prior to engaging in a task. A strength of this study is that it provides information about how both task-related and non-task-related affective influences might be disruptive to risk decision making in older adults, and provides some support for the position that affective context may influence older adults' risk decision making to a greater degree than younger adults'. Future research might use mood manipulations that are more self-relevant to older adults and tasks more related to real world financial decision making.

REFERENCES

Bechara, A., Damasio, A.R., Damasio, H., Anderson, S.W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50*:7–15.

Bruyneel, S. D., Dewitte, S., Franses, P. H., & Dekimpe, M. G. (2009). I felt low and my purse feels light: Depleting mood regulation attempts affect risk decision making. *Journal of Behavioral Decision Making, 22*(2), 153-170.

Carstensen, L. L. (1995). Evidence for a life-span theory of socioemotional selectivity. *Current Directions in Psychological Science, 4*, 151–156.

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of social selectivity. *American Psychologist, 54*, 165–181.

Chou, K., Lee, T., & Ho, A. H. Y. (2007). Does Mood State Change Risk Taking Tendency in Older Adults? *Psychology and Aging, 22* (2), 310 –318.

Clark, L. L., Li, R. R., Wright, C. M. C., Rome, F. F., Fairchild, G. G., Dunn, B. D. B., & Aitken, M. R. F. M. (2012). Risk-avoidant decision making increased by threat of electric shock. *Psychophysiology, 49*(10), 1436–1443.

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. *Handbook of affective sciences, 572*, V595.

Emery, L., & Hess, T. M. (2011). Cognitive consequences of expressive regulation in older adults. *Psychology and Aging, 26*, 388-396.

Figner, B., & Weber, E. U. (2011). Who Takes Risks When and Why?: Determinants of Risk Taking. *The Caregiver-child Attachment Relationship, 20*(4), 211–216.

Figner, B., Mackinlay, R. J., Wilkening, F., & Weber, E. U. (2009). Affective and deliberative processes in risky choice: age differences in risk taking in the Columbia Card Task. Journal of experimental psychology. *Learning, memory, and cognition, 35*(3), 709–730.

Gross, J.J., Carstensen, L.L., Pasupathi, M., Tsai, J., Gotestam, S. C., Hsu, A.Y. (1997). Emotion and aging: experience, expression, and control. *Psychology and Aging, 12*, 590 –599.

Gross, J.J., & John, O.P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85*, 348-362.

Grühn, D., & Scheibe, S. (2008). Age-related differences in valence and arousal ratings of pictures from the International Affective Picture System (IAPS): Does age make it more extreme? *Behavior Research Methods, 40*, 512-521.

Heckhausen, J. (1997). Developmental regulation across adulthood: Primary and secondary control of age-related challenges. *Developmental Psychology, 3*3, 176–187.

Huang, Y., Wood, S., Berger, D., & Hanoch, Y. (2013). Risky choice in younger versus older adults: Affective context matter. *Judgment and Decision Making, 8*(2), 179-187.

Kunzmann, U., & Grühn, D. (2005). Age differences in emotional reactivity: The sample case of sadness. *Psychology and Aging, 20*, 47-59.

Labouvie-Vief, G. (2009) Dynamic integration theory: Emotion, cognition and equilibrium in later life. In V. L. Bengsten, D. Gans, N. M. Putney, & M. Silverstein (Eds.), *Handbook of theory of aging* (2nd ed., pp. 277-93). New York: Springer.

Lejuez, C. W., Read, J. P., & Kahler, C. W. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology Applied, 8*, 75-84.

Lerner, J. S., Li, Y., & Weber, E. U. (2013). Financial costs of sadness. *Psychological Science, 24*, 72-79.

Lerner, J. S. , Small, D. A. D., & Loewenstein, G. G. (2004). Heart strings and purse strings: Carryover effects of emotions on economic decisions. *Psychological Science, 15*, 337–341.

Levenson, R. W., Carstensen, L. L., Friesen, W. V., & Ekman, P. (1991). Emotion, physiology, and expression in old age. *Psychology & Aging, 6*, 28-35.

Lezak, M. D., Howieson, D. B., & Loring, D.W. (2004). *Neuropsychological Assessment* (4th ed.). New York: Oxford University Press.

Mata, R., Josef, A. K., Samanez-Larkin, G. R., & Hertwig, R. (2011). Age differences in risky choice: a meta-analysis. *Annals of the New York Academy of Sciences, 1235*, 18–29.

Peters, E., Hess, T. M., Västfjäll, D., & Auman, C. (2007). Adult Age Differences in Dual Information Processes: Implications for the Role of Affective and Deliberative Processes in Older Adults' Decision Making. *Perspectives on Psychological Science, 2*(1), 1–23.

Phelps, E. A. (2006). Emotion and Cognition: Insights from Studies of the Human Amygdala. *Annual Review of Psychology, 57*(1), 27–53.

Phillips, L. H., Smith, L., Gilhooly, K. J. (2002). The effects of age and induced positive and negative mood on planning. *Emotion, 2*, 263–272.

Raghunathan, R., & Pham, M. T. (1999). All negative moods are not equal: Motivational influences of anxiety and sadness on decision making. *Organizational Behavior and Human Decision Processes, 79* (1), 56–77.

Rolison, J. J., Hanoch, Y., Wood, S. (2012). Risky decision making in younger and older adults: The role of learning. *Psychology and Aging, 27*(1), 129-140.

Sheikh, J. I., Yesavage, J. A. (1986). Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. *Clinical Gerontology : A Guide to Assessment and Intervention,* pp. 165-173. New York: The Haworth Press.

Watson, D. Clark, L. A. & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063-70.

APPENDICES

Appendix A

Instructions for the Cold Columbia Card Task (CCT) (from *columbiacardtask.org*)

Columbia Card Task

Introduction and Explanation

- You are now going to participate in a card game. In this game, you will turn over cards to win or lose points which are worth money.

