

# 博士學位論文

アレキシサイミアの構成と感情表出ステップの関係

近畿大学大学院

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# Doctoral Dissertation

The relationship between the construct of alexithymia  
and the steps of emotion expression

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論文題目

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The relationship between the construct of alexithymia and the steps of emotion expression

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## **Abstract**

**Background:** Alexithymia is a central concept in psychosomatic disorders, but its treatment has not been established. Therefore, in order to clarify the details of the pathogenesis of alexithymia for further treatment, the present study aimed to evaluate the association between alexithymia pathophysiology, classified by the presence or absence of alexithymia as assessed by the 20-item version of The Toronto Alexithymia Scale (TAS-20), and emotional expressive process functioning as assessed by Japanese version of the Difficulties in Emotion Regulation Scale (J-DERS).

**Methods:** From February 2018 to June 2019, first-time patients aged 16 years or older referred to our department were eligible for inclusion, and patients with mental illness, patients who declined to provide information, and those who consented but failed to complete the form were excluded. The comparison between the median J-DERS total and subscale scores of the TAS-20 high-scoring group (defined as  $\geq 52$  points) and the TAS-20 low-scoring group (defined as  $\leq 51$  points) was set as the primary outcome. J-DERS total score and subscales were used as dependent variables, and multiple linear regression analysis was used to analyze the association with the subscales of the TAS-20.

**Results:** Of the 188 total subjects, 106 (56%) were included in the analysis. On the median total J-DERS score, the TAS-20 high scoring group was significantly higher than the low scoring group. Similarly, a significant difference was seen with each J-DERS subscale. Of the three TAS-20 subscales, only difficulty in identifying feelings correlated with the J-DERS total score and subscales.

**Conclusions:** Although alexithymia has been considered to be a disruption in one of steps of the emotional expression process, the results of our study revealed that alexithymia affects the several emotional expression process. Future research may help treat alexithymia by providing psychotherapy that is commensurate with each step of the emotional expression process.

**Keywords:** alexithymia, psychosomatic disorder, emotions

## **Background**

Alexithymia consists of the clinically observed features of 1) difficulty in identifying and describing feelings; 2) difficulty in distinguishing between feelings and the bodily sensations of emotional arousal; 3) constricted imaginative processes; and 4) an externally oriented cognitive style in which attention is directed toward external facts connected to stimuli rather than one's internal self<sup>1</sup>.

Sifneos et al. coined the term “alexithymia” as a central concept to describe such a psychosomatic disorder, which was present in patients with physical disease, developed and progressed in close correlation with psychosocial factors, and exhibited organic or functional disturbances<sup>2-3</sup>. Alexithymia has been reported to correlate not only with psychosomatic disease but also with physical diseases such as diabetes mellitus and chronic pain<sup>4-5</sup>. Furthermore, psychotherapies, such as cognitive-behavioral therapy or supportive psychotherapy, are administered based on the premise that the subjects are aware of their emotions or stress, it is difficult to apply these therapies to an appreciable effect with alexithymic patients<sup>6</sup>. Therefore, it is important to clarify the pathogenesis of alexithymia.

Kennedy–Moore and Watson described the process of emotional expression in which emotional experiences brought about by emotion-eliciting stimuli are expressed, comprising the following five steps (Fig. 1).

STEP 1 [Initial prereflective reaction]

STEP 2 [Conscious perception of response]

STEP 3 [Labeling & interpretation of response]

STEP 4 [Evaluation of response as acceptable]

STEP 5 [Perceived context for expression]

Among these, a disruption in STEP 1 is not clinically problematic because the patient does not have any emotions as the expression of emotions by emotion-eliciting stimuli is limited to a prereflex response.-A disruption in STEP 2 is the inability to recognize emotions even when they are aroused by emotion-eliciting stimuli. Alexithymia reflects dysfunctional skills in STEP 3 (identifying, labeling and understanding emotions (Fig. 1)<sup>7</sup>.

Two traditional methods have been used to elucidate the mechanism underlying this emotional process: first is Swart et al.'s study, which employed Gross & John's Emotion

Regulation Questionnaire (ERQ)<sup>8</sup> to assess the difficulty of emotion regulation and second is Gratz & Roemer's The Difficulties in Emotion Regulation Scale (DERS) (Table 1-a)<sup>9</sup>. This questionnaire is based on Gratz & Roemer's (a) "awareness and understanding of emotions," (b) "acceptance of emotions," (c) "ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions," and (d) "ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands," which are reflected in the four domains of emotion regulation ability<sup>9</sup>. Of these, (a) "awareness and understanding of emotions" is not included in Gross' model of emotion regulation<sup>10</sup>.

There are emotional response processes and systems that are interrelated with neurophysiological processes, motor or behavioral expressive processes, and a cognitive-experiential system in emotional response in humans<sup>11</sup>. Alexithymia reflects deficits in a cognitive-experiential system (subjective awareness and verbal reporting of feeling states), according to Taylor and colleagues<sup>12</sup>. Moreover, according to Greenberg, emotion processing includes being aware of emotions, labeling emotional responses, regulating emotions, and accepting them<sup>13</sup>. Therefore, to clarify the relationship between the construct of alexithymia and the steps of emotional expression, it is necessary to use the DERS (Table 1-a)<sup>9</sup>, which includes (a) "awareness and understanding of emotions."

