Is Self-Positive Information More Appealing than Money? Individual Differences in Positivity Bias according to Depressive Symptoms

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Abstract

The self-positivity bias, which is inherent to healthy people, is known to be blunted in depression. The lack of positive or excessive negative self-reference is considered to be a potential mechanism underlying depressive rumination. However, the motivational factors that drive people to approach and avoid emotional self-related materials are still unclear. Therefore, we measured intrinsic motivation that is associated with emotional self-references by using a reward-based decision making task (Pay-Per-View paradigm). Forty-nine undergraduates completed two tasks in which they were asked to choose between negative vs. positive references (Task 1) and self vs. other references (Task 2) for variable monetary rewards. Participants with lower levels of depressive symptoms showed a self-positivity bias, sacrificing rewards for the opportunity to engage in positive self-reference, whereas those with higher levels of depressive symptoms had no specific preference for either negative or positive self-reference (Task 1). However, all participants sacrificed monetary rewards for the opportunity for self-reference versus other-reference, regardless of the symptom level or the primed valence (Task 2). Together, these findings suggest that depressive cognition could be characterized by the lack of intrinsic motivation for positive self-reference, which is attributable to the biased valence selection, but not to self-other preferences.

Keywords: self, positivity bias, depression, reward, motivation

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Introduction

Generally people have a self-positivity bias, whereby positive materials are more likely to be attributed to internal, stable, and global factors than negative materials (Mezulis, Abramson, Hyde, & Hankin, 2004). However, such a self-serving positivity bias is weakened in individuals with depression; the bias is absent or reversed, with those individuals judging negative events to be caused by more internal, stable, and global factors (Mezulis et al., 2004). Furthermore, studies have suggested that non-depressed individuals consistently judge positive words or personality traits to be self-referent (applicable to themselves) and that those individuals show enhanced recall of the self-positive information (Symons & Johnson, 1997), while depressed individuals exhibit no such positivity bias (e.g., Watson, Dritschel, Jentzsch, & Obonsawin, 2008). At the level of attentional processes, non-depressed people avoid negative stimuli, but people with depression attend equally to positive, neutral, and negative stimuli (Gotlib, McLachlan, & Katz, 1988; McCabe & Gotlib, 1995; McCabe, Gotlib, & Martin, 2000). Similarly, a meta-analysis of eye-tracking studies indicated that depression is associated with reduced gazing and dwelling on positive cues, but without a heightened vigilance for threatening stimuli (Armstrong & Olatunji, 2012). The lack of positivity bias or excessive negativity bias is considered to be associated with altered balance in the accessibility between positive and negative self-relevant information (e.g., Trew, 2011), which contributes to typical cognitive problems in depression such as negative self-schema and depressive rumination (Beck, 1976; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008).

Consistent with these arguments, studies on self-verification bias have suggested that individuals with depression prefer unfavorable feedback about themselves when offered a choice between favorable and unfavorable observations (Giesler, Josephs, & Swann, 1996;

Swann, Wenzlaff, Krull, & Pelham, 1992). This bias is interpreted to be driven by a motivation to collect information that is consistent with one's self-concepts (or that verifies the self), which are negatively biased in individuals with depression. Such individuals also believe that depressive rumination is a useful coping strategy that prevents future mistakes (Papageorgiou & Wells, 2001; Watkins & Moulds, 2005); they therefore excessively ruminate about negative aspects of the self rather than engage in active problem-solving behaviors, which reinforces depressive symptoms such as avoidance and inactivity (Jacobson, Martell, & Dimidjian, 2001).

These arguments regarding motivations and beliefs posit a possibility that individuals with depressive symptoms voluntarily discard positive and collect negative self-information. That is, they may estimate positive self-references to be less valuable than negative self-references, which could function as an intrinsic motivation to avoid positive and approach negative self-related stimuli. Recent cognitive theories of depression have placed greater emphasis on impaired attentional disengagement from negative self-relevant stimuli rather than early detection of (or attentional orienting toward) negative materials as an underlying mechanism of depressive cognitions (Gotlib & Joormann, 2010; Koster, De Lissnyder, Derakshan, & De Raedt, 2009). This theoretical account clearly explains why negative information processing is prolonged and perpetuated in depression. However, it is still unclear why individuals with depressive symptoms initially engage in such negative self-referent information processing. Therefore, we focused on the individual differences in subjective values of self-positive and self-negative materials in order to explore the intrinsic motivation for emotional self-references.

Value scaling by the Pay-Per-View paradigm

In the present study, we assessed subjective values associated with opportunities to engage in positive and negative self-references by using a newly developed adaptation of the

pay-per-view (PPV) task. This experimental task was originally introduced by Deaner, Khera, and Platt (2005), in whose study macaques had to choose between two options of viewing images of other monkeys that were associated with variable amount of rewards (juice). The male monkeys sacrificed the reward for the opportunity to view the images of female perinea and high-status monkey's faces, but demanded overpayment to watch the faces of low-status members. Applying similar logic to human social cognition, recent studies evaluated the attractiveness of visual images of the opposite sex (Hayden, Parikh, Deaner, & Platt, 2007) and the subjective value of disclosing about the self (Tamir & Mitchell, 2012) by offering varying monetary rewards. People are willing to forgo a small monetary reward for viewing a picture of a physically attractive person (this was particularly so for males), and for introspecting about the self and sharing the self-related information with another person.

