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Chinese version of the Perth Alexithymia Questionnaire: psychometric properties and clinical applications

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ABSTRACT

Background The alexithymia trait is of high clinical interest. The Perth Alexithymia Questionnaire (PAQ) was recently developed to enable detailed facet-level and valence-specific assessments of alexithymia.

Aims In this paper, we introduce the first Chinese version of the PAQ and examine its psychometric properties and clinical applications.

Methods In Study 1, the PAQ was administered to 990 Chinese participants. We examined its factor structure, internal consistency, test-retest reliability, as well as convergent, concurrent and discriminant validity. In Study 2, four groups, including a major depressive disorder (MDD) group (n=50), a matched healthy control group for MDD (n=50), a subclinical depression group (n=50) and a matched healthy control group for subclinical depression (n=50), were recruited. Group comparisons were conducted to assess the clinical relevance of the PAQ.

Results In Study 1, the intended five-factor structure of the PAQ was found to fit the data well. The PAQ showed good internal consistency and test-retest reliability, as well as good convergent, concurrent and discriminant validity. In Study 2, the PAQ was able to successfully distinguish the MDD group and the subclinical depression group from their matched healthy controls.

Conclusions The Chinese version of the PAQ is a valid and reliable instrument for comprehensively assessing alexithymia in the general population and adults with clinical/subclinical depression.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Alexithymia refers to difficulties in identifying and describing feelings, as well as externally orientated thinking. Its assessment is of clinical interest and important for understanding psychopathology.

⇒ The Perth Alexithymia Questionnaire (PAQ) was recently developed to comprehensively assess alexithymia across positive and negative emotions and has been validated in many other cultures. However, the PAQ has not been validated in the Chinese context.

WHAT THIS STUDY ADDS

⇒ A Chinese version of the PAQ is validated. Our results suggest that a five-factor structure of the Chinese version of the PAQ provides the best fit.

⇒ The Chinese version of the PAQ is adequate for distinguishing patients with major depressive disorder and individuals with subclinical depression from their matched controls.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The Chinese version of the PAQ could be a valid and reliable instrument for comprehensively assessing alexithymia across both negative and positive emotions in research and clinical practice.

INTRODUCTION

Alexithymia is a multidimensional trait characterised by a set of emotion-processing deficits: difficulty identifying one's own feelings (DIF), difficulty describing feelings (DDF) and an externally orientated thinking (EOT) style that focuses less on internal emotional states.[1] The trait is normally distributed in the general population, with the prevalence of alexithymia being approximately 10%.[2] Individuals with high levels of alexithymia have impairments in emotion regulation and coping strategies,[3] as well as functional alterations in brain regions associated with self-awareness, cognitive function and emotional processing,[4] consequently increasing the risk of psychopathology.[5 6] Alexithymia has also been found to commonly co-occur with a range of psychiatric conditions, including affective, autism spectrum and personality disorders,[7 8] and is established as a key transdiagnostic risk factor.[9] Therefore, alexithymia is an important aspect in both clinical and non-clinical contexts, and valid and comprehensive assessment tools are needed.

Alexithymia is commonly assessed via self-report questionnaires, with the most widely used measure since the 1990s being the 20-item Toronto Alexithymia Scale (TAS-20).[10] The TAS-20 remains a robust measure that continues to contribute to the alexithymia field, with items designed to assess DIF, DDF and EOT. However, several psychometric or

conceptual limitations have been noted, prompting the development of new measures. Primarily, the TAS-20 EOT items have low reliability and factor loadings, and the original authors of the scale have recommended against deriving subscales from the TAS-20. Instead, the authors recommended using only the total scale score as an overall marker of alexithymia.[11] This limits the use of the TAS-20 because researchers increasingly seek to explore alexithymia at the facet (ie, subscale) level.[12] Moreover, in the broader emotion field, it is recognised that emotional constructs can function differently across negative and positive emotions, thus requiring valence-specific assessments. However, the TAS-20 does not allow for the assessment of any alexithymia facets in terms of positive emotions.[12]

To address these limitations, Preece *et al* introduced the Perth Alexithymia Questionnaire (PAQ) in 2018. Originally developed in English, the PAQ contains 24 items and was designed to enable more detailed facet-level and valence-specific assessments across negative and positive emotions. It has five subscales, namely: negative-difficulty identifying feelings (N-DIF; four items, for example, *When I'm feeling bad, I get confused about what emotion it is*), positive-difficulty identifying feelings (P-DIF; four items, for example, *When I'm feeling good, I get confused about what emotion it is*), negative-difficulty describing feelings (N-DDF; four items, for example, *When something bad happens, it's hard for me to put into words how I'm feeling*), positive-difficulty describing feelings (P-DDF; four items, for example, *When something good happens, it's hard for me to put into words how I'm feeling*) and general-externally orientated thinking (G-EOT; eight items, for example, *I don't pay attention to my emotions*). These subscales can also be summed into a total score as an overall marker of alexithymia.[12] A five-factor model, corresponding to the intended five-subscale structure (online supplemental figure 1), has been supported by the results of confirmatory factor analyses (CFAs) across a range of clinical and non-clinical groups.[3 12] The PAQ has also consistently demonstrated good to excellent internal consistency at the subscale and composite score levels, with Cronbach's alphas between 0.85 and 0.96.[3 12–14] Good concurrent and discriminant validity has been established with markers of depression, anxiety and emotion regulation.[12 14] The PAQ also highly correlates with other alexithymia measures like the TAS-20.[13] Supporting the utility of the valence distinction for DIF and DDF within the PAQ, participants usually report more difficulties processing their negative emotions than their positive emotions.[12 15]

Cross-cultural validity is a critical consideration in the development of a questionnaire, especially for use across different cultures. So far, the PAQ has demonstrated robust performance in this regard, with the five-factor model and good psychometric indices reported across English,[12] Farsi[15] and Polish[14] versions. Although the psychometric properties of the PAQ have been examined in an Asian culture (Singapore), the questionnaire applied to the sample was the English version.[13] To date, there is no published Chinese version of the PAQ, and the psychometrics and applications of the PAQ have not been evaluated in a Chinese context.

Therefore, our purpose in this paper is to introduce the first Chinese version of the PAQ and evaluate its psychometrics and clinical applications across two studies. In Study 1, we aimed to evaluate the Chinese PAQ's factor structure, internal and 4-week test-retest reliability, and its convergent, concurrent and discriminant validity in a large general population sample. Based on past work across cultures,[13] we anticipated that the five-factor structure would suit the Chinese PAQ with good reliability and validity. In Study 2, we sought to examine the clinical utility of the Chinese PAQ in participants with major depressive disorder (MDD) and subclinical depression. Subclinical depression is an episode of significant depressive symptoms that does not meet the diagnostic criteria for MDD. It is often considered an early stage or precursor of MDD,[16] and individuals with subclinical depression have been found to be at higher risk of developing MDD.[16] The investigation of subclinical depression might provide further insights on the links between alexithymia and different levels of depressive symptoms. Because alexithymia is an established risk factor for depression,[9] we anticipated that the MDD group and the subclinical depression group may have higher PAQ scores than their matched controls.

STUDY 1

Methods

Participants

A total of 1508 participants from Hangzhou, Beijing, and Qiqihar in China were recruited through online advertisements. All participants completed a set of self-report questionnaires using an online platform (https://www.wjx.cn/). Ten pairs of lie or inattention detection items were incorporated into the set of questionnaires to detect non-valid response patterns.[17] The exclusion criteria were: (1) conflicting responses for more than three lie/inattention detection item pairs; (2) personal or family history of mental disorder; (3) substance abuse, neurological disorder or severe head injury; (4) duplicate data; or (5) a responding duration considered too short (less than 2 s per question). A total of 518 (34.35%) participants were excluded according to the exclusion criteria. Finally, data from 990 participants were obtained for further analysis. The mean age of the sample was 20.58 years (SD=3.00), 29.50% were males and the mean length of education was 14.00 years (SD=1.88). Moreover, 340 of these participants completed the PAQ again after a 4-week interval to examine the test-retest reliability. A systematic presentation of the study procedure is shown in figure 1. All participants received CN¥ 25 as compensation and all participants provided online informed consent.