In the Japanese version of DERS (J-DERS) (Table 1-b)<sup>14</sup>, GOALS and IMPULS as well as AWARENESS and CLARITY, which are similar to each other among the six DERS subscales created by Gratz & Roemer, are combined into the same factor, which is called the four-factor solution. This is because this four-factor solution reflects the four domains—(a) to (d)—that are important for emotion, as proposed by Gratz & Roemer, better than the six-factor solution. The relationship among the Kennedy–Moore & Watson model, the J-DERS concept, and Gratz & Roemer's explanation is shown in Figure 2.

By comparing the above-mentioned Kennedy–Moore & Watson's emotion expression process with Gratz & Roemer's four emotion regulation abilities and J-DERS, it can be concluded

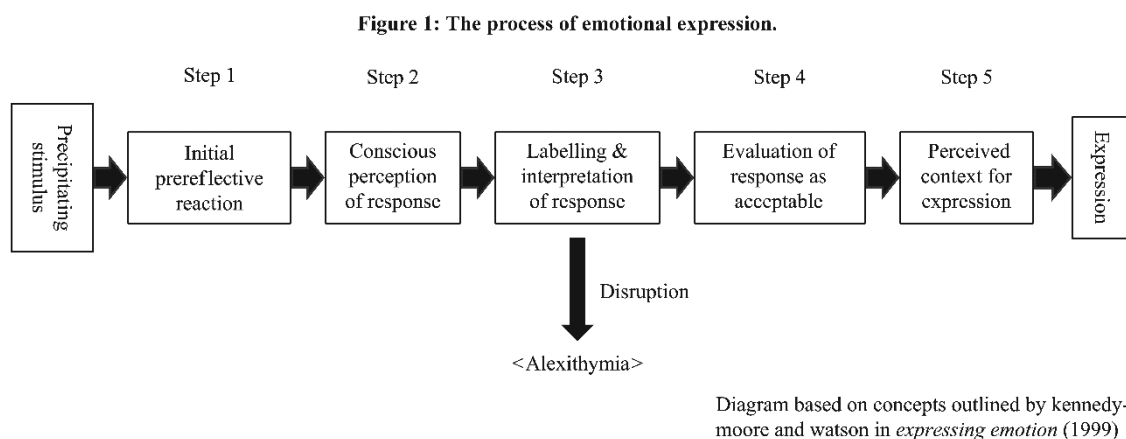


that STEPs 1–3 (arousing, recognizing, and identifying and labeling emotions) of Kennedy–Moore & Watson’s emotional expression process correspond to (a) “awareness and understanding of emotions” (emotional arousal, recognition, and understanding) of Gratz & Roemer’s emotion regulation abilities, and its disruption is considered to correspond to ① “lack of emotional awareness” in J-DERS. Similarly, STEP 4 (deciding whether to accept emotions considering personal beliefs and goals) corresponds to (b) “acceptance of emotions” (accepting and evaluating emotional responses) and its disruption corresponds to ② “nonacceptance of emotional responses.” In addition, STEP 5 (considering whether emotions can be expressed but are expressed depending on the environment of the situation) corresponds to (c) “ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions” and (d) “ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands” (“ability to control undesirable behaviors and behave in accordance with desired goals when experiencing negative emotions”), and its disruption is considered to correspond to ④ “impulse control difficulties” and ③ “limited access to emotion regulation strategies.” If the four emotion regulation abilities proposed by Gratz & Roemer correspond to each of the STEPs in Kennedy–Moore & Watson’s emotional expression process, as described above, emotional processing would be on a continuum. Therefore, we used the J-DERS (Table 1-b)<sup>14</sup> (Fig. 2), which is thought to reflect the emotion expression process, to evaluate each step of the emotion expression process in the presence and absence of alexithymia.

The 20-item version of the Toronto Alexithymia Scale (TAS-20) is a self-administered scale developed by Bagby et al<sup>15-18</sup>. The TAS-20 is based on three factors: Difficulty Identifying Feelings (DIF), Difficulty Describing Feelings (DDF), and Externally Oriented Thinking (EOT)<sup>18-19</sup>, and it uses the total scores to assess alexithymia.

As far as we know, there have been no studies comparing the presence or absence of alexithymia with the overall emotion expression process and the function of each STEP.

Therefore, this study aimed to evaluate the relationship between alexithymia pathophysiology classified with or without alexithymia as assessed by the TAS-20 and emotion expression process function using the J-DERS.