Current investigation

Extending the paradigm, we presented two parallel, emotionally loaded PPV tasks, in which participants were asked 1) to choose between positive and negative topics with variable financial rewards for "self" versus "other" references, and 2) to choose between self and other topics with variable rewards for predetermined positive and negative valences (Figure 1). In both tasks, participants could freely choose which type of (negative vs. positive; self vs. other) references they were going to engage in. However, because the two options were always tagged with variable amount of monetary rewards, they had to take into account the reward they could obtain from their choices. If a participant had a preference for positive self-reference, he/she would feel a conflict when deciding between a negative option with a greater reward and a positive option with a smaller reward. The experiment examined to what extent participants could forgo their potential rewards for an opportunity to engage in their preferred type of references, which could be used as an index of bias for emotionally valenced self-references.

Given the self-positivity bias, we hypothesized that individuals with lower levels of depressive symptoms would forgo a larger amount of rewards to engage in positive self-reference in Task 1. However, individuals with higher levels of depressive symptoms would show no such positivity bias, by showing no preference for positive or negative self-reference (weak hypothesis), or by disregarding the positive and appreciating the negative self-references by sacrificing rewards to obtain an opportunity for negative self-reference (strong hypothesis).

The purpose of Task 2 (reversing the temporal order of the reference target and valence) was to reveal the hierarchical structure between the target (self vs. other) and valence (negative vs. positive) selections, and to determine at which stage depression-specific bias could be generated. Neuroimaging studies have suggested that emotional self-reference modulates brain activity in cortico-limbic networks (e.g., Fossati et al., 2003, 2004; Yoshimura, Ueda, Suzuki, Onoda, Okamoto, & Yamawaki, 2009), and that the processing of self-reference and emotional valence takes place in different brain areas: medial prefrontal cortex for self-relevance judgment and ventral anterior cingulate for resolving the valence of the information (Moran Macrae, Heatherton, Wyland, & Kelley, 2006). A recent study using event-related brain potentials suggested enhanced cortical processing for negative stimuli under self-reference (primed by personal pronoun), implying that self-reference influences subsequent emotional processing (Herbert, Pauli, & Herbert, 2011).

Given such a processing hierarchy, there are three possibilities for the bias generating stages in individuals with depressive symptoms: when processing self/other-references, when processing emotional valence, or during both stages. Our first experimental task assumed the same temporal order of processing as argued in previous studies, in which the primed reference target should influence the subsequent selection of emotional valence. In this design, we could specify the bias in the relatively later stage of

processing, or valence selection. However, the preference for self and other references could not be fully captured. This issue was addressed in Task 2 by reversing the temporal order of the processing, which provides a direct comparison between self and other preferences under prefixed emotional valence. At the same time, Task 2 allowed us to test if there exists a feedback loop wherein priming specific emotional valence inversely influences subsequent self-referent processing. This backward processing has not been examined thoroughly in previous studies.

Thus, if a reduced self-positivity bias in individuals with depressive symptoms can be characterized by biased emotional processing of self-referent information, Task 1 would exhibit a significant difference in valence choice between higher and lower levels of depressive symptoms under the self-primed condition. Furthermore, if biased self-other preference is also relevant to depressive cognitions, Task 2 would reveal symmetrical results cf. Task 1, showing a significant effect of depressive symptoms on self-other selection under positive (and negative) valence.

Method

Participants and procedure

Forty-nine undergraduates (29 male, 20 female; mean age = 19.7 years old, *SD* = 1.0) were recruited during the introductory psychology courses at several universities in Japan, and provided their written informed consent upon arriving at the laboratory. All experimental instructions and stimuli were displayed using E-Prime software, version 2.0 (Psychology Software Tools, Pittsburgh, PA). Participants first completed a non-emotional version of the PPV task[1] (not reported here) that was identical to Study 2 conducted by Tamir and Mitchell

[1] This preliminary task comprised three conditions with varying question pairs: self-other, self-fact, and other-fact. Participants had to choose one question type for each of the pairs that were associated with variable monetary rewards, as in the main experimental tasks. In the *fact* condition, participants answered trivia items with "true" or "false" (e.g., "the sky is blue") instead of rating self- or other-related attitudes or opinions (*self* vs. *Barack Obama*). Bland questions were used for the self and other choices, which asked participants about their own (or Obama's) interests, preferences, and habits (e.g., I [or Obama] like[s] dogs; I often listen to classical

(2012), after which they performed the two PPV tasks (see below) reported in this paper. The order of the latter two PPV tasks was randomized across participants. All participants subsequently completed a set of self-report questionnaires, were debriefed, and paid the amount acquired during the tasks.

Measures

Depressive symptoms were assessed using the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977; Shima, Shikano, Kitamura, & Asai, 1985, for the Japanese version). The CES-D is a 20-item self-report scale that assesses the level of depression during the previous week, with each item being rated on a 4-point scale of frequency of occurrence ranging from 0 (*less than 1 day*) to 3 (*5–7 days*), with a cutoff score of 16 indicating significant depressive symptoms. In the present study, the CES-D mean score was 13.9 (*SD* = 6.7) and the scale had good internal consistency ($\alpha = .76$). We did not find either gender- or age-dependent differences in levels of depressive symptoms ($t = 0.44$, $p = .66$, for gender; $r = .16$, $p = .27$, for age).

Emotional pay-per-view tasks

In two parallel tasks, the participants completed two different emotional PPV tasks in which primer and question-type pairs were manipulated (see Figure 1). In both tasks, each trial started with a 500-ms fixation period, following which one of two primers appeared on the PC screen, remaining visible for 500 ms. In Task 1, the primer consisted either of *Self* or *Obama*; in Task 2, the primer was *Negative* or *Positive*. After the presentation of the primer, two question types were displayed (*Negative* and *Positive* in Task 1; *Self* and *Obama* in Task2). Barack Obama was selected as a representative "other" stimulus, because a public person has been used in prior studies self-other processing (Bower & Gilligan, 1979; Kelley, Macrae, Wyland, Caglar, Inati, & Heatherton, 2002; Tamir and Mitchell, 2012), and because

music; I'm interested in economic issues). We found no significant differences for levels of depressive symptoms in terms of self-choice frequencies, which suggests that there would be no depression-specific biases in preference for self (in support of the results of Task 2).

