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Emotional Time Distortion in Individuals with Depressive Traits*

Jeong Won Choi **Jang-Han Lee†**

Chung-Ang University

The aim of this study was to examine the perception of duration according to depression levels and how arousal and valence would affect time perception. The participants were classified according to a high-depressive group (n = 20) and a low-depressive group (n = 20), based on their depressive scores. We investigated the differences in the subjective perception of duration when the participants watched arousal-emotional pictures (positive-high arousal, positive-low arousal, negative-high arousal, and negative-low arousal). The results showed that overall, the high-depressive group perceived duration as slow compared to the low-depressive group. In addition, while experiencing negative emotions, the high-depressive group showed a slower distortion of time than the low-depressive group. These results suggested that application of distorted time perception to clinically depressive groups may be helpful in escaping the vicious cycle of depression.

Key words : Time perception, Depressive traits, Emotion, Arousal, Internal clock model

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† Correspondence concerning this article should be addressed to Jang-Han Lee, Chung-Ang University, 84 Heukseok-ro, Dongjak-gu, Seoul 06974, Korea. Fax: 02-816-5124, E-mail: clipsy@cau.ac.kr

Depressive individuals seem to have a distorted perception of time, experiencing duration as relatively slow compared to non-depressive persons. These individuals have difficulty estimating time lapses (Blewett, 1992; Kitamura & Kumar, 1982). Additionally, depressive persons tend to experience a greater number of negative emotions (e.g., terrible, unchanging, and dissatisfied) rather than positive ones when they perceive time as passing slowly (Blewett, 1992). In this regard, several authors have illustrated the relationship between slow time perception and negative emotions among depressive persons with rumination. After experiencing a negative emotion, depressive persons repeatedly think about the causes and effects of the negative emotional experience, which is referred to as "rumination". Negative rumination induces depression and leads to slow time perception, which in turn evokes negative emotions. This process results in a vicious cycle of depression, with the depressed individual repeatedly experiencing this process over a long period (Blewett, 1992; Gil & Droit-Volet, 2009).

Although there is currently no suitable theory to explain time perception among depressive persons, the basic theory of time perception offers some explanation in the form of the "internal clock model" (Treisman, 1963). This model postulates that an organism's perception of duration depends on internal factors. The model explains the process that occurs during the subjective perception of duration using "internal temporal information" within an organism. It assumes that there is an "internal clock system" within each person, which enables the estimation of duration. This system is facilitated by units of temporal information that recognize cues based on physiological responses, such as arousal. More specifically, the processing of time perception depends on the ratio of arousal and frequencies thereof. Arousal responses, which are units of temporal information, are regularly emitted in the structure of the "pacemaker". These arousal responses are transported to the "counter" through the gate, where they accumulate. These three factors function in relation to the internal clock. Temporal information collected by the internal clock is subsequently conveyed to the "two-memory system" consisting of "reference memory" in which memories of duration are held, and "working memory" in which short-term temporal memory induced by particular events or stimuli is held. Finally, the "comparator" is a structure that enables the perception of time by comparing the processes occurring in the working memory and reference memory (Church, 1984; Wilkie, 1987). According to the model, if the pacemaker induces more arousal, it accelerates the internal clock and emits arousal at a faster rate. This process results in the over-estimation of duration.

Arousal is regarded as an important factor in the alteration or distortion of duration within the internal clock model. However, time

