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Depression and Choice of Emotional Stimuli

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Abstract

Recent research argued that people with major depressive disorder (MDD) tend to prefer sad stimuli because they want to upregulate their sad feelings. This paper aims to examine investigate the choice of emotional stimuli among those who have MDD, compared to individuals without MDD (healthy controls, HC), and explore the reasons for their choice. Seventy six female university students (38 per group) completed three tasks: 1) In the replication music task, participants listened to happy, neutral, and sad music excerpts, chose the one they wanted to listen most, and reported the reasons of their choice. 2) The Emotional Stimuli Selection Task (ESST)'s music task considered different intensity levels and another negative emotion (fear). Participants listened to 84 pairs of music clips and decided which one they would prefer to listen to. 3) In the ESST's image task, the same procedure was run with images.

In the replication music task, MDD status predicted a greater likelihood of choosing sad music. However, compared to before listening, the MDD reported feeling more happiness and less sadness after listening to their chosen music. In addition, inconsistent with a motivation to upregulate persons with MDD singled out low intensity as their most frequently reported reason for choosing sad music. Results from the ESST's music task showed that the MDD preferred low intense music, compared to the HC. These results suggested that the MDD may prefer sad stimuli not because they want to augment their sad feeling, but because they desire low intensity experiences. The MDD's reduced preference for happy stimuli, relative to the HC, was found across ESST tasks. Implications as well as limitations of the study were discussed.

Chapter One: Depression and Choice of Emotional Stimuli

In daily life, we engage in diverse emotional stimuli. There can be many different reasons why we want to engage with emotional stimuli. Some researchers argue that selecting situations that are likely to elicit particular emotions in an emotional regulatory strategy (Gross, 1998). In their view, selecting emotional stimuli is an antecedent-focused emotion regulation strategy that can lead to increased experience of the emotion. There are many examples in which people select to engage with particular emotional stimuli when they want to increase or maintain a target emotional state (see Millgram, Joormann, Huppert, & Tamir, 2015). For instance, we might select 'Les Misérables' to maintain feelings of sadness, or turn on a comedy show to increase or maintain a positive mood. Thus, a person's pattern of emotional stimuli choice may reflect his or her consciously or unconsciously preferred direction of emotion regulation.

Major depressive disorder (MDD) has been regarded as a disorder of emotion regulation (Gross & Muñoz, 1995). Although substantial efforts have been invested in understanding dysfunctional emotion regulation in depression, exactly how and why people with MDD have difficulty regulating their emotions remains unclear. For example, many researchers focused on individuals with MDD's reduced endorsement of healthy positive emotion regulation strategies, particularly re-appraisal and acceptance (Ehring, Tuschen-Caffier, Schnülle, Fischer, & Gross, 2010; Garnefski & Kraaij, 2006; Liverant, Brown, Barlow, & Roemer, 2008; Martin & Dahlen, 2005), and many studies suggest that treatment might focus on enhancing these strategies (Liverant et al., 2008; Moore, Zoellner, & Mollenholt, 2008; Troy, Wilhelm, Shallcross, & Mauss,

2010). At the same time, a recent meta-analysis showed that the most well-studied strategies, re-appraisal and acceptance, show only small to medium effect sizes for depression (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Thus, there remains considerable room to understand emotion regulation in depression.

Indirectly, work on attentional biases and motivational goals (approach and avoidance goals) in depression provides some perspective on emotion stimuli preference, but have also produced seemingly conflicting results. A review of eye tracking studies (Armstrong & Olatunji, 2012) concluded that depressed participants tended to have diminished attentional preference to positive emotion-eliciting stimuli and longer attention maintenance to depression-related stimuli, compared to non-depressed participants. On the other hand, studies on motivational goals consistently show depressed individuals tend to avoid undesirable internal and external stimuli including depression-related stimuli (see Trew, 2011). In some contexts, depressed people are attentive to depression-related stimuli; in others, they are avoidant of the stimuli. Because studies did not directly measure a choice of emotional stimuli, it is difficult to interpret these tensions. Therefore, this study aims to more directly investigate which emotional direction individuals with depression tend to choose by examining depressed persons' reactivity to various emotional stimuli and their pattern of emotional stimuli choice. As we explain below, by overcoming limitations in recent studies, this study will represent a key first step towards understanding emotional stimuli preference in depression.

Only a few studies have directly addressed this topic, with inconsistent findings. First, Punkanen, Eerola and Erkkila (2011) examined preference for emotional stimuli using music excerpts, and compared the choice pattern between patients with MDD and healthy controls (HC). They found that patients with MDD showed reduced preference for angry and highly

energetic music excerpts, compared to HC. There was no group difference in other emotional music excerpts including sad and happy music excerpts. More recently, Millgram et al. (2015) compared patterns of emotional stimuli selection between individuals with MDD and HC. The investigators obtained striking, provocative results that purported to demonstrate that depressed individuals, unlike their non-depressed counterparts, preferred sad mood-eliciting stimuli such as music and photos, and even chose to increase their sad mood by choosing to enhance their sadness by looking at sad photos.

Depressed persons' apparent preference for sad material in Millgram et al (2015) is counterintuitive, given the widespread observation from clinicians that depressed individuals experience depression as an ego-dystonic state (i.e., depressed people expressed distress over their feelings and go to great lengths to curtail their unpleasant emotional states). In addition, the apparent indication that depressed individuals want to feel sad mood by selecting to engage in sad-mood inducing activities carries with an implication that depressed individuals are in some sense to blame for choosing to be sad. Given this potentially harsh implication, it is important to revisit this issue, while also addressing the limitations of this work.

There are several reasons to question the findings of Millgram et al. (2015)'s study. Firstly, these findings appear to conflict with other results. Many studies showed that depressed people tend to hold negative attitudes about negative emotional states (Beblo et al., 2012; Brockmeyer et al., 2012; Slee, Garnefski, Spinhoven, & Arensman, 2008). Although preference for emotion and preference for emotional stimuli are not the same thing, ordinarily these should be linked (i.e., depressed people would avoid watching or listening to the kinds of negative emotional stimuli that induce the states they most want to avoid). For instance, depression is positively related to cognitive and behavior avoidance of unpleasant internal and external stimuli;

increased attempt to avoid negative-emotion evoking thoughts or avoid unpleasant situations (Ottenbreit & Dobson, 2004). In addition, depressed individuals tend to report feeling nervous and afraid when experiencing both negative and positive emotions, and have greater fear that they may lose their control over those emotional experiences, relative to non-depressed people (Hughes, Gunthert, Wenze, & German, 2015; Stapinski, Abbott, & Rapee, 2010; Werner-Seidler, Banks, Dunn, & Moulds, 2013). Moreover, people with depression tend to report feeling negative emotions such as shame or irritation when they experience other negative emotional states and report greater avoidance of pleasant emotional states, relative to non-depressed people (Beblo et al., 2012; Brockmeyer et al., 2012; Slee et al., 2008). Given these findings, it is plausible to assume that depressed people would avoid unpleasant emotional stimuli.

In addition, studies in musicology also show that persons who were in a sad mood tended not to choose to listen to sad music (Friedman, Gordis, & Förster, 2012; Hunter, Schellenberg, & Griffith, 2011). Two studies examining the effect of sad mood on the preference for emotional music using standardized sad and happy music excerpts demonstrated that sad mood makes people avoid happy music but does not increase the selection of sad music excerpts (Friedman et al., 2012; Hunter et al., 2011). Although we cannot assume that that emotional choices in clinical depression are similar to that of transient sad emotional states, these results show that depression-related moods do not necessarily lead to increased selection of sad music.

Secondly, Millgram et al (2015)'s study had potential design limitations, which may have affected their results. In their design, the researchers used two kinds of emotional stimuli, photos and music excerpts, in order to examine participant's selecting preference for emotional stimuli. In the first study using photos, participants were presented with a happy, neutral or sad photo and had to decide whether they wanted to watch each photo again or not. In the second

study using short music excerpts that had been normed in another sample for their emotional quality, participants listened to brief excerpts of sad, happy and neutral music types and were then asked to select which musical piece they would like to listen at greater length.

One problem is that Millgram et al. (2015)'s study design may be probing other characteristics of emotional stimuli besides emotion. Although the emotional stimuli used in the study were found to evoke intended emotions across all participants (e.g., sad stimuli were significantly sadder than happy stimuli across the whole sample of depressed and non-depressed participants), the stimuli may also differ in terms of other features such as arousal or energy levels. For example, sad music clips may be both sadder and less energetic than other music clips. Indeed, when considering both emotion and energy levels of music, patients with MDD showed decreased preference for high energetic music excerpts; however their preference for sad music was similar to HC (Punkanen et al. 2011).

Secondly, Millgram et al. (2015) only examined sad stimuli and did not include other negative or mixed emotion as a point of comparison. Even if the finding accurately reflected depressed individuals' tendency of selecting sad stimuli over happy and neutral stimuli, it remains unclear whether they selected to watch sad stimuli because the stimuli are sad or because they are negative in general.