Barack Obama, as a president of the US, is widely known in Japan. Close friends or family members were possible alternative "other" stimuli that could have eliminated influences of familiarity and knowledge, which were potential limitations of the Barack Obama stimulus. However, we considered it more important to control for individual differences in the alternative stimuli, because low-quality social relationships among depressed individuals might influence their choice behaviors (Teo, Choi, & Valenstein, 2013). Furthermore, an interdependent view of the self, which is typical among non-Western people (Markus & Kitayama, 1991), could blur the contrast between self and other if we used "other" stimuli that are closely associated with the self.

Each question type was associated with a small monetary reward ranging from 1 to 4 JPY (1 JPY = 0.01 USD) following the previous study of Tamir and Mitchell (2012). The payoff values were quasi-randomly determined across trials, with the frequencies of the relative payoffs for the two choices (ranging from −3 to 3) being equal. The relative payoffs were determined by the differences in the payoffs between the Positive and Negative (Self and Obama) choices, indicating the rewards for Positive (Self) choices relative to Negative (Obama) choices.

At the choice stage, participants were to indicate within 2000 ms which question type they preferred to answer, taking into account the payoff amount associated with the two question types. Prior to the experimental session, all participants were informed that they would receive the money they had accumulated during the PPV tasks at the end of the experiment. Although we did not explicitly instruct participants to maximize their total rewards, participants were informed that any choice strategy was acceptable and that they could always choose the option with a greater reward. After the preference choice was made, participants were asked to answer a brief question corresponding to the selected primer-question pair. For example, if *Self* was primed and the participant selected a *Positive*

question type, a positive question (e.g., “Happy?”) was displayed on the PC screen and the participant had to indicate to what extent the question was applicable to themselves. On the other hand, if *Negative* was primed and *Obama* selected, participants rated to what extent they thought the displayed negative statement (e.g., “Unhappy?”) applied to Barack Obama. Each question was rated on a 5-point Likert scale, ranging from 1 (*not at all*) to 5 (*very much*). When making the preference choices, participants were informed only of the question types (i.e., Negative vs. Positive; Self vs. Obama); the specific content of the questions (e.g., “Happy?”) was blinded until the question-rating display appeared. Thus, within a trial, the participant’s choice behavior was not influenced by whether the subsequent question was applicable to themselves (and Barack Obama) or not.

We compiled a list of short sentences describing personalities and moods, which included 98 pairs of negative and positive sentences (the two tasks shared the same list). Most of the sentences were derived from existing questionnaires on personality, depression, anxiety, and social skills, but the negative and positive sentences were modified to produce bipolar sets of traits (e.g., *happy* vs. *unhappy*, *arrogant* vs. *humble*, *frequently having troubles with family members* vs. *having a good relationship with family members*). All items had been validated as having negative or positive valence by two psychology researchers who were blind to the aims of the study.

This question rating was inserted to prompt the participants to search and process the information that corresponded to the primer and selected question type for each trial. Because our primary interest was in the preference that existed before engaging in actual self/other-referent processing, we do not regard it as important to investigate what kind of information was actually processed at the end of trials (i.e., the ratings to the short questions). However, in our data, the frequency of the rating response of 1 (*not at all*) was only 8.8% (Task 1) and 9.5% (Task 2) across all trials. These results suggest that in more than 90% of

the trials, participants retrieved their own (or Barack Obama's) attributes that corresponded to the primer and question type, although the extent of applicability differed across individuals depending on levels of depressive symptoms (see also Table 1).

Each task comprised eight practice trials followed by 112 experimental trials (8 trials, each with 7 payoffs and 2 primers). The order of the two tasks was randomized across participants. Our main results remained when we controlled in our analyses for task order, which had no significant influence on the *Positive* (Task 1) and *Self* (Task 2) choice frequencies (*p*s > .27). Because we applied multilevel modeling analysis (described in the next section), we determined the sample size following a prior suggestion of at least 30 participants with at least 30 responses per participant (Hox, 2010). Although a sample size of 30 is enough to estimate fixed parameters, simulation studies suggest that 50 participants could provide less biased estimates of the standard errors, while this larger sample size is also less likely to suffer from the non-convergence problem (Maas & Hox, 2005).

Statistical analyses

Multilevel logistic analyses were performed with choice pattern as the within-subject outcome and with the CES-D score as the between-subjects predictor. This analytical approach enabled us to test the between-subject differences in depression in terms of the psychometric functions of choice, and to estimate the points of subjective equality (PSE) as a function of the levels of depression. The within-person level model was as follows:

$$y_{ij} = \frac{1}{1+e^{-(\beta_{0j}+\beta_{1j}x_{ij})}} \quad (1)$$

where y_{ij} is the choice on the *i*th trial of the *j*th participant, which is a binary distributed variable, coded as 1 for a *Positive* and 0 for a *Negative* choice in Task 1 and as 1 for *Self* and 0 for *Other* in Task 2. x_{ij} is the relative payoff given the two choices, ranging from −3 to 3 JPY. The intercept (β_{0j}) and slope (β_{1j}) determine the shape of the logistic function; the overall probability of a "yes" response in y_{ij} is determined by β_{0j}, and the

steepness of the logistic function depends on β_{1j}. These parameters were assumed to be different between primer types, and also influenced by levels of depressive symptoms. Thus, the person-level equations of the intercept were:

