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Debilitative and Facilitative Perception of Trait and State Anxiety and Their Relationships to Self-confidence among Undergraduate Students on a Serial Addition Task

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Abstract

The first purpose of the present study was to examine the relationship between the intensity (i.e., level) and direction (i.e., debilitative/facilitative) of state anxiety in predicting a serial addition task performance. Participants rated the degree to which the intensity of each anxiety symptom was either debilitative or facilitative to subsequent performance. The second purpose of the present study was to examine the effect of the intensity and direction of trait anxiety on the intensity and direction of state anxiety. A total of 502 undergraduate students (170 females, 332 males) completed the State Trait Anxiety Inventory, the modified Competitive State Anxiety Inventory-2, and each direction scale prior to the task. Performance measures comprised of computational speed, percentage of correct answers, and percentage of correct counted numbers of beep tones. Participants were divided into high/low and debilitative/facilitative groups, based on their intensity and direction scores of trait anxiety. Four groups were created; high-debilitative (n = 256), high-facilitative (n = 93), low-debilitative (n = 31), and low-facilitative (n = 63). The intensity of trait anxiety, state anxiety, cognitive anxiety, and somatic anxiety showed negative linear correlations with each direction of these anxieties. The intensity of self-confidence was negatively correlated with the intensity of trait and state anxieties, whereas, it was positively related to the direction of these anxieties. Unlike previous studies using sport performance, the present cognitive computational task performance measures did not reveal significant relationships with the intensity and direction of these anxieties and self-confidence. Furthermore, there were individual differences in the intensity and direction of trait anxiety, and both the intensity and direction of trait anxiety influenced the intensity and direction of state anxiety separately. These findings systematically replicate previous studies with regard to the significant relationships between the self-report measures of the intensity and direction of trait anxiety, state anxiety, cognitive anxiety, somatic anxiety, and self-confidence. Future studies should use another cognitive task with a higher level of difficulty to test the utility of the intensity and direction model of trait and state anxieties in a non-sport performance context.

Keywords

State-trait Anxiety; Cognitive and Somatic Anxiety; Self-confidence; Intensity; Direction; Serial Addition Task

Introduction

A number of studies have examined the concept and assessment of anxiety theoretically over the years. Anxiety is an unpleasant and aversive state, and it might have a biological significance (Eysenck, 1992). Spielberger (1966) identified two kinds of anxiety, and differentiated state anxiety and trait anxiety. State anxiety reflects a transient emotional state or a condition that is characterized by subjective conscious perceived feelings of tension and apprehension, and gives rise to autonomic nervous system activity simultaneously. It may fluctuate and can vary in intensity. In contrast, trait anxiety refers to a general tendency to respond with anxiety to perceived threats in the environment. It is a relatively stable characteristic of individuals. Individuals with higher trait anxiety feel more threats in many situations than someone with lower trait anxiety. In addition, anticipated failure or threats to self-esteem can be more damaging than threats to physical condition. As regards the relationships among trait anxiety, state anxiety and performance, Eysenck (1992) expressed that state anxiety is produced interactively by trait anxiety and situational stress, and then the level of

performance is determined by state anxiety. To assess two different types of anxiety, Spielberger et al. (1970) developed the State-Trait Anxiety Inventory (the STAI). Individuals with higher trait anxiety scores on the STAI tend to have higher state anxiety scores, and indicate that they feel more threats regardless of the objective danger in circumstances. State anxiety scores should be low in non-stressful situations or in situations where dangers are not perceived as threat (Spielberger, 1972). Scores on the STAI indicate the intensity of anxiety, and they were viewed as detrimental to performance. However, considering Yerkes-Dodson's law (Yerkes, & Dodson, 1908), performance improves as the intensity increases, but performance deteriorates if the intensity becomes too high. Thus, the intensity of state anxiety does not necessarily have negative effects. Research still lacks consistent results on the explanation of relationship among state anxiety, trait anxiety and performance.