perception may be affected by factors related to valence as well. According to Russell (1980), who suggested that emotional experiences are multi-dimensional, individuals experience emotions consisting of two axes, namely, valence and arousal. Russell proposed that emotions occur as a result of valence and arousal levels. In his article, two terms define valence as one of the attributions of emotion comprising positive (pleasant) to negative (unpleasant) affect, and arousal is the other attribution comprising states ranging from relaxation to tension. Thus, the role played by both valence and arousal are acknowledged in the definition of emotions and classify the dimension of the emotion. These two valence and arousal axes are not independent concepts, so all of the emotions experienced were classified on the axes. Concepts can be mapped in relation to the location on the axes of an emotion because, generally, there is a difference in the degree of emotional experience within each person. For example, most people experience fear as a negative valence and high arousal. This perspective has contributed towards the validation and standardization of emotional stimuli, leading to the development of the International Affective Picture System (IAPS), the International Affective Digitalized Sounds System (IADS), and various facial expressions stimuli. These stimuli have been used in numerous psychological experiments, including research related to time perception. Several studies have tried to identify the effects of valence and arousal on time perception among individuals without mental health problems using emotional stimuli (Mella, Contry, & Pouthas, 2011; Smith, McIver, Di Nella, & Crease, 2011). According to these studies, high-arousal negative stimuli were perceived slowly compared to high-arousal positive stimuli. Moreover, low-arousal positive stimuli were perceived slowly compared to low-arousal negative stimuli. These results suggested that arousal and valence could concurrently influence time perception.

Recent studies on time perception have conducted experiments that empirically demonstrate distorted time perception among persons with psychopathology, which also revealed factors that affect time perception. Empirical studies on time perception in relation to depression were initiated as a result of clinical reports showing slow time percep tion among depressive patients. To examine the differences in time perception according to depressive levels, a study examined time perception among depressive patients, manic patients, and a control group (Msetfi, Murphy, & Kornbrot, 2012). This study found that depressive patients reported the perception of duration as slow, whereas manic patients perceived the duration as fast, compared to the control group that perceived a balanced duration. Other studies found that clinically depressive patients perceived duration as slow (Bschor et al., 2004). Additionally, depressive persons reported more sadness when perceiving a slow duration (Gil & Droit-Volet, 2009).

Although these studies measured time perception differently (e.g., by using different types of tasks), they all demonstrated slow time perception among depressive persons in studies conducted in clinical settings.

Research on time perception considering emotions in depressive persons is rare. However, only one study has examined the role of valence in time perception among individuals with depression. A recent study (Ko, Kang, & Ko, 2012) of non-clinical persons considering valence as well as depression revealed a slow time perception of negative stimuli (i.e., anger) in a depressive group compared with a non-depressive group. However, this result suggested that valence may also affect the time perception of depressed persons.

According to several clinical reports, depressive persons have low levels of physical arousal responses compared to non-depressive persons (Bylsma, Morris, & Rottenberg, 2008). Taken together, because persons with depression are different from persons without depression in emotion recognition, time perception may also vary depending on the depressed levels in the situation evoking the emotion. It is known that depressive persons experience unbalanced emotions. It has been reported that individuals without depressive symptoms experience emotions differently from persons without depression. More specifically, depressive persons experience attenuated positive emotional reactivity and elevated negative emotional reactivity (Bylsma et al., 2008). Given the effects of valence and arousal on time perception, as identified in studies involving normal persons, it is assumed that these two factors may lead to differences in time perception between depressive and non-depressive persons. The current study, therefore, aimed to investigate (a) whether there are differences in patterns of time perception between depressive and non-depressive individuals, (b) whether valence and arousal factors affect time perception, and (c) whether the effects of these two factors differ depending on depression levels.

Method

Participants

Before the experiment, 432 undergraduate students from C University in Seoul, Korea, completed the trait anxiety subscale of the State-Trait Anxiety Inventory (STAI-T) (Spielberger, Gorsuch, & Lushene, 1983) and the Beck Depression Inventory-II (BDI-II) (Beck, Steer, & Brown, 1996). We selected individuals who scored between 40 and 60 on the trait anxiety subscale after controlling for the effect of trait anxiety, which is commonly comorbid with depression, and we excluded those who had scores above 2 standard deviations of the mean scores of the STAI-T of all respondents. Forty students were assigned to the low-depressive

