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Self-concept molds choice experiences among multiple alternatives: An fMRI study

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Abstract

This study addresses the relationship between individual differences regarding self-concept, measured by Self Concept Clarity (SCC) scale and Relational-Interdependent Self-Construal and relationships (RISC) scale, and diverse affective consequences after choice behavior. We hypothesized that lower self-concept clarity and higher relational interdependence would be related to increased susceptibility to choice context – for example, how a choice set is constructed based on one's initial preference. We examined how variations in a choice set can produce different affective consequences after making choices, and investigated the underlying neural mechanism using fMRI. In this experiment, participants first rated their preferences for art posters, and made a series of choices from a presented set. After the choice task, they completed post-choice measures including preferences for the chosen posters, as well as measures of their self-concept clarity and relational interdependence. Our behavioral results demonstrated that when participants faced more conflicting choice context, self-concept clarity was related to more positive affective consequences after choice, whereas relational interdependence was correlated with a lower second-rated attractiveness of the chosen option. The neuroimaging analysis of choice-making revealed that self-concept clarity and the degree of their relational interdependence served as modulators in shaping how one perceives and experiences the same decision-making process. These results have theoretical and practical importance in that it is one of the first studies investigating the influence of the individual differences regarding self-concept on value-based decision making process among diverse choice set contexts.

Key words : Choice Context, Self-concept Clarity, Relational Interdependence, fMRI, Striatum, Ventromedial Prefrontal Cortex

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1. Introduction

“Is the glass half-full or half-empty?” This is a traditional metaphor indicating the importance of our viewpoints and attitudes. Often, if not always, people see the exactly same situation in very different ways. The ‘half-drunk bottle of water’ can be seen as ‘half-full’ or ‘half empty’ according to the perspective of the viewer. The differences in how the given situation is perceived consequently lead to the differences not only in actual decision-making but also in the way that results after the decision-making are processed or interpreted. Empirically, a considerable number of studies suggest that variations in an individual’s self-view have a close relationship with choice behaviors as well as changes in attitude after decision-making has taken place (Heine & Lehman, 1997; Hoshino-Brown, Zanna, Spencer, Zanna, Kitayama, & Lackenbauer, 2005; Kim & Drolet, 2003; Markus & Kitayama, 1991).

Especially, how we view ourselves greatly influences on the amount of context-sensitivity, the variability of the actual behaviors according to different contexts (Haberstroh, Oyserman, Schwarz, Kuhnen, & Ji, 2002; Kashima et al., 2004). Many of the past research have focused on the individual differences of decision-making pattern in diverse social contexts. However, in the present study, we aimed to advance the past research further by comparing individual differences in a multiple-alternatives-forced-choice context, which embodies various choice set attributions but does not include any social factors.

Even though there might exist lots of other attributes consisting of a choice set context, consideration set size and preference contrast are two major subcomponents of a choice set that change accordingly when the number of choice alternatives increases in a set (Kim, Shin, & Han; unpublished). In this paper, we are going to refer the consideration set size and preference contrast as ‘context’ in general sense. According to a number of studies regarding human decision behavior, people undergo a phased decision-making process especially when we make a choice from various choice alternatives. People first filter out all the alternatives and then consider the reduced number of alternatives in more detail, instead of taking all the available options into account at the first place (Hauser & Wernerfelt, 1990; Payne, 1976; Shocker, Ben-Akiva, Boccara, & Nedungadi, 1991; Wright & Barbour, 1977). The reduced choice set, which is selected to be worth considering for choice-making, is called ‘consideration set’ (Brown & Wildt, 1992; Roberts & Lattin, 1991; Shocker, Ben-Akiva, Boccara, & Nedungadi, 1991). The phased search and choice process is not only established into computational dynamic search models (Jovanovic, 1979; Willemsen & Johnson, 2010), but also demonstrated by using eye-tracking technology (Reutsakaja, Nagel, Camerer, & Rangel, 2011; Russo & Leclerc, 1994). Also, when we face multiple options to choose, the subjective value of each option is interdependent because we actively compare the given options before making a choice (Hsee, 1998; Shafir, Simonson, & Tversky, 1993; Tversky & Shafir, 1992). Since the same option can appear as more attractive when it is surrounded by less attractive options, which is called “contrast effect”, the choice set context itself can influence on our choice behavior, as well as on our affective experiences after the choice.