The present study, therefore, aimed to re-investigate the topic with stronger methodology. Firstly, we attempted to replicate Millgram et al. (2015)'s central finding with the same musical excerpts. Then, more importantly, we tested whether the depressed person's emotional stimuli choice is altered when a different selection task is used. As the previous study, we included two kinds of stimuli in order to generalize findings across stimulus types: emotional music clips and images.

Secondly, in addition to emotion, other characteristic such as intensity (arousal for images and energy levels for music) of stimuli was measured. The intensity of emotional stimuli is particularly important because Punkanen et al. (2011)'s study showed the presumed pattern in which patients with MDD less prefer both highly intensive positive and negative music excerpts. In addition, studies show that both the intensity of emotional response (Rottenberg, Joormann, Brozovich, & Gotlib, 2005) and emotional stimuli (Cavanagh & Geisler, 2006) play an important role in understanding emotional processing of depression.

Thirdly, participants were presented with a pair of stimuli and asked which stimulus was preferred to watch or listen to. We believe that paired choice is more generalizable to everyday emotional situations than designs where only one stimulus can be considered at a time (i.e., study 1 in Millgram et al. (2015). The paired stimulus design makes it possible to examine the relative preference by comparing with an alternative, tested with each pair of emotional stimuli. In addition, participants were allowed to choose neutral (non-decision).

Fourth, including 'fear' stimuli allowed us an additional comparison, to examine whether depressed individuals have unique preference (or aversion) for sadness, or negative emotions in general. Finally, as an exploratory aim, we wanted to gather information concerning participants' stated reasons for choosing a stimulus, which might help explain why the MDD group chooses sad music.

Hypotheses:

H1: For music, we expected to replicate Millgram et al. (2015)'s study 2. Specifically, we anticipated that MDD group status would predict a greater likelihood of choosing sad music excerpt as most preferred.

H2: The MDD group's most preferred music excerpt would be not only sadder, but also

less energetic, compared to the HC's group's chosen music excerpt.

H3: For the new music choice task, there would be no group difference in preference in terms of emotion (happy, sad, scary, neutral). Importantly, there would be a significant interaction between group (the MDD and the HC groups) and intensity (high and low energetic): the MDD group would less prefer high energetic music excerpts compared to the HC group.

H4: For the new image choice task, same pattern would be found in images as well as music excerpts. There would be no group difference in emotional stimuli preference in terms of emotion (happy, sad, scary, neutral). However, there would be a significant interaction between group (the MDD and the HC groups) and intensity (high and low arousal), such that the MDD group would prefer lower intensity music excerpts compared to the HC group.

Chapter Two: Method

Participants.

In total, 38 depressed and 38 age-and gender matched female undergraduate students were included in the current study. The recruitment was done in two phases: online screening and in-person clinical interview. In the first step, participants were screened on an online research participation pool system using two questions: 'during the past two weeks, how often have you felt sad, down, or depressed?' and 'during the past two weeks, how often have you been less interested in your usual activities?' with 4 answers (a, Not at all; b, Some of the time; c, More than half the time; d, All the time). To recruit the MDD group, only those who responded 'c' or 'd' to both questions were potentially eligible to enroll the study, and for HC group, participants were potentially eligible when they responded 'a' to both questions. Through the online screening, 151 students were invited to clinical interview and consented to participate in the study for course credits.

In the clinical interview, the mood module of SCID-I (the Structured Clinical Interview for DSM-IV Axis I Disorders) was used for MDD diagnosis. The MINI (the Mini-International Neuropsychiatric Interview) was used to examine exclusion criteria. The first author, a trained graduate student, and a trained undergraduate research assistant conducted the screening interview. Both interviewers had previously administered clinical interviews. The interviewers assessed the first several participants together, compared each other's clinical decisions, and reached an agreement about whether or not a participant had MDD. Any disagreement was

resolved through discussion. Participants were excluded if they had reported or met criteria for any of following: a history of serious brain injury or other neurological disorders, alcohol or substance dependence or abuse within the past 6 months, a lifetime history of bipolar disorder and psychotic ideation. For the HC group, participants were excluded if they met the current or past MDD criteria based on the SCID-I. All MDD group participants met the criteria for current MDD on the SCID-I.

After the interview, 39 depressed and 40 non-depressed participants met inclusion criteria and completed the tasks. One from the MDD group and two participants from the HC group were excluded from the analysis due to attention problems during the tasks. In total, 38 female participants were included per group. Flow chart of recruitment is presented in Figure 1.

Replication task of Millgram et al. (2015).

Following Millgram et al. (2015), the six music excerpts (two per emotion, one classical and one modern genre per emotion) were used. The music excerpts were exactly same excerpts used in Milgram et al. (2015)'s study 2. Excerpts were from sad music (Adagio for Strings" by Samuel Barber; "Rakavot" by Avi Balili), happy music ("Track 8" by Jay Hannah; "Infernal Galop" from Orpheus in the Underworld by Jacques Offenbach) and neutral music ("Pickles" by Edgar Meyer; "First Thing" by Four Tet). Each music excerpt lasted 30 seconds. Participants listened to the six music excerpts in a randomized order, and then were asked to choose the one music excerpt they most wanted to listen to in the future. Additionally, unlike Millgram et al. (2015), we asked participants to report the reason for their preference. Then, participants listened to each musical excerpt again and rated how much they experienced happy, sad, and arousal using a 9 point Likert scale (e.g., 0 = not at all, 8 = extremely). For feeling happy, the average

score of happy and joyful was used. For sad, the average score of sad and downhearted was used. In addition, participants rated how energetic the music excerpt was to them using the same 9 point Likert scale.

Emotional stimuli selection task (ESST), music task.

In the current study, intensity (high, low) and emotion (happy, sad, fear and neutral) were considered, resulting in 7 different categories: happy/high (HH), happy/low (HL), sad/high (SH), sad/low (SL), fear/high (FH), fear/low (FL), and neutral (N). Because it is difficult to find neutral music clips with different intensity levels, intensity was not considered for neutral stimuli. Based on Eerola & Vuoskoski (2011)'s standardized emotional music excerpts (mean ratings of each emotion, valence and energy), 16 music excerpts were selected (two excerpts per emotional category and four excerpts for neutral) based on the mean ratings of emotion and energy. In Eerola & Vuoskoski (2011)'s study, the affective ratings were measured on a 1-9 scale. The screening criteria for music excerpts were as follows: 1) mean rating greater than 4 on target emotion for each emotion, 2) mean rating greater than 4 on energy level for high intensity, and 3) mean rating less than or equal to 3 on energy level for low intensity.

Based on these criteria, excerpt no. 19 ($M_{happy} = 5.50$, $M_{energy} = 5.83$) and 264 ($M_{happy} = 6.17$, $M_{energy} = 5.00$) were selected for HH, and no. 61 ($M_{happy} = 5.83$, $M_{energy} = 2.80$) and 201 ($M_{happy} = 5.67$, $M_{energy} = 3.00$) for HL. Excerpt no. 40 ($M_{sad} = 6.20$, $M_{energy} = 4.33$) and 210 ($M_{sad} = 5.67$, $M_{energy} = 4.83$) were for SH, no. 41 ($M_{sad} = 6.17$, $M_{energy} = 2.60$) and 44 ($M_{sad} = 6.00$, $M_{energy} = 2.20$) were for SL, no. 100 ($M_{fear} = 6.00$, $M_{energy} = 5.50$) and 103 ($M_{fear} = 5.83$, $M_{energy} = 6.00$) were for FH, and no.106 ($M_{fear} = 5.50$, $M_{energy} = 2.80$) and 107 ($M_{fear} = 5.50$, $M_{energy} = 2.83$) were selected for FL. As for N, four music excerpts were selected: excerpt no. 155 (M_{energy}

= 3.00), 180 (M_{energy} = 3.00), 204 (M_{energy} = 4.17) and 353 (M_{energy} = 4.00). Each music excerpt lasted 10 seconds. When the original excerpt was longer than 10 seconds, the first 10 seconds from the beginning of the music was used.

On each trial, participants listened to a pair of the music clips, and were asked to select which one of the two they would prefer to listen to, using a mouse. At each trial, the mouse begins in the middle (non-decision). Participants moved the mouse to the left if they preferred the first music excerpt and to the right if they preferred the second. Participants could take up to 5 seconds to make a decision. We used this relatively brief decision time in order to reduce demand characteristics (i.e., participants may try to guess the stimulus that, they think, other people are likely to select) and since emotional preference decisions should require relatively little conscious deliberation. Participants listened to all the possible combinations of each category in a random order, which resulted in 84 trials with two breaks. The number of presentation of stimuli of each category was equal, 24 times, across categories. This made it possible to compare the number of choice per category between groups. The total task duration was approximately 30 minutes. After completing the ESST, participants listened to each music excerpt again in a random order, and rated how much they experienced happy, sad, fear, arousal and energy levels using a 9 point Likert scale (e.g., 0 = not at all, 8 = extremely). The scores for happy and sad were the same as the Music task 1. The average score of scared and jittery was used for feeling fear.