Table 1
Results of Self-Questionnaires for Low and High Depressive Groups

		Low Depressive Group		High Depressive Group	
		M	*SD*	*M*	*SD*
	BDI-II	8.60	5.83	21.45	4.72
	STAI-T	48.15	5.23	53.55	4.83
Pre-Questionnaires	PANAS PA	26.80	7.59	25.80	6.49
	PANAS NA	19.30	8.84	20.55	8.26
	STAI-S	33.89	5.17	37.53	8.41
Post-Questionnaires	PANAS PA	24.72	9.51	26.35	6.56
	PANAS NA	17.94	7.97	20.00	9.01
	STAI-S	37.25	8.28	36.32	8.39
	VAS-M	5.95	2.84	6.25	1.62
	VAS-S	3.80	2.17	3.35	1.95

Note. BDI-II = Beck Depression Inventory-II, STAI-T = State-Trait Anxiety Inventory-Trait, PA = Positive Affect, NA = Negative Affect of PANAS = Positive Affect and Negative Affect Schedule; STAI-S = State-Trait Anxiety Inventory-State; VAS-M = Visual Analogue Scale for motivation in conducting the task; VAS-S = Visual Analogue Scale for stress in conducting the task.

(LD) group (n = 20) and high-depressive (HD) group (n = 20), using scores obtained on the BDI-II. The LD group (10 males, mean age = 22.20 ± 1.99 years) had minimal depression scores (M = 7.30, SD = 3.45), whereas the HD group (8 males, mean age = 21.95 ± 2.50 years) had moderate to severe depression scores (M = 22.75, SD = 2.36). There was a significant difference in the BDI-II scores between the two groups (M = 8.60, SD = 5.83 in the LD group; M = 21.45, SD = 4.72 in the HD group, $F(1, 38) = 273.26$, MSE = 4.45, $p < .001$) and no difference in the STAI-T scores between the two groups (M = 48.15, SD = 5.23 in the LD group; M = 53.55, SD = 4.83 in the HD group, $F(1, 38) = 11.50$, MSE = 7.67, *n.s.*). Table 1 shows the results of the self-questionnaires for the two groups.

Materials

Self-questionnaires

Beck Depression Inventory-II (BDI-II). The Beck Depression Inventory-II (BDI-II; Beck et al., 1996) measures the individual's current

depressive level. This inventory consists of 21 statements with responses ranging from 0 (“not at all”) to 4 (“very much so”). The scores range from 0 to 63. The level of depression was rated minimal (0-13), mild (14-19), moderate (20-28), or severe (29-63). We used the Korean version of the BDI-II (Kim, Lee, & Lee, 2007). Cronbach’s α in the current study was .76. This scale has been used in selected subjects. Based on their BDI-II scores, we classified the respondents into either the LD or HD group, and assessed them to be at the minimal or moderate level. The LD group's BDI-II scores belonged to the minimal range, and the HD group's BDI-II scores belonged to the severe range. Moreover, the participants in the LD group are considered currently not depressed in accordance with the BDI-II results in this study.

State-Trait Anxiety Inventory-Trait (STAI-T). The State-Trait Anxiety Inventory-Trait (STAI-T) is a subscale of the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983), which measures trait anxiety. This inventory consists of 20 statements with responses ranging from 1 (“not at all”) to 4 (“very much so”). The scores range from 20 to 80, with the higher scores indicating greater trait anxiety. We used the Korean version of the STAI-Trait. Cronbach’s α in the current study was .76. This scale has been used in selected subjects.

State-Trait Anxiety Inventory-State (STAI-S). State-Trait Anxiety Inventory-State (STAI-S) is a subscale of the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983) that measures state anxiety. This inventory consists of 20 statements with responses ranging from 1 (“not at all”) to 4 (“very much so”). The scores range from 20 to 80, with the higher scores indicating greater state anxiety. We used the Korean version of the STAI-State. Cronbach’s α in the current study was .72.

Positive Affect and Negative Affect Schedule (PANAS). The Positive Affect and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) consists of two subscales, namely, positive affect and negative affect, each consisting of 10 items. The items on the PANAS are measured using a 5-point scale ranging from 1 (“not at all”) to 5 (“extremely”). The scores range from 10 to 50 for positive and negative affect, respectively. We used the Korean version of the PANAS, and Cronbach’s α in the current study was .89 for the positive affect subscale and .92 for the negative affect subscale.