In the field of sport psychology, a number of studies attempted to explain the relationship between anxiety and performance, using the Competitive State Anxiety Inventory (the CSAI, CSAI-2) (Martons, Burton, Vealey, Bump, & Smith, 1990). The CSAI-2 is designed to measure cognitive anxiety, somatic anxiety, and self-confidence, affecting sport performance differently, and is more sensitive scales in sports than the STAI. Cognitive anxiety refers to negative expectations, cognitive concern about oneself or performance, anticipated failure, and negative self-evaluation. Somatic anxiety refers to one's perception of the physiological elements of anxiety, which arises from autonomic arousal. Self-confidence was regarded as a factor that emerged at opposite ends of cognitive anxiety (Martons, Burton, Vealey, Bump, & Smith, 1990). Cognitive and somatic anxiety had a positive linear relationship, and cognitive anxiety and somatic anxiety had inconsistent relationships with self-confidence (Chamberlain, & Hale, 2007; Kais, & Raudsepp, 2004; Kais, & Raudsepp, 2005; Raudsepp, & Kais, 2002; Swain, & Jones, 1996). As regards the relationships among cognitive anxiety, somatic anxiety, self-confidence, and sport performance, cognitive anxiety and self-confidence were stronger predictors of performance than somatic anxiety, because somatic anxiety symptoms were hypothesized to disappear at the onset of competition (Martons, Burton, Vealey, Bump, & Smith, 1990). Multidimensional Anxiety Theory (Martons, Burton, Vealey, Bump, & Smith, 1990) hypothesized that, cognitive anxiety would show a negative linear relationship, self-confidence would show a positive linear relationship, and somatic anxiety would show an inverted-U relationship with performance. Many inconsistent findings were reported (Chamberlain, & Hale, 2007; Kais, & Raudsepp, 2004; Kais, & Raudsepp, 2005; Raudsepp, & Kais, 2002; Swain, & Jones, 1996), but Craft et al's finding (Craft, Magyar, Becker, & Feltz, 2003) showed that self-confidence was most strongly and consistently related to performance.

On the other hand, some researches argued that the CSAI-2 measured only the intensity of anxiety symptoms, and demonstrated that the intensity of cognitive and somatic anxiety was not necessarily negative and detrimental to performance (Jones, & Cale, 1989; Jones, Swain, & Hardy, 1993; Parfitt, & Hardy, 1993). Jones and Swain (1992) proposed another dimension to predict sport performance, which referred to the direction, that is, the individual's positive or negative interpretation of perceived anxiety symptoms. Individuals with same intensity score of anxiety might have different interpretations of direction. So, the direction scale, which measures the degree to which the intensity of anxiety symptom was either debilitative or facilitative to subsequent performance, was added to the CSAI-2 (Jones, & Swain, 1992). Jones and his colleagues (Jones, Swain, & Harwood, 1996; Swain, & Jones, 1996) showed that intensity and direction of cognitive and somatic anxiety had negative correlations. And the intensity of cognitive and somatic anxieties had negative correlations with the intensity of self-confidence. Furthermore, the direction of cognitive and somatic anxiety had positive correlations with the intensity of self-confidence. Some studies have revealed a consistent pattern of results in comparisons between elite and non-elite performers (Jones, & Swain, 1995; Jones, Hanton, & Swain, 1994), high and low competitive individuals (Jones, & Swain, 1992), good and poor performers (Jones, Swain, & Hardy, 1993) and positive and negative goal experience groups (Jones, & Hanton, 1996). Although the intensity of symptoms between these groups had no significant differences, the elite performers, high competitive individuals, good performers, and members of the positive goal expectancy group reported significantly more facilitative interpretations of anxiety symptoms than their comparison groups. Another study showed that the direction subscale scores accounted for a larger portion of performance variance (42 %) than intensity subscale scores (22 %) (Chamberlain, & Hale, 2007), thus direction of anxiety was a better predictor of performance than intensity of anxiety.