- In each game round, you will see 32 cards on the computer screen, face down. You will decide how many of these cards to turn over. Each card is either a gain card or a loss card (there are no neutral cards). You will know *how many* gain cards and loss cards are in the deck of 32, and how many points you will gain or lose if you turn over a gain or loss card. What you don't know is which of the 32 cards that you see face-down are gain cards and which are loss cards.

- You indicate the number of cards (from 0 to 32) you want to turn over by clicking on a small button. Then, cards are randomly chosen to be turned over, one at a time. For each gain card turned over, points are added to your round total and another card is turned over. This continues until a loss card is uncovered or until the number of cards you chose to turn over is reached. The first time a loss card is turned over, the loss points will be subtracted from your current point total and the round is over – even if you indicated that more cards should be turned over. The accumulated total will be your number of points for that round, and you go on to the next round. Each new round starts with a score of 0 points; that means you play each round independently of the other rounds.

- You will play a total of 24 rounds, three of which will be randomly selected at the end of the session, and you will be paid out for those in real money. Each point is worth 1 cent.

- This game is for real money and requires some concentration. Please minimize distractions in your environment and close any other programs running in the background.

Click to Continue

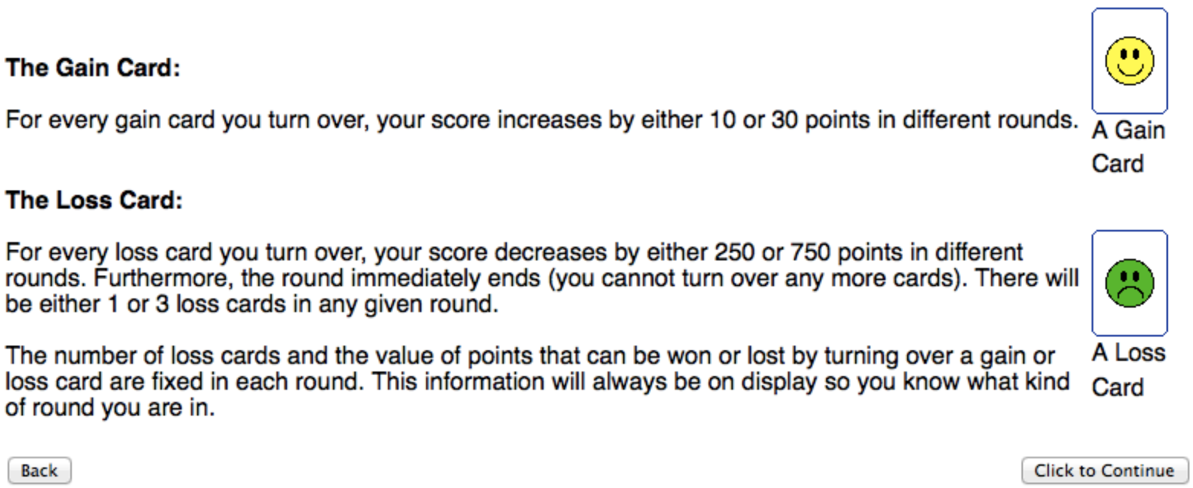
Unknown Cards:

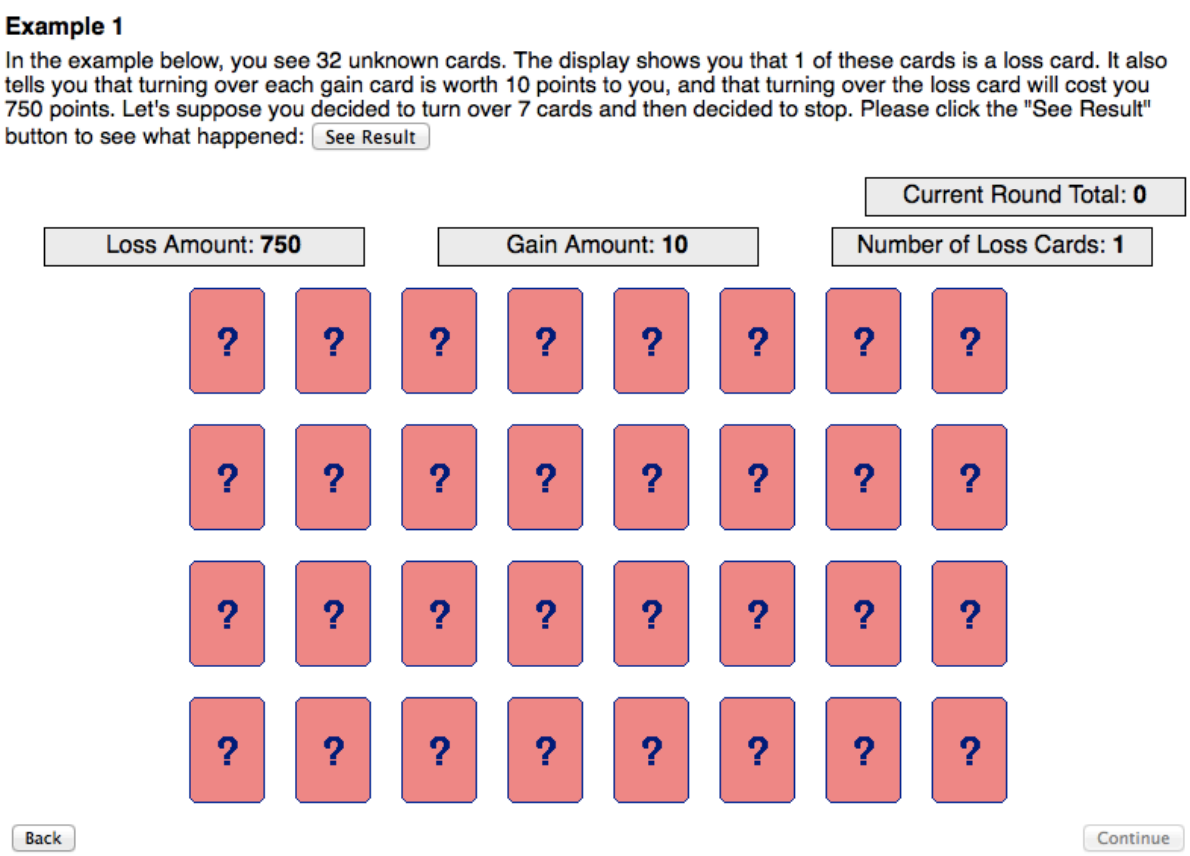
This is what unknown cards look like. Turn it over by clicking on it.