Visual analogue scale (VAS). The Visual analogue scale (VAS; Huskisson, 1983) is a psychometric scale measuring subjective characteristics or attitudes. The scores for items on the VAS were obtained through a continuous line between two end-points, ranging from 0 (“none”) to 10 (“very strong”). The respondents could indicate their subjective responses on a

point along the line. The motivation levels regarding participation in this experiment and the stress evoked by the experiment were each assessed through a specific item on the VAS. A higher score meant greater motivation and stress levels.

Stimuli

In this study, we used the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005), classified by valence (positive and negative) and arousal (high and low) of affect. We had a primary selection of 73 picture stimuli that were used in a previous study (Vogt, De Houwer, & Koster, 2008). We asked the participants, namely, 28 students majoring in psychology, to rate the stimuli on valence (ranging from 1 ("negative feeling") to 10 ("positive feeling")) and arousal (ranging from 1 ("relaxation") to 10 ("arousal")). The valence and arousal of these pictures were rated to determine the level and type of stimuli for the experiment. Based on the allocated rating, we conducted second choosing for the experiments involving 30 undergraduate students. We finally selected 12 pictures, with 3 pictures from each category (e.g., positive-high arousal, positive-low arousal, negative-high arousal, and negative-low arousal). See Table 2.

Task

We conducted a verbal estimation task that involved asking the participants to estimate the duration of the presented stimuli. In this task, a cross fixation appeared for 1000 ms in the middle of a screen, following this, each of the selected pictures appeared for 4 seconds in random order. After the pictures disappeared, this question appeared in the middle of the screen: "How much time has passed from the moment you initially saw the previous picture?" The participants were asked to provide, as specifically as possible, a verbal reply in milliseconds, and the researchers manually recorded the participants' responses. The verbal response served as our measure of 'subjectively

Table 2
Summary of Results from Picture Stimuli by Valence and Arousal

		positive-high arousal	positive-low arousal	negative-high arousal	negative-low arousal
valence	*M*	7.06	6.86	2.14	3.07
	SD	2.70	3.64	2.11	2.19
arousal	*M*	6.54	3.49	7.28	4.29
	SD	2.46	3.48	3.47	3.84

perceived time' in the present study. The main task consisted of a total of 72 trials following 10 practice trials. The task took approximately 20 minutes. In a previous study (Cocenas-Silva, Bueno, & Droit-Volet, 2012), the participants learned that 4 seconds was the standard time and then judged whether the presented time of the target stimulus was shorter or longer than the standard time in the main task. In our study, however, the presented time of the stimuli was limited to 4 seconds because the pilot study revealed that a duration of less than 4 seconds was not enough time to be aware of the valence and arousal of our emotional stimuli and because we received feedback that the participants could not continue to see a stimuli for more than 4 seconds due to decreasing concentration and increasing visual and mental fatigue.

Procedures

The experiments were conducted individually in a quiet laboratory. When the participants arrived, they were asked to complete the consent form and questionnaires, which included the PANAS and STAI-S. The subjects had been informed about the task and the methods that would be used before completion of the verbal estimation task. After the task, the participants were asked to complete the questionnaires, including the PANAS, STAI-S, VAS-M, and VAS-S. Finally, the participants were debriefed and received approximately $3 as a reward for participating.

Data analysis

To determine time distortion, the data from the verbal estimation task were used to calculate the modified time-corrected score. The time-corrected score, indicating the time distortion index, was computed by subtracting the actual presentation time from the subjectively perceived time. A recent study (Kim & Lee, 2012) revealed that people generally underestimate the time by 0.5 seconds during a verbal estimation task. We corrected this by adding 0.5 seconds. The use of a time-corrected score of a normal person would allow for the easy comparison of time distortion between the LD and HD groups during the verbal estimation task. Accordingly, we used the formula, "modified time-corrected score = subjectively perceived time - actual presentation time + 0.5" to determine the time distortion. A modified time-corrected score of zero indicates the time distortion for the general population. A greater distance from the zero point indicates a greater distortion of time perception compared to the normal population. A positive time-corrected score indicates that the participants perceive the duration as longer compare to normal persons. A negative time-corrected score indicates that the participants perceive the duration as shorter compared to normal persons.