However, most of these findings are limited to sport situations. The first purpose of the present study was to examine the relationship between intensity and direction of state anxiety in predicting performance in other fields than sport, using the STAI with a direction scale on a serial addition task. Specifically, the present study focused on a cognitive task. The second purpose of the present study was to examine the effect of the intensity and direction of trait anxiety on the intensity and direction of state anxiety. State anxiety, which is produced by trait anxiety and situational stress, affects the level of performance. For these purposes, I modified the CSAI-2 for use in a cognitive task situation and measured the intensity and direction of the STAI and the modified CSAI-2. I examined the relationships among the intensity and direction of trait anxiety, state anxiety, cognitive anxiety, somatic anxiety, and self-confidence under stress situation. In this study, the stress situation was manipulated by a serial addition task. I measured computational speed, percentage of correct answers, and percentage of the correct counted numbers of beep tones as measures of cognitive performance. My hypotheses for the first purpose were that: (1) the relationships between the intensity and direction of trait anxiety, state anxiety, cognitive anxiety, and somatic anxiety would be negatively and linearly correlated, (2) the direction of state anxiety would correlate positively with self-confidence and performance. Hypotheses for the second purpose were that: (3) individuals with high intensity of trait anxiety would interpret anxiety symptoms as more debilitative than those with low intensity, while, individuals with low intensity of trait anxiety would interpret anxiety symptoms as more facilitative than those with high intensity, and (4) individuals with high trait anxiety and a debilitative interpretation would evaluate state anxiety symptoms most strongly and interpret them as most debilitative, consequently, their performance would deteriorate.

Methods

Participants

A total of 502 undergraduate students attending two psychology classes at a university in Japan volunteered to participate in the study (age: 18–41 years, M = 19.3 years; 170 females, 332 males). All participants signed informed consent including a detailed explanation of the purpose and procedures of the study.

Measures

1）The STAI

The Japanese version of the STAI (Shimizu, & Imae, 1981) was comprised of 20 items to assess intensity of anxiety, which was rated on four-point Likert-scales ranging from 1 (“not at all”) to 4 (“very much so”). Thus, total intensity scores of the STAI ranged from 20 to 80.

2）The CSAI-2

The Japanese version of CSAI-2 (Hashimoto, Tokunaga, Tatano, & Kanezaki, 1984) was comprised of 27 items, with nine items in each of three subscales of cognitive anxiety, somatic anxiety, and self-confidence. The intensity of each subscale was rated on four-point Likert-scales ranging from 1 (“not at all”) to 4 (“very much so”). Thus, total intensity scores of each subscale ranged from 9 to 36. The Japanese version of CSAI-2 was adapted for task performance situation, and then it was named the CSAI-2T. I replaced the word “competition” in Item 1, 7 with “task”, and also the word “losing” in Item 10 with “failing”. The English-Japanese translation was based on Hashimoto et al. (Hashimoto, Tokunaga, Tatano, & Kanezaki, 1984).

3）The Direction Scale

The direction scale developed by Jones and Swain (1992) was rated according to the degree to which the experienced intensity of each symptom was either debilitative or facilitative to subsequent performance, on seven-point Likert-scales ranging from -3 (“very debilitative”) to +3 (“very facilitative”). Thus, total direction score of the STAI ranged from -60 to +60, and that of the CSAI-2T ranged from -27 to +27.

4）The TAI

The Japanese version of the Test Anxiety Inventory (the TAI) (Iwaki, & Araki, 1989) to assess test anxiety as a situation-specific trait was also used, which measured worry and emotionality in an examination situation. The TAI comprised 20 items, rated the degree to which specific symptoms of anxiety experienced before, during and after an examination, on four-point Likert-scales ranging from 1 (“almost never”) to 4 (“almost always”). Thus, total score of the TAI ranged from 20 to 80.

5）Performance Task and Measures

Performance task was a serial addition task, which contained 12 lines of random single digit,

horizontally aligned 30 numbers. Participants were required to add adjacent single digits and write a unit digit of the answer correctly as fast as possible for three minutes. At the same time, they were required to put a mark on musical notes printed on the upper part of paper each time when they heard a beep tone. This additional task was designed to distract attention from the serial addition task to make it difficult. The beep tones which were 1000 Hz and 70 db were sounded eight times per minute randomly from eight speakers. Participants' performance was measured in terms of computational speed (180 sec/the number of answers), percentage of correct answers, and percentage of the correct counted numbers of beep tones.

6）Procedure

The investigation was conducted for two days because we manipulated intensity of participants' anxiety using a serial addition task. On the first day, all participants were told a detailed explanation of the purpose and procedures of the study and signed informed consent. And then they evaluated the intensity and direction of state-trait anxiety of the STAI to assess as a usual situation. Also they responded to the TAI, because the score of TAI was used on a subsequent analysis. On the second day, that is, a week after the first day, they initially evaluated the intensity and direction of state anxiety of the STAI to establish a baseline. After an instruction for the serial addition task they practiced it for a minute. Just prior to the serial addition task for three minutes, they re-evaluated the intensity and direction of state anxiety of the STAI and the CSAI-2T. After the serial addition task they evaluated the intensity and direction of state anxiety of the STAI once again.