## Methods

### *Subjects*

From February 2018 to June 2019, among 188 first-time patients aged 16 years or older referred to the outpatient clinic of the Department of Psychosomatic Medicine at Kindai University Hospital, ① Neurocognitive Disorders, ② Depressive Disorders ③ Obsessive-Compulsive and Related Disorders, ④ Neurodevelopmental Disorders, ⑤ Feeding and Eating Disorders, ⑥ Personality Disorders, and ⑦ Anxiety Disorders (including patients diagnosed as comorbidities) were excluded. Of the remaining 152 patients, 106 were eligible for inclusion after excluding patients who declined to provide information and those who consented but failed to complete the form. In all cases, the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) was used for diagnosis.

### *Psychological parameters*

#### *20-item version of The Toronto Alexithymia Scale, TAS-20*

To assess alexithymia in this study, we used the TAS-20, which is a self-administered scale developed by Bagby et al<sup>15-18</sup>. The TAS-20 is based on three factors, namely, DIF, DDF, and

EOT<sup>18,19</sup>.

F1: DIF: Difficulty in identifying and in distinguishing between feelings and the bodily sensations of emotional arousal.

F2: DDF: Difficulty in describing feelings.

F3: EOT: An externally oriented cognitive style.

The TAS-20's reliability and validity have been previously verified internationally<sup>18,20</sup>. The test comprises 20 statements that are graded from one (strongly disagree) to five (strongly agree). The total scores are used to assess alexithymia, and a sum of  $\geq 61$  points indicates alexithymia, 52–60 indicates an intermediate zone, while  $\leq 51$  indicates non-alexithymia<sup>15-17</sup>. In this study, patients with a TAS-20 score of  $\geq 52$  points (which covers both the alexithymia and an intermediate zone) and  $\leq 51$  were grouped in the TAS-20 high- and low-scoring groups, respectively. To assess alexithymia, the Japanese version of the TAS-20 was used<sup>19</sup>.

*The Difficulties in Emotion Regulation Scale of Japanese version, J-DERS* (Table 1-b).

As shown in Table 1-b, to assess difficulties in emotion regulation in this study, the J-DERS, which is a Japanese version of the DERS, was used<sup>13</sup>. The J-DERS comprises four subscales (awareness, clarity, goals, and impulse) corresponding to the same subscales in the six-scale DERS (Table 1-a)<sup>9</sup>. The subscales measure a patient's ability to regulate emotion in four areas, comprehensively covering the process of emotion regulation from arousal to expression<sup>14</sup>.

The manner in which the J-DERS subscales for ① lack of emotional awareness, ② nonacceptance of emotional responses, ③ limited access to emotion regulation strategies, and ④ impulse control difficulties are thought to correspond to the process of emotional expression outlined by Kennedy–Moore & Watson is shown in Figure 2. Participants were asked to indicate on a five-point Likert-type scale depending on how the items applied to them, with 1 = almost never, 2 = sometimes, 3 = about half the time, 4 = most of the time, and 5 = almost always. Higher scores indicate greater difficulties in emotion regulation. The reliability and validity of this psychological test have been well validated internationally<sup>14</sup>.

### *Procedures and statistics*

Psychological assessments using TAS-20 and J-DERS were administered with the medical questionnaire that patients filled in before being examined at their initial visit to our hospital. We then retrospectively investigated this data based on our medical records for patients who met the eligibility criteria.

In the present study, TAS-20 scores of  $\geq 52$ , including alexithymia and an intermediate zone of alexithymia, were defined as the TAS-20 high-scoring group and scores of  $\leq 51$  were defined as the TAS-20 low-scoring group.

To evaluate how the presence of alexithymia affected each step of the process of emotional expression, the comparison between the median J-DERS total and subscale scores of the TAS-20 high-scoring group (defined as  $\geq 52$  points) and the TAS-20 low-scoring group (defined as  $\leq 51$  points) was set as the primary outcome.

The Mann–Whitney U test was used, and the significance level was set at 0.05. When corrected using the Bonferroni method, there were five primary outcomes (J-DERS total score and four subscales), and the significance level of the test was  $0.05 \times 1/5 = 0.01$ .

The secondary outcome examined factors related to the J-DERS total score and J-DERS subscales. The J-DERS total score and subscales were analyzed with multiple linear regression analysis using the forced imputation method, considering the J-DERS total score and subscales as dependent variables and age, sex, years of education, and the three TAS-20 subscales as independent variables. Here there were six independent variables, and the significance level was set at  $0.05 \times 1/6 = 0.00833$ .

SPSS V.25 (SPSS, Inc., Chicago, IL, USA) was used to statistically analyze all data.

This study was conducted in accordance with the principles of the Declaration of Helsinki and Japan's ethical guidelines for clinical research and approved by the Clinical Research Preliminary Review Board of the Kindai University Ethics Committee (Approval No. R2-073).

### **Results**

Figure 3 shows how the subjects were selected. Out of 188 initial candidates, 152 met the eligibility criteria. Out of these, 46 met the exclusion criteria; thus, only 106 cases (56%) were finally included in the analysis. The patient backgrounds are shown in Table 2. Patient ages ranged from 16 to 88 years with a mean age of 50.5. The most common main complaint was pain, which was reported by 40 patients (38%), followed by digestive symptoms (diarrhea, abdominal pain, or heartburn accompanying enterokinesis) in 19 patients (18%), dizziness in 13 (12%), and numbness in 13 (12%). All patients underwent a psychosomatic general consultation with a psychosomatic physician.