$$\beta_{0j} = \begin{cases} \gamma_{000} + \gamma_{001} DEP_j + u_{0j} & \text{if Primer} = 0 \\ \gamma_{010} + \gamma_{011} DEP_j + u_{0j} & \text{if Primer} = 1 \end{cases} \quad (2)$$

where DEP_j is the CES-D score, and u_{0j} is a random effect expressing individual differences in the intercept estimate. The CES-D score was standardized prior to being entered into the analysis for ease of interpretation. Each experimental task had two types of Primer with 0 indicating *Self* and 1 indicting *Obama* in Task 1, and with 0 indicating *Negative* and 1 indicating *Positive* in Task 2. As in equation (2), the slope was also described by the mean, effect of depressive symptoms, and random effects for the two types of primer:

$$\beta_{1j} = \begin{cases} \gamma_{100} + \gamma_{101} DEP_j + u_{1j} & \text{if Primer} = 0 \\ \gamma_{110} + \gamma_{111} DEP_j + u_{1j} & \text{if Primer} = 1 \end{cases} \quad (3)$$

In this model, the PSE (the amount of money at which the values of two question types are perceived to be equal) is described as follows:

$$PSE_j = -\frac{\beta_{0j}}{\beta_{1j}} \quad (4)$$

Using this equation, we calculated four conditional PSEs (primer type vs. levels of depressive symptoms) for each task by substituting specific values of higher and lower levels of depressive symptoms (mean ± 1SD; e.g., Preacher, Curran, & Bauer, 2006). These PSE scores provide absolute-value estimates of the opportunity to engage in a particular kind of self-/other-reference on the money scale (with zero PSE inferring no preference for either of the question types). For example, if we observed PSE = -1 in Task 1, this would mean that participants chose the *Positive* option even when the reward for the *Positive* option was 1 JPY smaller than that for the *Negative* option. As such, a negative value of the PSE can be interpreted as the relative reward amount that participants can (or are willing to) forgo for the

opportunity for positive self-reference. It should be noted that the interpretation of the conditional PSEs is different between the two experiments because the choice responses concerned different pairs of question types: a greater negative value of the conditional PSE indicates a greater preference for the *Positive* question type in Task 1, while it reflects a greater preference for the *Self* question type in Task 2.

We tested whether the conditional PSEs were significantly different from zero by estimating 95% confidence intervals. Differences between any pairs of conditional PSEs (e.g., differences in PSEs for the *Self* primer for higher and lower levels of depression) were also tested. These analyses were conducted using the SAS NLMIXED procedure. The ESTIMATE statement was used to calculate the means and standard errors of the conditional PSEs, and to test the significance of the differences between the PSE target pairs (Spoth, Redmond, Shin, & Azevedo, 2004).

Results

Manipulation check

As a preliminary analysis, we examined the mean rating score for each primer and question type (Table 1), by estimating linear multilevel models in which the rating score was predicted by the CES-D, primer type, selected question type, and their interactions. In the Self-primer condition of Task 1, participants with higher levels of depressive symptoms gave a higher score when they selected a negative question type ($t = 7.10$, $p = .00$). They also provided a lower score in response to a positive question ($t = 3.39$, $p = .00$), consistent with the results of Watson et al. (2008). However, in the Obama-primer condition, there were no significant differences according to the level of depressive symptoms, although positive attributes were judged to be more applicable than negative attributes across all participants ($t = 22.73$, $p = .00$). A similar pattern was observed in Task 2, suggesting that only when the Self question type was selected, did individuals with higher levels of depressive symptoms

consider the negative attributes as more applicable and the positive attributes as less applicable. These results suggest that depressive symptoms are associated with a self-concept that includes more negative and less positive attributes. However, such depression-related differences only existed for self-regard, not other-regard (i.e., Obama, who tended to be more positively evaluated).

Main results

In Task 1, we found a significant effect of the CES-D on the intercept component (β_{04}) of the model predicting the probability of *Positive* choice (Table 2), indicating that the participants with lower levels of depressive symptoms exhibited a greater tendency to choose *Positive* when *Self* was primed (Figure 2A). This significant effect of the CES-D was only observed in the *Self* prime condition, which was significantly larger than the *Obama* prime condition ($t = 4.84$, $p < .001$). In the self-as-primer condition, conditional PSEs differed significantly as a function of depression level (difference = .35, $t = 3.26$, $p = .002$; Figure 3), with students who reported higher levels of depression showing no specific preference for negative or positive items (PSE = -.05), while those with lower levels of depressive symptoms had a greater tendency to choose positive self-related topics, more frequently sacrificing a reward to get an opportunity to engage in positive self-reflections (PSE = -.40). However, in the Obama-as-primer condition (Figure 2B), there were no significant differences according to the level of depressive symptoms (difference = -.02, $t = 0.19$, $p = .85$), with all participants exhibiting a moderate preference for *Positive* items (high depression: PSE = -.18; low depression: PSE = -.19). Within the "high depression" group, the PSE was significantly lower when *Self* was primed than when *Obama* was primed (difference = .12, $t = 2.87$, $p = .006$), whereas in the "low depression" group the PSE was significantly higher when *Self* was primed (difference = .21, $t = 3.32$, $p = .002$). These results suggest that depressive symptoms are associated with a lack of preference for positive self-relevant

information, although the participants did show a moderate preference for positive topics when these related to Obama, irrespective of the symptom level.