Emotional stimuli selection task (ESST), image task.

Based on Libkuman et al. (2007)'s standardized emotional IAPS pictures (mean ratings of each emotion, valence and arousal), 16 images were selected (two per emotional category and

four for neutral) based on the mean ratings of emotion and arousal. Since Libkuman et al. (2007) used the same 9 Likert scale as used in the music validation study (Eerola & Vuoskoski, 2011), the same screening criteria was used for images. IAPS no. 4599 (M_{happy} = 6.44, $M_{arousal}$ = 5.73) and 8502 (M_{happy} = 6.72, $M_{arousal}$ = 5.78) were selected for HH, and no. 5000 (M_{happy} = 6.29, $M_{arousal}$ = *2.24*) and 5390 (M_{happy} = 5.64, $M_{arousal}$ = 2.04) for HL. IAP no. 2800 (M_{sad} = 7.63, $M_{arousal}$ = 5.79) and 3170 (M_{sad} = 7.78, $M_{arousal}$ = 5.44) were for SH, no. 2520 (M_{sad} = 5.78, $M_{arousal}$ = 2.7) and 2752 (M_{sad} = 5.04, $M_{arousal}$ = 2.44) were for SL, no. 1302 (M_{fear} = 5.82, $M_{arousal}$ = 5.38) and 6510 (M_{fear} = 5.92, $M_{arousal}$ = 6.67) were for FH, and no.2682 (M_{fear} = 4.32, $M_{arousal}$ = 2.44) and 6241 (M_{fear} = 4.68, $M_{arousal}$ = 2.75) were selected for FL. As for N, four images were selected: IAPS no. 5531 ($M_{arousal}$ = 2.24), 5535 ($M_{arousal}$ = 2.45), 7080 ($M_{arousal}$ = 2.23), and 7830 ($M_{arousal}$ = 2.58). The task procedure was same as the music task of ESST.

Other measures.

Demographic characteristics. Ethnic background, age, education, and the current medication usage were measured.

BDI and BAI. BDI-II (Beck, Steer, & Brown, 1996) and Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988) were used to measure participants' depression and anxiety symptom severity. Both scales are based on a 4 point Likert scale. In the current sample, Cronbach's alpha for the 21 items of BDI and BAI were .97 and .95, respectively.

Concurrent emotional states. Using PANAS-X scales (Watson & Clark, 1999), the emotional states (happy, sad, fear) prior to the tasks were measured using a 5 point Likert scale from 1 (very slightly) to 5 (extremely). The scores were the same as the ESST.

Procedure.

After providing informed consent, participants were screened using MINI and SCID-I mood module to check study eligibility. Those who passed the screening completed the BDI-II and BAI. Then, half the participants performed the replication task, the ESST- music task and then ESST-image task. The other half performed the ESST-image task, the replication task and then ESST-music task. The total duration of the study was approximately 150 minutes. At the end of the procedure, participants were thanked and debriefed.

Chapter Three: Results[i]

Demographic and clinical characteristics.

The mean age was 19.8 years for the MDD and 19.5 years for the HC group. The average education year was 13.5 for the MDD and 13.2 for the HC group. In addition, the percentage of Caucasian was 52.6% for the MDD and 55.6 for the HC group. There were no group differences in age, education or ethnic background (*p*s > .05). As expected compared to the HC group, the MDD group reported higher scores for BDI (M = 28.7 vs. 3.2, respectively for the MDD and HC; $t(72) = 14.078$, $p < .001$) and of BAI (26.3 vs. 6.0; $t(71) = 9.123$, $p < .001$). Among the MDD group, 23.7% were taking on antidepressants. Demographic features and clinical symptoms by group are displayed in Table 1.

Throughout the analyses, when Mauchly's sphericity test was violated, Huynh-Feldt correction was used.

Replication music task.

Manipulation check and characteristic of stimuli. In order to examine if the sad and happy music excerpts induced intended sadness and happiness, more than other music clips, a series of repeated measures ANOVAs were run. Firstly, a repeated measures ANOVA in which happy ratings as a dependent variable (DV), Music condition (Happy, Sad, Neutral) as a within-subject factor, and Group (MDD, HC) as a between-subject factor. The results showed a significant main effect for Music condition, $F(1.767, 130.760) = 116.815$, $p < .001$. As expected,

participants reported more happiness while or after listening to happy music excerpts than others (M = 4.7, SD = 2.2) for happy, (M = 1.2, SD = 1.3) for sad, and (M = 2.2, SD = 1.6) for neutral music excerpts, ps < .001. In addition, the Music by Group interaction was significant, F(1.767, 130.760) = 17.904, p < .001: compared to HC group, the MDD group reported less happiness to happy music (M_{MDD} = 3.5, SD_{MDD} = 2.2 vs. M_{HC} = 5.9, SD_{HC} = 1.6, p < .001), and neutral music (M_{MDD} = 1.6, SD_{MDD} = 1.5 vs. M_{HC} = 2.7, SD_{HC} = 1.5, p = .003). There was no group difference in reported happiness to sad music (M_{MDD} = 1.4, SD_{MDD} = 1.4 vs. M_{HC} = .9, SD_{HC} = 1.1, p = .125).

The same repeated measures ANOVA with sad ratings as a DV was conducted. The results showed a significant main effect of Music condition, F(1.362, 100.814) = 115.199, p < .001. The comparison analysis using the Bonferroni correction showed that participants across groups reported more sadness while or after listening to sad music excerpts compared to others (M =3.1, SD = 2.0) for sad, (M = 0.2, SD = 0.5) for happy, and (M = 0.9, SD = 1.0) for neutral music excerpts, ps < .001. These results suggest that the six music clips successfully induced the intended emotions.

Most preferred music choice. To examine a group difference in the choice of most preferred music excerpts, a multi-nominal logistic regression was conducted with Group (MDD, HC) as an independent variable and Music condition (happy, sad, neutral) as a dependent variable. Group predicted music preference, $\chi 2(2) = 23.022$, p <.001. More specifically, compared to the HC group, the MDD group was more likely to prefer sad music clips, relative to happy music clips, b = 2.605, Wald $\chi 2(1) = 17.260$, p <.001, and relative to neutral music clips, b = 1.863, Wald $\chi 2(1) = 6.669$, p =.010. These results are consistent with H1 in replicating Milgram et al. (2015)'s finding that the MDD group preferred sad music clips more, compared to

the HC group. Remarkably, about 55% of the MDD group chose sad music whereas the corresponding figure in the HC group was only 13%. The percentages of MDD group and HC group who selected each emotional music excerpt are presented in Figure 2.

The characteristics of most preferred music clips per group. Additionally, we wanted to examine if there was a significant group difference in affective responses to their most preferred music excerpt. To facilitate this analysis, a MANOVA was run on the affective response ratings (Happy, Sad, Arousal, Energy level) to the chosen music as the dependent variable and Group (MDD, HC) as the independent variable. Group differences were observed for Happy, $F(1, 74) = 15.969$, $p < .001$, $\eta_p^2 = .177$, Sad, $F(1, 74) = 8.735$, $p = .004$, $\eta_p^2 = .106$, and Energy level, $F(1, 74) = 22.599$, $p < .001$, $\eta_p^2 = .234$. Specifically, the MDD rated their preferred music as less happy ($M_{MDD} = 3.5$, $SD_{MDD} = 2.3$, vs. $M_{HC} = 5.7$, $SD_{HC} = 2.4$) and sadder ($M_{MDD} = 1.4$, $SD_{MDD} = 1.5$, vs. $M_{HC} = 0.5$, $SD_{HC} = 1.2$). The MDD group also rated their preferred music as less energetic, compared to the HC group ($M_{MDD} = 3.5$, $SD_{MDD} = 2.4$ vs. $M_{HC} = 6.1$, $SD_{HC} = 2.3$). In other words, consistent with our second hypothesis, persons with depression preferred music that was not only less happy and sadder, but also less energetic, compared to a healthy non-depressed group.

To check whether ratings for happy and sad to their chosen music differ from baseline emotional ratings (prior to the tasks), a repeated measures ANOVA was conducted in which affective ratings were DV, Emotion (happy, sad) and Time (before, after) were within-factor and Group (MDD, HC) was a between factor variable. Since the baseline emotional ratings were measured using a 5 Likert scale whereas affecting ratings after listening were measured on a 9 Likert scale, the 5 Likert scale was converted to a 9 Likert scale (i.e., 1 = 0, 2 = 2, 3= 4, 4= 6, 5 = 8). The results showed a significant three way interaction of Emotion, Time, by Group, $F(1, 74)$

= .28.075, $p < .001$. The comparison analysis using the Bonferroni correction revealed that the MDD group rated more happy and less sad after listening to their chosen music, compared to their ratings before taking part in tasks (M_{before} = .7, SD_{before} = .8, vs. M_{after} = 3.5, SD_{after} = 2.3 for sad, M_{before} =3.4, SD_{before} = 2.2, vs. M_{after} = 1.4, SD_{after} = .5, ps < .001). There was no such pattern found in HC. In addition, both MDD and HC group reported more happiness than sadness in response to their chosen music (M_{happy} = 3.5, SD_{happy} = 2.3, vs. M_{sad} = 1.4, SD_{sad} = 1.5 for MDD, M_{happy} = 5.7, SD_{happy} = 2.4, vs. M_{sad} = .5, SD_{sad} = 1.2 for HC, ps < .001).