The mean TAS-20 and J-DERS total and subscale scores and their standard deviations (SD) are shown in Table 3. TAS-20 total score was  $53.3 \pm 9.8$  (mean  $\pm$  SD), DIF  $17.3 \pm 6.2$ , DDF  $14.3 \pm 3.6$ , and EOT  $21.7 \pm 3.3$ . J-DERS total score was  $37.9 \pm 13.3$ , Lack of Emotional Awareness  $9.3 \pm 3.3$ , Nonacceptance of Emotional Responses  $9.6 \pm 4.2$ , Limited Access to Emotion Regulation Strategies  $9.7 \pm 4.0$ , and Impulse Control Difficulties  $9.6 \pm 4.0$ .

J-DERS scores in the TAS-20 high- and low-scoring groups are shown in Table 4.

There were 60 subjects (57%) in the group that scored a total of  $\geq 52$  on the TAS-20 (assigned as the TAS-20 high-scoring group), and 46 subjects (43%) in the group that scored a total of  $\leq 51$  (assigned as the TAS-20 low-scoring group).

A significant difference ( $p < 0.01$ ) was found in the median total J-DERS scores between the TAS-20 high- and low-scoring groups, which was 42.0 (IQR 31.0–52.8) and 29.5(23.0–37.3), respectively.

For the TAS-20 high- and low-scoring groups, the median subscale score for lack of emotional awareness, nonacceptance of emotional responses, limited access to emotion regulation strategies, and impulse control difficulties was 11.0 (8.3–13.0) and 7.0 (6.0–9.0), 11.0 (8.0–15.0) and 7.0 (4.0–10.0), 10.0 (8.0–14.0) and 8.0 (6.0–10.0), and 11.0 (8.0–13.0) and 7.0 (5.0–10.0), respectively. A significant difference was observed between the two groups for each of the subscales ( $p < 0.01$ ).

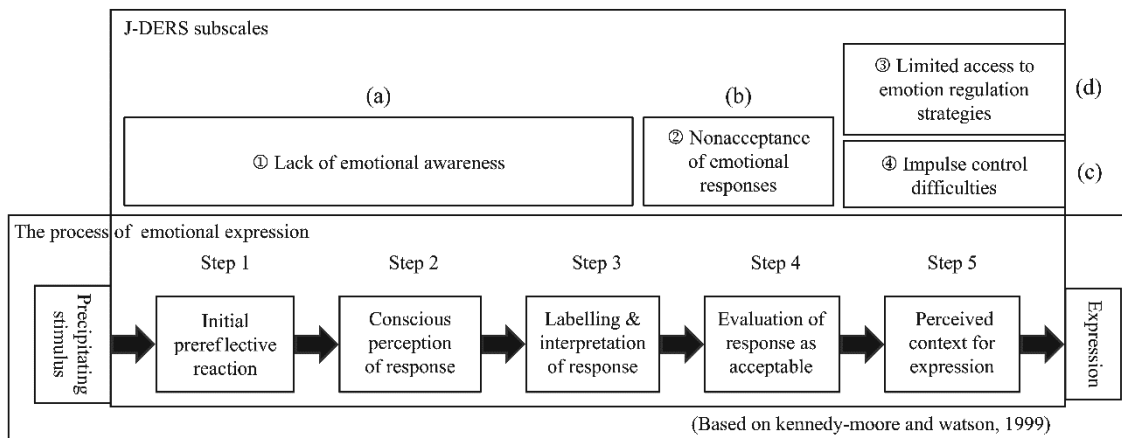
The factors related to J-DERS total and subscale scores and the results of a multivariate

analysis applied to the covariates age, sex, years of education, and TAS-20 subscales are shown in additional file 1.