An unknown card. Click on it to turn it over!

Back

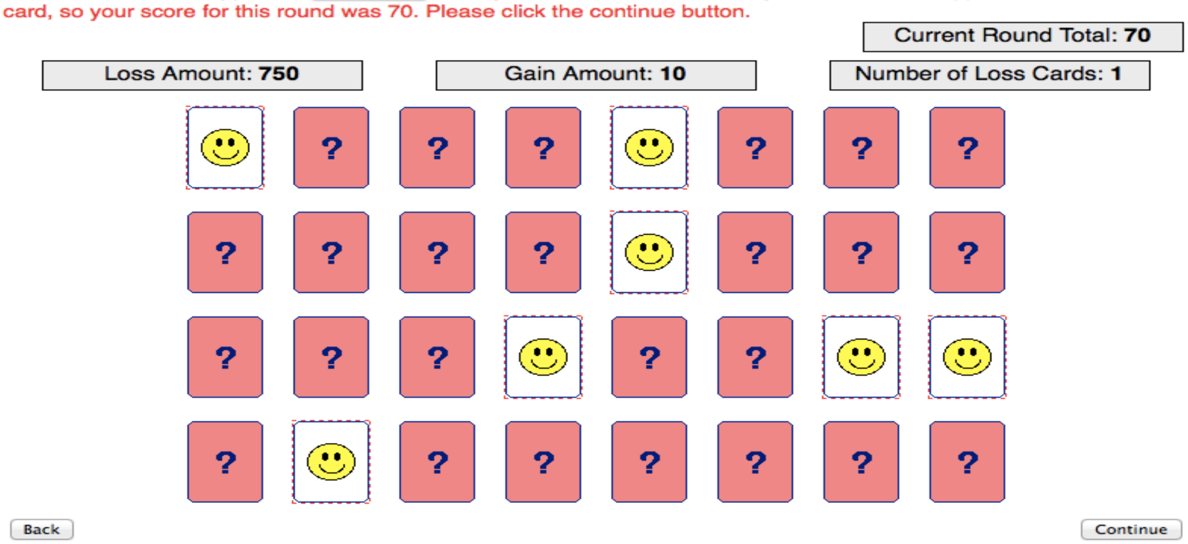
Click to Continue


The Gain Card:
For every gain card you turn over, your score increases by either 10 or 30 points in different rounds.
A Gain Card
The Loss Card:
For every loss card you turn over, your score decreases by either 250 or 750 points in different rounds. Furthermore, the round immediately ends (you cannot turn over any more cards). There will be either 1 or 3 loss cards in any given round.
A Loss Card
The number of loss cards and the value of points that can be won or lost by turning over a gain or loss card are fixed in each round. This information will always be on display so you know what kind of round you are in.
Back
Click to Continue


Example 1
In the example below, you see 32 unknown cards. The display shows you that 1 of these cards is a loss card. It also tells you that turning over each gain card is worth 10 points to you, and that turning over the loss card will cost you 750 points. Let's suppose you decided to turn over 7 cards and then decided to stop. Please click the "See Result" button to see what happened:
See Result
Current Round Total: 0
Loss Amount: 750
Gain Amount: 10
Number of Loss Cards: 1
Back
Continue

Example 1

In the example below, you see 32 unknown cards. The display shows you that 1 of these cards is a loss card. It also tells you that turning over each gain card is worth 10 points to you, and that turning over the loss card will cost you 750 points. Let's suppose you decided to turn over 7 cards and then decided to stop. Please click the "See Result" button to see what happened: See Result Luckily, none of the seven cards you turned over happened to be the loss card, so your score for this round was 70. Please click the continue button.