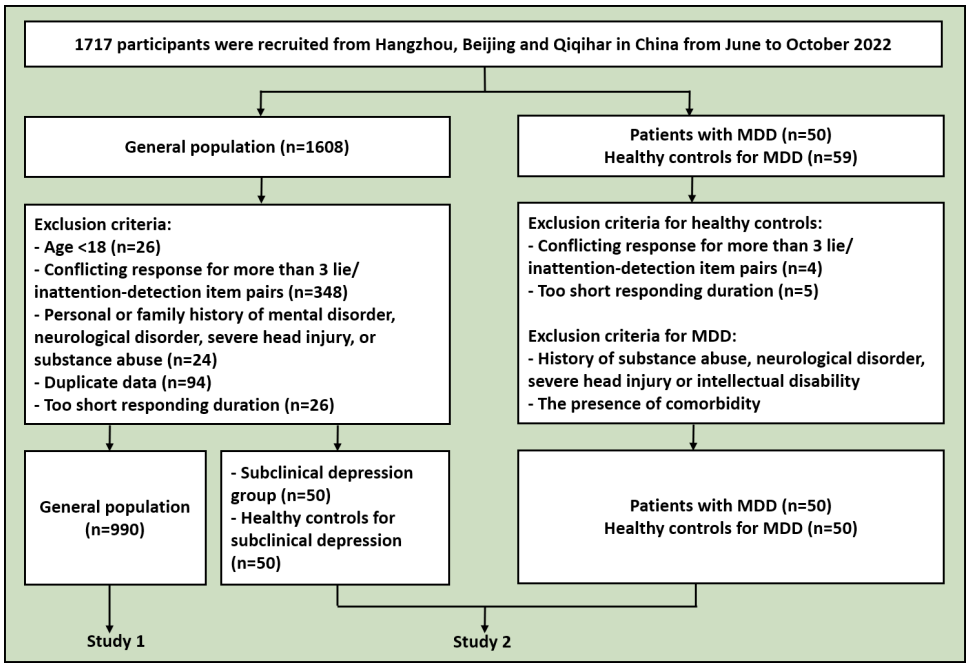

Figure 1 Flowchart of the study. MDD, major depressive disorder.

Measures

Chinese version of the PAQ

The PAQ is a 24-item questionnaire designed to assess alexithymia.[12] Items of the PAQ are scored on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree), with higher scores indicating higher levels of alexithymia. The PAQ has five subscales (N-DIF, P-DIF, N-DDF, P-DDF and G-EOT), which can also be summed into theoretically meaningful composite scores, including a total scale score as an overall marker of alexithymia.

The translation of the PAQ from its original English form into Chinese was conducted according to standard guidelines. First, the original English version of the PAQ was translated into Chinese independently by a bilingual psychology expert and a bilingual postgraduate psychology student. The two draft versions were compared, and discrepancies were discussed and reconciled through consensus. Then, the revised version was back-translated into English by a bilingual psychology expert who was blind to the original questionnaire. Inconsistencies between the original questionnaire and the back-translated version were fully discussed and resolved among the authorship team, resulting in the final version of the Chinese PAQ that was administered in the present study.

Chinese version of the TAS-20

The TAS is a 20-item questionnaire for measuring alexithymia.[10] The TAS-20 was designed to provide a total scale score. Three subscale scores are often also extracted within the literature (DIF, DDF and EOT). Each item is rated on a 5-point Likert scale (from 1 'strongly disagree' to 5 'strongly agree'), with higher scores indicating higher levels of alexithymia. The Chinese version of the TAS-20 has been validated and is shown to generally have good reliability and validity,[18] though like the other language versions, the EOT items have low reliability when used as a subscale score. The Cronbach's alphas for the DIF subscale, the DDF subscale, the EOT subscale and the total scale score in the present sample were 0.90, 0.64, 0.38 and 0.85, respectively.

Chinese version of the Depression Anxiety Stress Scales-21

The Depression Anxiety Stress Scales-21 (DASS-21) is a 21-item self-report measure of depression, anxiety and stress symptoms.[19] Each subscale contains seven items, and each item is rated on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time), with higher scores indicating higher levels of symptoms in the past week. The Chinese version of the DASS-21 has been validated as having good reliability and validity.[20] The Cronbach's alphas for the depression subscale, anxiety subscale, stress subscale and the total scale score were 0.88, 0.84, 0.87 and 0.95, respectively.

Chinese version of the Emotion Regulation Questionnaire

The Emotion Regulation Questionnaire (ERQ)[21] is a 10-item questionnaire designed to assess two commonly used emotion-regulation strategies (cognitive reappraisal and expressive suppression). Items of the ERQ are rated on a 7-point Likert scale (from 1 'strongly disagree' to 7 'strongly agree'), with higher scores indicating a higher frequency of using the regulation strategy. Typically, cognitive reappraisal is regarded as an adaptive strategy, and expressive suppression is regarded as a maladaptive strategy.[21] The Chinese version of the ERQ has been shown to have good reliability and validity.[22] The Cronbach's alphas for the cognitive reappraisal subscale and the expressive suppression subscale in the present sample were 0.86 and 0.79, respectively.

Chinese version of the Difficulties in Emotion Regulation Scale

The Difficulties in Emotion Regulation Scale (DERS) is a 36-item self-report measure of overall emotion regulation difficulties for negative emotions.[23] Each item is rated on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores indicating more difficulties in emotion regulation. The DERS has six subscales: lack of awareness of emotions, lack of emotion clarity, non-acceptance of emotions, impulsiveness, difficulty engaging in goal-directed behaviour in the presence of negative emotion and limited emotion regulation strategies. The Chinese version of the DERS has shown good reliability and validity.[24] The Cronbach's alphas for the six subscales in the current sample were 0.79, 0.74, 0.89, 0.87, 0.84 and 0.89, respectively.

Data analysis

Data analysis was carried out using SPSS V.22 and AMOS V.21.0 (IBM, released 2013; IBM SPSS Statistics for Windows, V.22.0). First, six different PAQ factor structures (one-factor model, two-factor model, three-factor non-valenced model, three-factor valenced model, five-factor model and a bifactor model; online supplemental figure 1) were assessed via CFA using AMOS V.21.0. A maximum likelihood estimation procedure was used. These six models reflected those tested by Preece *et al*.[12] We anticipated that the five-factor model (corresponding to the five intended subscales) and the bifactor version of that model (which added in a general factor alongside the five narrow factors) would represent the best fitting models.

Model fit indices, including the comparative fit index, the Tucker-Lewis index, the root mean square error of approximation, the standardised root mean residual and the Akaike information criterion, were reported. The model would be considered an acceptable fit to the data if the comparative fit index and Tucker-Lewis index values were ≥0.90, and the root mean square error of approximation and the standardised root mean residual values were ≤0.08. Akaike information criteria values were used to compare different CFA models, with lower values indicating a better model fit.[25]

The Cronbach's alpha coefficients of the PAQ subscales, composite scores and total scale were calculated to evaluate the scale's internal consistency (with values ≥0.70 judged as acceptable, ≥0.80 good and ≥0.90 excellent). Four-week test-retest reliability was calculated using the intraclass correlation (ICC) function in SPSS. An ICC ≥0.70 represents good reproducibility over time. To evaluate convergent validity, correlations between PAQ scores and TAS-20 scores were calculated. Correlations between PAQ scores and DASS-21/ERQ/DERS scores were also calculated to assess concurrent validity with other relevant constructs. Discriminant validity was examined by conducting a second-order exploratory factor analysis (EFA) of the PAQ and DASS-21 subscale scores to determine whether the PAQ measured a construct separable from an individual's current levels of distress.[12] It was expected that the PAQ subscales and the DASS-21 subscales would load on two different factors.