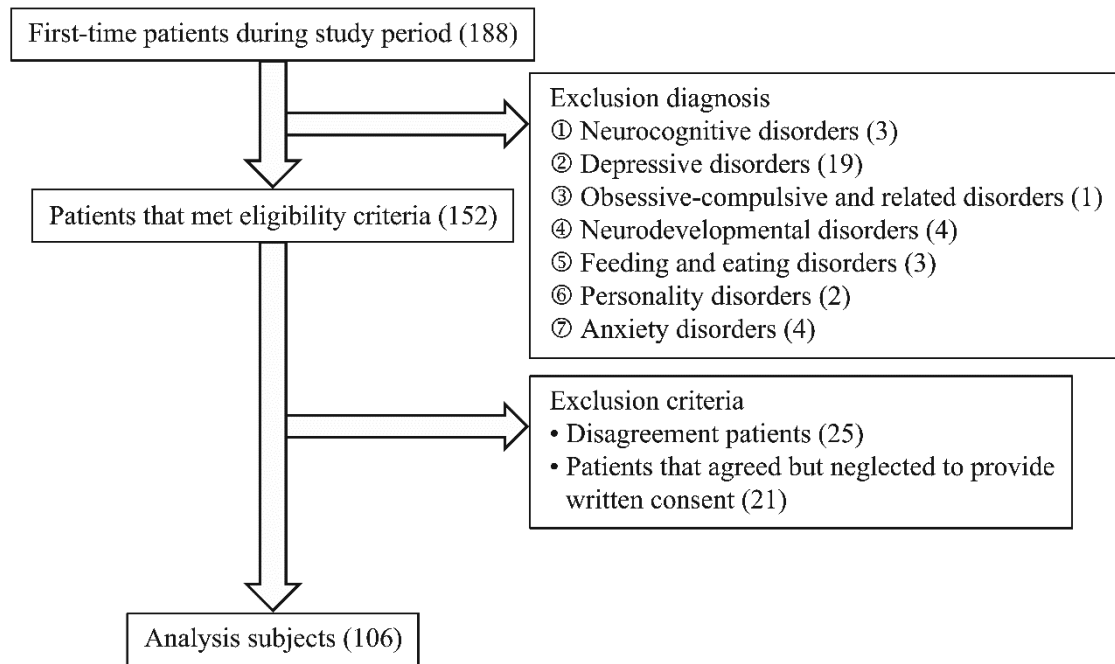
None of the variance inflation factors exceeded 10, and multicollinearity did not exist; all the Durbin-Watson ratios were close to 2, and there were no outliers in which the predicted values exceeded  $\pm 3$  SD of the measured values.

As summarized in additional file 1, out of the three TAS-20 subscales (DIF, EOT, and DDF), only DIF was correlated with the J-DERS total score, and each of the J-DERS subscales (lack of emotional awareness, nonacceptance of emotional responses, limited access to emotion regulation strategies, and impulse control difficulties) ( $p < 0.01$ ). Conversely, EOT and DDF had no correlation with any of the J-DERS subscales.

**Figure 2: J-DERS and its relation to the process of emotional expression**



**Figure 3: Flowchart of the study.**



## Discussion

To our knowledge, this study is the first to have used J-DERS to evaluate the patient's function at each step of the process of emotional expression that is also affected by the presence or absence of alexithymia as assessed by TAS-20.

There was a significant difference in the J-DERS total score and all subscale scores between the TAS-20 high- and low-scoring groups. This indicates that alexithymia has been considered to be a disruption of STEP 3 of the emotional expression process proposed by Kennedy–Moore & Watson<sup>6</sup>, but since emotional processing is considered to be on a continuum, as shown in Figure 2, disruptions in STEP 3 of the emotional process affects the subsequent STEPs 4 and 5, suggesting that they do not function well and have been disrupted too. Therefore, alexithymia affects the entire emotional expression process.

On the other hand, a comparison of the TAS-20 and J-DERS subscales showed that although DIF was correlated with all of the J-DERS total and subscale scores, DDF and EOT were not. This suggests that DIF is related to difficulty in emotion regulation ability, and DIF plays an important role in emotion regulation. In addition, J-DERS may not have correlated with DDF,

which is related to the expression of emotions, or EOT<sup>21</sup>, which is related to mechanical thinking (*pensée opératoire*), because J-DERS focuses on internal emotional processing until the expression of emotions.

The present study had the following three limitations:

First, this study assessed alexithymia using self-administered tests. The self-report measure (TAS-20) used to evaluate alexithymia is prone to two types of errors: false positives and false negatives. In the future, the use of two separate alexithymia measures should be considered.

Next, the presence of alexithymia was defined as a TAS-20 score of  $\geq 52$ , which meant that an intermediate zone was also included in the TAS-20 high-scoring group.

Third, in the present study, the cut-off values for TAS-20 were not derived from a Japanese sample.

As this study revealed, patients with alexithymia had deficits not only in STEP 3, but also in STEPs 4 and 5 of the emotional expression process. Psychotherapies that affect the entire emotional expression process, such as supportive psychotherapy and cognitive-behavioral therapy, are unlikely to work well with alexithymia patients. Future research may help treat alexithymia if psychotherapy appropriate to each step of the emotional expression process improves the functioning of each step.

## **Conclusions**

We used J-DERS to investigate whether disruptions existed in various steps of the process of emotional expression in alexithymia, which is closely connected with psychosomatic disorders and physical disease. The results of our study revealed that disruption occurs, not only in STEP 3, which is essentially what defines alexithymia, but also in STEPs 4 and 5.

Future research may help treat alexithymia by providing psychotherapy that is commensurate with each STEP of the emotional expression process.