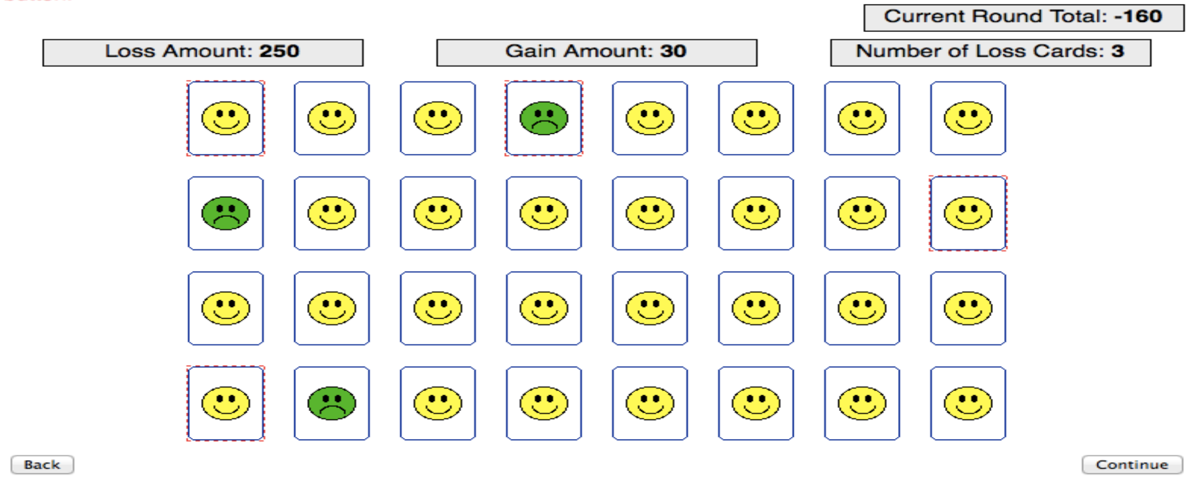
Example 2

In the example below, you see 32 unknown cards. The display shows you that 3 of these cards are loss cards. It also tells you that turning over each gain card is worth 30 points to you, and that turning over a loss card will cost you 250 points. Let's suppose you decided to turn over 10 cards. Please click the "See Result" button to see what happened: See Result

Example 2

In the example below, you see 32 unknown cards. The display shows you that 3 of these cards are loss cards. It also tells you that turning over each gain card is worth 30 points to you, and that turning over a loss card will cost you 250 points. Let's suppose you decided to turn over 10 cards. Please click the "See Result" button to see what happened:

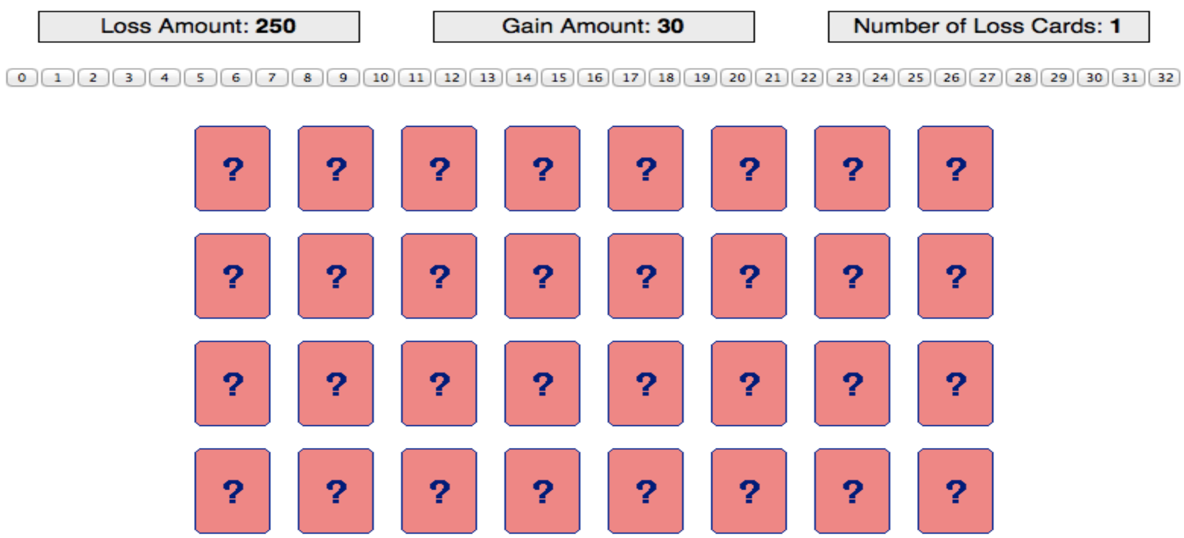
See Result This time, the fourth card you turned over was a loss card. As you saw, the round immediately ended when you turned over the loss card. You had earned 90 points for the 3 gain cards, and then 250 points were subtracted for the loss card, so your score for this round was -160. After the loss points were subtracted from your Round Total, the computer also showed you the cards that you had not yet turned over. Please click the continue button.