The two major personality measures that are known to be closely related to our choice behaviors in different context are RISC (relational-interdependent self-construal and relationships; Cross, Bacon, & Morris, 2000) and SCC (self-concept clarity; Campbell, Trapnell, Heine, Katz, Lavallee, & Lehman, 1996).

RISC measures the independent view of self, which has been characterized as a major factor in contributing to cross-cultural variation in attitude changes after choice behaviors (Heine & Lehman, 1997; Kitayama, Snibbe, Markus, & Suzuki, 2004). Past findings have commonly noted that people with a relationally interdependent self-concept demonstrated significant attitude changes in order to justify their choices only when there was an external reference viewpoint that could evaluate their choices, such as others’ preferences of an in-group.

Self-concept clarity indicates the extent to which the contents of an individual’s self-concept are clearly and confidently defined, internally consistent, and temporally stable (Campbell et al., 1996). Previous studies suggest that people with uncertain beliefs about themselves tend to be dependent on, and affected by, external information, rather than making decisions based on their innate preferences reported before choice behaviors (Burger & Guadagno, 2003; Cialdini & Goldstein, 2004).

Based on the previous research results regarding these two personality indexes, it can be inferred that people with higher interdependent self-construal or with unclear self-concept are commonly liable to extrinsic circumstances of decision-making. Furthermore, literature also empirically have shown the negative correlation between self-concept clarity and the level of self-construal, which means that an independent person tends to have clearer and more confident self-concept(Campbell et al., 1996). Therefore, we focused on *1) relational interdependence and 2) self-concept clarity* in this study as possible moderators that lead us to involve in different decision-making processes and thereby, to experience different affective consequences. Specifically, we expected that participants with interdependent, unclear self-concepts would be more susceptible to the attributes of choice set context in our study.

Functional neuroimaging is particularly important in that the fundamental mechanism, which is not seen directly with our eyes but underlies behavioral differences, can be uncovered and offer significant clues to explain observable phenomena. According to the previous neuroimaging studies, it has been consistently demonstrated that value-based decision-making recruits the fronto-striatal circuit including medial prefrontal cortex (mPFC) and striatum. Specifically, the role prefrontal cortex in value- based decision-making encompasses the representation of expected values, the comparison of hedonic values, and the conflict detection (Arana et al., 2003; Blair et al., 2006; Botvinick, 2007; Elliott et al., 2003). Also, an ever-growing number of studies have shown that the striatum involves in the reward-based decision-making process by reflecting the rewarding values of the presented outcomes (Delgado, Locke, Stenger, & Fiez, 2003; Kuhnen & Knutson, 2005; Sharot, De Martino, & Dolan, 2009). Therefore, we hypothesized that the individual differences in one's self-view, the self-concept clarity and the relational interdependence in this study, not only modulate behavioral differences in choice-making, but would also be represented in the neural activation of the fronto-striatal circuit during decision-making.

2. Methods

2.1. Participants

Twenty-eight healthy subjects (including 15 participants for the fMRI experiment) participated in the study for either course credit or payment ($10 per hour for the behavioral experiment, and $20 per hour for the fMRI experiment). Before the study commenced, informed written consent was obtained from the subjects in a manner approved by the Institutional Review Board of Yonsei University. Before scanning, participants completed a screening form to declare any significant medical conditions they might have.

2.2. Experimental Tasks & Procedures

The present experiment consisted of five parts: *1) Pre-choice Preference task, 2) Consideration Set Size Decision task, 3) Choice task, 4) Post-choice Evaluation task, and 5) Post-experimental task.* The Post-experimental task was conducted only for fMRI participants after the three scanning sessions.