## **List of abbreviations**



TAS-20: 20-item version of The Toronto Alexithymia Scale

DIF: Difficulty Identifying Feeling

DDF: Difficulty Describing Feeling

EOT: Externally Oriented Thinking

J-DERS: The Difficulties in Emotion Regulation Scale of Japanese version

DSM-5: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

## **Declarations**

### **Ethics approval and consent to participate**

This study received the approval of the Clinical Research Preliminary Review Board of the Kindai University Ethics Committee (Approval No. R2-073). Although there were no opportunities to inform the research subjects that did not visit Kindai University Hospital during the period in which the study was conducted, we did inform and obtain the verbal consent of each research subject that visited during the study period when such an opportunity arose. All study procedures were carried out in accordance with the principles in the Declaration of Helsinki and its later amendments.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Authors' contributions**

TY and AK conceived the study and participated in its design. TY performed the statistical analysis. AK, HM, and RS analyzed the data and helped draft the manuscript. All authors

read and approved the final manuscript.

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Table 1-a The Difficulties in Emotion Regulation Scale (DERS)

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The DERS contains six subscales:

- ① Nonacceptance of Emotional Response (NONACCEPTANCE)
- ② Difficulties in Engaging in Goal-Directed Behavior (GOALS)
- ③ Impulse Control Difficulties (IMPULSE)
- ④ Lack of Emotional Awareness (AWARENESS)
- ⑤ Limited Access to Emotion Regulation Strategies (STRATEGIES)
- ⑥ Lack of Emotional Clarity (CLARITY)

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Gratz & Roemer. J Psychopathol Behav Assess. 2004

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Table 1-b Japanese version of the Difficulties in Emotion Regulation Scale (J-DERS)

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The J-DERS is a Japanese scale for evaluating potentially clinically problematic disruption in four abilities. Described by Gratz and Roemer, the scale reflects the process of emotional regulation from emotional arousal to emotional expression, using the following subscales:

- ① Lack of Emotional Awareness
- ② Nonacceptance of Emotional Responses
- ③ Limited Access to Emotion Regulation Strategies
- ④ Impulse Control Difficulties

Questions to be included in each subscale:

① Lack of Emotional Awareness

- 1) I am clear about my feelings. (r)
- 2) I have difficulty making sense of my feelings.
- 3) I know exactly how I am feeling. (r)
- 4) I am confused about how I feel.

② Nonacceptance of Emotional Responses

- 1) When I'm upset, I become angry with myself for feeling that way.
- 2) When I'm upset, I become embarrassed for feeling that way.
- 3) When I'm upset, I become irritated with myself for feeling that way.
- 4) When I'm upset, I start to feel very bad about myself.

③ Limited Access to Emotion Regulation Strategies

- 1) When I'm upset, I believe that I will remain that way for a long time.
- 2) When I'm upset, I believe that I'll end up feeling very depressed.
- 3) When I'm upset, I believe that there is nothing I can do to make myself feel better.
- 4) When I'm upset, it takes me a long time to feel better.

④ Impulse Control Difficulties

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1) When I'm upset, I have difficulty getting work done.

2) When I'm upset, I get out of control.

3) When I'm upset, I lose control over my behaviors.

4) When I'm upset, I have difficulty thinking about anything else.

Answers are given on a 5-point Likert scale ranging from 1 (almost never) to 5 (always)

Higher scores indicate greater difficulty regulating emotions

(r) Indicates a reverse-score item.

J-DERS was used with its creators' permission.

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In the J-DERS, among the six subscales of the original version of the DERS (Table 1-a), goals and impulses and awareness and clarity are treated as single factors, generating a subscale comprising four factors. Yamada & Sugie. *Japn J Res Emot* 2013



Table 2 Clinical characteristics of the participants

	Number of participants (n = 106)
<b>Age (years)</b>	
Mean (range)	50.5 (16–88)
<b>Education (years)</b>	
Mean (range)	13.0 (9–16)
<b>Sex, n (%)</b>	
Men	35 (33)
Women	71 (67)
<b>Symptoms, n (%)</b>	
Pain	40 (38)
Digestive symptoms (diarrhea, abdominal pain, or heartburn accompanying enterokinesis)	19 (18)
Dizziness	13 (12)
Numbness	13 (12)
Palpitations	11 (10)
Others	10 (9)

Table 3 TAS-20 and J-DERS total scores and subscales of the participants (n = 106)

	Mean	Standard Deviation
<b>TAS-20</b>		
TAS-20 Total	53.3	9.8
Difficulty Identifying Feeling	17.3	6.2
Difficulty Describing Feeling	14.3	3.6
Externally Oriented Thinking	21.7	3.3
<b>J-DERS</b>		
J-DERS Total	37.9	13.3
Lack of Emotional Awareness	9.3	3.3
Nonacceptance of Emotional Responses	9.6	4.2
Limited Access to Emotion Regulation Strategies	9.7	4.0
Impulse Control Difficulties	9.6	4.0

TAS-20: 20-item version of The Toronto Alexithymia Scale

J-DERS: Japanese version of the Difficulties in Emotion Regulation Scale

Table 4 J-DERS total and subscale scores in the TAS-20 high/low groups (Mann–Whitney U test)