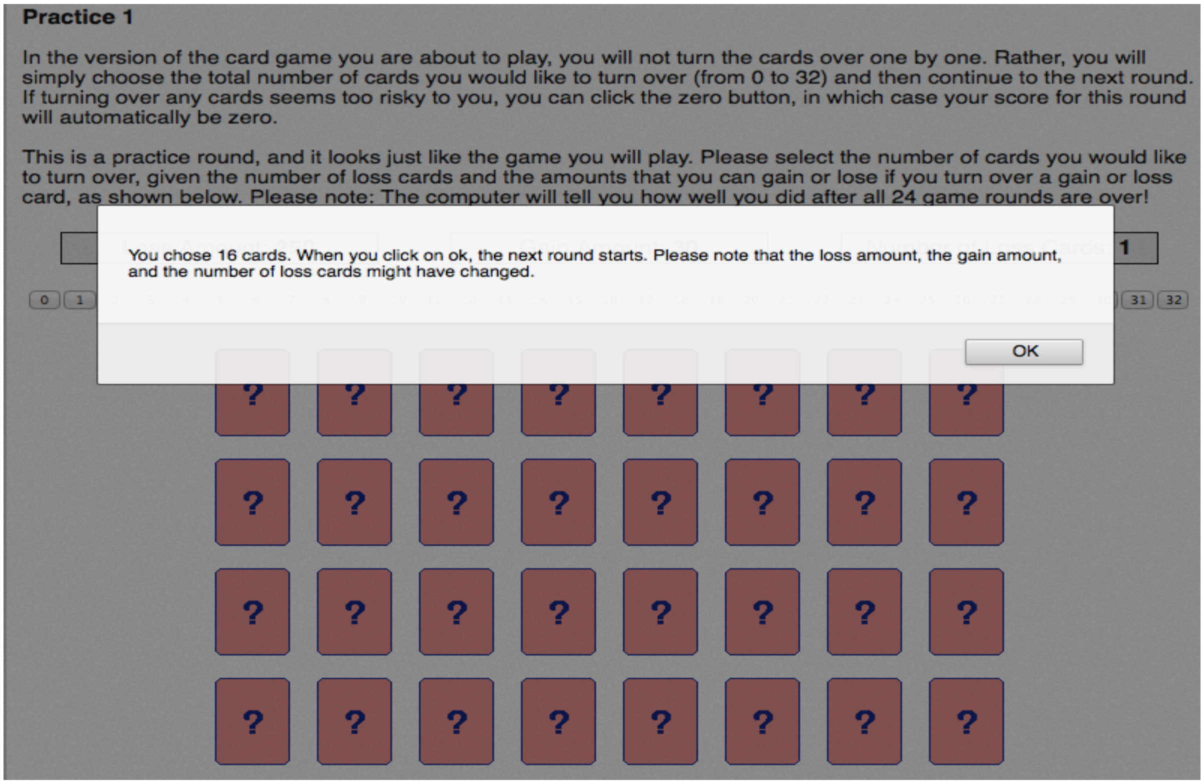


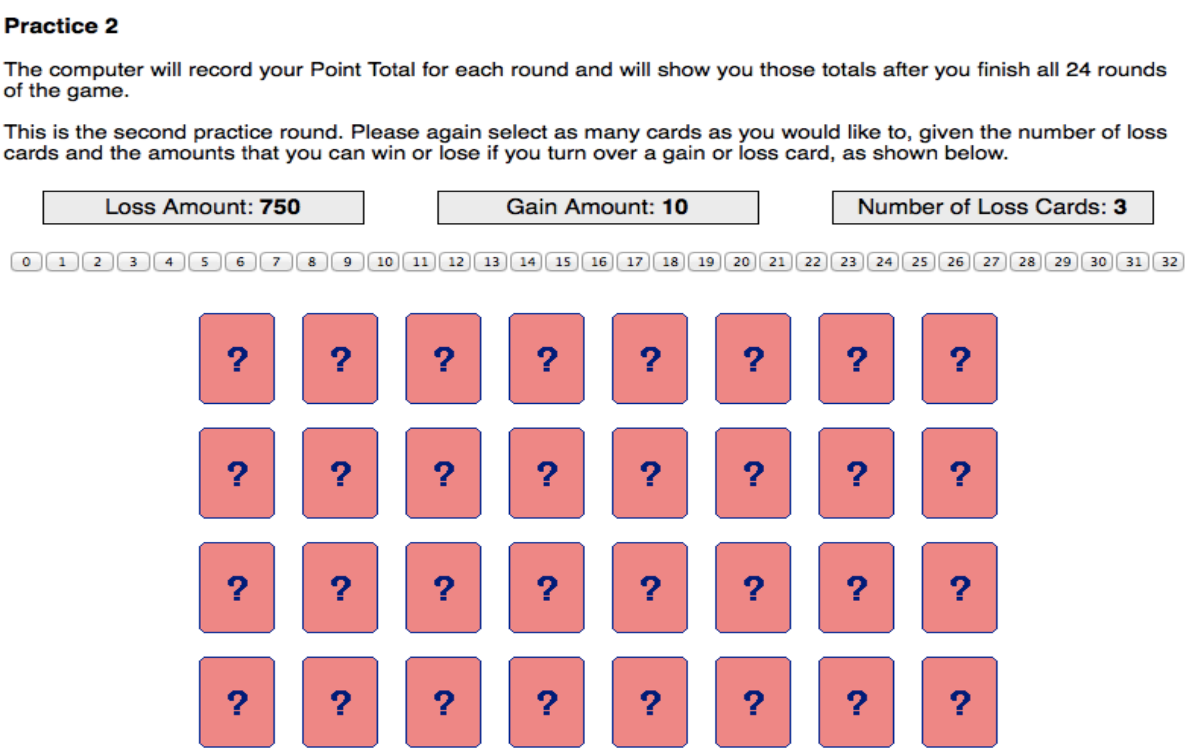
Practice 1

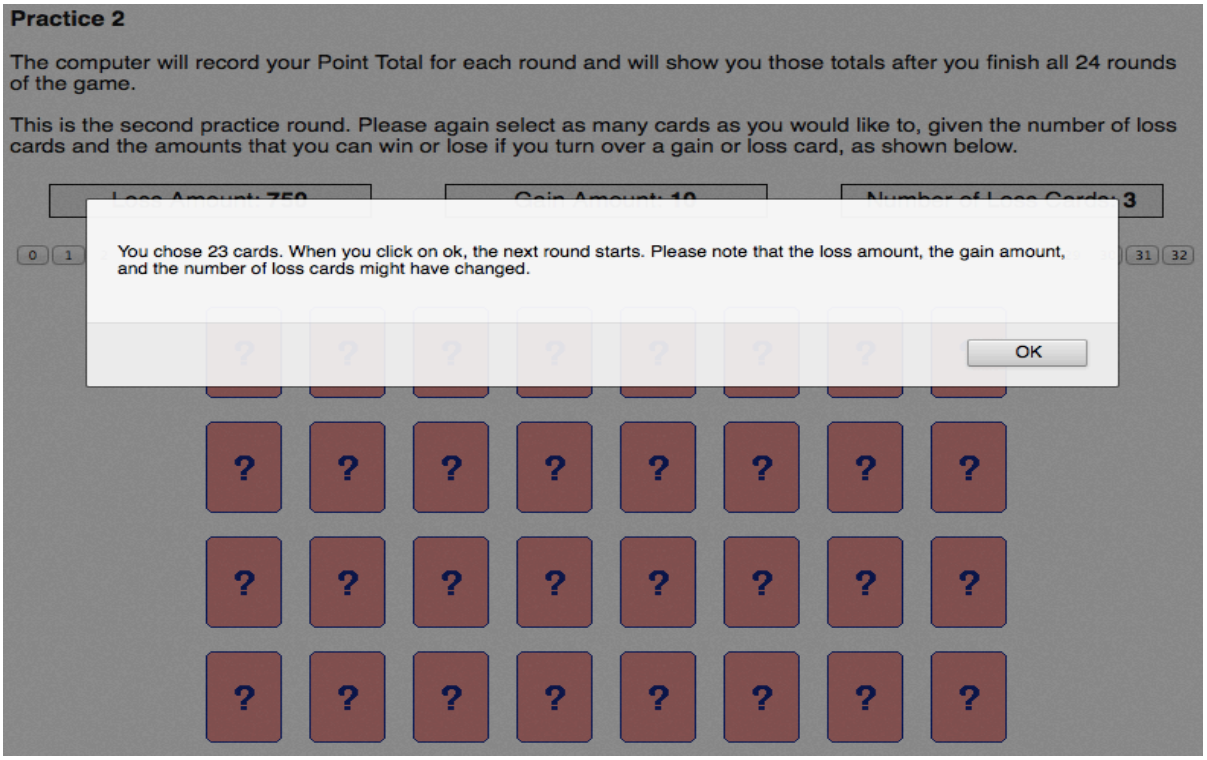
In the version of the card game you are about to play, you will not turn the cards over one by one. Rather, you will simply choose the total number of cards you would like to turn over (from 0 to 32) and then continue to the next round. If turning over any cards seems too risky to you, you can click the zero button, in which case your score for this round will automatically be zero.