Results

Prior to the data analyses for the first purpose, I examined the reliability and validity of the CSAI-2T in which three items were modified from the original CSAI-2. And I also examined those of each direction scale because it was used together with the CSAI-2T or the STAI for the first time. Excluding the participants with missing values in their data, a total of 489 remaining participants comprised the final group.

The CSAI-2

Table 1 shows the descriptive statistics for the CSAI-2T. For the internal consistency reliability of the CSAI-2T, the Cronbach's alphas for the intensity and direction subscales of the CSAI-2T ranged from 0.88 to 0.91, respectively, indicating high levels of internal consistency. Table 2 shows the correlations among the CSAI-2T subscales, state anxiety, and the TAI. To examine the criterion validity of the CSAI-2T, Pearson's product-moment correlation coefficients were calculated between the CSAI-2T subscales and the state subscale of the STAI. Both the cognitive and somatic anxiety intensity subscales of the CSAI-2T moderately and positively correlated with the state subscale of the STAI (ps < 0.01). On the other hand, self-confidence intensity was moderately and negatively related to the state subscale of the STAI (ps < 0.01). To examine the construct validity of the CSAI-2T, the correlation coefficients were calculated between the CSAI-2T subscales and the TAI. Both cognitive and somatic anxiety intensity subscales of the CSAI-2T weakly and

TABLE 1 DESCRIPTIVE STATISTICS FOR THE CSAI-2T

subscale	*M*	*SD*	α
Cognitive anxiety			
Intensity	15.65	5.68	0.88
Direction	-1.85	9.92	0.83
Somatic anxiety			
Intensity	14.97	4.77	0.88
Direction	-.45	10.08	0.91
Self-confidence			
Intensity	19.06	5.90	0.90
Direction	5.06	9.78	0.91

Notes. CSAI-2T = Competitive State Anxiety Inventory-2 for task. α = Cronbach's alpha coefficient.

TABLE 2 CORRELATIONS AMONG THE CSAI-2T SUBSCALES, STATE ANXIETY, AND THE TAI

subscale	State anxiety	Test anxiety
Cognitive anxiety		
Intensity	0.35**	0.30**
Direction	-0.15**	-0.08
Somatic anxiety		
Intensity	0.43**	0.29**
Direction	-0.18**	-0.07
Self-confidence		
Intensity	-0.49	-0.18**
Direction	-0.43**	-0.12**

Notes. CSAI-2T = Competitive State Anxiety Inventory-2 for task; TAI = Test Anxiety Inventory. ** $p < 0.01$, *$p < 0.05$.

TABLE 3 DESCRIPTIVE STATISTICS FOR THE STAI

	M	*SD*	α
Trait anxiety			
Intensity	48.14	10.65	0.88
Direction	-2.60	16.97	0.86
State anxiety			
Intensity	43.72	10.27	0.89
Direction	3.86	19.03	0.92

Notes. STAI = Sate-Trait Anxiety Inventory. α = Cronbach's alpha coefficient.

positively correlated with the TAI (p < 0.01). On the other hand, self-confidence intensity was negatively related to the TAI (p < 0.01). These results are congruent with the previous researches (Chamberlain, & Hale, 2007; Kais, & Raudsepp, 2004; Kais, & Raudsepp, 2005), and consequently support hypothesis 1.

The Direction Sales of the STAI and CSAI-2T

Table 3 (see, p160) shows the descriptive statistics for the STAI. For the internal consistency reliability of the direction of the STAI, the Cronbach's alphas for the intensity and direction scales of both state and trait anxiety ranged from 0.86 to 0.92, respectively, indicating high levels of internal consistency. Table 4 shows the correlation of the intensity and direction of the STAI subscales and the CSAI-2T subscales. To examine the construct validity of each direction scale of the STAI and the CSAI-2T, the correlation coefficients were calculated between the STAI subscales and the CSAI-2T subscales. Each intensity subscale of trait anxiety, state anxiety, cognitive anxiety and somatic anxiety was negatively correlated with each direction subscale of them (ps < 0.01). The intensity subscale of self-confidence was negatively related to each intensity subscales of trait anxiety, state anxiety, cognitive anxiety, and somatic anxiety (ps < 0.02), whereas, was positively related to each direction of them (ps < 0.01). These results are congruent with the previous researches (Chamberlain, & Hale, 2007; Kais, & Raudsepp, 2004; Kais, & Raudsepp, 2005), and consequently support hypothesis 1.