	TAS-20 High- scoring Group (n = 60)	TAS-20 Low- scoring Group (n = 46)	
Age, mean ± SD	49 ± 24.7	52 ± 19.8	
Sex, n (%)			
Men	19(32)	16(35)	
Women	41 (68)	30 (65)	
J-DERS Total (IQR)	42.0 (31.0–52.8)	29.5 (23.0–37.3)	<i>p</i> < 0.01
Lack of Emotional Awareness (IQR)	11.0 (8.3–13.0)	7.0 (6.0–9.0)	<i>p</i> < 0.01
Nonacceptance of Emotional Responses (IQR)	11.0 (8.0–15.0)	7.0 (4.0–10.0)	<i>p</i> < 0.01
Limited Access to Emotion Regulation Strategies (IQR)	10.0 (8.0–14.0)	8.0 (6.0–10.0)	<i>p</i> < 0.01
Impulse Control Difficulties (IQR)	11.0 (8.0–13.0)	7.0 (5.0–10.0)	<i>p</i> < 0.01

SD: standard deviation, IQR: interquartile range

TAS-20: 20-item version of The Toronto Alexithymia Scale

J-DERS: Japanese version of the Difficulties in Emotion Regulation Scale

## Additional file

Additional file 1. Linear regression analysis using age, sex, years of education, and TAS-20 subscale scores.

Coefficients	Covariates	Simple Regression Model				Multiple Regression Model				Durbin-Watson Ratio	
		$\beta$	$t$	Partial Regression Coefficient (95% CI)	$p$	$\beta$	$t$	Partial Regression Coefficient (95% CI)	$p$		$R^2$
DERS Total Score	Age	-0.182	-1.884	-0.122 (-0.251 to 0.006)	0.062	-0.068	-0.736	-0.046 (-0.169 to 0.077)	0.463	0.287	1.871
	Sex	0.01	0.103	0.283 (-5.174 to 5.741)	0.918	-0.001	-0.008	-0.020 (-4.935 to 4.894)	0.993		
	Years of education	0.089	0.909	0.479 (-0.566 to 1.523)	0.366	0.023	0.274	0.125 (-0.781 to 1.031)	0.785		
	DIF	0.558	6.853	1.184 (0.841 to 1.527)	0.000	0.511	4.846	1.080 (0.638 to 1.522)	0.000		
	DDF	0.38	4.194	1.408 (0.742 to 2.074)	0.000	0.063	0.583	0.231 (-0.557 to 1.020)	0.561		
EOT	0.016	0.163	-0.064 (-0.718 to 0.847)	0.871	-0.021	-0.244	-0.082 (-0.751 to 0.586)	0.807			
Lack of Emotional Awareness	Age	-0.248	-2.607	-0.040 (-0.070 to -0.009)	0.010	-0.141	-1.571	-0.023 (-0.051 to 0.006)	0.119	0.326	1.823
	Sex	0.06	0.615	0.402 (-0.896 to 1.700)	0.54	0.028	0.33	0.189 (-0.948 to 1.326)	0.742		
	Years of education	0.052	0.533	0.067 (-0.182 to 0.316)	0.595	-0.016	-0.189	-0.020 (-0.230 to 0.190)	0.85		
	DIF	0.566	6.997	0.286 (0.205 to 0.367)	0.000	0.506	4.929	0.254 (0.152 to 0.357)	0.000		
	DDF	0.399	4.432	0.351 (0.194 to 0.509)	0.000	0.055	0.528	0.049 (-0.134 to 0.231)	0.599		
EOT	0.135	1.393	0.130 (-0.055 to 0.314)	0.167	0.099	1.211	0.094 (-0.060 to 0.249)	0.299			
Nonacceptance of Emotions	Age	-0.108	-1.105	-0.023 (-0.064 to 0.018)	0.272	0.009	0.09	0.002 (-0.041 to 0.044)	0.929	0.166	1.865
	Sex	0.038	0.385	0.336 (-1.394 to 2.066)	0.701	0.039	0.407	0.348 (-1.348 to 2.043)	0.685		
	Years of education	0.087	0.885	0.149 (-0.185 to 0.482)	0.378	0.04	0.44	0.069 (-0.243 to 0.382)	0.661		
	DIF	0.459	5.262	0.309 (0.192 to 0.425)	0.000	0.451	3.952	0.304 (0.151 to 0.456)	0.000		
	DDF	0.278	2.951	0.326 (0.107 to 0.546)	0.004	0.011	0.092	0.013 (-0.259 to 0.285)	0.927		
EOT	0.016	0.16	0.020 (-0.228 to 0.268)	0.873	-0.01	-0.113	-0.013 (-0.244 to 0.217)	0.91			
Limited access to Emotions	Age	-0.103	-1.054	-0.021 (-0.060 to 0.018)	0.294	-0.038	-0.384	-0.008 (-0.048 to 0.033)	0.702	0.16	1.808
	Sex	-0.049	-0.5	-0.416 (-2.067 to 1.235)	0.618	-0.043	-0.451	-0.366 (-1.976 to 1.245)	0.653		
	Years of education	-0.008	-0.085	-0.014 (-0.330 to 0.303)	0.932	-0.06	-0.645	-0.097 (-0.393 to 0.200)	0.52		
	DIF	0.432	4.889	0.278 (0.165 to 0.391)	0.000	0.391	3.413	0.249 (0.104 to 0.394)	0.001		
	DDF	0.319	3.432	0.358 (0.151 to 0.564)	0.001	0.086	0.732	0.095 (-0.163 to 0.354)	0.466		
EOT	-0.024	-0.247	-0.030 (-0.266 to 0.270)	0.805	-0.066	-0.72	-0.079 (-0.299 to 0.140)	0.473			
Impulse control difficulties	Age	-0.172	-1.778	-0.034 (-0.072 to 0.004)	0.078	-0.092	-0.989	-0.018 (-0.054 to 0.018)	0.325	0.28	2.157
	Sex	-0.059	-0.606	-0.489 (-2.092 to 1.113)	0.546	-0.074	-0.829	-0.602 (-2.043 to 0.839)	0.409		
	Years of education	0.088	0.893	0.137 (-0.168 to 0.442)	0.374	0.014	0.167	0.022 (-0.243 to 0.288)	0.868		
	DIF	0.532	6.405	0.332 (0.229 to 0.435)	0.000	0.495	4.666	0.305 (0.175 to 0.435)	0.000		
	DDF	0.363	3.968	0.395 (0.197 to 0.592)	0.000	0.06	0.552	0.064 (-0.167 to 0.295)	0.582		
EOT	-0.068	-0.694	-0.080 (-0.310 to 0.149)	0.489	-0.104	-1.233	-0.122 (-0.318 to 0.074)	0.22			