Results

Factor structure

Fit indices for the six tested models of the PAQ are presented in table 1. The results showed that the intended five-factor structure (the five-factor model and the bifactor model) fit the data well (see table 1). In the five-factor model, all items loaded above 0.60 on each factor and all five factors were significantly positively correlated (see figure 2). Compared with the five-factor model, the addition of the 'general alexithymia' factor in the bifactor model further improved model fit (see table 1). The simpler models had poorer fit, thus supporting the utility of separating factors based on the facets of alexithymia (ie, DIF, DDF and EOT) and by negative and positive valence.

Reliability

As shown in table 2, the Cronbach's alpha coefficients of the PAQ total scale, subscales and composite scores ranged from 0.83 to 0.96, demonstrating good to excellent internal consistency. In addition, the ICC for the PAQ total scale, subscales and composite scores ranged from 0.70 to 0.79, indicating good test-retest reliability over 4 weeks.

Table 1 Goodness-of-fit index values from confirmatory factor analyses of the Perth Alexithymia Questionnaire

	χ^2	df	CFI	TLI	RMSEA	SRMR	AIC
One-factor model	3609.06	252.00	0.80	0.78	0.12	0.07	3705.06
Two-factor model	2433.37	251.00	0.87	0.86	0.09	0.06	2531.37
Three-factor non-valenced model	2143.21	249.00	0.89	0.87	0.09	0.05	2245.21
Three-factor valenced model	1783.14	249.00	0.91	0.90	0.08	0.05	1885.14
Five-factor model	1347.17	242.00	0.93	0.92	0.07	0.04	1463.17
Bifactor model	1225.10	224.00	0.94	0.93	0.07	0.03	1377.10

AIC, Akaike information criterion; CFI, comparative fit index; df, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardised root mean residual; TLI, Tucker-Lewis index.

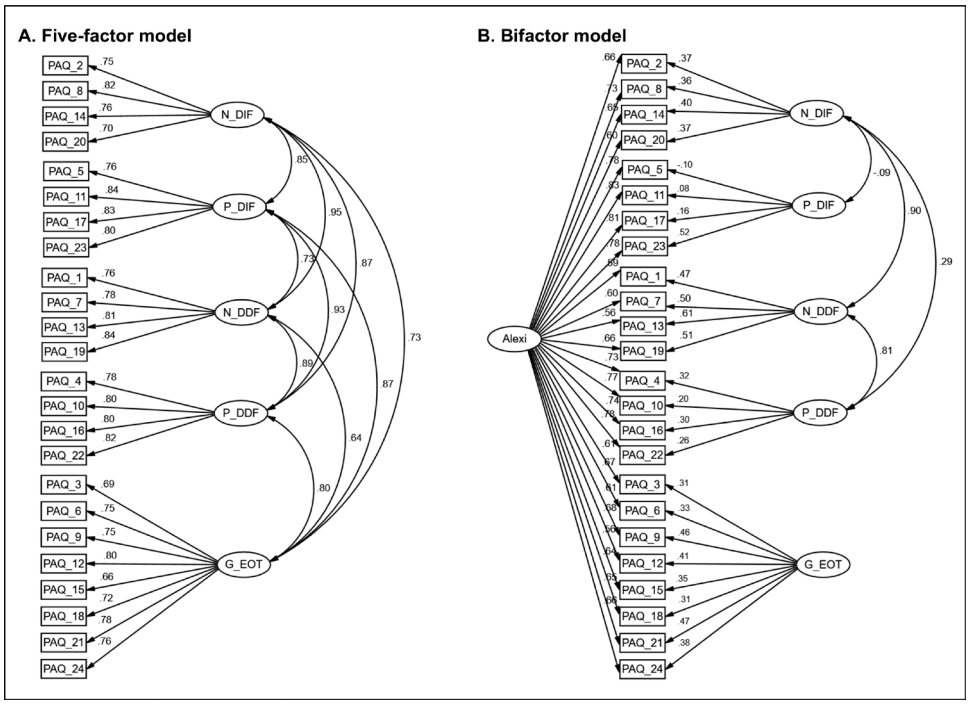

Figure 2 Graphical representations of the (A) five-factor model and (B) bifactor model with factor loadings. G-EOT, general-externally orientated thinking; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings.

Validity

Pearson correlation coefficients between the PAQ and the TAS-20, DASS-21, ERQ and DERS are summarised in online supplemental table 1. In general, higher PAQ scores were significantly associated with higher levels of alexithymia as measured by the TAS-20, higher levels of stress, anxiety and depression symptoms (as measured by the DASS-21), more use of maladaptive emotion-regulation strategies and less use of adaptive strategies (as measured by the ERQ) and more overall emotion-regulation problems (as measured by the DERS). Taken together, the results indicated that the PAQ had good convergent validity and concurrent validity.

For discriminant validity, the second-order EFA of the five PAQ subscales and the three DASS-21 subscales (stress, anxiety and depression) extracted two factors (ie, factor 1 'general alexithymia' and factor 2 'general distress'; online supplemental table 2). All the PAQ subscales loaded cleanly on the 'general alexithymia' factor (loadings from 0.72 to 0.94) and did not load on the 'stress, anxiety and depressive symptoms' (loadings from −0.04 to 0.05). Therefore, the results suggested that the PAQ measured a clinically relevant construct that was statistically distinct from participants' current levels of psychological distress.

STUDY 2

Methods

Participants

A total of 200 participants were recruited in Study 2. Participants were divided into four groups: the MDD group (n=50, 13 males), a matched healthy control group for the MDD group (n=50, 16 males), the subclinical depression group (n=50, 14 males) and a matched healthy control group for the subclinical depression group (n=50, 11 males).

Patients with MDD were recruited from the Qiqihar Mental Health Center. All patients were diagnosed with MDD according to the Structured Clinical Interview for DSM-IV Axis I Disorders.[26] Patients were aged between 18 and 55 years and had at least 9 years of education. Exclusion criteria for the MDD group were: (1) history of substance abuse, neurological disorder or severe head injury; (2) history of transcranial magnetic stimulation or electroconvulsive therapy in the past 12 weeks; (3) the presence of comorbidity or (4) intellectual disability. Their clinical symptoms were assessed by a qualified psychiatrist using the Hamilton Rating Scale for Depression (HAMD). The mean age of patients with MDD was 32.96 years (SD=8.89), the mean length of education was 12.98 years (SD=2.97), the mean illness duration of patients with MDD was 4.18 years (SD=6.17), the mean dosage of antidepressant was 29.96 mg/day (fluoxetine equivalence, SD=15.89), the mean score of HAMD was 22.80 (SD=5.04) and the mean score of the Beck Depression Inventory (BDI[27]) was 19.14 (SD=10.83).