The Relationships Among the STAI, the CSAI-2T, and Performance Measures

Mean of the computational speed was one second per one answer. Both means percentages of correct answers and correct counted numbers of beep tones were very high, and were 96.69 % and 99.60 %, respectively (see, Table 7). Table 5 shows the correlations among three performance measures, the intensity and direction of the STAI subscales and the

TABLE 4 CORRELATIONS BETWEEN THE INTENSITY AND DIRECTION SUBSCALES OF THE STAI AND THE CSAI-2T

		Trait		State		Cognitive		Somatic		Self-confidence	
		Intensity	Direction	Intensity	Direction	Intensity	Direction	Intensity	Direction	Intensity	Direction
Trait	Intensity										
	Direction	-0.49**									
State	Intensity	0.46**	-0.22**								
	Direction	-0.34**	0.46**	-0.51**							
Cognitive	Intensity	0.32**	-0.11**	0.35**	-0.14**						
	Direction	-0.19**	0.36**	-0.15**	0.57**	-0.20**					
Somatic	Intensity	0.30**	-0.07	0.43**	-0.20**	0.73**	-0.16**				
	Direction	-0.21**	0.33**	-0.18**	0.63**	-0.15**	0.87**	-0.20**			
Self-confidence	Intensity	-0.31**	0.26**	-0.49**	0.34**	-0.11*	0.23**	-0.16**	0.24**		
	Direction	-0.28**	0.25**	-0.43**	0.54**	-0.29**	0.35**	-0.30**	0.35**	0.48**	

Notes. CSAI-2T = Competitive State Anxiety-2 for task; STAI = State-Trait Anxiety Inventory; Trait = Trait Anxiety; State = State Anxiety; Cognitive = Cognitive Anxiety; Somatic = Somatic Anxiety. ** p < 0.01, *p < 0.05.

TABLE 5 CORRELATIONS AMONG THREE PERFORMANCE MEASURES, THE INTENSITY AND DIRECTION OF THE STAI SUBSCALES AND THE CSAI-2T SUBSCALES

	Trait		State		Cognitive		Somatic		Self-confidence	
	Intensity	Direction	Intensity	Direction	Intensity	Direction	Intensity	Direction	Intensity	Direction
Computational Speed	0.11*	-0.06	0.07	0.03	0.10*	0.01	0.01	0.03	-0.14**	-0.11*
Computational Accuracy	0.01	0.01	-0.03	0.05	-0.04	0.02	-0.03	0.02	0.06	0.06
Sound Accuracy	-0.03	0.04	-0.04	-0.01	-0.03	0.00	-0.06	0.01	0.03	0.04

Notes. STAI = State-Trait Anxiety Inventory; CSAI-2T = Competitive State Anxiety-2 for task; Trait = Trait Anxiety; State = State Anxiety; Cognitive = Cognitive Anxiety; Somatic = Somatic Anxiety. Computational Speed = 180 seconds/the number of answers (sec); Computational Accuracy = percentages of correct answers (%); Sound Accuracy = percentages of correct counted numbers of beep tones (%). ** p < .01, *p < .05.

TABLE 6 MEANS AND SDS OF THE INTENSITY AND DIRECTION OF STATE ANXIETY, COGNITIVE ANXIETY, SOMATIC ANXIETY, AND SELF-CONFIDENCE FOR THE FOUR TRAIT ANXIETY GROUPS

	Group	High		Low	
		Debilitative	Facilitative	Debilitative	Facilitative
	n	256	93	31	63
state	intensity	45.58 (9.31)	45.31 (9.75)	37.10 (9.38)	36.67 (10.60)
	direction	−1.95 (16.69)	10.58 (18.46)	6.00 (14.73)	18.46 (20.56)
cognitive	intensity	16.31 (5.60)	16.95 (6.31)	13.55 (4.97)	13.06 (4.19)
	direction	−4.29 (8.68)	1.13 (9.41)	−4.90 (10.75)	3.70 (11.83)
somatic	intensity	15.32 (4.76)	16.12 (4.72)	13.45 (3.99)	12.76 (4.05)
	direction	−3.00 (9.04)	2.38 (9.74)	−2.16 (10.24)	5.27 (11.70)
self-confidence	intensity	17.74 (5.20)	19.75 (6.10)	21.74 (5.18)	22.17 (6.10)