A total of 340 unfamiliar art posters were obtained from the internet and resize to 280 * 280 mm to control stimuli sizes. In order to make decisions more salient, participants were asked to evaluate and select pictures as if they were choosing paintings to hang in their room. Prior to scanning, participants rated the subjective attractiveness of each art poster using an 8-point scale (1 = very unattractive, 8 = very attractive). In the following tasks, only 204 pictures (13 stimuli for score 1, 3, 4, and 8, 23 stimuli for score 2 and 5, 53 stimuli for score 6 and 7) were randomly selected to construct four different choice conditions. Participants were able to change their preference rating until they felt satisfied and confident with their report. All the tasks were programmed using the Cogent toolbox (http://www.vislab.ucl.ac.uk/Cogent) and MATLAB 7.8.0 (The MathWorks).

Prior to the main Choice task, the Consideration Set Size Decision task was conducted in order to check the subjective minimum attractiveness level to be included in each participant's consideration set. There were twenty-four trials for deciding individual consideration set size (3 stimuli from each attractiveness score ranging from 1 to 8). Subjects answered with either "Yes" or "No" to the question: "Is this picture good enough to be hung in your room?". A detailed explanation about the question was given in advance, telling them that they should answer "No" only if they could not bear for the presented stimuli to be hung in their rooms. Based on our independent pilot test results, we used an attractiveness rating of 5 as a consideration criterion point to configure the choice conditions in this experiment. Individual consideration criterion point was calculated by the midpoint of the average attractiveness rating of the pictures that were reported as acceptable and the average attractiveness rating of the pictures that were rejected (Mean = 4.41, SD = 0.32).

In the main Choice task, a set of pictures were presented on a screen and participants were instructed to choose the picture that they prefer the most among the multiple alternatives in the set. Based on the results from the pilot test regarding an individual's consideration criterion, four different choice sets were configured varying in set size, consideration set size, and the level of contrast among alternatives. The four choice set conditions were 1) a larger consideration set (LCS) with four 6-rated items, 2) a large consideration set and a small contrast set (LCSCT) with two 7-rated and two 5-rated items, 3) a larger contrast set (LCT) with two 7-rated and two 2-rated items, and 4) a small set (SSET) with two 6 or 7-rated items. Compared with the SSET, which has a consideration set size of two items (each of which are rated equally), the LCS has the consideration set size of four (which is doubled from two in the SSET) with no increase in contrast among alternatives, an alteration that would make choice-making harder. The LCSCT includes two 5-rated items, which enable relative comparison among the given choice options but at the same time construct an enlarged consideration set size (of four items, doubling the consideration set size of two in the SSET). The LCT leads to a far more distinct comparison among items by having two additional unattractive items, but the consideration set size remains the same as in the SSET (two items). The Choice task consisted of 40 trials with 10 trials for each of the four conditions. A set of pictures was displayed on the screen simultaneously and remained present for 5500 msec, with a preceding 500 msec fixation cross. The order in which the choice set condition was presented was pseudo-randomized. Each picture appeared only once through the Choice task.

After the Choice task, participants were reminded which stimulus they had chosen among the alternatives, they then proceeded to the Post-choice evaluation task. The picture sets used during the Choice task were presented again in a pseudo-randomized order. For every choice set displayed, subjects reported the perceived average attractiveness rating of choice set, choice satisfaction, and choice difficulty. The same 8-point scale was used for expressing average set values (1 = very unattractive, 8 = very attractive) and choice difficulty (1 = not difficult at all, 8 = very difficult). We used a 100-point scale for the choice satisfaction report. In the task a red square appeared around the chosen picture while answering choice satisfaction and choice difficulty questions, but this square did not appear while answering the average set value question. Every question was presented for 5500 msec, with an additional 500 msec fixation cross. Participants' ratings of the post-choice evaluation stage were our main dependent variables. This was because we aimed to explore the subjective affective consequences that emerged after a choice had been made.

Subsequent to the scanning sessions, subjects rated the attractiveness of all the items which had been presented during the experiment using the same 8-point scale. This was conducted to monitor any changes in attitude after choice behaviors. Finally, participants completed questionnaires assessing the degree of their relational-interdependent self-construal (RISC; Cross, Bacon, & Morris (2000)) and their self-concept clarity (SCC; Campbell et al. (1996)). For RISC, participants rated the items using a 7-point scale (1 = *strongly disagree*, 7 =