The healthy controls for the MDD group were recruited from the local community via advertisements. They were aged between 18 and 55 years and had at least 9 years of education. The mean age of the control group was 30.28 years (SD=5.98) and the mean length of education was 15.32 years (SD=1.85). Moreover, this healthy control

Table 2 The Cronbach's alpha reliability coefficients of the PAQ and the TAS-20 and the ICCs of the PAQ

	Cronbach's alpha reliability coefficients					ICCs
	General population	MDD	Controls for MDD	Subclinical depression	Controls for subclinical depression	General population
PAQ						
Subscales						
N-DIF	0.83	0.93	0.83	0.75	0.57	0.71
P-DIF	0.87	0.86	0.85	0.83	0.70	0.74
N-DDF	0.88	0.89	0.82	0.91	0.85	0.70
P-DDF	0.88	0.89	0.90	0.85	0.90	0.75
G-EOT	0.91	0.93	0.83	0.89	0.81	0.74
Composites						
G-DIF	0.90	0.93	0.89	0.85	0.78	0.76
G-DDF	0.92	0.94	0.93	0.92	0.91	0.76
N-DAF	0.91	0.95	0.91	0.90	0.85	0.73
P-DAF	0.92	0.94	0.92	0.88	0.89	0.77
G-DAF	0.95	0.97	0.95	0.93	0.92	0.78
Total	0.96	0.98	0.94	0.94	0.91	0.79
TAS-20						
DIF	0.90	0.91	0.84	0.87	0.88	–
DDF	0.64	0.53	0.70	0.63	0.58	–
EOT	0.38	0.62	0.57	0.36	0.45	–
Total	0.85	0.84	0.88	0.82	0.76	–

DDF, difficulty describing feelings; DIF, difficulty identifying feelings; EOT, externally orientated thinking; G-DAF, general-difficulty appraising feelings; G-DDF, general-difficulty describing feelings; G-DIF, general-difficulty identifying feelings; G-EOT, general-externally orientated thinking; ICCs, intraclass correlations; MDD, major depressive disorder; N-DAF, negative-difficulty appraising feelings; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire; P-DAF, positive-difficulty appraising feelings; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings; TAS-20, Toronto Alexithymia Scale-20.

group had a BDI score below 16 ($mean_{BDI}$=2.62, SD=4.20). The patients with MDD and the healthy controls for MDD were matched on age and gender distribution (age: t_{98}=1.77, p=0.080; gender distribution: χ^2=0.44, p=0.660), while the healthy controls had a significantly longer duration of education (t_{98}=−4.73, p<0.001).

Individuals with subclinical depression (ie, not meeting criteria for a diagnosis of MDD but with elevated depressive symptoms; $mean_{age}$=21.66, SD=1.70; $mean_{length\ of\ education}$=15.30, SD=1.45; $mean_{BDI}$=22.34, SD=6.53) and healthy controls for this group ($mean_{age}$=21.48, SD=1.11; $mean_{length\ of\ education}$=15.36, SD=1.23; $mean_{BDI}$=3.40, SD=0.50), matched on gender, age and duration of education (age: t_{98}=0.63, p=0.532; gender distribution: χ^2=0.48, p=0.645; length of education: t_{98}=−0.22, p=0.823), were recruited via an online questionnaire. Subclinical depression was screened using the BDI.[27] A BDI score of 16 and above (ie, above a moderate level of depressive symptoms) was applied to classify individuals with subclinical depression.[28] Individuals who had a BDI score below 16 were classified as healthy controls for subclinical depression. The exclusion criteria for all these groups were the same as in Study 1 (figure 1).

Measures

The PAQ, TAS-20, DASS-21, ERQ and DERS were completed after participants had given online informed consent. Moreover, the Chinese version of the BDI was used to assess the severity of depression.[27] The BDI is a 21-item self-report measure, and all items are scored on a 4-point Likert scale. A higher score on the BDI indicates more severe depression symptoms. The BDI has previously demonstrated good validity and reliability[27] and had good internal consistency in Study 2 (0.93 for the entire sample including the four groups).

Data analysis

The internal consistency of the PAQ scale was evaluated for each group. Convergent and concurrent validity were evaluated for each group in the same way as in Study 1. The PAQ's factor structure and discriminant validity with EFA were not examined for each group considering the small sample size for analyses of that type.

The clinical utility of the PAQ was assessed by comparing the PAQ scores of the MDD group and its control group, as well as the subclinical depression group and its control group. Independent t-tests were used to compare the

PAQ total scores and a multivariate analysis of variance (MANOVA) was used to compare the PAQ subscale scores, so as to control for type I error. As patients with MDD had significantly shorter education length than healthy controls and education length was significantly correlated with alexithymia (online supplemental table 3), education length was included as a covariate to test the group differences again (online supplemental methods). Moreover, we conducted the receiver operating characteristic (ROC) analysis to explore the possibility of using the PAQ cut-off score to distinguish MDD, subclinical depression and their matched controls. To explore the effects of antidepressants on the PAQ scores in the MDD group, correlations between the PAQ scores and the HAMD or BDI scores were conducted before and after including daily antidepressant dosage as covariates.

Results

Reliability

The internal consistency of the PAQ for each group is displayed in table 2. The Cronbach's alpha coefficients of the PAQ total scale, subscales and composite scores ranged from 0.86 to 0.98 in the MDD group and from 0.75 to 0.94 in the subclinical depression group. As a comparison, we also report the internal consistency of the TAS-20 in table 2. As shown in table 2, the Cronbach's alpha coefficients for the DDF subscale of the TAS-20 were lower than the N-DDF, P-DDF and G-DDF subscales of the PAQ in each group, and the EOT subscale of the TAS-20 was lower than the G-EOT subscale of the PAQ in each group.

Validity

For convergent validity and concurrent validity, the pattern of correlations in each group (online supplemental tables 1 and 4) followed the same patterns observed in Study 1. For the MDD group, the subclinical depression group and their matched healthy control groups, higher PAQ scores were associated with higher alexithymia on the TAS-20, higher depression, anxiety and stress symptoms (DASS-21), more use of maladaptive emotion-regulation strategies and less use of adaptive emotion-regulation strategies (ERQ), and more overall emotion-regulation problems (DERS).

Clinical utility

The difference in the PAQ total score between the MDD group ($mean_{PAQ\ total}$=92.86, SD=36.84) and its matched healthy control group ($mean_{PAQ\ total}$=57.00, SD=21.46) was statistically significant (t_{98}=5.95, p<0.001), with the MDD group having significantly higher levels of overall alexithymia. A similar significant group difference was observed between the subclinical depression group ($mean_{PAQ\ total}$=92.56, SD=25.45) and its matched control group ($mean_{PAQ\ total}$=67.78, SD=20.31; t_{98}=5.38, p<0.001). As for the subscale scores of the PAQ, our MANOVA showed significant group differences between the MDD group and the MDD control group (V=0.71, F(5, 94)=7.58, p<0.001), as well as the subclinical depression group and the subclinical depression control group (V=0.72, F(5, 94)=7.36, p<0.001), on an overall linear composite of the five subscales (figure 3). Our follow-up analyses of variance revealed significant group differences between the MDD group and the MDD control group on each subscale (N-DIF: F(1, 98)=32.01, p<0.001; P-DIF: F(1, 98)=28.90, p<0.001; N-DDF: F(1, 98)=27.93, p<0.001; P-DDF: F(1, 98)=23.05, p<0.001; G-EOT: F(1, 98)=33.31, p<0.001). The group differences between the subclinical depression group and the subclinical depression control group on each subscale were also significant (N-DIF: F(1, 98)=32.26, p<0.001; P-DIF: F(1, 98)=20.31, p<0.001; N-DDF: F(1, 98)=13.01, p<0.001; P-DDF: F(1, 98)=21.26, p<0.001; G-EOT: F(1, 98)=14.77, p<0.001). Results remained unchanged after including the covariates (online supplemental results). The ROC curve analysis revealed that the PAQ total score could differentiate the MDD group from its healthy controls with a cut-off value of 91.00 (area under curve: 0.77), as well as the subclinical depression group from its healthy controls with a cut-off value of 81.50 (area under curve: 0.78) (figure 3).

Moreover, significantly positive correlations between the PAQ scores and the HAMD scores as well as the BDI scores were found in patients with MDD (online supplemental table 5). After including daily antidepressant dosage as a covariate, most findings remained significant (online supplemental table 5).