Notes. Trait High = High Intensity Group of Trait Anxiety; Trait Low = Low Intensity Group of Trait Anxiety; Debilitative = Debilitative Direction Group of Trait Anxiety; Facilitative = Facilitative Direction Group of Trait Anxiety. State = State Anxiety; Cognitive = Cognitive Anxiety; Somatic = Somatic Anxiety. The value in a parenthesis shows *SD*.

CSAI-2T subscales. Only the computational speed was significantly and positively correlated with the intensity of trait anxiety and cognitive anxiety (*p*s < 0.05). And also the computational speed was significantly and negatively correlated with the intensity and direction of self-confidence (*p*s < 0.05). These results are different from hypothesis 2.

The Manipulation of State Anxiety

In the present study, a serial addition task to assess the level of participants' anxiety was used, and the intensity and direction of state anxiety were measured three times; baseline, pre phase, and post phase. To examine the effects of phase, I performed one-way repeated measures ANOVA on the intensity and direction scores of state anxiety, respectively. For the intensity, the main effect of phase was significant, F (2, 976) = 18.35, $p < 0.01$, $\eta^2 = 0.36$. A further Bonferroni test revealed that pre phase was significantly higher than baseline and post phase ($p < 0.01$), and baseline was lower than post phase ($p < 0.06$). For the direction, the main effect of phase was significant, F (2, 976) = 10.50, $p < 0.01$, $\eta^2 = 0.21$. A further Bonferroni test revealed that baseline was significantly higher than pre and post phase ($p < 0.01$), whereas, there were no difference between pre and post phase. These results show the levels of intensity and direction of state anxiety were manipulated by a serial addition task as intended.

The Relationships Between the Intensity and Direction of Trait Anxiety

To conduct the data analyses for the second purpose, participants were dichotomized into high/low in terms of the intensity scores and into debilitative/facilitative in terms of the direction scores via median split technique. And four groups (high-debilitative: HD, high-facilitative: HF, low-debilitative: LD, and low-facilitative: LF) were created excluding those participants with either a 40 intensity score or a zero direction score, leaving a total of 443. Each group had 256, 93, 31, and 63 participants, respectively (see, Table 6). To examine whether four distinct groups were formed, I performed two separate two-way MANOVAs with the levels of intensity (high/low) and direction (debilitative/facilitative) as independent variables, on the intensity and the direction scores of trait anxiety as dependent variables. The main effects of the levels of intensity and direction were significant (Wilks Lambda = 0.51, $F(2,438) = 208.44$, $p < 0.01$, $\eta^2 = 0.49$; Wilks Lambda = 0.57, $F(2,438) = 166.67$, $p < 0.01$, $\eta^2 = 0.43$). And the interaction between them was significant (Wilks Lambda = 0.99, $F(2,438) = 3.41$, $p < 0.03$, $\eta^2 = 0.02$). Follow-up between-group (high/low) ANOVA of trait anxiety showed significant differences on the intensity and the direction scores ($F(1,439) = 414.25$, $p < 0.01$, $\eta^2 = 0.49$; $F(1,439) = 14.17$, $p < 0.01$, $\eta^2 = 0.03$). And follow-up between-group (debilitative/facilitative) ANOVA of trait anxiety showed significant differences in the intensity and the direction scores ($F(1,439) = 10.63$, $p < 0.01$, $\eta^2 = 0.02$; $F(1,439) = 330.88$, $p < 0.01$, $\eta^2 = 0.43$), furthermore, the interaction between the levels of intensity and direction was shown only in the intensity score ($F(1,439) = 4.10$, $p < 0.05$, $\eta^2 = 0.01$). A further Bonferroni test revealed that the intensity scores of high group were significantly higher than the low group, and the direction scores of high group were significantly lower than low group ($p < 0.01$). And also, another Bonferroni test revealed that the intensity scores of debilitative group were significantly higher than the facilitative group, and the direction scores of debilitative group were significantly lower than facilitative group ($p < 0.01$). For support of hypothesis 3, four distinct groups were formed for subsequent analyses appropriately.