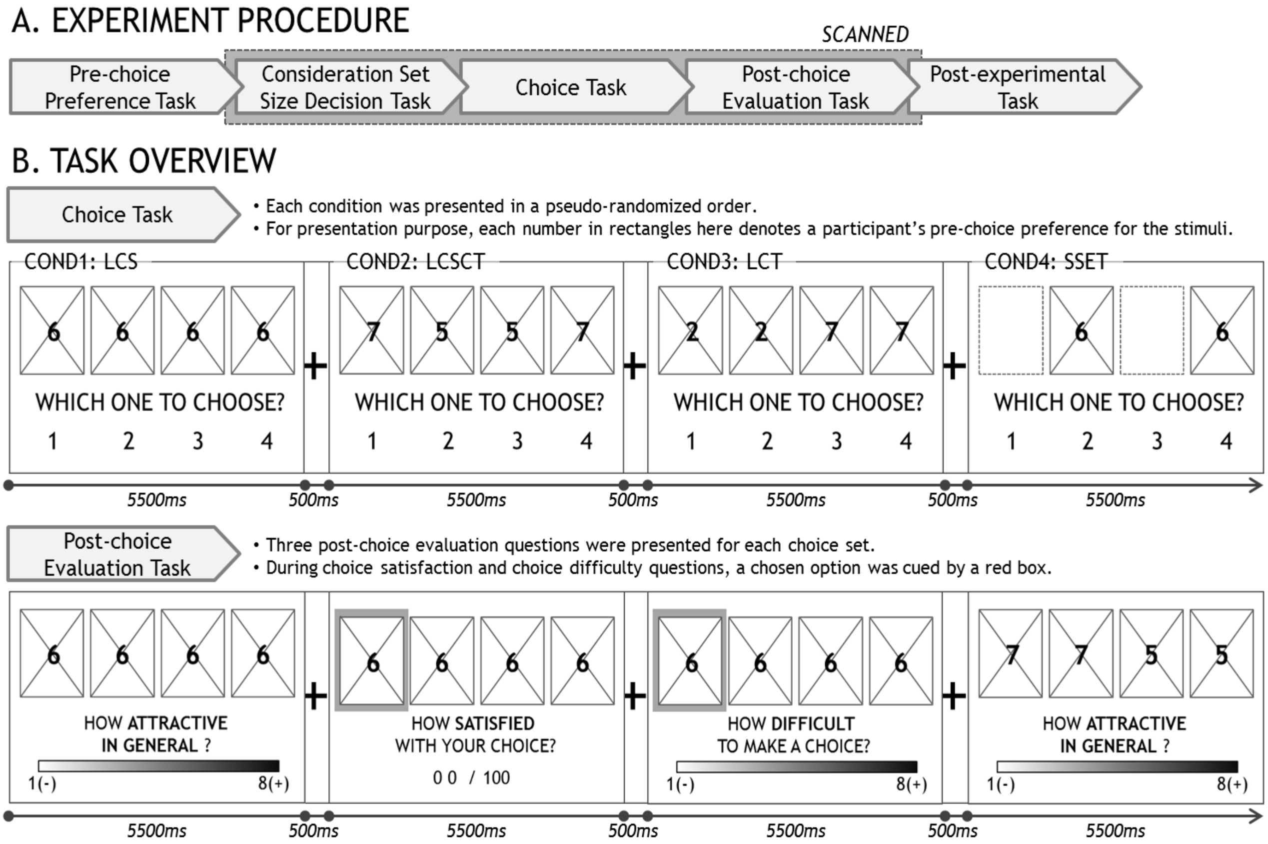

Figure 1. *A*, Participants performed five behavioral tasks, among which the middle three tasks were scanned. *B*, In the choice task participants chose the most preferable stimulus among the provided alternatives. See *METHOD* for abbreviations. They the nproceeded to the post-choice evaluation task, which requested participants to report on 1) a set's overall attractiveness, 2) choice satisfaction for the chosen option, and 3) choice difficulty for each set.

strongly agree) and for SCC, they used a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*).