In other words, while MDD group were more likely to choose music that was normatively sad, the MDD group reported feeling more happiness and less sadness during engaging in their chosen music, compared to prior to listening to the music. Notably, the MDD group and the HC group both reported more happiness than sadness to their chosen music. These results contradict Millgram et al. (2015)'s interpretation that the MDD group prefers sad stimuli in order to upregulate their sadness in that the MDD group reported feeling happier after listening to their preferred music, and that they felt more happiness than sadness to their preferred music.

Self-reported reasons for sad music choices in the MDD group. As an exploratory aim, we wanted to examine stated reasons for the sad music choice in the MDD group. Participants reported reasons for their music choice (multiple answers were allowed). For MDD persons (n=21) who chose a sad music excerpt, 14 reported reasons related to that the selected music being relaxing, calming or soothing. Further, 2 participants reported that they chose sad music because the music was powerful. The rest of responses included "I have heard the song before", "it sounds like the music I usually listen to" and "it reminded me of stories of heroes and adventure". Only 4 participants reported reasons related to negative emotion such as pensive,

emotionally dark, mellow or sad. In other words, depressed persons offered a variety of reasons for choosing sad music excerpts, and did not typically allude to its downcast affective quality. [ii]

The ESST, music task.

Two participants from the MDD group was excluded due to technical error with data (n = 1) and attention problem during the ESST music task (n = 1). Thus, 36 MDD and 38 HC data was analyzed.

Manipulation check. In the ESST, music task, a different set of music stimuli were used in order to consider both emotion (happy, H; sad, S; fear, F) and intensity (high, H; low, L) as well as neutral music (N). Again, a series of ANOVAs were conducted to check if the music excerpts induced intended emotions and intensity. Firstly, a repeated measures ANOVA in which happy ratings as a dependent variable (DV), Music condition (HH, HL, SH, SL, FH, FL, N) as a within-subject factor, and Group (MDD, HC) as a between-subject factor. The results showed a main effect for Music condition, $F(3.856, 277.653) = 126.982$, $p < .001$. Across groups, participants reported more happiness while or after listening to both HH and HL music excerpts compared to other conditions (M = 4.6, SD = 1.8) for HH and (M = 3.8, SD = 1.9) for HL vs. (M = 1.8, SD = 1.3) for SH, (M = 0.7, SD = 1.0) for SL, (M = 1.2, SD = 1.8) for FH, (M = 0.2, SD = 0.6) for FL, (M = 1.3, SD = 0.9) for N, ps < .001. In addition, Music by Group interaction was significant, $F(3.856, 277.653) = 3.106$, p = .017. The Bonferroni corrected comparison analysis showed that the MDD group felt less happiness to HH, compared to the HC group (M_{MDD} = 4.0 , SD_{MDD} = 1.9, vs. M_{HC} = 5.2, SD_{HC} = 1.5, p = .004).

A similar repeated measures ANOVA with sadness ratings as a DV was run. The results showed a significant main effect of Music condition, $F(4.063, 288.450) = 91.665$, $p < .001$.

Across groups, participants reported more sadness while or after listening to both SH and SL music excerpts compared to the other music excepts (M = 1.8, SD = 1.4) for SH and (M = 3.6, SD = 1.8) for SL vs. (M = 0.1, SD = 0.5) for HH, (M = 1.0, SD = 1.2) for HL, (M = 0.6, SD = 0.8) for FH, (M = 0.9, SD = 1.3) for FL, (M = 1.0, SD = 0.9) for N, ps $\leq$ .001. Finally, a repeated measures ANOVA on fear ratings again indicated a main effect of Music condition, F(3.060, 211.163) = 90.271, p < .001. Participants reported more fear to both FH and FL, compared to the other conditions (M = 3.3, SD = 2.0) for FH and (M = 3.0, SD = 2.0) for FL vs. (M = 0.9, SD = 1.1) for HH, (M = 0.3, SD = 0.6) for HL, (M = 1.2, SD = 1.2) for SH, (M = 0.7, SD = 1.1) for SL, (M = 1.0, SD = 1.0) for N, ps < .001. Thus, as predicted, the music excerpts induced intended emotions.

Finally, a repeated measures ANOVA was run on energy level ratings. Again, we observed an effect of Music condition, F(4.994, 359.586) = 89.957, p < .001. As we intended, participants reported feeling more energetic to the high arousal conditions versus their low arousal counterparts (M_{HH} = 5.2, SD_{HH} = 1.2, vs. M_{HL} = 2.7, SD_{HL} = 1.3, p < .001; M_{SH} = 3.4, SD_{SH} = 1.4 vs. M_{SL}= 1.8, SD_{SL} = 1.2, p < .001; M_{FH} = 2.3, SD_{FH}= 1.4 vs. M_{FL} = 2.2, SD_{FL} = 1.0, p < .001).

Music choice. In order to examine that MDD group would prefer less intense music compared to the HC group (H3), a repeated measures ANOVA was run in which the number of choices was the dependent variable, Emotion (happy, sad, fear) and Intensity (high, low) were within-subject and Group (MDD, HC) was a between-subject factor. Because neutral music excepts did not have two levels of intensity, initial analyses were run without neutral stimuli. The average number of choices per Emotion condition per group is displayed in Figure 3, and the

average number of choices per Intensity condition per group is presented in Figure 4. The results showed interactions between Emotion and Group, $F(2, 144) = 7.750$, $p < .001$, $\eta_p^2 = .097$, and Intensity and Group, $F(1, 72) = 10.951$, $p < .001$, $\eta_p^2 = .132$. The comparison analysis using the Bonferroni correction on Emotion and Group interaction displayed that the pattern of group differences for sad music preference was opposite of the pattern of group differences for happy music preference. That is, compared to the HC group, the MDD group chose fewer happy music excerpts ($M_{MDD} = 29.4$, $SD_{MDD} = 8.4$ vs. $M_{HC} = 36.0$, $SD_{HC} = 4.7$, $p < .001$) but more sad music excerpts ($M_{MDD} = 23.2$, $SD_{MDD} = 6.7$ vs. $M_{HC} = 24.7$, $SD_{HC} = 5.5$, $p = .016$). In addition, both groups preferred happy and sad music to fear music excerpts (ps $< .001$). The HC group preferred happy music excerpts more than sad ($p < .001$); however, such pattern was not found in the MDD group ($p = 1.000$). Further, the comparison analysis using the Bonferroni correction on Intensity and Group interaction showed that the pattern of group differences varied as a function of the intensity of the music stimuli. For high intense music MDD group chose fewer excerpts than HC ($M_{MDD} = 34.2$, $SD_{MDD} = 7.7$ vs. $M_{HC} = 40.7$, $SD_{HC} = 6.6$, $p < .001$); by contrast, the MDD group chose more low intense music excerpts than HC ($M_{MDD} = 34.9$, $SD_{MDD} = 7.2$ vs. $M_{HC} = 31.3$, $SD_{HC} = 6.3$, $p = .025$). The details of the analysis are presented in Table 2.

These results partially supported H3 that relative to the HC group the MDD group would prefer less intense music across emotions. As predicted, the MDD group also preferred less intense music excerpts across emotions including sadness, compared to the HC group. These results suggest an alternative to Milgram et al. (2015)'s argument that the MDD group prefers sad stimuli, relative to the HC group. As was observed in Study 1, the MDD group also preferred fewer happy and more sad music excerpts, compared to the HC group. There was no group

difference in preference for fearful music excerpts, which shows that the group difference in music preference was specific to sadness, and not observed for negative emotional music in general. Finally, with a new set of stimuli, the MDD group did not demonstrate an absolute preference for sad over happy music..

The ESST, image task.