This is a practice round, and it looks just like the game you will play. Please select the number of cards you would like to turn over, given the number of loss cards and the amounts that you can gain or lose if you turn over a gain or loss card, as shown below. Please note: The computer will tell you how well you did after all 24 game rounds are over!



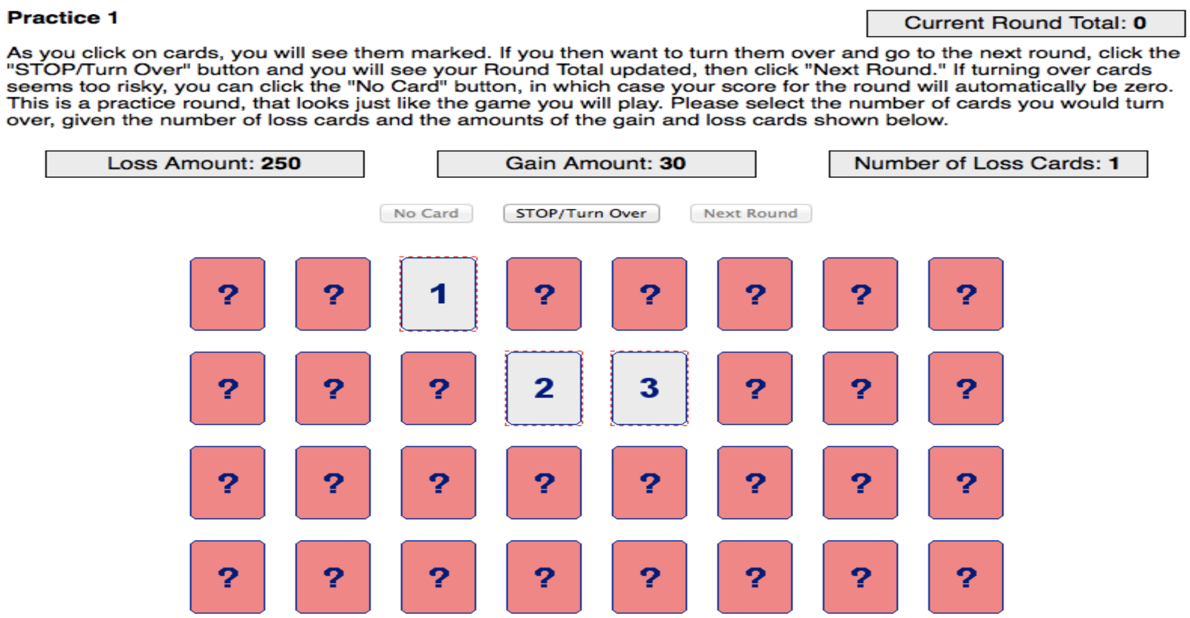

Practice 1
In the version of the card game you are about to play, you will not turn the cards over one by one. Rather, you will simply choose the total number of cards you would like to turn over (from 0 to 32) and then continue to the next round. If turning over any cards seems too risky to you, you can click the zero button, in which case your score for this round will automatically be zero.
This is a practice round, and it looks just like the game you will play. Please select the number of cards you would like to turn over, given the number of loss cards and the amounts that you can gain or lose if you turn over a gain or loss card, as shown below. Please note: The computer will tell you how well you did after all 24 game rounds are over!
You chose 16 cards. When you click on ok, the next round starts. Please note that the loss amount, the gain amount, and the number of loss cards might have changed.
OK