2.3. fMRI Data Acquisition & Analyses

The functional imaging was conducted on a 3-T Siemens MAGNETOM Trio MRI scanner. Functional data were acquired by using a gradient-echo planar pulse sequence (repetition time = 2000 msec, TE = 30 msec, 3 x 3 x 4 mm resolution, 33 axial slices tilted 30° to the AC – PC plane, no gap, interleaved collection). High-resolution whole brain T1-weighted anatomical scans (1 x 1 x 1 mm resolution, 192 axial slices) were also acquired. The first four volumes of each session were discarded to allow T1 equilibration effects. Stimuli were presented with MRI-compatible goggles and responses were received with two MRI-compatible button boxes with four buttons each.

fMRI data were analyzed using SPM8 (Wellcome Department of Cognitive Neurology, London, U.K.). The slice acquisition timing was corrected by resampling all slices in time relative to the middle slice. Functional images were realigned to correct for head movement and co-registered with each subject's anatomical scan. After the segmentation of co-registered images, preprocessing further included the spatial normalization of the co-registered structural image to a Montreal Neurological Institute (MNI) template provided in SPM8, with volumes then resampled into 3mm cubes. The resulting normalization parameters were then applied to the functional images, followed by spatial smoothing with an 8mm full-width, half-maximum isotropic Gaussian kernel. To minimize the effect of signal changes due to movements, we used the robust weighted least-squares algorithm (rWLS) that weights each observation with the inverse of its variance (Diedrichsen & Shadmehr, 2005). Each scanning session was rescaled such

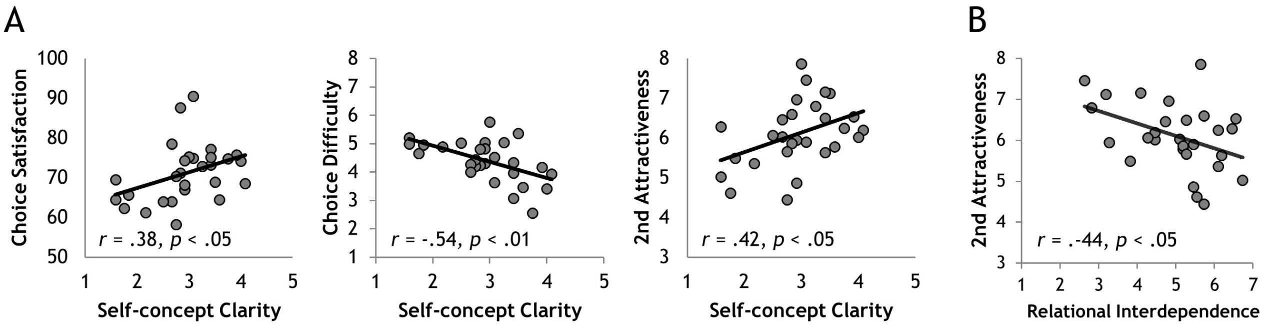

Figure 2. Personality modulation effect on the affective consequences after choices *A. Self-concept clarity*, When choices were made from a large number of options(LSET), self-concept clarity showed significant positive correlations with choice satisfaction, second-rated attractiveness of the chosen option, and a negative correlation with the choice difficulty. (r = .38, p < .05; r = .42, p < .05; r = -.54, p < .01 respectively). Please note that higher self-concept clarity score means that one's self-concept is unclear. *B. Relational interdependence*, A negative correlation was observed between relational interdependence and the chosen option's post-choice attractiveness(r = -.44, p < .05).

that the mean global signal was 100 across the volumes. For the analyses, the volumes were treated as a temporally correlated time series and modeled by convolving a canonical hemodynamic response function (HRF) and its temporal derivative with a delta function marking the onset of each trial. The resulting hemodynamic functions were used as covariates in a general linear model along with a basis set of cosine functions that were used to high-pass filter the data and a covariate representing session effects. Least-squares parameter estimates of the best-fitting synthetic HRF for each condition of interest (averaged across scans) were used in pairwise contrasts and stored as a separate image for each subject. These different images were then tested against the null hypothesis of no difference between contrast conditions using one-tailed t tests. The data were statistically analyzed by treating subjects as a random effect at the group level.

All the general linear models (GLM) treated each trial as an event with zero duration. Analyses focused on the imaging scans during the Choice task. Unless stated otherwise, statistics were corrected for multiple comparisons by using a Monte Carlo simulation (Slotnick, Moo, Segal, & Hart, 2003) to determine volumetric cluster sizes corresponding to an alpha level of $p < .05$.