DISCUSSION

Main findings

Our aim in this paper was to introduce the first Chinese version of the PAQ, and examine its psychometric properties and clinical relevance/applications across two studies. Specifically, we evaluated its psychometrics in a large sample of Chinese participants from the general community (Study 1), and examined the clinical utility of this scale in patients with MDD and individuals with subclinical depression as compared with matched controls (Study 2). Overall, the Chinese version of the PAQ appeared to have strong psychometrics and clinical utility across our studies, functioning similarly to the original English version.

Consistent with our hypothesis, our CFA results suggested that the intended five-factor structure first obtained in the original study by Preece *et al*[12] was the best-fit solution. This result is also in line with prior validation studies across a range of settings and cultural groups.[12–15] Furthermore, the addition of the 'general alexithymia' factor in the bifactor model further improved fit. Therefore, our findings provide strong statistical support for this multidimensional alexithymia construct in an Asian culture. Importantly, previous studies in Asian samples using the TAS-20 to operationalise alexithymia have reported low reliability and factor loadings for the EOT items.[29] In contrast, we found excellent internal reliability for

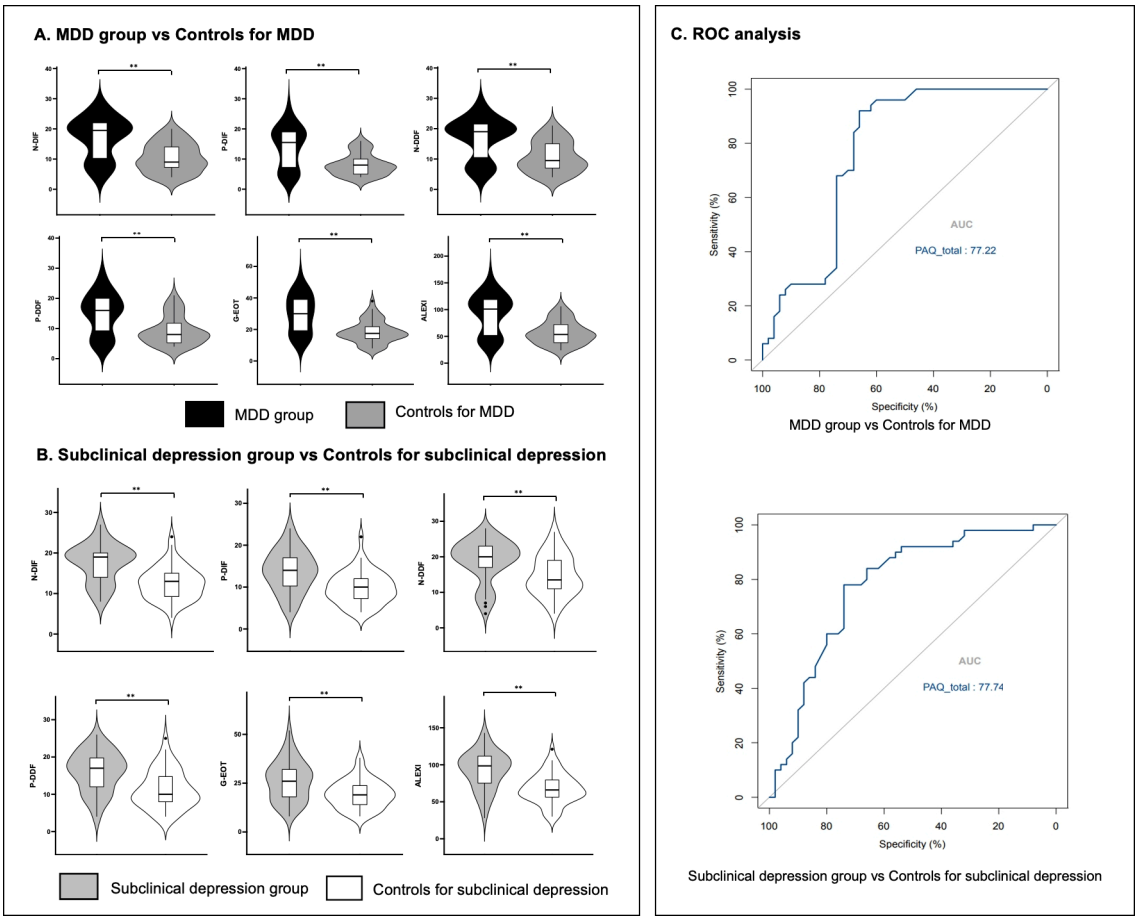

Figure 3 (A) Violin plots of the PAQ subscale and total scale scores in the MDD group and the MDD control group. (B) Violin plots of the PAQ subscale and total scale scores in the subclinical depression group and the subclinical depression control group. (C) The ROC curves for the data analysed between the MDD group and the MDD control group, and between the subclinical depression group and the subclinical depression control group with the PAQ total score. **P<0.001. ALEXI, alexithymia; AUC, area under curve; G-EOT, general-externally orientated thinking; MDD, major depressive disorder; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings; ROC, receiver operating characteristic.

the EOT subscale of the PAQ in our general population sample, as well as in patients with MDD and individuals with subclinical depressive symptoms (table 2). These findings are consistent with a previous study in a Singaporean sample.[13] In addition to the EOT subscale, all the other alpha coefficients of the PAQ subscales, composite scores and total scale were greater than 0.80, suggesting good internal consistency, which was also found in other studies.[14 15] Moreover, our results yielded good test-retest reliability, with comparable findings with those reported by Lashkari *et al*.[15] Thus, our findings highlight the good cross-cultural applicability of the PAQ to an Asian context.

Our findings of the significant and positive correlations between the PAQ and the TAS-20 suggest a robust convergent validity of the PAQ with other markers of alexithymia.[14 15] As in several previous studies,[14 15] the DASS-21, ERQ and DERS were chosen as markers of other related constructs for the testing of concurrent validity. Our findings further showed that the PAQ scores were significantly correlated with DASS-21, ERQ and DERS scores, thus underpinning the relevance of the alexithymia construct and the PAQ to affective disorder symptoms and emotion regulation processes.[12 14 15] The good discriminant validity of the PAQ against markers of distress was further confirmed via EFA of the PAQ and DASS-21 subscale scores, in view of two distinct factors extracted. As such, the PAQ can assess an alexithymia construct that is separable from people's current levels of distress.

It is noteworthy that our study is the first published investigation of alexithymia across positive and negative emotions, specifically in a clinical sample formally diagnosed with depression. Compared with healthy controls, patients with MDD and individuals with subclinical depression showed significantly higher levels of alexithymia on all subscales of the PAQ. Additionally, the results of the ROC analysis further demonstrated the possible potential of the PAQ scores to distinguish patients with MDD and individuals with subclinical depression from healthy controls. This is consistent with previous work showing links between depression and higher alexithymia levels.[30] Importantly, our findings extend that work by

demonstrating that these difficulties exist across all facets of alexithymia and across both the negative and positive valence domains. These findings may provide guidance for the treatment and prevention of depression. Our results suggest that alexithymia should be routinely screened for in cases of depression, and that alexithymia may be an important component of case formulations for depression. Clinicians and researchers should be aware that alexithymia could be problematic across all facets of the construct, and focus may be required across both negative and positive emotions.

Limitations

Several limitations of our study should be noted. First, the absence of clinical interviews, such as the Mini-International Neuropsychiatric Interview, to exclude possible psychiatric disorders for participants in Study 1 and healthy controls in Study 2, is notable. Second, the inclusion of patients with MDD who were receiving antidepressant treatment may affect alexithymia scores. Different populations, such as patients with MDD who are medication-free and those who are in remission, should be considered in future research to explore how antidepressants affect alexithymia in depression. Third, our sample characteristics, including gender distribution imbalance and the average level of education around the undergraduate level, may not be representative of the broader population, thus restricting the generalisability of the findings. Future studies are encouraged to recruit larger and more diverse samples to enhance the generalisability of these findings. Finally, alexithymia has been found to be associated with various psychiatric disorders,[9] yet our study focused solely on patients with MDD and individuals with subclinical depression in Study 2. Future studies should include a more diverse range of psychiatric disorders to extend the data on the potential clinical utility of the PAQ.