Manipulation check. The same series of ANOVAs, as the music task, were conducted to check if the images induced intended emotion and intensity. For images, we measured arousal ratings for intensity. A repeated measures ANOVA with happy ratings as a dependent variable (DV) showed a main effect of Image condition, $F(3.125, 231.258) = 158.089$, $p < .001$. The comparison analysis using the Bonferroni correction showed that as expected, participants across groups reported more happiness to HH and HL, compared to others ($M = 3.6$, $SD = 2.2$) for HH & ($M = 4.2$, $SD = 2.0$) for HL vs. ($M = 0.1$, $SD = 0.3$) for SH, ($M = 0.8$, $SD = 1.1$) for SL, ($M = 0.4$, $SD = 1.0$) for FH, ($M = 0.1$, $SD = 0.4$) for SL and ($M = 0.7$, $SD = 0.8$) for N, $ps < .001$. In addition, a Music by Group interaction was significant, $F(3.125, 231.258) = 2.675$, $p = .046$. The Bonferroni corrected comparison analysis showed that the HC group reported less happiness to FH images, compared to the MDD group ($M_{MDD} = .7$, $SD_{MDD} = 1.3$, vs. $M_{HC} = .2$, $SD_{HC} = .5$, $p = .040$).

A parallel repeated measures ANOVA with sad ratings as a DV revealed a main effect of Image condition, $F(4.394, 325.171) = 190.100$, $p < .001$. As expected, participants across group reported more sadness to both SH and SL images, compared to the other conditions ($M = 5.8$, $SD = 1.6$) for SH & ($M = 2.6$, $SD = 1.6$) for SL vs. ($M = 0.7$, $SD = 1.3$) for HH, ($M = 0.3$, $SD = 0.7$) for HL, ($M = 1.3$, $SD = 1.5$) for FH, ($M = 1.7$, $SD = 1.9$) for FL and ($M = 0.2$, $SD = 0.4$) for N, ps

≤ .004.

A parallel repeated ANOVA with fear ratings as a DV also revealed a main effect of Image condition, $F(3.597.\ 262.582) = 120.414$, $p < .001$. The comparison analysis using the Bonferroni correction showed that both FH and FL induced more fear than other images except for SH ($M = 3.7$, $SD = 1.9$) for FH & ($M = 3.3$, $SD = 2.1$) for FL vs. ($M = 0.6$, $SD = 1.0$) for HH, ($M = 0.2$, $SD = 0.5$) for HL, ($M = 0.9$, $SD = 1.3$) for SL and ($M = 0.3$, $SD = 0.7$) for N, ps = .000. However, FL images did not differ from SH images in fear ratings ($M = 3.3$, $SD = 2.1$) for FL vs. ($M = 2.7$, $SD = 1.9$) for SH, $p = .269$, while FH images induced more fear than SH ($M = 3.7$, $SD = 1.9$) for FH vs. ($M = 2.7$, $SD = 1.9$) for SH, $p < .001$. Since FL images failed to induce intended emotions more than the other image types, the interpretation regarding FL should be done with caution.

Lastly, another repeated ANOVA with arousal ratings as a DV was run, and found a significant main effect of Image type, $F(4.367.\ 296.967) = 70.664$, $p < .001$. Across groups, participants reported more arousal to the high arousal stimuli than to the low arousal stimuli for happy stimuli ($M_{HH} = 2.4$, $SD_{HH} = 1.8$ vs. $M_{HL} = 1.6$, $SD_{HL} = 1.6$, $p = .016$), sad images ($M_{SH} = 4.5$, $SD_{SH} = 2.0$ vs. $M_{SL} = 2.5$, $SD_{HL} = 1.6$, $p < .001$) and fear images ($M_{FH} = 4.4$, $SD_{FH} = 2.0$ vs. $M_{FL} = 3.8$, $SD_{FL} = 2.1$, $p = .014$). These results indicate that, as expected, images with high intensity were experienced as more arousing than low intensity images.

Image choice. In order to examine whether the same pattern of results on ESST's music task would be found with images as music (H4), the same repeated measures ANOVA was run with images in which the number of choices was the dependent variable, Emotion (happy, sad, fear) and Intensity (high, low) were within-subject and Group (MDD, HC) was a between-

subject factor. A main effect of Emotion, $F(2, 148) = 310.645$, $p < .001$, $\eta_p^2 = .808$, and intensity, $F(1, 74) = 80.780$, $p < .001$, $\eta_p^2 = .522$, were observed, which were qualified by interactions between Emotion and Group, $F(2, 148) = 3.230$, $p = .042$, $\eta_p^2 = .042$ and Emotion and Intensity, $F(2,148) = 54.640$, $p < .001$, , $\eta_p^2 = .425$.

The comparison analysis using the Bonferroni correction on Emotion and Intensity interaction showed that compared to high intense images, participants across groups preferred low intense happy images ($M = 20.1$, $SD = 3.7$) for HL vs. ($M = 18.0$, $SD = 4.6$) for HH, $p = .003$, and low intense sad images ($M = 11.2$, $SD = 4.2$) for SL vs. ($M = 3.0$, $SD = 4.0$) for SH, $p < .001$. However there was no such preference for low intensity in fear images ($M = 5.9$, $SD = 3.9$) for FL vs. ($M = 6.6$, $SD = 4.5$) for FH, $p = .241$. More importantly, the comparison analysis using the Bonferroni correction on Emotion and Group interaction showed that this interaction was due to the MDD group reduced preference for happy images compared to the HC group ($M_{MDD} = 36.4$, $SD_{MDD} = 6.9$ vs. $M_{HC} = 39.7$, $SD_{HC} = 4.3$, $p = .016$), with no such corresponding group difference for sad images ($M_{MDD} = 14.1$, $SD_{MDD} = 6.8$ vs. $M_{HC} = 14.3$, $SD_{HC} = 6.0$, $p = .901$) or fear images ($M_{MDD} = 13.8$, $SD_{MDD} = 7.6$ vs. $M_{HC} = 11.3$, $SD_{HC} = 6.0$, $p = .109$). Full details of the analysis are presented in Table 3, and the average number of choices per Emotion condition per group is displayed in Figure 5.

Contrary to H4 that the MDD group would have a greater preference for low intense images than the HC group, no group difference in chosen intensity of images was observed. Instead, the MDD group preferred fewer happy images, compared to the HC group. The average number of choices per Emotion condition per group is displayed in Figure 4.

Chapter Four: Discussion

The current study aimed to examine if the MDD group prefers sad stimuli as observed in Millgram et al. (2015) and to dive deeper into possible explanations for such a preference. We hypothesized that if MDD group preferred sad stimuli more than healthy people, it might be secondary to a preference for low intensity emotional stimuli. Our main findings were as follows: 1) we replicated Millgram et al. (2015)'s finding that the MDD group was indeed more likely to prefer normatively sad music excerpts, relative to the HC group. 2) At the same time, when examining affective responses to the selected music excerpt, the MDD group perceived their selected music to be sadder and less happy but also less energetic, relative to the HC group. Notably, when considering change in affective ratings after listening to their chosen music, the MDD group felt more happiness and less sadness when listening to their chosen music, compared to before the task. 3) Importantly, the most frequently reported reason for the choice of sad music among the MDD group suggested that the perceived intensity of the music influenced their preference. 4) Using the ESST's music task, in which both emotion and intensity of stimuli were considered, the MDD group preferred more sad and low intense music excerpts, compared to the HC group. Further, the MDD group showed no particular preference for happy over sad music, whereas the HC group preferred happy to sad music. 5) Finally, the results from an ESST's image task showed that the MDD group preferred fewer happy images, compared to the HC group. We review these findings in turn.

As we predicted , using the same music task as Millgram et al. (2015)'s study, the MDD

group preferred sad music excerpts more than the HC group, affirming Millgram et al. (2015)'s result. However, our results contradict Millgram et al. (2015)'s interpretation of their findings. In Millgram et al. (2015)' study, three studies were conducted. In study 1, when presented with happy, sad, and neutral images, one at a time, the MDD group selected more sad images to watch it again, compared to the HC group. In study 2, using the same replication music task as the current study, the MDD group status predicted more choice of sad music. In study 3, participants were trained to increase and decrease emotions, and presented happy, sad and neutral images at a time. The MDD group chose to 'increase' their sadness to sad images more often than the HC group. Based on these findings, Millgram et al. (2015) implied that people with MDD prefer sad stimuli because they consciously or unconsciously want to up-regulate or maintain levels of sadness, suggesting the possibility that depressed person have a problematic emotional goal. By extension, this could mean depressed individuals get depressed via having a maladaptive emotional goal, selectively engaging in stimuli that make or keep them sad.

The following results of the current study contradicted Millgram et al. (2015)'s explanation of MDD persons' preference for sad stimuli as enhancing sadness. First, the MDD group not only reported feeling more sadness and less happiness to their selected music excerpt, but also they perceived the chosen music as less intense (energetic), compared to the HC group. This indicates the possibility that the MDD group selected sad music excerpt not because the music was sad, but because it was less energetic. Specifically, 66% of the MDD group who selected sad music excerpt reported that they sought out the music excerpt because it is low intensity (calm, relaxing or soothing qualities). In addition, when examining affective change before and after listening to the selected music excerpt, the MDD group reported feeling more happy and less sadness after, compared to before listening to the chosen music. These results

directly contradict Millgram et al. (2015)'s interpretation that the MDD group has a self-regulatory motive to enhance or maintain their sadness via engaging in stimuli that made them sadder.