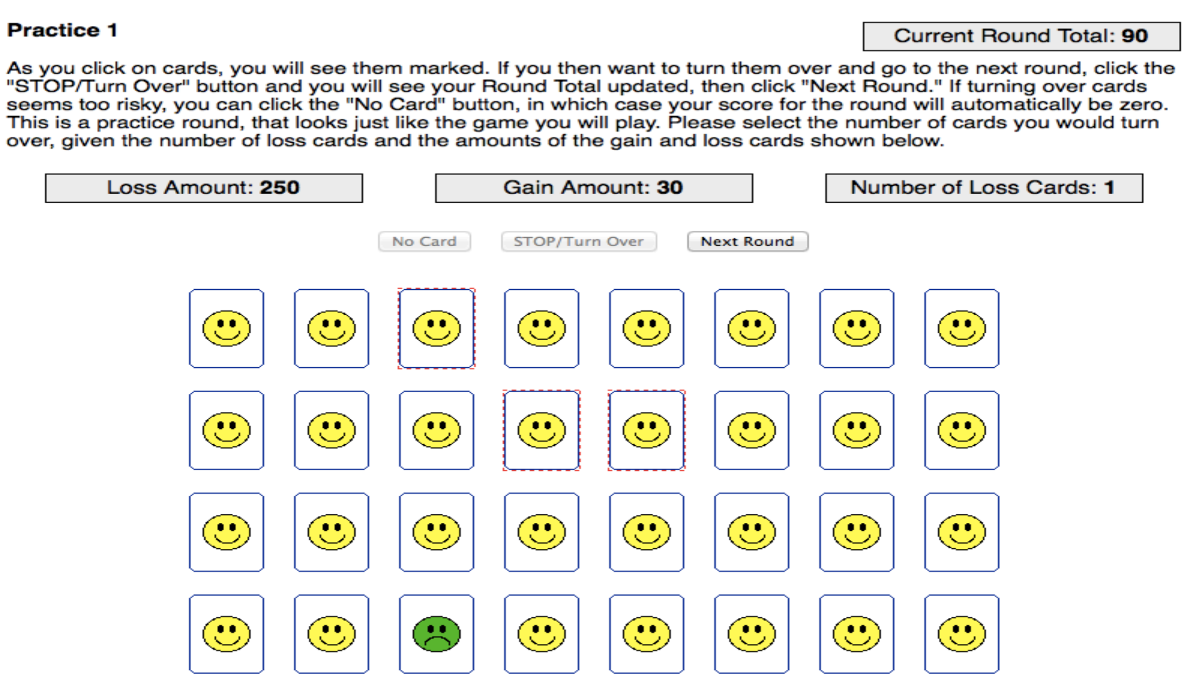

Practice 2
The computer will record your Point Total for each round and will show you those totals after you finish all 24 rounds of the game.
This is the second practice round. Please again select as many cards as you would like to, given the number of loss cards and the amounts that you can win or lose if you turn over a gain or loss card, as shown below.
Loss Amount: 750
Gain Amount: 10
Number of Loss Cards: 3
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

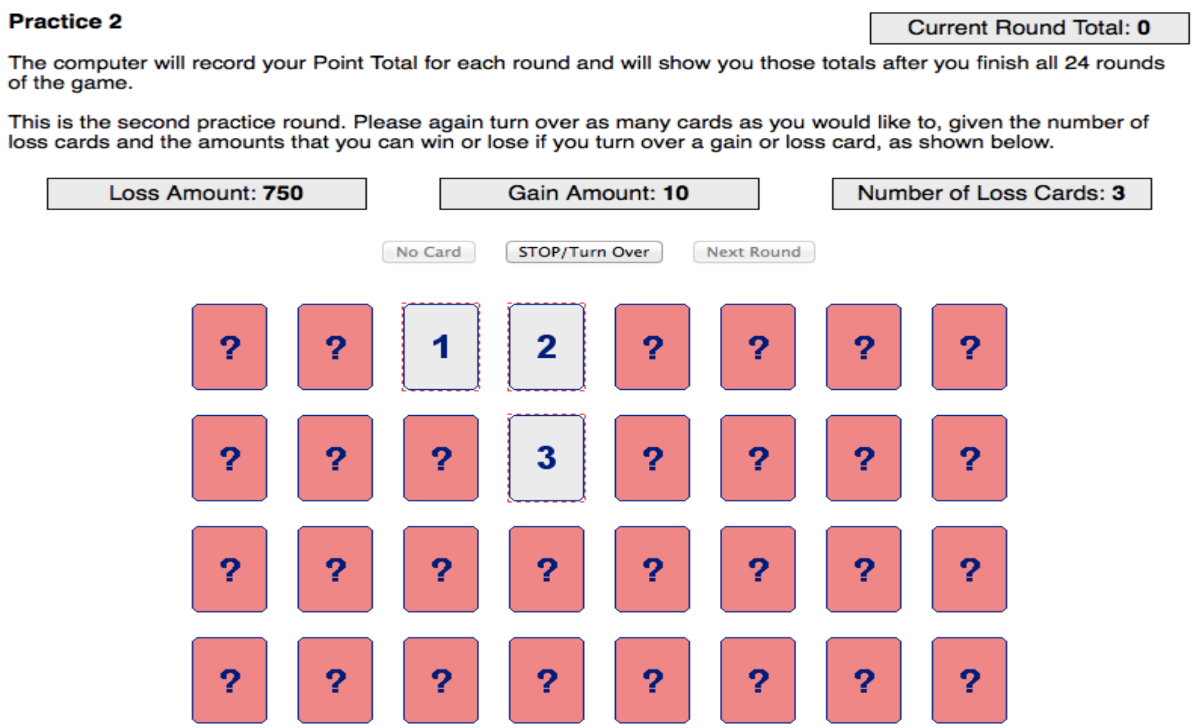

Practice 2
The computer will record your Point Total for each round and will show you those totals after you finish all 24 rounds of the game.
This is the second practice round. Please again select as many cards as you would like to, given the number of loss cards and the amounts that you can win or lose if you turn over a gain or loss card, as shown below.
You chose 23 cards. When you click on ok, the next round starts. Please note that the loss amount, the gain amount, and the number of loss cards might have changed.
OK
0
1
31
32