The Effect of the Intensity and Direction of Trait Anxiety on the Intensity and Direction of State Anxiety and Self-Confidence

To examine the effect of the intensity and direction of trait anxiety on the intensity and direction of state anxiety, which was produced by trait anxiety and situational stress, the data analyses for the second purpose were conducted. Table 6 shows all means and *SD*s of the intensity and direction of state anxiety,

cognitive anxiety, somatic anxiety, and self-confidence with respect to each four trait anxiety group (HD, HF, LD, and LF). To examine the effects of trait anxiety groups on state anxiety, cognitive anxiety, somatic anxiety, and self-confidence, I performed two separate two-way MANOVAs with the levels of intensity (high/low) and direction (debilitative/facilitative) as independent variables, on the intensity and the direction scores on state anxiety, cognitive anxiety, somatic anxiety, and self-confidence as dependent variables.

Significant main effects of the levels of intensity and direction were found on state anxiety (Wilks Lambda = 0.90, $F(2,438) = 25.34$, $p < 0.01$, $\eta^2 = 0.10$; Wilks Lambda = 0.92, $F(2,438) = 19.49$, $p < 0.01$, $\eta^2 = 0.08$), cognitive anxiety (Wilks Lambda = 0.95, $F(2,438) = 11.43$, $p < 0.01$, $\eta^2 = 0.05$; Wilks Lambda = 0.92, $F(2,438) = 18.04$, $p < 0.01$, $\eta^2 = 0.08$), and somatic anxiety (Wilks Lambda = 0.95, $F(2,438) = 10.50$, $p < 0.01$, $\eta^2 = 0.05$; Wilks Lambda = 0.94, $F(2,438) = 14.41$, $p < 0.01$, $\eta^2 = 0.06$). However, the interaction between the levels of intensity and direction on all scales were not significant.

On state anxiety, follow-up between-group (high/low) ANOVA showed significant differences in the intensity and the direction scores ($F(1,439) = 50.70$, $p < 0.01$, $\eta^2 = 0.10$; $F(1,439) = 12.86$, $p < 0.01$, $\eta^2 = 0.03$). And follow-up between-group (debilitative/facilitative) ANOVA showed a significant difference in the direction score ($F(1,439) = 32.05$, $p < 0.01$, $\eta^2 = 0.07$). A further Bonferroni test revealed that the intensity score of high group was significantly higher than that of the low group, and the direction score of high group was significantly lower than that of the low group ($p < 0.01$). Further Bonferroni test revealed that the direction score of debilitative group was significantly lower than the facilitative group ($p < 0.01$).

On both cognitive anxiety and somatic anxiety, follow-up between-group (high /low) ANOVA showed significant differences in the intensity scores ($F(1,439) = 22.91$, $p < 0.01$, $\eta^2 = 0.05$; $F(1,439) = 20.47$, $p < 0.01$, $\eta^2 = 0.05$). Similarly, follow-up between-group (debilitative/ facilitative) ANOVA showed significant differences in the direction scores ($F(1,439) = 34.80$, $p < 0.01$, $\eta^2 = 0.07$; $F(1,439) = 27.83$, $p < 0.01$, $\eta^2 = 0.06$). Further Bonferroni tests revealed that the intensity score of high group was significantly higher than the low group ($p < 0.001$), and that the direction score of debilitative group was significantly lower than facilitative group ($p < 0.001$). These results, which are shown on state anxiety, cognitive anxiety, and somatic anxiety, support hypothesis 3.

On self-confidence, the main effect of the level of intensity was significant (Wilks Lambda = 0.94, $F(2,438) = 13.80$, $p < 0.01$, $\eta^2 = 0.06$). Follow-up between-group (high/low) ANOVA showed significant differences in the intensity and the direction scores ($F(1,439) = 21.48$, $p < 0.01$, $\eta^2 = 0.05$; $F(1,439) = 17.99$, $p < 0.01$, $\eta^2 = 0.04$). Further Bonferroni test revealed that the intensity and direction score of high group was significantly lower than the low group ($p < 0.01$). These results show the same relationships as in the previous findings using the CSAI-2 (Jones, & Swain, 1992; Jones, Swain, & Harwood, 1996).