To determine the statistical significance of the differences between the two groups, mixed analysis of variance (ANOVA) was conducted with one between-subject variable, the groups (LD, HD), and two within-subject variables, valence (positive, negative) and arousal (high arousal, low arousal). Additionally, a paired samples *t*-test was used to analyze the main results as well as the results obtained from the self-questionnaires. All of the statistical data were analyzed using SPSS 17.0 for Windows.

Results

Self-questionnaires

In Table 2, there were no significant differences between the groups on positive emotions, negative emotions, state anxiety, motivation, and stress (all $p > .05$). This result indicated that the groups did not differ significantly with respect to their emotional and psychological states. Furthermore, there were no significant differences between the pre- and post-task results for positive affect, negative affect, and state anxiety for either group (all $p > .05$). This finding indicated that participation in the experiment did not affect the levels of the participants' emotions or state of anxiety for either of the groups.

Verbal estimation task

We conducted 2 (the groups: LD, HD) × 2 (valence: positive, negative) × 2 (arousal: high arousal, low arousal) mixed ANOVA to examine the effects of valence and arousal on the modified time-corrected scores between the LD and HD groups. The results showed significant interactions among the groups, arousal, and valence ($F(1, 38) = 4.13$, $MSE = .01$, $p < .05$, $\eta^2 = .10$). To examine this interaction in more detail, the effects of arousal and valence were examined separately within each group.

As shown in Figure 1, in the LD group, the interaction effect between valence and arousal was significant ($F(1, 19) = 5.33$, $MSE = .02$, $p < .05$, $\eta^2 = .22$). Furthermore, a main effect of arousal ($F(1, 19) = 14.06$, $MSE = .03$, $p = .001$, $\eta^2 = .43$), and valence ($F(1, 19) = 20.42$, $MSE = .11$, $p < .001$, $\eta^2 = .52$) was found. In the follow-up analyses, the LD group indicated that a shorter time had passed during which they were exposed to the positive-low arousal pictures instead of the positive-high arousal pictures ($t(19) = -3.78$, $p = .001$). However, there was no significant difference between the negative-low-arousal and negative-high-arousal conditions ($t(19) = -.58$, *ns*). Additionally, this group perceived a shorter time in the negative-low-arousal than in the positive-low-arousal condition ($t(19) = 2.67$, $p < .05$) and in the negative-high-arousal than in the positive-high-arousal condition ($t(19) = 4.13$, p

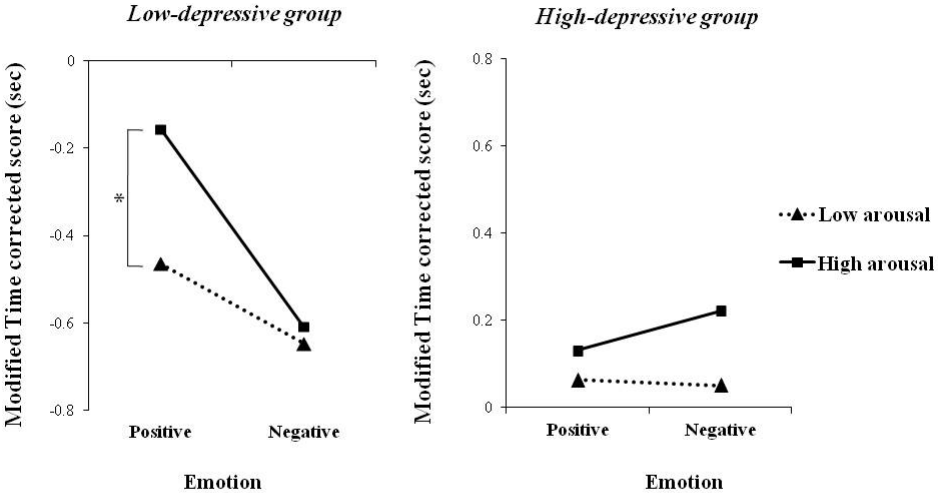

Figure 1. Patterns of time distortion in high-depressive and low-depressive groups

= .001).