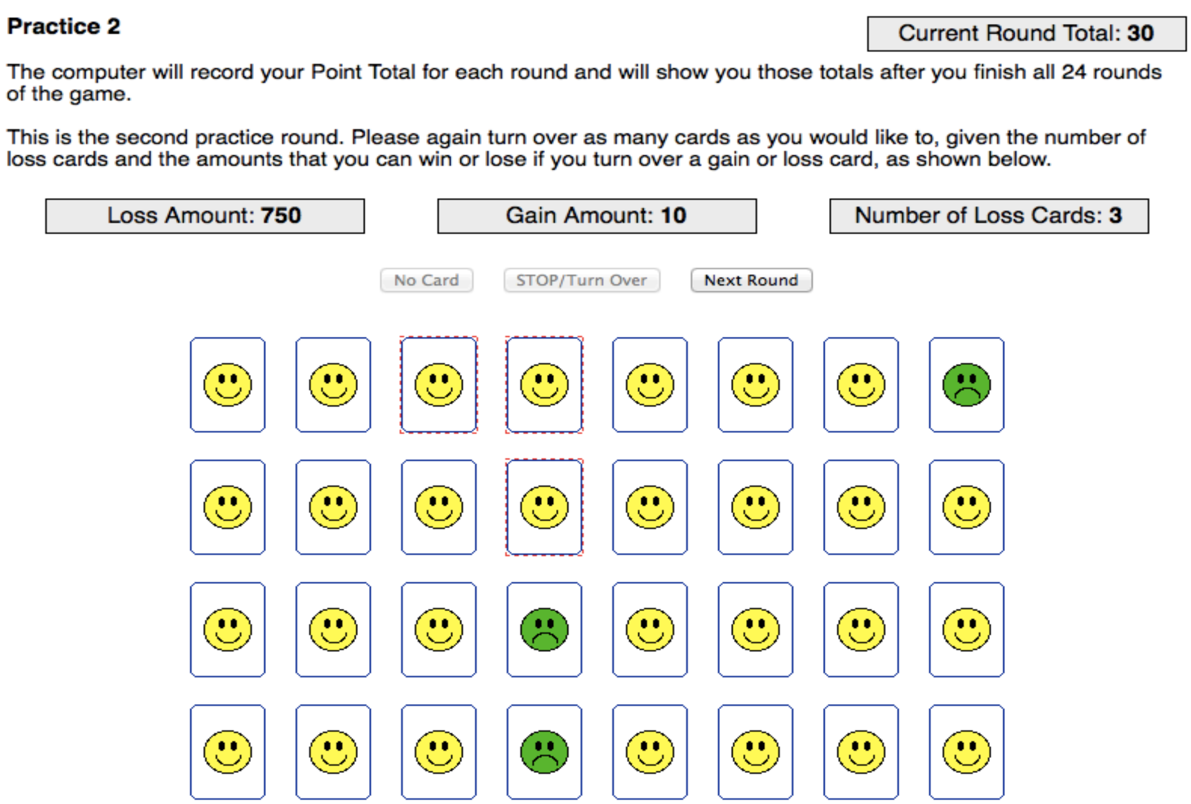
Appendix B

Warm CCT Instructions






Practice 2
Current Round Total: 0
The computer will record your Point Total for each round and will show you those totals after you finish all 24 rounds of the game.
This is the second practice round. Please again turn over as many cards as you would like to, given the number of loss cards and the amounts that you can win or lose if you turn over a gain or loss card, as shown below.
Loss Amount: 750
Gain Amount: 10
Number of Loss Cards: 3
No Card
STOP/Turn Over
Next Round
1
2
3


Practice 2
Current Round Total: 30
The computer will record your Point Total for each round and will show you those totals after you finish all 24 rounds of the game.
This is the second practice round. Please again turn over as many cards as you would like to, given the number of loss cards and the amounts that you can win or lose if you turn over a gain or loss card, as shown below.
Loss Amount: 750
Gain Amount: 10
Number of Loss Cards: 3
No Card
STOP/Turn Over
Next Round

Appendix C

Columbia Card Task (CCT) Practice Questions

Before the game starts, please answer the following questions.

We will now ask a few questions to be sure you understand the way the game works. Suppose you are playing a round with 32 cards, in which the gain cards are worth 10, the loss cards are worth -750 and there are 3 loss cards. Please consider each question carefully:

Loss Amount: **750**	Gain Amount: **10**	Number of Loss Cards: **3**

1. What is the maximum number of gain cards you could turn over (if you were very very lucky)?

2. How many points would you make in that case? In other words, what is the maximum score you could earn in this round?

Let's assume you want to turn over 10 cards, but the 5th card is a loss card:

3. How many cards would be turned over in this round?

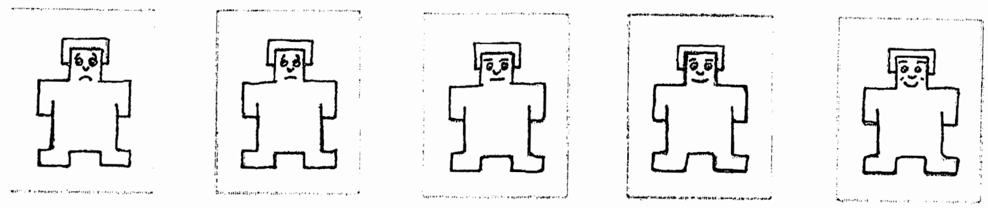
4. What would your final score be in this round?

Back

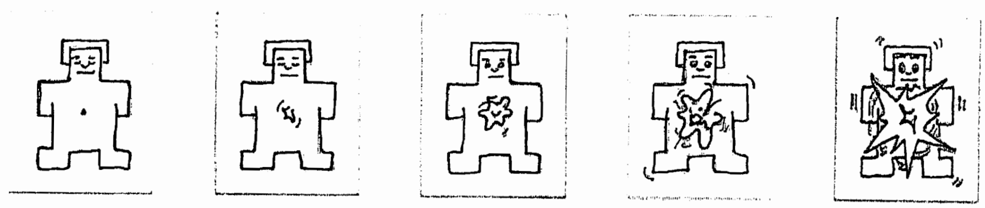
Submit

Appendix D

Please rate how you are feeling right now by circling the appropriate number below the symbols.



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



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

T1

P#______