The Relationship Between Trait Anxiety and Performance

Table 7 shows means of performance measure of each four trait anxiety group (HD, HF, LD, and LF). The means of computational speed for each group showed almost same values, which were about one second per one answer. Both the means of percentages of correct answers and percentages of correct counted numbers of beep tones for each group showed almost same values and were close to 100 %. To examine the effects of trait anxiety groups on three performance measures, I performed one -way ANOVAs on the computational speed, the percentage of correct answers, and the percentage of correct counted numbers of beep tones as dependent variables. There were no significant main effects of the levels of intensity and direction on three performance measures. These results failed to support hypothesis 4.

TABLE 7 MEANS OF PERFORMANCE MEASURE OF EACH FOUR TRAIT ANXIETY GROUP

	High		Low		Total
	Debilitative	Facilitative	Debilitative	Facilitative	
Computational Speed	1.01	0.99	0.95	0.98	1.00
Computational Accuracy	96.87	95.90	96.49	96.66	96.69
Sound Accuracy	99.45	99.67	99.73	99.80	99.60

Notes. Trait High and Trait Low indicate the intensity groups of trait anxiety; Debilitative and Facilitative indicate the direction groups of trait anxiety. Computational Speed = 180 seconds/the number of answers (sec); Computational Accuracy = percentages of correct answers (%); Sound Accuracy = percentages of correct counted numbers of beep tones (%).

Discussion

The first purpose of the present study was to examine the relationship between intensity and direction of state anxiety in predicting performance using the STAI with a direction scale on a serial addition task. The

previous studies using the CSAI-2 (Kais, & Raudsepp, 2005) showed the relationships between the intensity and direction of cognitive anxiety, somatic anxiety, and self-confidence, which demonstrated that each intensity subscale of cognitive anxiety and somatic anxiety was negatively correlated with each direction subscale of them and the intensity subscale of self-confidence was negatively related to each intensity subscale of cognitive anxiety and somatic anxiety. The present results, in which trait anxiety and state anxiety were added, also showed the same relationships as in the previous studies (Kais, & Raudsepp, 2005) and supported hypothesis 1. The reliability and validity of the CSAI-2T and each direction scales were congruent with the previous studies (Kais, & Raudsepp, 2004; Swain, & Jones, 1996).

However, the performance results did not support hypothesis 2 and 4. Contrary to the findings of previous studies (Chamberlain, & Hale, 2007; Craft, Magyar, Becker, & Feltz, 2003; Jones, & Cale, 1989; Jones, & Swain, 1992; Jones, Swain, & Hardy, 1993; Kais, & Raudsepp, 2004; Kais, & Raudsepp, 2005; Parfitt, & Hardy, 1993; Raudsepp, & Kais, 2002; Swain, & Jones, 1996), the intensity of trait anxiety and cognitive anxiety had positive correlations with the speed only, and both the intensity and direction of self-confidence had negative correlations with the computational speed. In addition, the intensity and direction of state anxiety of the STAI could not reveal any relationships to performance measures. Considering results of all performance measures that showed ceiling effects, a serial addition task might be too easy for undergraduate students, and the level of anxiety intensity was not high enough to deteriorate their performance (Martons, Burton, Vealey, Bump, & Smith, 1990; Yerkes, & Dodson, 1908). Also, the present results suggest the differences between sports and cognitive tasks.

Despite the individual differences of trait anxiety, the interaction effects between intensity and direction were not significant on state anxiety, cognitive anxiety, and somatic anxiety. These results suggest that the intensity and direction of trait anxiety influence the intensity and direction of state anxiety separately without interaction. Consequently, it is possible to approach from two dimensions of intensity and direction independently in order to control the total state anxiety which determines the level of performance (Eysenck, 1992).

To conclude, using a non-sport performance task, the present results showed the same relationships between the intensity and direction of trait anxiety, state anxiety, cognitive anxiety, somatic anxiety, and self-confidence. However, the performance results failed to reveal any relationships between the intensity and direction of these anxieties and self-confidence on an easy cognitive task. Furthermore, the present findings suggest that the intensity and direction of trait anxiety influenced the intensity and direction of state anxiety separately. Future studies could use another, more difficult, cognitive performance task to test whether or not the intensity and direction of state and trait anxieties would influence cognitive task performance.

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