In the HD group, the interaction effect between valence and arousal was not significant ($F(1, 19) = .53$, $MSE = .00$, *n.s*). This finding suggested that, contrary to the LD group, the HD group perceived the duration as longer, regardless of valence and arousal. Furthermore, the main effect of valence and arousal was not significant ($F(1, 19) = .16$, $MSE = .00$, *ns.* for valence, $F(1, 19) = 3.65$, $MSE = .02$, p = *.ns.* for arousal). These results indicated that the depressive persons were not affected by valence and arousal.

The significant interactions found between the groups and valence ($F(1, 38) = 8.54$, $MSE = .03$, $p < .01$, $\eta^2 = .18$) indicated that the HD group perceived longer durations in the negative rather than positive condition, whereas the LD group perceived shorter durations in the negative rather than the positive condition. No significant interactions were found for valence and arousal, ($F(1, 38) = .84$, $MSE = .00$, *n.s.*), or arousal and the groups ($F(1, 38) = .48$, $MSE = .00$, *n.s*). These results suggest that neither valence and arousal, nor depressive level and arousal affected the time perception differently.

The results yielded a main effect of the groups ($F(1, 38) = 14.92$, $MSE = .02$, $p < .001$, $\eta^2 = .34$), indicating that the HD group perceived the duration as longer compared with the LD group. Additionally, the main effects of arousal ($F(1, 38) = 14.18$, $MSE = .02$, $p = .001$, $\eta^2 = .27$) and valence ($F(1, 38) = 5.17$, $MSE = .02$, $p < .05$, $\eta^2 = .12$) were found, indicating that the participants perceived a longer duration at high arousal than low arousal, as well as in the positive as opposed to the negative condition.

Discussion

This study examined arousal and valence as factors affecting time perception among depressed individuals. To accomplish this task, four types of pictures depending on the different levels of valence and arousal were presented to the HD and LD groups. The participants performed a verbal estimation task that measured subjective duration. The main finding of this study is that valence and arousal affect time perception differently for the LD and HD groups. The overestimation of perceived time indicated that the participants believed that more time had passed when they were asked to recall the duration. The terms of overestimation and underestimation are based on the T value converted in this paper. They also felt that time had passed slowly during the actual experience.

First, there was a clear difference between the two groups in terms of patterns of time perception. The HD group perceived the overestimated time more than the LD group, regardless of valence and arousal. This observation indicated that the HD group may have perceived time as passing more slowly compared with the LD group. According to previous studies (Bschor et al., 2004; Gil & Droit-Volet, 2009), the depressive patients perceived that there was a slow duration, a phenomenon that was attributed to psychomotor retardation among depressive patients (American Psychiatry Association, 2000; Blewett, 1992).

Second, the current study compared time perception between the two groups based on valence and arousal levels. The LD group underestimated time perception in both conditions in accordance with previous studies (Burle & Casini, 2001; Treisman, 1963) and may have demonstrated a particularly greater underestimation of time perception in the low-arousal condition. This result could reflect the effect of arousal on time distortion, as indicated in the internal clock model. The time perception of the HD group, however, was not affected by arousal. This result suggested that the depressive group was less sensitive to stimuli evoking arousal.

The current study assumed that time perception may be different for the two groups due to differences in the recognition of emotions. The LD group underestimated duration more in the negative condition than the positive condition. This result signified that the valence could influence the time perception and has been demonstrated only for people who do not present depressed symptoms in this study. However, there was no difference in time perception based on valence for the HD group, indicating that this group's emotional experience had not changed after viewing the pictures. This finding could be due to the limited experience of emotion in the case of depressive persons after viewing emotional pictures (Bylsma et al., 2008), which meant that their perception of time was not affected by valence or arousal. The

differences between the effects of positive and negative stimuli on time perception were observed for the LD group, indicating greater changes in this group's emotional experiences than in the HD group's emotional experiences after viewing the pictures.