The current study results fit with an alternative account that the MDD group preference to engage in sad stimuli is secondary to a preference for low intensity calming stimuli. Indeed, our results are similar to Punkanen et al.(2011) who found that when patients with MDD and HC listened to music excerpts with different affective dimensions (high and low energy levels, angry, sad, and happy, negative and positive valence) and rated how much participants liked each excerpt patients with MDD's preference score for high energetic music was significantly lower than the HC group. Contrary to Millgram et al.(2015)'s finding, Punkanen et al. (2011) did not find increased preference for sad music excerpts in patients with MDD. Thus, two sets of findings, the current findings and Punkanen et al. (2011)'s results, suggest that depressed individuals may not necessarily prefer sad music because the music is sad; instead they may prefer it because sad music reportedly elicit calming and soothing feelings.

When we used a relatively more robust task, ESST's music task, the MDD group selected fewer high intense music excerpts across emotions, including sadness. At the same time, we found that the MDD group's preference for more sad and fewer happy music excerpts held across energy levels, compared to the HC group. Notably, although the MDD group chose more sad music excerpts in the ESST music task relative to HC, they did not choose more sad music excerpts, compared to happy ones. Instead, they did not show the HC's bias towards selecting happy music excerpts over others music tasks. Unlike the replication music task where participants listened to all six music excepts at a time and were to select one, the ESST task required participants to select between two music excerpts (paired choice). Such a design

allowed us to examine all the possible combinations of stimuli, and rely less on participants' memory than the first non-paired music task. It is significant to note that despite the difference in task designs, the results from ESST's music task are compatible with the results from the non-paired music task that the MDD group's preferred music excerpts were perceived less happy and intense, compared to the HC group. Further, notably, there was no significant group difference in preference for fearful music excerpts. Both group preferred sad and happy music excerpts to fearful ones across energy levels.

What does it mean that the MDD group preferred low intense music excerpts and preferred sad music excerpts because the music made them feel relaxed? Our study results demonstrate an important possibility that depressed people prefer sad music excerpts due to their typically low intensity. Many previous studies found that slow and flowing music with low tones (vs. simulative) helps reduce anxiety and pain (see Nilsson, 2008) for review). Indeed, a number of clinical trial studies showed promising effect of soothing music on stress reduction (Han et al., 2010; Lee, Chung, Chan, & Chan, 2005; Nilsson, Unosson, & Rawal, 2005). Given this research and our finding of MDD group preferring low intense music excerpt, we see no evidence of maladaptive emotional goals. On the contrary, presumably the MDD group has an adaptive emotional goal by selecting to engage in stimuli that help them feel less intense negative emotions, which can help, rather than worsen, their depression. Future studies are needed to elucidate the consequences of listening to their selected music in MDD group, and its comparison to HC.

In order to examine if any preference bias in the MDD group for music can be generalized to other types of stimuli, we conducted the same ESST task with images. Contrary to our hypothesis (H4) that the MDD group would prefer less intense images, we found that the

MDD group preferred fewer happy images, relative to the HC group. There was no significant group difference for the numbers of selection on other emotional stimuli such as arousal levels or sad images. These results suggest a possible tension with the current results from ESST's music task. The increased preference for low intense music excepts in the MDD group was not found with images. One possible explanation concerns the nature of images and music in general as they connect to arousal and energy, that arousal in images may not equal the energy levels in music. Music excerpts with low energy levels (and low arousal) are usually defined as of slow tempo, slow rhythm and very predictable in melody (Khalfa, Roy, Rainville, Bella, & Peretz, 2008; North & Hargreaves, 1997), whereas low arousing images, of course, do not involve tempo or rhythms. Thus, it is possible these particular components of low intense music makes the MDD group prefer the low energetic music, which are absent from low intense images.

In addition, unlike current findings on music tasks and findings from Millgram et al. (2015), we could not find the MDD group's increased preference for sad stimuli using images. One explanation is that sad images do not carry the benefits of sad music, such as relaxation (Carpentier & Potter, 2007). The MDD group may not select more sad images because images do not provide these benefits, compared to HC group. These results displayed that preference for sad or low intense stimuli in MDD group may depend on the type of stimuli in question.

It is important to note that decreased preference for happy stimuli, compared to the HC group, and no significant preference for happy to sad stimuli in the MDD group was consistently found across the tasks. This is consistent with MDD's symptom that diminished interested in pleasurable activities (APA, 2013). Further, this results is compatible with previous research on the effect of sad mood on decreased preference for happy music (Friedman et al., 2012; Hunter et al., 2011). Friedman et al. (2012) examined if people in sad mood believed that listening to

happy music would improve their mood, and if not, what mediated the relationship between sad mood and decreased preference for happy music. The researchers found that participants in sad mood, compared to those in neutral mood, felt that listening to happy music would not enhance their mood partly because they felt inappropriate or wrong to listen to happy music when feeling sad. It is plausible that the MDD group did not prefer happy stimuli because they believe engaging in happy stimuli would induce the negative and counteractive feeling of inappropriateness, and accordingly they did not think engaging in happy stimuli would help their mood.

There are a few limitations of the current study as well as suggestions for future studies. Firstly, we could not control anxiety difference between groups. Although anxiety and depression are generally highly co-morbid (Cloninger, 1990), the current study could not rule out the possibility that anxiety may have impacted the stimuli preference, especially for low intense stimuli. Secondly, the current sample consists of only female students. Previous studies showed significant gender difference in musical preference (McCown, Keiser, Mulhearn, & Williamson, 1997; Staum & Brotons, 2000). Future studies can do the same experiment including both genders. Finally, the current study did not examine the downstream consequences of engaging with their preferred stimuli. Millgram et al. (2015) described the increased preference for sad stimuli in participants with MDD as if it was detrimental to depression. However, Sachs et al. (2015) reviewed literature on the 'pleasures' of listening to sad music, and found that sad music can induce both sad and positive emotions when the music is not fearful, aesthetically pleasant and provides other cognitive benefits such as empathetic feelings. In addition, Jiang et al. (2013) found that the effect of sedating music, relative to stimulating, on state anxiety diminished when listening to preferred music, indicating that state anxiety is reduced even when they listen to

stimulating music as long as they like it. These previous studies demonstrate that increased preference for sad stimuli may not be detrimental to depression. More importantly, the current study showed that the MDD group increased preference for sad music was not associated with their maladaptive intention to feel more sadness. Future studies should investigate the impact of engaging in preferred and un-preferred sad stimuli on depression.

Despite these limitations, the current study revealed significant findings on emotional stimuli selection in depression. Across music tasks, we found that the MDD group prefer more sad and less happy music excerpts, compared to healthy control individuals. In addition, the MDD group showed increased preference for music with low energy levels, compared to healthy controls. More importantly, the most frequently reported reasons of the choice of sad music excerpt among the MDD group was associated with intensity (i.e., the music was relaxing or soothing). This clearly contradicts Millgram et al. (2015)'s argument that depressed individuals may select to engage in sad stimuli because they want to feel sad. The current results from the ESST's image task displayed that increased preference for sad and low intense stimuli relies on the types of stimuli. Decreased preference for happy stimuli in the MDD group, relative to the HC, was consistently found across different types of stimuli and tasks.

These results may have clinical implications for depression intervention. Following Millgram et al. (2015)'s findings and interpretations would suggest that depressed individuals should be discouraged from engaging in sad music more often in order to change their maladaptive emotion regulation goal of enhancing sadness. However, the current study showed that persons with MDD may prefer sad music excerpts because the music helps them relax. Given the current study results, we cannot argue that engaging in sad music makes their depressive symptoms worse (and may possibly be beneficial).

Notably, we found no particular preference for happy to sad stimuli in the MDD group, whereas people without MDD preferred happy to sad stimuli across tasks. Because we did not examine the consequences of the engagement in emotional stimuli, the current study cannot determine whether decreased preference for happy stimuli of the MDD group might indicate maladaptive or adaptive emotion regulation. However, previous studies found that recalling happy memories (engaging in past happy memories), an effective emotion regulation strategy for non-depressed persons, does not help depressed persons repair their sad mood (Joormann & Siemer, 2004), and even worsens their sad mood after recalling (Joormann, Siemer. & Gotlib, 2007). It is possible that choosing engaging in happy stimuli might not be as helpful for depressed persons to repair their sad mood as for non-depressed persons. Future studies should therefore examine the short and medium term consequences of engaging in different emotional stimuli.