Implications

Overall, the findings from our two studies suggest that the Chinese version of the PAQ is a reliable and valid tool that provides a robust and detailed alexithymia profile across both non-clinical, clinical and subclinical groups. Moving forward, the use of the PAQ in future studies in China can help to advance our understanding of alexithymia among Chinese-speaking populations, and in turn, help to learn more about the cross-cultural applicability of the construct.

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Contributors B-ML, X-LC and DP collaboratively designed the study. X-LC and QY analysed the data. X-LC, DP and QY wrote the drafts of the paper. KN, QY, LZ and QZ recruited participants and collected data. ZZ, WW, MY, DP and B-ML interpreted the findings and commented on the manuscript critically. All authors commented and approved the final version for submission. X-LC acts as the guarantor of the study.

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Ethics approval This study involves human participants. Ethical procedures followed the Declaration of Helsinki and were approved by the Research Ethics Review Board of the School of Basic Medical Sciences, Hangzhou Normal University (protocol number: 20221206). Participants gave informed consent to participate in the study before taking part.

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Supplementary materials

1. Supplementary Methods

2. Supplementary Results

3. Supplementary Table S1. Pearson correlations between the Perth Alexithymia Questionnaire scores and the scores of Toronto Alexithymia Scale-20/Depression Anxiety Stress Scales-21/Emotion Regulation Questionnaire/Difficulties in Emotion Regulation Scale (Study 1 general population/Study 2 the clinical depression group /Study 2 the subclinical depression group).

4. Supplementary Table S2. Factor loadings from a second-order exploratory factor analysis of the Perth Alexithymia Questionnaire and Depression Anxiety Stress Scales-21 subscale scores.

5. Supplementary Table S3. Pearson correlations between alexithymia and educational level (the subclinical depression control group/the subclinical depression group/the clinical depression control group/ the clinical depression group).

6. Supplementary Table S4. Pearson correlations between the Perth Alexithymia Questionnaire scores and the scores of Toronto Alexithymia Scale-20/Depression Anxiety Stress Scales-21/Emotion Regulation Questionnaire/Difficulties in Emotion Regulation Scale (the clinical depression control group/the subclinical depression

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control group).

7. Supplementary Table S5. Pearson correlations and partial correlations between alexithymia and depressive symptoms in patients with major depressive disorder.

8. Supplementary Figure S1. The confirmatory factor analysis models examined in Study 1.

Supplementary Methods

As patients with major depressive disorder (MDD) had significantly shorter education length than healthy controls, the PAQ total scores were compared between patients with MDD and healthy controls using an analysis of covariance (ANCOVA) with a covariate of education length. The PAQ subscale scores were compared between the two groups using a multivariate analysis of covariance (MANCOVA) with a covariate of education length. When main effects were significant in the MANCOVA, the ANCOVA was conducted for each subscale scores. To explore the relationships between alexithymia and education length, Pearson correlations between alexithymia and educational level were conducted.

Supplementary Results

Patients with MDD had significantly higher PAQ total scores than healthy controls ($F(1, 97)=20.80$, $p<0.001$). As for the subscale scores, MANCOVA found significant group differences ($V=0.81$, $F(4, 94) =5.52$, $p<0.001$). The follow-up ANCOVAs revealed significant group difference between the MDD group and the MDD control group on each subscale (N-DIF: $F(1, 97)=18.37$, $p<0.001$; P-DIF: $F(1, 97)=17.53$, $p<0.001$; N-DDF: $F(1, 97)=15.75$, $p<0.001$; P-DDF: $F(1, 97)=12.75$, $p<0.001$; G-EOT: $F(1, 97)=20.15$, $p<0.001$). The results of Pearson correlations were shown in Supplementary Table S5.

Supplementary Table S1. Pearson correlations between the Perth Alexithymia Questionnaire and the Toronto Alexithymia Scale-20/Depression Anxiety Stress Scales-21/Emotion Regulation Questionnaire/Difficulties in Emotion Regulation Scale (Study 1 general population/Study 2 the clinical depression group/Study 2 the subclinical depression group).