3. Results

3.1. Behavioral Results

We performed a behavioral experiment first, and then conducted an fMRI experiment in order to validate the behavioral experiment's results as well as to explore the underlying neural mechanisms that operate during choice-making among multiple alternatives. The general result pattern from the behavioral experiment remained the same when additional behavioral data from the fMRI experiment were included in the analysis. Therefore, the behavioral results from both the behavioral experiment and the fMRI experiment are collapsed here.

A correlational analysis was conducted to investigate a possible modulation effect of personality on the affective consequences after making a choice. When choices were made from a large number of options (LSET; LCS + LCSCT + LCT combined), self-concept clarity score showed significant positive correlations with the level of choice satisfaction, second-rated attractiveness of the chosen option, change in attractiveness of the chosen option, and a negative correlation with the level of choice difficulty. (r = .38, p < .05; r = .42, p < .05; r = .39, p < .05; r = -.54, p < .01 respectively; SCC Mean = 2.93; SD = 0.69). These results imply that a person whose self-identity or preference is not clearly and not confidently defined is more likely to feel difficult, dissatisfied, and unattractive about their choices from a large number of available options.

Also, a negative correlation was observed between relational interdependence scale and the reported measure of the chosen option's post-choice attractiveness, as well as between the same scale and the attractiveness change for the chosen option ($r = -.44$, $p < .05$; $r = .39$, $p < .05$; RISC Mean = 5.01; SD = 1.12) only when the choices were made among large number of options. These results indicate that interdependent selves are especially influenced by other alternatives, showing lower preferences and smaller changes in attractiveness for the chosen options.

3.2. fMRI Results: regression analyses on individual differences

On the basis of the behavioral correlation between post-choice affective responses and individual personality, we predicted that differences in personality would also be reflected in the neural representations of a subjective perception of a choice set – the size of consideration set and the level of preference contrast.

First, we performed a simple regression analysis on the parametric GLM models tracking the size of the consideration set and the level of contrast, using Self-Concept Clarity (SCC; Campbell et al. (1996)) scores as a covariate. This regression analyses revealed that subjects with a clear self-concept exhibited greater parametrically sensitive activations in the striatum, including the bilateral caudate nucleus and putamen. On the contrary, unclear self-concept showed positive correlation with the activation in the striatum, as the degree of preference contrast among available options is magnified. Next, even though the possible confounding effect of the total set size was regressed out in the previous parametric GLM model, we directly examined the modulatory effect of self-concept clarity in a separate contrast that embodies a difference not in total set size but only in consideration set size - (LCS + LCSCT) versus LCT. From this contrast, the correlational brain activation with self-concept clarity was restricted only to the right part of the caudate nucleus that was found in the previous parametric GLM analysis. Moreover, from the same contrast, significantly stronger activation was observed in the rostral anterior cingulate cortex (rACC) as one's self-concept is vaguer.

Secondly, another simple regression analysis was conducted using Relational-Interdependence Self-Construal and relationships (RISC; Cross, Bacon, & Morris (2000)) score as a covariate. As RISC scores increase, the orbitofrontal cortex (OFC) and the right temporal pole exhibited a more sensitive tracking to variations in the size of the consideration set. Additionally, the two different consideration set sizes of four and two were directly compared in the same total set size of four in the contrast of (LCS + LCSCT) versus LCT. Consistent with the results from the parametric modulation analysis, stronger activations were found in the exactly same region of the OFC. Moreover, as participants have more interdependent relational traits, the rostral ACC was recruited more actively when they make a choice among larger number of considerable options. All the coordinate data of above-mentioned regions are provided in Table 1.