Chapter Five: Tables

Table 1. Demographic features and clinical symptoms of sample

	MDD *(n=38)*	**HC (*n=38*)**		
	Mean (SD)	Mean (SD)	$t(\chi^2)$	*p*
Age (year)	19.84 (1.70)	19.53 (1.96)	.75	.46
Education (year)	13.45 (1.31)	13.18 (1.06)	.96	.34
Caucasian (%)	52.60	55.60	1.63*	.80
BDI	28.65 (10.70)	3.16 (2.59)	14.08	0.00
BAI	26.33 (11.97)	6.03 (6.25)	9.12	0.00
Antidepressants (%)	23.70			

Note: *, χ^2; BDI, Beck Depression Inventory; BAI, Beck Anxiety Inventory

Table 2. Results from a repeated measures Analysis of Variance, ESST: music task

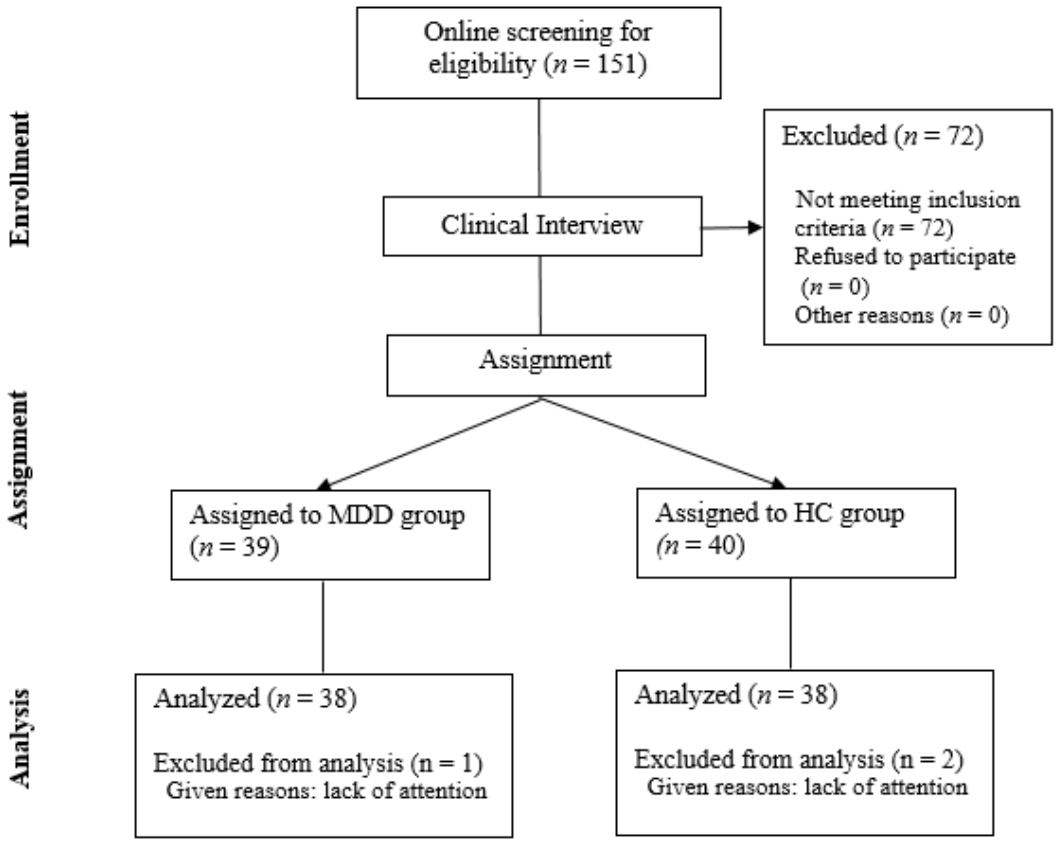
	SS	*MS*	*F*	η_p^2	*p*
Within-subjects					
Emotion	8829.330	4414.665	138.102	.657	<.001
Emotion x Group	495.592	247,726	7.750	.097	.001
Error	4603.211	31.967			
Intensity	234.636	234.636	8.150	.102	.006
Intensity x Group	315.266	315.255	10.951	.132	.001
Error	2072.817	28.789			
Emotion x Intensity	64.515	32.257	2.749	.037	.067
Emotion x Intensity x Group	16.155	8.077	.688	.009	.504
Error	1689.647	11.734			
Between-subjects					
Group	26.211	26.211	7.816	.098	.007
Error	241.458	3.354			

Table 3. Results from a repeated measures Analysis of Variance, ESST: image task

	SS	*MS*	*F*	η_p^2	*p*
Within-subjects					
Emotion	15469.987	7734.993	310.645	.808	<.001
Emotion x Group	160.846	80.423	3.230	.042	.042
Error	3685.167	24.900			
Intensity	1168.640	1168.640	80.789	.522	<.001
Intensity x Group	5.930	5.930	.410	.006	.524
Error	1070/430	14.465			
Emotion x Intensity	1548.504	774.252	54.630	.425	<.001
Emotion x Intensity x Group	17.925	8.963	.632	.008	.533
Error	2097.570	14.173			
Between-subjects					
Group	2.535	2.535	.323	.003	.632
Error	810.254	10.949			

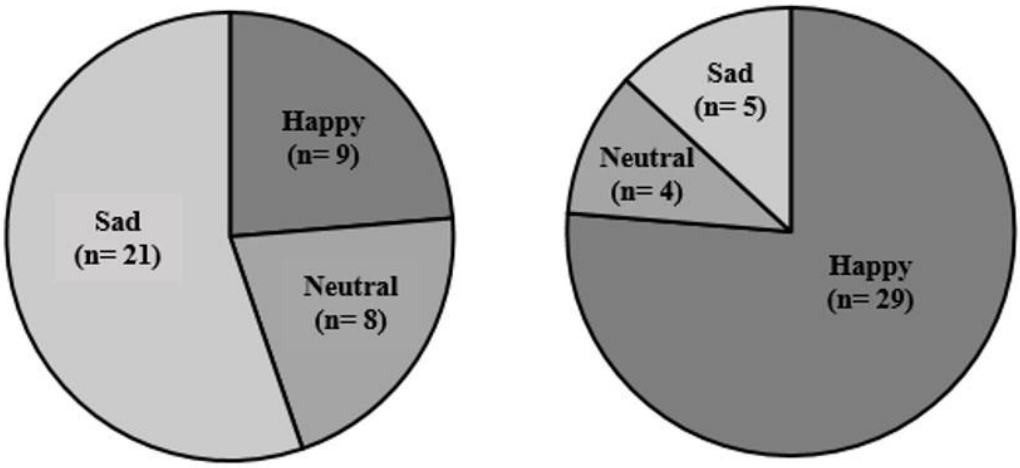
Chapter Six: Figures

Figure 1. Flow chart on recruitment



Note: MDD, major depressive disorder; HC, healthy controls

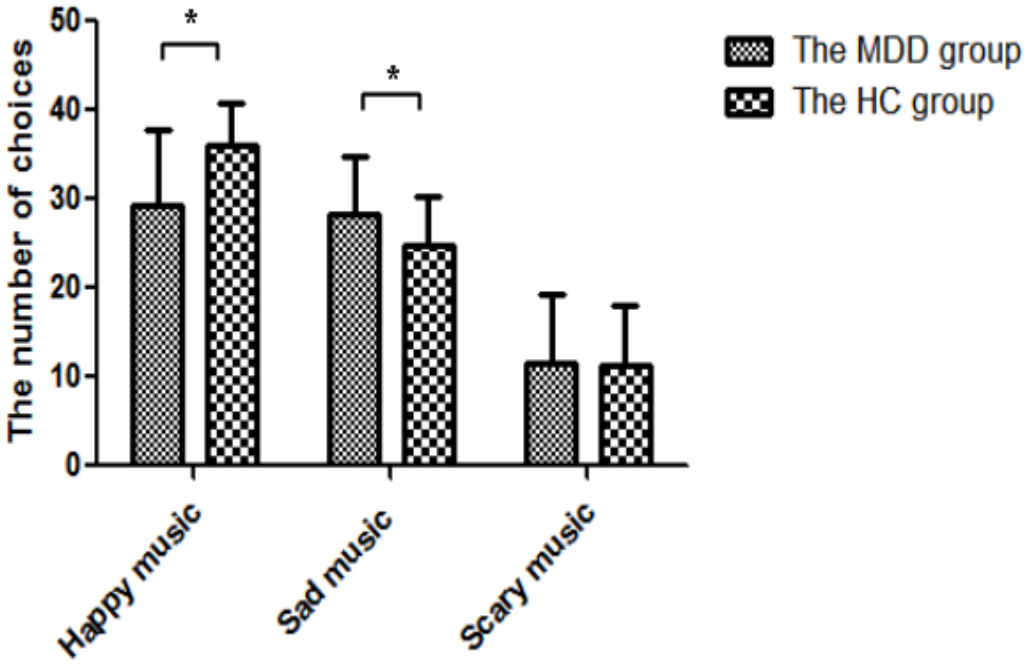
Figure 2. The MDD and HC groups' music choice