In Task 2, two participants could not complete the task due to a program error, which meant that data from 47 participants was used for the multilevel logistic analysis. This showed neither a significant main effect nor an interaction effect for depression and type of primer in the model predicting the probability of a *Self* choice (Table 3). These results indicate that there were no significant differences in the shapes of the sigmoid functions depending on depression level and primer type (Figure 2C, D). Conditional PSEs are shown in Figure 3. Although all four PSEs were significantly smaller than zero (PSEs < - .24, upper limits of 95% CI < - .04), comparisons between the two primers and higher and lower levels of depression did not yield any significant differences (*t*s < 1.22, *p*s > .23). These results suggest that, irrespective of depression level, the participants all deemed *Self* a more valuable topic to think about than *Obama*, regardless of its valence.

Discussion

We sought to shed new light on the differential motivational functions of emotional self-references in relation to levels of depressive symptoms. Our results of Task 1 support the weak hypothesis, which states that depressive symptoms are associated with a lack of intrinsic motivation to engage in positive self-reference. The participants reporting higher levels of depressive symptoms showed no specific preference for either negative or positive self-reference, whereas those with lower levels of depressive symptoms did show a significant preference for positive self-references, forgoing monetary rewards for an opportunity to engage in self-referencing cognition. However, this depression-specific bias was only observable in the valence choices of Task 1; all participants preferred self-reference to other-reference independent of valence and symptom level in Task 2, which implies that the individual differences in depressive symptoms are generated at the stage of emotional

self-referent processing, or when selecting the emotional valence, but not when selecting the target of reference.

The results of Task 1 are consistent with previous findings suggesting a self-positivity bias in non-vulnerable or non-depressed individuals (e.g., Mezulis et al., 2004), meaning that such individuals exhibit cognitive avoidance of negative self-related stimuli and/or are oriented towards positive ones, whereas depressed individuals show no such bias (negative or positive). This protective positivity bias is thought to enable non-depressed people to divert their attention away from negative stimuli and direct it towards positive stimuli, thereby shielding themselves from negative self-referent processing while preserving and promoting positive self-views (McCabe et al., 2000). Our findings indicate that this defense mechanism may be driven by an intrinsic motivation to enhance positive information processing, which is perceived as more valuable than negative self-reference. However, when selecting the valence of reference for another individual, our participants all showed moderate preferences for positive reference, irrespective of the level of depressive symptoms. This suggests that in individuals with depressive symptoms the protective positivity bias is active if their attention is focused on others, while it is "turned off" when reflecting on the self.

This lack of preference for positive (or avoidance of negative) self-reference might not only contribute to negative cognitive activities such as depressive rumination. It is possible that it is also associated with maladaptive interpersonal styles, such as increased negative speech content and excessive reassurance-seeking in interactions with others (e.g., Coyne, 1976; Gotlib & Robinson, 1982). Researchers have argued that depression-prone individuals do not have the motivation to refrain from choosing negative topics in their self-reference (Coyne, 1976; Kendall, Howard, & Hays, 1989). This argument is supported by a number of studies that suggest that such socially inappropriate behaviors induce negative affect in interaction partners and elicit social rejection, which in turn exacerbates depressive

symptoms and constitutes a vicious cycle of negative affect (see Starr & Davila, 2008, for a meta-analytic review).

In Task 2, all participants sacrificed monetary rewards for the opportunity for self-reference, regardless of the symptom level or the primed valence, implying that self-reference is considered more valuable than other-reference even if the content is negative (cf., Tamir & Mitchell, 2012). From these asymmetrical results between Tasks 1 and 2, we infer that the bias is generated not at the stage of self-referent processing, but only at the emotional processing stage after the information framing of self-relatedness. Researchers have suggested that processing of self-relevance and emotional valence takes place in different brain areas: Incoming information is judged to be self-relevant in medial prefrontal cortex, and the valence of the information is resolved in an adjacent brain area, ventral anterior cingulate (Moran et al., 2006; Watson et al., 2007).In line with these findings, our results show that these two types of information processing is separable in terms of the bias in depressive symptomatology. Furthermore, the bias-generating process (i.e., resolving the valence of given self-referent information) would be unidirectional because Task 2 revealed null effects of primed emotional valence and depressive symptoms on subsequent self-other choice preferences (i.e., processing self-reference of given negative or positive information).

The process captured in the present study may reflect a strategic aspect of self-focus, which involves evaluation and integration of self-relevant materials as in our decision making tasks (Lemogne, Delaveau, Freton, Guionnet, & Fossati, 2012). This process is considered to be separate from more automatic processes, which underlie encoding incoming information as being potentially self-relevant, and attracting attention to such self-relevant information (Lemogne et al., 2012; Northoff, Heinzel, de Greck, Bermpohl, Dobrowolny, & Panksepp, 2006). Because we explicitly manipulated the self- (or other-) tagging of information by presenting a primer, we cannot know how self-positivity bias was related to these automatic

processes in the present study. However, previous studies have suggested that automatic processes are also relevant to depression by contributing to increased spontaneous and difficult-to-inhibit forms of self-focus, such as depressive rumination (Gotlib & Joormann 2010; Johnson, Nolen-Hoeksema, Mitchell, & Levin, 2009). We speculate that these two processes might interact to generate negative and persistent self-relevant processing in individuals with depression, who tend to perceive a stimulus as being self-referent and are less motivated to process the positive aspects of self than those without depression

The analyses of the ratings for short questions replicated the positivity bias in non-depressed individuals that previous studies have reported (e.g., Watson et al., 2008). Individuals with lower levels of depressive symptoms judged positive attributes to be more applicable and negative attributes less applicable to themselves. Given the self-verification bias theory (Giesler et al., 1996; Swann et al., 1992), we speculate that the motivation to approach positive self-relevant information is driven by the fact that the positive materials reassure the non-depressed individuals that their relatively positive self-views are veridical and reliable. Such a self-confirming evaluation promotes a sense of self-coherency, and fosters the perception that individuals are correctly apprehending themselves (Giesler et al. 1996). This speculation posits another hypothesis stating that the value estimation of self-references might reflect the distance between core self-concepts and given personality trait stimuli. For example, individuals with higher levels of self-esteem and narcissism are expected to estimate positive self-statement to be more valuable (cf. Giesler et al., 1996; Swann et al., 1992). Future research needs to clarify if the value estimation in the PPV task is actually linked to the self-confirming evaluation, and to what extent PPV valuation reflects positivity or negativity of self-concepts, by using other "self" experiments such as the Implicit Association Test (Greenwald & Farnham, 2000).