Table 1. fMRI Results coordinate information

Regions	Lat.	BA	Talairach Coordinates x	y	z	z-score
1. Self-Concept Clarity						
1) Parametric Modulation Analysis						
Consideration Set Size						
Caudate Nucleus	L	N/A	-16	19	-1	3.23
	R	N/A	18	16	8	3.12
Putamen	L	N/A	-30	4	-2	3.21
Contrast (negative correlation)						
Putamen*	L	N/A	-26	12	1	3.24
Precuneus*	L	19	-26	-76	35	2.92
2) (LCS + LCSCT) vs. LCT						
Caudate Nucleus	L	N/A	-16	19	-3	3.05
	R	N/A	12	14	11	3.65
Putamen	L	N/A	-30	2	-2	3.32
Anterior Cingulate Cortex*	R	32	10	45	8	3.71
Inferior Frontal Cortex*	R	47	36	34	-12	3.65
2. Relational Interdependence						
1) Parametric Modulation Analysis						
Ventromedial Prefrontal Gyrus	R	11	4	38	-15	3.23
Inferior Frontal Gyrus	L	45	-46	26	5	3.95
Middle Temporal Gyrus	L	21	-57	-8	-11	3.37
Temporal Pole	L	38	-32	9	-17	3.37
2) (LCS + LCSCT) vs. LCT						
Ventromedial Prefrontal Gyrus	L	11	-4	36	-20	3.33
	R	11	4	32	-20	3.60
Anterior Cingulate Cortex	N/A	10	0	49	6	3.27
	L	10	-6	49	11	2.91
Inferior Parietal Lobule	L	40	-36	-52	51	3.24
Middle Temporal Gyrus	L	21	-55	-5	-22	3.16

Lat. = laterality; * = reverse correlation
BA = approximate Brodmann's locations

4. Discussion and Conclusion

In the present study, we explored the effect of the two major measures of self-concept on choice behavior and its affective consequences. Results indicated that differences among individual personalities, such as the clarity of one's self-concept and the degree of relational interdependence, could produce differences in how people perceived and experienced the same decision-making process.

The current research advances our understanding of how individual traits can affect the decision-making process and post-decisional emotions. Even though most studies showing the above individual differences are cross-cultural comparative experiments, the effect might have been fundamentally rooted in the systematic variations in self-concept that people in Western and Asian cultures hold in general. For instance, individualists (e.g. European-Americans), who are more confident in having a clear self-concept compared to collectivists (e.g. East Asian) (Campbell et al., 1996), tend to be more satisfied with choices made on the basis of their personal preferences, seek more variety when making their choices, and show greater attitude changes in trying to reduce any cognitive dissonance that arises after choices have been made (Hoshino-Browne et al., 2005; Iyengar & Lepper, 1999; Kim & Drolet, 2003). In addition, Kitayama et al. (2004) identified that Asians, who are predominantly interdependent, exhibited post-decisional attitude changes to justify their choices only when a relevant social context was provided. Extending these findings, we found that the choice sets with the same attributes (i.e. same number of options, same size of consideration set, or same magnitude of contrasts) could be perceived and experienced very differently depending on an individual's personality traits.

The current data demonstrated that participants with an unclear self-concept underwent unpleasant experiences both during and after the decision-making process, by showing encountering greater difficulties and lower choice satisfaction. The effect of these personality traits were also reflected in the participants' brain activity during decision-making. Among participants with a clearer self-concept, the striatum represented the consideration set