A. The MDD group B. The HC group

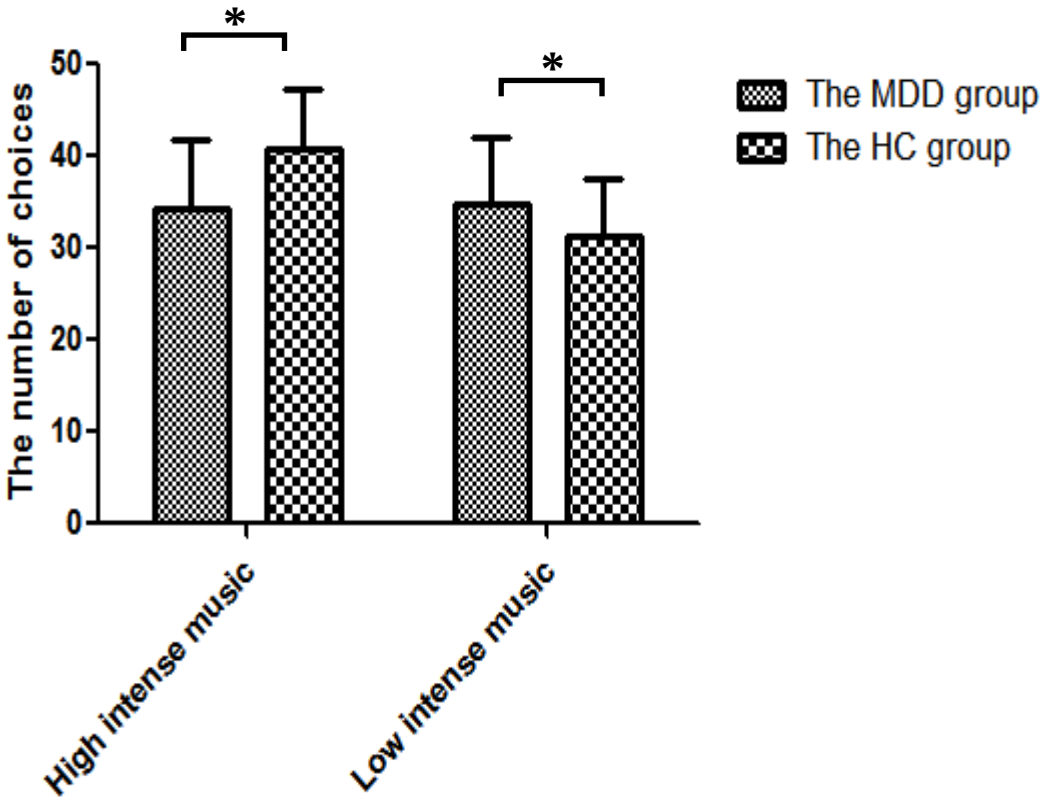
Note: MDD, major depressive disorder; HC, healthy controls

Figure 3. The average number of choices for each emotional music condition per group



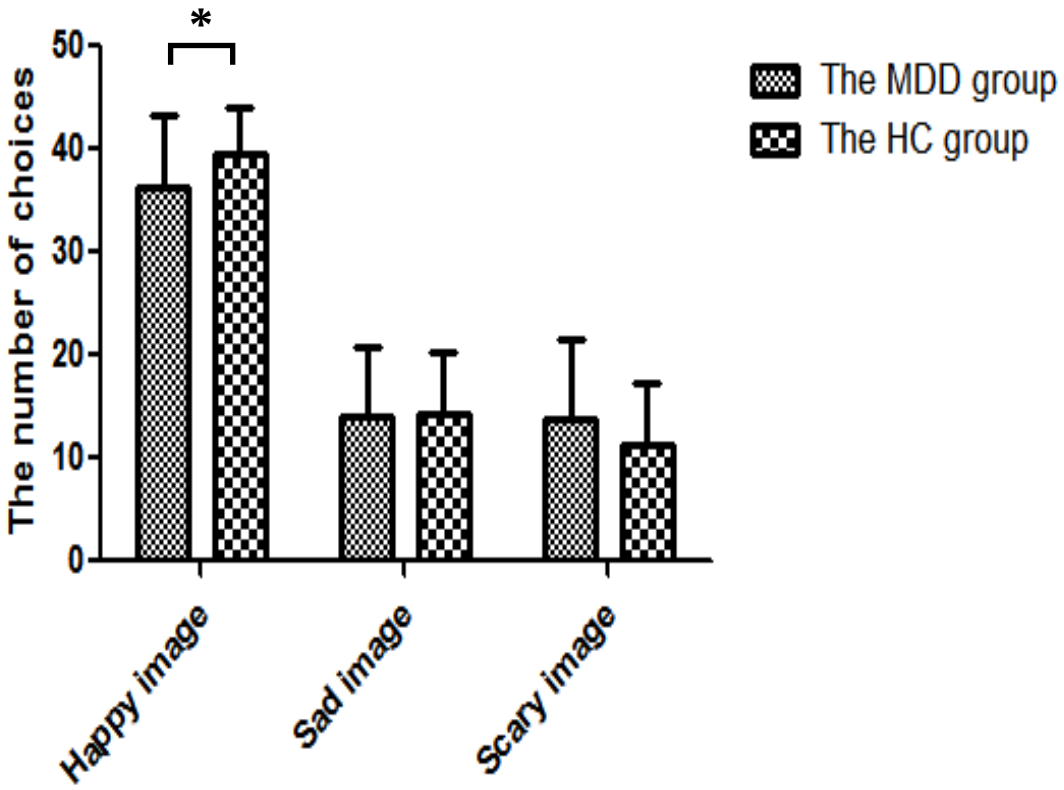
Note. MDD, participants with the major depressive disorder; HC, healthy controls; error bar, *SD*

Figure 4. The average number of choices for each intensity music condition per group



Note. MDD, participants with the major depressive disorder; HC, healthy controls; error bar, *SD*

Figure 5. The average number of choices for each emotional image condition per group



Note: None, no-choice; MDD, major depressive disorder; HC, healthy controls; error bar, *SD*

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[i] **Additional analyses.**

Neutral and no choice in ESST tasks. In order to examine possible group difference in N and no choice conditions, independent t-tests were performed per task with N choice and no choice as DV and Group (MDD, HC) as a grouping variable. For both tasks, there was no group difference in both choices: $t(72) = .090$, $p = .988$ for N in music task, $t(72) = 1.960$, $p = .054$ for no-choice in music task, $t(74) = .029$, $p = .977$ for N in image task, $t(74) = .409$, $p = .683$ for no-choice in image task.

Choice analyses of ESST tasks with samples of less than 10% (<= 8) of no- choice. Due to the possibility of inattention in participants who had many no-choices (did not move the cursor either left or right), we conducted the same analyses per task using samples who had less than 10% (<= 8) of no-choice. For music task, 5 from the MDD and 1 from the HC groups were excluded, which makes 31 MDD and 37 HC. The interactions between Emotion and Group, $F(2, 132) = 6.731$, $p = .002$, $\eta_p^2 = .093$, and Intensity and Group, $F(1, 66) = 7.297$, $p = .009$, $\eta_p^2 = .100$, remained significant. For image task, 9 participants from each group were excluded, making 29 MDD and 29 HC. The interaction between Emotion and Group became marginally significant, $F(2, 112) = 3.044$, $p = .052$, $\eta_p^2 = .052$. These results indicated that no-choice unlikely had significant impact on our main findings.

[ii] Although only 5 HC participants chose sad music, similar pattern was found in the HC group. Among the HC group who chose sad music excerpt, 60% (n=3) reported reasons related to that the music was calming, peaceful and relaxing. The other two participant's reasons were "the music had a lot of variety in structure" and "I heard it before".

Appendix A

USF
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SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX(813)974-7091

6/29/2016

Sunkyung Yoon
Psychology
4202 East Fowler Ave
Tampa, FL 33620

RE: **Full Board Approval for Initial Review**
IRB#: Pro00026319
Title: DEPRESSION AND CHOICE OF EMOTIONAL STIMULI

Study Approval Period: 6/17/2016 to 6/17/2017

Dear Ms. Yoon:

On 6/17/2016, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Protocol_clean

Consent/Assent Document(s)*:
IC.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson
USF Institutional Review Board

Appendix B

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

6/16/2017

Sunkyung Yoon
Psychology
10511 Plantation Bay Drive
Tampa, FL 33647

RE: **Full Board Approval for Continuing Review**
IRB#: CR1_Pro00026319
Title: DEPRESSION AND CHOICE OF EMOTIONAL STIMULI

Study Approval Period: 6/17/2017 to 6/17/2018

Dear Ms. Yoon:

On 6/16/2017, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Protocol_clean

Consent/Assent Document(s)*:
IC_clean.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab on the main study's workspace. Please note, these consent/assent document(s) are valid until they are amended and approved.

The Board determined the study participant over enrollment to be Not Serious, Not Continuing Noncompliance.

The Board requests that an Amendment be submitted within 10 calendar days upon receipt of this approval letter, to increase the study sample size.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with USF HRPP policies and procedures and as approved by the USF IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D., Chairperson
USF Institutional Review Board