Finally, when the participants' responses on the time estimation task were compared with the scores obtained by normal persons for time perception (the zero point of the modified time-corrected score), the HD group perceived a longer duration for all types of pictures, which means that this group had a slow time distortion compared to normal persons. In contrast, the LD group perceived a shorter time for all types of pictures, which indicated that this group has fast time distortion compared to normal persons. It is argued that the time perception patterns for the participants in this study differ from those time perception patterns in the normal population because the participants in a previous study (Kim & Lee, 2012) included both depressive and non-depressive persons. The participants in the current study included two groups that were divided according to upper and lower depression scores.

Although the current study confirmed the influence of arousal and valence on time perception, particularly among depressed individuals, this study has several limitations. First, there is the likelihood of habituation or the practice effect of a task. The duration of the stimuli presented to participants was fixed at 4 seconds, which is not a sufficient period to measure time perception because it is difficult to identify how the time perception changes during shorter or longer durations than 4 seconds. The participants might use the strategy of counting for a fixed duration. Additionally, there may be the effect of habituation or practice effect on duration by repeatedly presenting the stimuli rather than the effects of the stimuli itself, namely, valence and arousal. In additional investigations to establish the ecological validity of time perception, the trials need to constitute more elaborate tasks by presenting various time durations of stimuli. Despite these limitations, this study has significantly expanded the scope of previous studies. The preceding studies identified that time perception was based on two factors (i.e., depression and valence, depression and arousal), whereas the current study considered three factors (i.e., depression, valence, and arousal) on time perception. Accordingly, the current study revealed a difference in time perception between the LD and HD groups, suggesting that a depressed state may affect time perception. Second, we screened the participants using the depressive scale BDI- II, which reflected the state of depression at the time because no follow-up measures were undertaken. Additionally, the HD group included individuals with moderate to severe depression. Therefore, the time perception of the HD group in this study is not necessarily the same for a

clinically depressed group. Further research must examine the applicability of the current findings to a clinically depressed group. Third, the stimuli used to provoke negative affect were not the same emotional stimuli that had an effect on depressive persons. In this study, we used pre-validated stimuli (i.e., the IAPS), which included pre-rating for valence, and some pictures provoking disgust or fear elicited strong responses not only from highly depressive persons, but also from those with low-depression levels. Because the individuals with depressive symptoms have a stronger response to pictures provoking depression, sadness, or anger than non-depressed individuals (Victor, Furey, Fromm, Ohman, & Drevets, 2010), additional studies must select depression-specific stimuli. Fourth, several extraneous variables affected the participants' performance in the experiment and may have changed the motivation or concentration during the experiment over time because the participants had to focus on the pictures presented on the monitor. Therefore, additional studies may be needed to devise a way to maintain or enhance the continued motivation and concentration.

In summary, the current study examined the effects of arousal and valence factors on time perception among depressive persons. We conducted a verbal estimation task that involved the presentation of pictures that are known to elicit valence and arousal. The results showed some possibilities of slow time distortion among individuals with high depressive levels, and fast time distortion in the negative rather than positive condition. Additionally, compared to the low-arousal condition, the high-arousal condition led to slow time distortion. Based on these results, we suggested that more studies be conducted to evaluate ways to correct slow time distortion among depressive persons when they are experiencing negative emotions to help alleviate their pain. The results indicated that depressive persons may perceive duration to be slower than their non-depressive counterparts, which has led to the understanding that there is a relationship between depression and slow time distortion. Thus, if slow time distortion is corrected among depressive persons, that is, if they perceive the duration as fast, then the pain resulting from depression could be remedied. Furthermore, reconstruction of duration during emo tional experiences can be coupled with psychological therapy, which would lead to faster time perception during emotional experiences in this group, thereby helping them escape the vicious cycle of depression.

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