Our results should be interpreted with caution because of the following two important

limitations. First, the non-clinical nature of our sample (i.e., university students) tempers the conclusions we can draw regarding depression. Although participants with higher levels of depression exhibited no specific preference towards negative or positive materials, it is still possible that individuals with clinically diagnosed depression would show an explicit preference for negative self-reference. It is also noteworthy that university students tend to score higher on depression scales than the general population and other age groups (e.g., Ibrahim, Kelly, Adams, Glazebrook, 2013; Ministry of Health, Labour and Welfare, 2000), which might limit the generalizability of our findings. Second, we did not include any comparisons between neutral and negative (or positive) self-references. Although our PPV paradigm can clearly define a "point of zero preference," which indicates no preference either for negative or positive self-references, this zero point is set on a unidimensional negative-positive scale, and so reveals nothing about preference towards neutral self-references (cf. Gotlib et al., 1988). Thus, future research needs to reexamine our hypotheses and conclusions using clinical samples, making use of comparisons between valenced and neutral materials. Third, we used a particular public person (i.e., Barack Obama) as an "other" stimulus. It is possible that the findings of the present study are specific to this stimulus. Furthermore, we did not control the participants' familiarity with Barack Obama, which leaves the possibility that the preference for self-reference in Task 2 may be attributed to a lack of knowledge about Barack Obama (e.g., participants were unwilling to make ratings of an unfamiliar person). Future research needs to examine whether the current findings can be replicated for different "other" stimuli, such as close friends and relatives, which could control for influences of familiarity and knowledge regarding other references.

In conclusion, our data suggest that individuals with higher levels of depressive symptoms did not have a specific preference for negative or positive self-references, whereas those with lower levels of depressive symptoms had a clear self-positivity bias. This

individual difference in the value estimation of emotional self-references could be generated at the stage of emotional valence (but not self-other relevance) processing. Such reduced intrinsic motivation for positive self-reference could contribute to a relatively greater tendency to engage in negative ruminative thinking and socially inappropriate self-disclosure among depression-prone people. As for clinical implications, it seems relevant to boost the subjective value of positive self-concepts, thus activating the blunted protective bias. This could be achieved, for instance, by training (depressed) individuals to orient themselves more positively with regard to their attention, interpretation, and behavior; this may promote better regulation of emotion and increase the tendency to approach, rather than avoid, environmental rewards (Holmes, Lang, & Shah, 2009; Wadlinger & Isaacowitz, 2011; Watkins et al., 2011).

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Table 1

Mean (and SD) of rating scores for individuals with higher and lower levels of depressive symptoms

Task 1	Primer = Self		Primer = Obama	
	Negative	Positive	Negative	Positive
Low CES-D	2.90 (1.21)	3.41 (0.98)	2.37 (1.04)	3.92 (0.93)
High CES-D	3.27 (1.22)	2.89 (1.07)	2.41 (1.13)	4.03 (0.87)
Task 2	Primer = Negative		Primer = Positive	
	Self	Obama	Self	Obama
Low CES-D	2.86 (1.18)	2.35 (1.07)	3.36 (1.04)	3.84 (0.96)
High CES-D	3.31 (1.20)	2.48 (1.16)	2.91 (1.02)	3.94 (0.94)

Note. CESD-D = Center for Epidemiologic Studies Depression Scale. Mean and SD were calculated on a trial basis (not on within-person means). The number of trials varied across cells, ranging from n = 358 to 656. For high and low levels of depressive symptoms (Task 1: n = 16 and n = 17; Task 2: n = 16 and n = 16), participants with upper and lower one-thirds of the CES-D score (more than 16 and less than 11) were selected based on the CES-D cutoff score of 16.

Table 2

Parameter estimates for the multilevel logistic models predicting the probability of a positive *choice in Task 1*

Parameter	Primer = Self			Primer = Obama			Differences	
	Estimate (SE)	*t*	*p*	Estimate (SE)	*t*	*p*	*t*	*p*
Intercept								
Intercept (γ_{000}, γ_{010})	0.71 (0.13)	5.25	.000	0.64 (0.13)	4.81	.000	0.60	.554
CES-D (γ_{001}, γ_{011})	-0.51 (0.14)	3.75	.000	0.03 (0.13)	0.25	.805	4.84	.000
Slope								
Intercept (γ_{100}, γ_{110})	3.42 (0.44)	7.75	.000	3.52 (0.44)	7.97	.000	1.33	.191
CES-D (γ_{101}, γ_{111})	0.41 (0.40)	1.04	.300	0.34 (0.40)	0.85	.397	0.82	.419
Pseudo R^2	.66							

Note. CESD-D = Center for Epidemiologic Studies Depression Scale. Pseudo R^2 was adapted from McFadden's R^2 (Hox, 2010).