ANOVA  $p < 0.05$

Description of data:  $\beta$ : standardized partial regression coefficient

$R^2$ : coefficient of determination

CI: confidence interval

$p < 0.00833$  was statistically significant using Bonferroni correction for multiple tests

## **Figure Legends**

### **Figure 1. The process of emotional expression**

Five steps exist between affective arousal and emotional expression.

**STEP 1: Initial prereflective reaction: emotional arousal**

When the emotion-eliciting stimulus is received, a reaction happens in which the stimulus is perceived, preconscious cognitive and emotional processing takes place, and emotional arousal occurs. This arousal is a bodily signal.

**STEP 2: Conscious perception of the response: recognition of emotional states**

The individual observes the affective reaction caused by the bodily signal, and consciously recognizes this experience. Specific bodily signs such as a racing heart or shaking hands may be noticed. Includes repressor, which is a lack of awareness of negative emotional states.

**STEP 3: Labeling and interpreting the response: identification, labeling, and understanding of emotions**

If the affective response can be consciously perceived, then the experience undergoes cognitive processing and is labeled as an emotional experience, and an attempt is made to label and interpret it. Alexithymia is a disruption of this step.

**STEP 4: Evaluation of the response as acceptable: assessment for emotional acceptance**

If the affective response can be labeled and interpreted, then it is compared with the individual's beliefs and goals, and the individual decides whether to accept the feeling.

**STEP 5: Perceived context for expression: determining the expression of emotions**

If the individual perceives that revealing their feelings is possible or desirable in their interpersonal environment, they then ultimately express these feelings.

### **Figure 2. J-DERS and its relation to the process of emotional expression**

**(Kennedy–Moore & Watson model and Gratz & Roemer model)**

By comparing the above-mentioned Kennedy–Moore & Watson process of emotional expression with Gratz & Roemer's four emotion regulation abilities and J-DERS, it can be concluded that STEPs 1–3 (arousing, recognizing, and identifying and labeling emotions) of

Kennedy–Moore & Watson’s emotion expression process correspond to (a) “awareness and understanding of emotions” (emotional arousal, recognition, and understanding) of Gratz & Roemer’s emotion regulation abilities, and its disruption is considered to correspond to ① lack of emotional awareness in J-DERS. Similarly, STEP 4 (deciding whether to accept emotions considering personal beliefs and goals) corresponds to (b) “acceptance of emotions” (accepting and evaluating emotional responses) and its disruption corresponds to ② nonacceptance of emotional responses. In addition, STEP 5 (considering whether emotions can be expressed but are expressed depending on the environment of the situation) corresponds to (c) “ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions” and (d) “ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands” (“ability to control undesirable behaviors and behave in accordance with desired goals when experiencing negative emotions”), and its disruption is considered to correspond to ④ impulse control difficulties and ③ limited access to emotion regulation strategies.

### **Figure 3. Flowchart of the study**

The subjects of the study were first-time patients referred to the Kindai University Hospital Department of Psychosomatic Medicine Outpatient Clinic in the period from February 2018 to June 2019 that did not have dementia or mental illness and that met the criteria below:

Eligibility criteria: ① 16 years and over ② No refusal to provide information

Exclusion diagnosis: ① Neurocognitive Disorders ② Depressive Disorders ③ Obsessive-Compulsive and Related Disorders ④ Neurodevelopmental Disorders ⑤ Feeding and Eating Disorders ⑥ Personality Disorders ⑦ Anxiety Disorders (DSM-5)

Exclusion criteria: Disagreement patients, Patients who agreed but neglected to provide written consent.

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