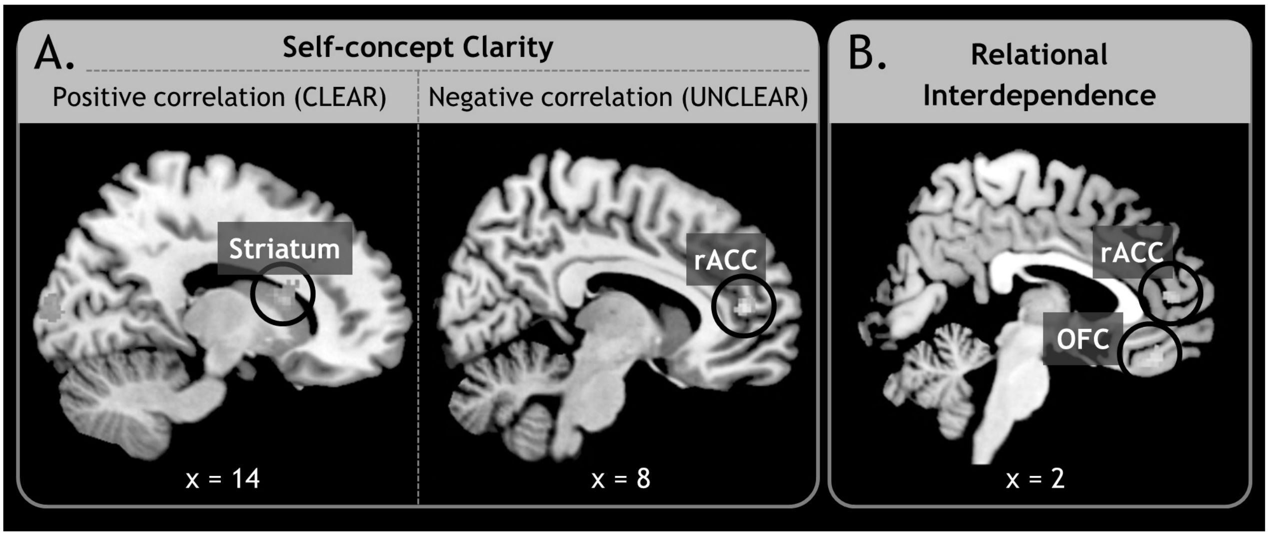

Figure 3. Neural substrates reflecting individual differences in RISC and SCC scores *A. Self-concept clarity*, When choices were made from larger number of considerable options (LCS + LCSCT) compared to smaller number of considerable options (LCT), stronger activation in the right caudate nucleus was found as participants possess clearer self-concept. On the contrary, stronger activation in the rostral anterior cingulated cortex was observed among participants with unclear self-concept. *B. Relational interdependence*, From the same contrast above (LCS + LCSCT vs. LCT), stronger activations in the rostral anterior cingulate cortex and orbitofrontal cortex were observed as the degree of relational interdependence increases. The effects of both *A* and *B* were significant $p < .05$, corrected. See Table 1 for coordinate information.

size more sensitively. Based on the well-established literature regarding the role of the striatum in reward processing, these results indicate that larger sized consideration sets were more rewarding among people who have a clearer self-concept (Delgado et al., 2003; Elliott et al., 2003; Montague, King-Casas, & Cohen, 2006; Tricomi, Delgado, & Fiez, 2004). However, in the case of an unclear self-concept, greater activation in the striatum was observed when the contrast effect was large, so that the relative comparison among the given options was easy. Furthermore, participants who were unsure about their general preferences (unclear self-concept) demonstrated a greater level of activation in the rostral ACC during making a choice among larger number of options. The role of the ACC in conflict monitoring has been extensively demonstrated so far, and recent studies specifically examined its involvement in higher level decision conflicts among similarly attractive alternatives (Botvinick et al., 1999; Bush, Luu, & Poster, 2000; Marsh, et al., 2007; Pochon et al., 2008). Upon this literature, the current results imply that participants with unclear self-concept experienced more decision conflict.

Relational interdependence also influenced evaluations of the choice set. When the consideration set was larger, it took more effort for interdependent people to compare the subjective values among the options, and they also showed a greater level of negative affect after having made their choices. This was also confirmed via different neural expressions in the orbitofrontal cortex (OFC) and rostral ACC as a function of the individually reported interdependence scale. As subjects are relationally interdependent, more active recruitment of the OFC and rostral ACC were required to make a choice among large number of options. It is widely agreed that the ventral and orbital part of the prefrontal cortex involves in value-guided decision-making, and in particular, a large number of recent findings suggest the extended role for the OFC in subjective value computation and value comparison (FitzGerald, Seymour, & Dolan, 2009; Levy & Glimcher, 2012; Lim, O'Doherty, & Rangel, 2011; Rangel, 2008). Therefore, the present data suggest that interdependent people (as compared to independent people) experience severer decision conflict when they are faced with multiple alternatives, and thus undergo more active revaluation process for decisions. This is particularly interesting in that interdependence, a personality characteristic in a social context, could modulate or even predict the brain activation patterns in a context which involves no social interaction but only subjective valuations on multiple options.

In sum, the current findings suggest that individual differences in self-concept could produce different choice-related behaviors and neural representations. As self-concept is unclear and relationally interdependent, choice making among large number of alternatives costs more effort. This finding is supported not only by behavioral differences, such as higher choice difficulty and lower preference for the chosen option, but also by different neural mechanism recruited during decision-making.

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