Table 3

Parameter estimates for the multilevel logistic models predicting the probability of a self *choice in Task 2*

Parameter	Primer = Negative			Primer = Positive			Differences	
	Estimate (SE)	*t*	*p*	Estimate (SE)	*t*	*p*	*t*	*p*
Intercept								
Intercept (γ_{000}, γ_{010})	1.28 (0.24)	5.45	.000	1.20 (0.24)	5.10	.000	0.76	.449
CES-D (γ_{001}, γ_{011})	0.31 (0.23)	1.36	.182	0.37 (0.23)	1.58	.122	0.46	.645
Slope								
Intercept (γ_{100}, γ_{110})	3.59 (0.45)	8.01	.000	3.62 (0.45)	8.07	.000	0.39	.699
CES-D (γ_{101}, γ_{111})	0.14 (0.40)	0.34	.734	0.15 (0.40)	0.38	.708	0.20	.846
Pseudo R^2	.65							

Note. CESD-D = Center for Epidemiologic Studies Depression Scale. Pseudo R^2 was adapted from McFadden's R^2 (Hox, 2010).

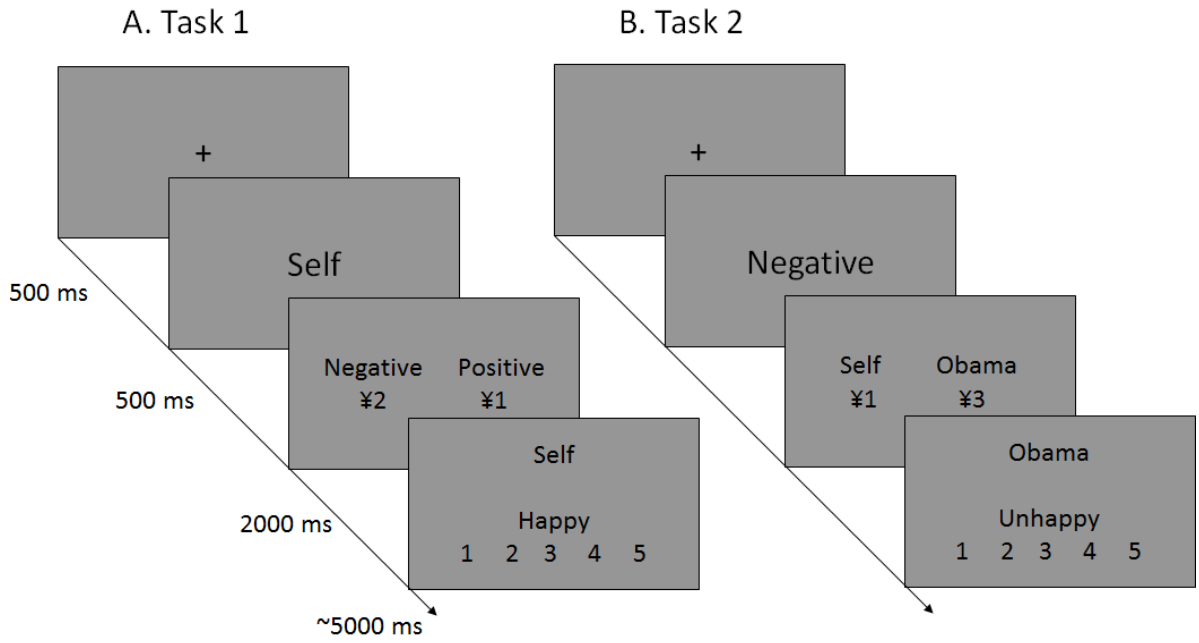

Figure 1. Schematic flows of the two tasks. After the presentation of a prime (Self or Obama in Task 1; Negative or Positive in Task 2), participants indicated which question type they wished to answer (Negative vs. Positive in Task 1; Self vs. Obama in Task 2) while considering the monetary reward associated with each question type. Depending on their decision, they answered a short question that corresponded to the prime and their chosen question type on a 5-point Likert scale.