	PAQ subscales					PAQ composite scales					
Measure	N-DIF	P-DIF	N-DDF	P-DDF	G-EOT	G-DIF	G-DDF	N-DAF	P-DAF	G-DAF	ALEXI
TAS											
DIF	0.67*/0.74*/0.74*	0.64*/0.57*/0.52*	0.60*/0.71*/0.73*	0.63*/0.67*/0.57*	0.55*/0.53*/0.52*	0.70*/0.70*/0.71*	0.65*/0.70*/0.70*	0.67*/0.74*/0.78*	0.67*/0.63*/0.61*	0.70*/0.71*/0.75*	0.70*/0.67*/0.74*
DDF	0.60*/0.58*/0.58*	0.56*/0.47*/0.42*	0.63*/0.56*/0.72*	0.64*/0.53*/0.49*	0.50*/0.35*/0.57*	0.62*/0.55*/0.56*	0.68*/0.56*/0.66*	0.65*/0.58*/0.70*	0.63*/0.51*/0.51*	0.68*/0.56*/0.66*	0.66*/0.51*/0.69*
EOT	0.31*/-0.06/0.26	0.39*/-0.12/0.39*	0.32*/-0.07/0.24	0.38*/-0.11/0.25	0.46*/-0.04/0.35*	0.37*/-0.10/0.36*	0.37*/-0.09/0.26	0.33*/-0.07/0.26	0.40*/-0.12/0.35*	0.39*/-0.10/0.33*	0.44*/-0.08/0.37*
Total	0.67*/0.60*/0.70*	0.67*/0.44*/0.57*	0.65*/0.57*/0.72*	0.68*/0.53*/0.57*	0.62*/0.41*/0.60*	0.72*/0.55*/0.71*	0.71*/0.56*/0.70*	0.70*/0.60*/0.76*	0.71*/0.49*/0.63*	0.74*/0.56*/0.75*	0.75*/0.53*/0.77*
DASS-21											
Stress	0.47*/0.60*/0.40*	0.45*/0.48*/0.25	0.41*/0.51*/0.25	0.43*/0.56*/0.22	0.41*/0.30*/0.32*	0.50*/0.57*/0.36*	0.45*/0.55*/0.26	0.47*/0.57*/0.34*	0.46*/0.53*/0.26	0.49*/0.56*/0.32*	0.50*/0.50*/0.36*
Anxiety	0.47*/0.66*/0.49*	0.49*/0.66*/0.36*	0.42*/0.65*/0.33*	0.46*/0.72*/0.24	0.45*/0.51*/0.48*	0.52*/0.70*/0.48*	0.46*/0.70*/0.31*	0.47*/0.67*/0.43*	0.50*/0.70*/0.33*	0.51*/0.71*/0.41*	0.52*/0.66*/0.48*
Depression	0.44*/0.42*/0.26	0.50*/0.40*/0.25	0.40*/0.40*/0.24	0.45*/0.41*/0.13	0.49*/0.32*/0.38*	0.51*/0.44*/0.29*	0.45*/0.41*/0.20	0.45*/0.42*/0.27	0.50*/0.41*/0.21	0.50*/0.43*/0.26	0.53*/0.41*/0.33*
Total	0.49*/0.61*/0.43*	0.51*/0.56*/0.33*	0.44*/0.57*/0.31*	0.47*/0.61*/0.22	0.48*/0.42*/0.45*	0.54*/0.62*/0.42*	0.48*/0.60*/0.29*	0.49*/0.60*/0.39*	0.52*/0.59*/0.30*	0.53*/0.62*/0.37*	0.55*/0.57*/0.44*
ERQ											
Reappraisal	-0.06/-0.47*/-0.29	-0.16*/-0.36*/-0.36*	-0.09/-0.41*/-0.09	-0.08*/-0.37*/-0.13	-0.16*/-0.16/-0.16	-0.11*/-0.44*/-0.37*	-0.09*/-0.40*/-0.12	-0.08*/-0.45*/-0.19	-0.12*/-0.37*/-0.27	-0.10*/-0.42*/-0.25	-0.13*/-0.35*/-0.24
Suppression	0.33*/0.21/0.17	0.42*/0.14/0.39*	0.31*/0.16/0.23	0.41*/0.20/0.30*	0.49*/0.28*/0.60*	0.40*/0.19/0.32*	0.38*/0.18/0.28*	0.34*/0.19/0.22	0.44*/0.17/0.38*	0.41*/0.19/0.32*	0.46*/0.22/0.47*
DERS											
Awareness	0.15*/-0.14/0.27	0.21*/0.06/0.40*	0.18*/-0.09/0.43*	0.22*/0.02/0.44*	0.33*/-0.11/0.37*	0.20*/-0.04/0.38*	0.21*/-0.03/0.47*	0.18*/-0.12/0.38*	0.23*/0.04/0.47*	0.22*/-0.04/0.46*	0.27*/-0.06/0.47*
Clarity	0.56*/0.29*/0.68*	0.60*/0.26/0.63*	0.50*/0.23/0.55*	0.57*/0.23/0.45*	0.58*/0.10/0.56*	0.63*/0.29*/0.73*	0.57*/0.24/0.54*	0.56*/0.26/0.65*	0.62*/0.25/0.59*	0.62*/0.26/0.67*	0.65*/0.22/0.70*
Nonacceptanc	0.52*/0.64*/0.46*	0.47*/0.61*/0.33*	0.43*/0.62*/0.43*	0.42*/0.60*/0.19	0.44*/0.44*/0.12	0.53*/0.66*/0.44*	0.45*/0.62*/0.34*	0.50*/0.64*/0.48*	0.47*/0.61*/0.29*	0.51*/0.65*/0.41*	0.52*/0.60*/0.34*
Impulses	0.50*/0.56*/0.30*	0.49*/0.55*/0.27	0.45*/0.50*/0.29*	0.43*/0.51*/0.15	0.43*/0.36*/0.21	0.53*/0.59*/0.32*	0.47*/0.52*/0.24	0.50*/0.55*/0.31*	0.49*/0.54*/0.23	0.52*/0.56*/0.29*	0.52*/0.51*/0.29*
Goals	0.38*/0.53*/0.18	0.26*/0.44*/0.03	0.41*/0.45*/0.32*	0.32*/0.46*/0.25	0.21*/0.31*/0.08	0.35*/0.51*/0.12	0.39*/0.47*/0.31*	0.42*/0.50*/0.28	0.31*/0.46*/0.16	0.38*/0.49*/0.24	0.35*/0.45*/0.20
Strategies	0.50*/0.61*/0.37*	0.45*/0.59*/0.16	0.45*/0.53*/0.44*	0.42*/0.58*/0.19	0.41*/0.45*/0.22	0.51*/0.63*/0.30*	0.46*/0.56*/0.35*	0.50*/0.58*/0.44*	0.46*/0.60*/0.20	0.50*/0.60*/0.35*	0.50*/0.57*/0.34*
Total	0.58*/0.56*/0.51*	0.55*/0.56*/0.40*	0.54*/0.51*/0.56*	0.52*/0.54*/0.36*	0.52*/0.36*/0.34*	0.61*/0.59*/0.50*	0.56*/0.53*/0.50*	0.59*/0.54*/0.57*	0.56*/0.56*/0.42*	0.61*/0.57*/0.53*	0.62*/0.52*/0.51*

Note: ALEXI, alexithymia; DASS-21, Depression Anxiety Stress Scales-21; DDF, difficulty describing feelings; DERS, Difficulties in Emotion Regulation Scale; DIF, difficulty

identifying feelings; EOT, externally orientated thinking; ERQ, Emotion Regulation Questionnaire; G-DAF, general- difficulty appraising feelings; G-DDF, general-difficulty describing feelings; G-DIF, general-difficulty identifying feelings; G-EOT, general-externally orientated thinking; N-DAF, negative-difficulty appraising feelings; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire; P-DAF, positive-difficulty appraising feelings; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings; TAS-20, Toronto Alexithymia Scale-20.

* $p<0.05$.

Supplementary Table S2. Factor loadings from a second-order exploratory factor analysis of the Perth Alexithymia Questionnaire and Depression Anxiety Stress Scales-21 subscale scores.

	Factor 1 (General alexithymia)	Factor 2 (General distress)
PAQ		
N-DIF	**0.83**	0.02
P-DIF	**0.85**	0.03
N-DDF	**0.84**	-0.04
P-DDF	**0.94**	-0.06
G-EOT	**0.72**	0.07
DASS-21		
Stress	-0.04	**0.95**
Anxiety	0.003	**0.92**
Depression	0.05	**0.84**

Note: Principal components with direct oblimin rotation were used. Factor loadings⩾0.40 are in boldface. G-EOT, general-externally orientated thinking; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings.

Supplementary Table S3. Pearson correlations between alexithymia and educational level in Study 2.

	PAQ					
	N-DIF	P-DIF	N-DDF	P-DDF	G-EOT	ALEXI
MDD group	-0.31*	-0.22	-0.26	-0.24	-0.18	-0.25
HC group for MDD	0.02	0.02	-0.08	-0.08	-0.18	-0.09
Subclinical depression group	-0.02	0.00	-0.12	0.08	-0.03	-0.03
HC group for subclinical depression	-0.25	-0.40**	-0.26	-0.42**	-0.17	-0.36**

Note: ALEXI, alexithymia; G-EOT, general-externally orientated thinking; HC, healthy controls; MDD, major depressive disorder; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire.

* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

Supplementary Table S4. Pearson correlations between the Perth Alexithymia Questionnaire and the Toronto Alexithymia Scale-20/Depression Anxiety Stress Scales-21/Emotion Regulation Questionnaire/Difficulties in Emotion Regulation Scale (the clinical depression control group/the subclinical depression control group).

	PAQ subscales						
Measure	N-DIF	P-DIF	N-DDF	P-DDF	G-EOT	G-DIF	G-DDF
TAS							
DIF	0.60*/0.49*	0.62*/0.36*	0.63*/0.44*	0.51*/0.51*	0.57*/0.16	0.65*/0.47*	059*/0.51*
DDF	0.43*/0.55*	0.51*/0.45*	0.52*/0.64*	0.40*/0.61*	0.60*/0.05	0.50*/0.55*	0.48*/0.68*
EOT	0.18/-0.04	0.29*/0.16	0.25/0.15	0.22/0.14	0.43*/0.14	0.24/0.06	0.24/0.16
Total	0.48*/0.49*	0.56*/0.45*	0.55*/0.57*	0.45*/0.60*	0.62*/0.18	0.55*/0.52*	0.52*/0.63*
DASS-21							
Stress	0.29*/0.47*	0.22/0.14	0.30*/0.32*	0.17/0.18	0.23/0.26	0.28*/0.34*	0.25*/0.27
Anxiety	0.25/0.26	0.13/0.22	0.21/0.26	0.07/0.21	0.16/0.19	0.21/0.26	0.15/0.26
Depression	0.28*/0.43*	0.25/0.38*	0.26/0.37*	0.16/0.45*	0.37*/0.30*	0.28*/0.44*	0.22/0.44*
Total	0.30*/0.44*	0.21/0.26	0.28/0.35*	0.15/0.30*	0.26/0.28*	0.28/0.39*	0.22/0.35*
ERQ							
Reappraisal	-0.06/0.05	-0.34*/-0.15	-0.08/0.21	-0.23/0.05	-0.16/-0.02	-0.19/-0.05	-0.16/0.14
Suppression	0.36*/0.19	0.32*/0.23	0.39*/0.37*	0.19/0.30*	0.54*/0.43*	0.37*/0.23	0.30*/0.36*
DERS							
Awareness	0.18/0.00	0.24/0.24	0.08/0.01	0.15/0.03	0.38*/0.24	0.22/0.13	0.12/0.02
Clarity	0.50*/0.53*	0.61*/0.49*	0.62*/0.49*	0.60*/0.52*	0.43*/0.33*	0.58*/0.56*	0.63*/0.55*
Nonacceptance	0.29*/0.28*	0.34*/0.08	0.35*/0.22	0.23/0.13	0.27/0.24	0.33*/0.20	0.30*/0.19
Impulses	0.20/0.41*	0.28*/0.19	0.32*/0.13	0.27/0.22	0.23/0.24	0.25/0.33*	0.31*/0.19
Goals	0.20/0.33*	0.23/-0.03	0.41*/0.22	0.40*/0.19	0.20/-0.02	0.23/0.17	0.42*/0.22
Strategies	0.28*/0.41*	0.33*/0.14	0.40*/0.26	0.30*/0.29*	0.33*/0.14	0.33*/0.30*	0.36*/0.29*
Total	0.36*/0.46*	0.44*/0.23	0.48*/0.30*	0.42*/0.31*	0.41*/0.26	0.42*/0.38*	0.47*/0.34*

Note: ALEXI, alexithymia; DASS-21, Depression Anxiety Stress Scales-21; DDF, difficulty describing feelings; DERS, Difficulties in Emotion Regulation Scale; DIF, difficulty identifying feelings; EOT, externally orientated thinking; ERQ, Emotion Regulation Questionnaire; G-DAF, general-difficulty appraising feelings; G-DDF, general-difficulty describing feelings; G-DIF, general-difficulty identifying feelings; G-EOT, general-externally orientated thinking; N-DAF, negative-difficulty appraising feelings; N-DDF, negative-difficulty describing feelings; N-DIF, negative-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire; P-DAF,

positive-difficulty appraising feelings; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings; TAS-20, Toronto Alexithymia Scale-20.

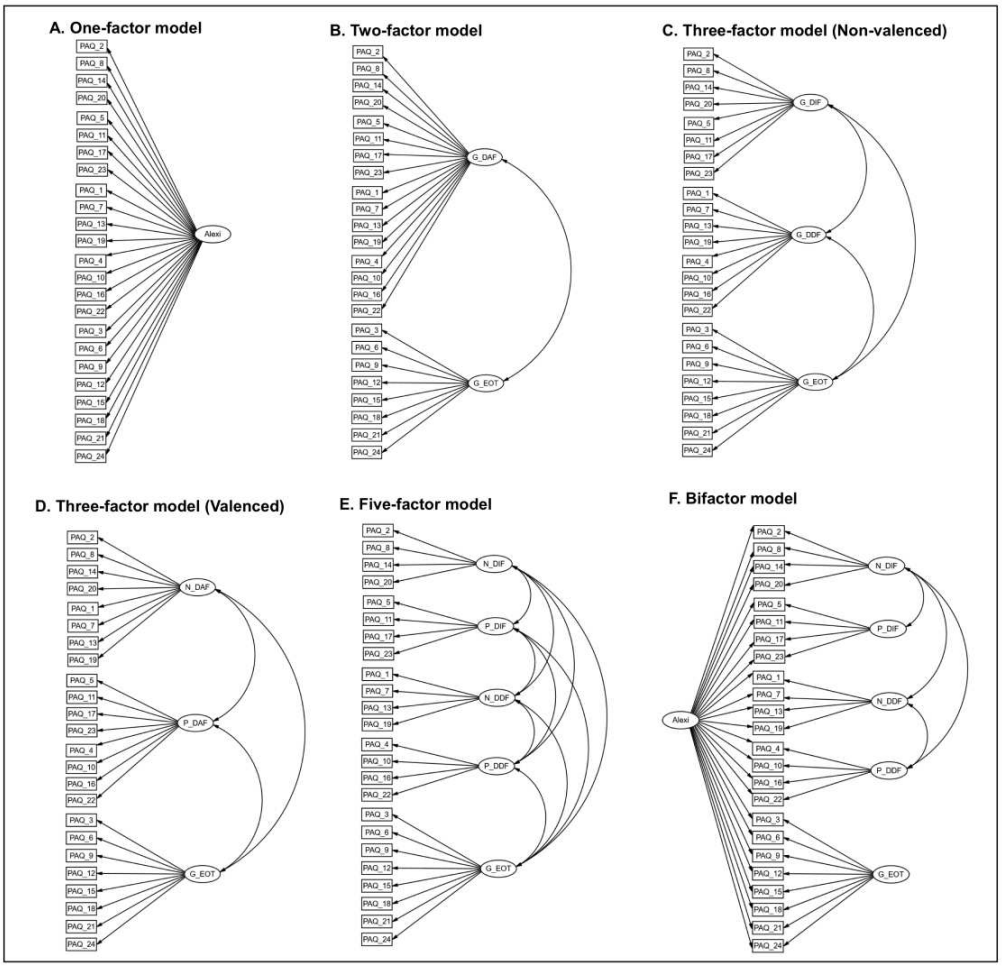
* $p<0.05$.

Supplementary Table S5. Pearson correlations and partial correlations between alexithymia and depressive symptoms in patients with major depressive disorder.

PAQ subscales					PAQ composite scales				
N-DIF	P-DIF	N-DDF	P-DDF	G-EOT	G-DIF	G-DDF	N-DAF	P-DAF	G-DAF
0.41***	0.31***	0.37***	0.34***	0.34***	0.38***	0.36***	0.40***	0.33***	0.38***
0.65***	0.69***	0.61***	0.67***	0.53***	0.71***	0.66***	0.65***	0.69***	0.69***
ing medication									
0.41***	0.31***	0.39***	0.34***	0.35***	0.38***	0.37***	0.41***	0.33***	0.38***
0.66***	0.69***	0.61***	0.68***	0.53***	0.71***	0.66***	0.65***	0.70***	0.69***

Note: ALEXI, alexithymia; BDI, Beck Depression Inventory; G-DAF, general-difficulty appraising feelings; G-DDF, general-difficulty describing feelings; G-DIF, general-difficulty identifying feelings; G-EOT, general-externally orientated thinking; HAMD, Hamilton Rating Scale for Depression; N-DAF, negative-difficulty appraising feelings; N-DDF, negative-difficulty describing feelings;N-DIF, bnegative-difficulty identifying feelings; P-DAF, positive-difficulty appraising feelings; P-DDF, positive-difficulty describing feelings; P-DIF, positive-difficulty identifying feelings; PAQ, Perth Alexithymia Questionnaire.

* $p<0.05$; ** $p<0.01$; *** $p<0.001$.



Supplementary Figure S1. The confirmatory factor analysis models examined in Study 1. PAQ, Perth Alexithymia Questionnaire; Alexi, alexithymia; G-DAF, General-Difficulty appraising feelings; G-EOT, General-Externally orientated thinking; G-DIF, General-Difficulty identifying feelings; G-DDF, General-Difficulty describing feelings; N-DAF, Negative-Difficulty appraising feelings; P-DAF, Positive-Difficulty appraising feelings; N-DIF, Negative-Difficulty identifying feelings; P-DIF, Positive-Difficulty identifying feelings; N-DDF, Negative-Difficulty describing feelings; P-DDF, Positive-Difficulty describing feelings.