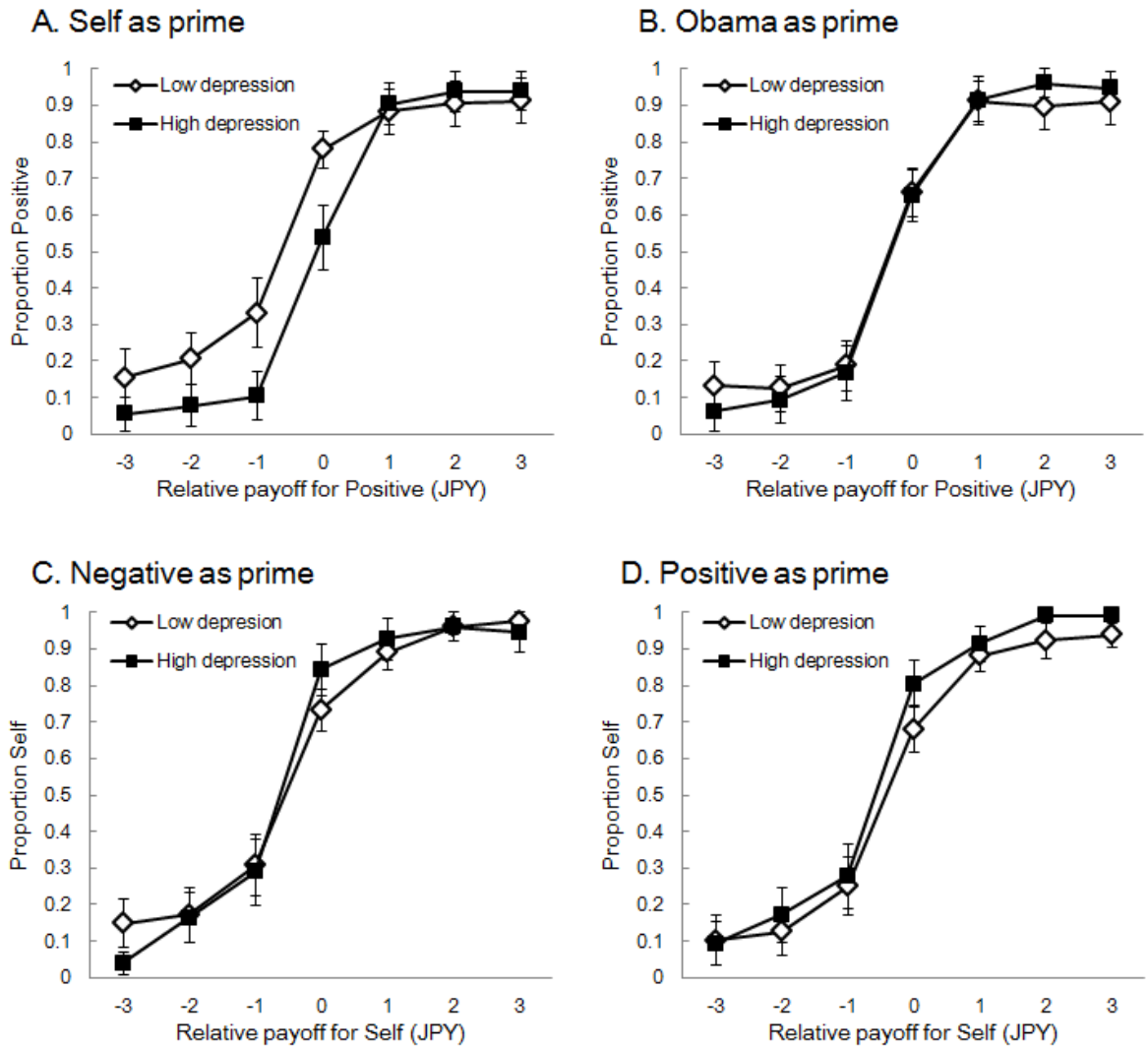

Figure 2. The proportion of *Positive* (Task 1; panels A and B) and *Self* (Task 2; panels C and D) choices as a function of the relative payoffs for each primer condition. For high and low levels of depressive symptoms (Task 1: n = 16 and n = 17; Task 2: n = 16 and n = 16), participants with upper and lower one-thirds of the CES-D score (more than 16 and less than 11) were selected based on the CES-D cutoff score of 16. Error bars indicate ±1SEM (standard error of the mean).

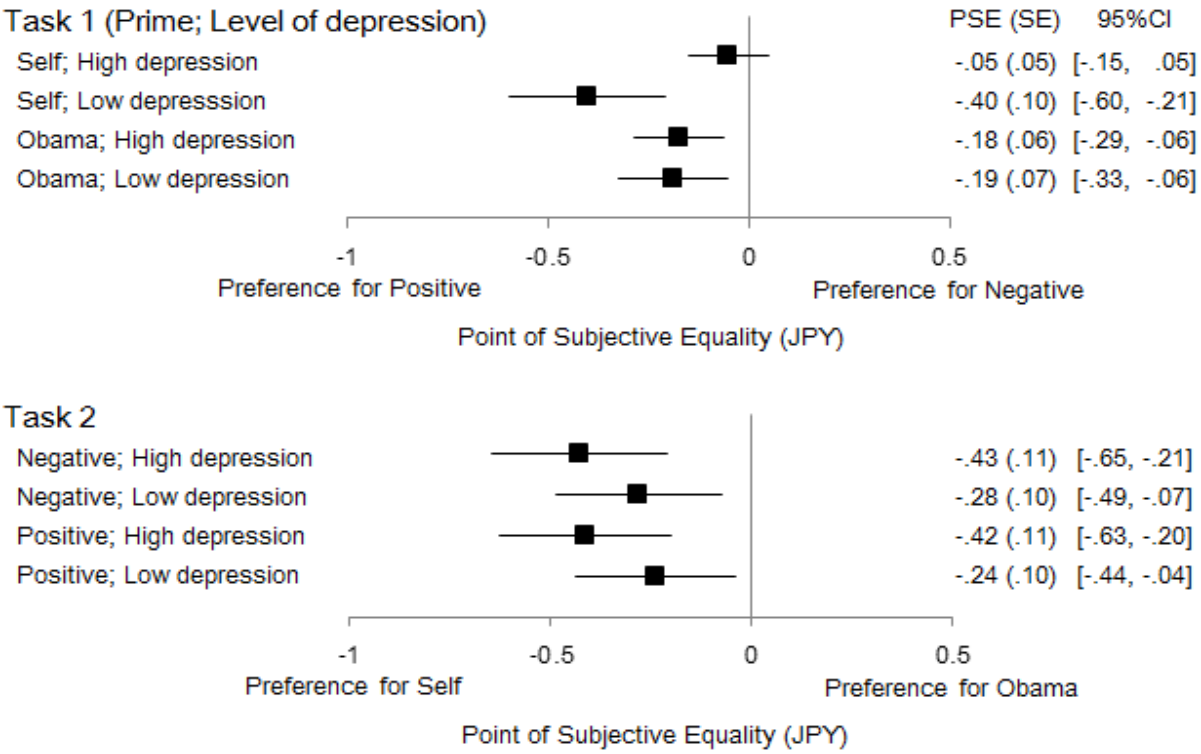

Figure 3. Points of subjective equality (PSEs) for the *Negative* (Task 1) and *Self* (Task 2) question types. Conditional PSEs were calculated from the estimated multilevel models for each primer (*Self* and *Obama* in Task 1; *Negative* and *Positive* in Task 2) and for higher and lower levels of depressive symptoms by substituting specific scores of the depression scale (mean ± 1 SD). A greater negative value of the conditional PSE indicates a greater preference for the *Positive* question type in Experiment 1 and for the *Self* question type in Experiment 2. Error bars indicate the 95% confidence interval.