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Development and Measurement Invariance Test of the Chinese Social-Emotional Climate Scale from the Social-Relational Perspective

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Abstract

Background Social-emotional climate refers to individuals' perceptions of the emotional environment within a collective and profoundly shapes emotional experience, interpersonal interaction, and social behavior. However, most existing scales were developed in Western cultural contexts and cannot adapt to the paradigm of indigenous Chinese social psychology. Against this backdrop, this study, grounded in de Rivera's two-dimensional emotional climate framework and adopting the social-relational perspective, developed the Chinese Social-Emotional Climate Scale using the semantic differential scale paradigm and conducted measurement invariance tests.

Methods This study adopted a convenience sampling method and collected data via online and offline questionnaires. A total of 500 participants were recruited, with 250 allocated for item analysis and exploratory factor analysis and 250 for confirmatory factor analysis, to examine the scale's factorial structure, reliability, and validity. Measurement invariance was subsequently tested across gender, age, and educational level.

Results Exploratory factor analysis yielded three factors—"Relation to others," "Relation to ideals," and "Relation to groups"—explaining 78.60% of the variance, with factor loadings of 0.743–0.861 in the confirmatory three-factor model. Fit indices were satisfactory (χ^2/df = 1.418; NFI = 0.976; RFI = 0.964; IFI = 0.993; TLI = 0.989; CFI = 0.993; RMSEA = 0.041). Cronbach's α coefficients of the three dimensions ranged from 0.61 to 0.90, indicating good internal consistency, and measurement invariance was supported across gender, age, and educational level.

Conclusions Grounded in the social-relational perspective, this study developed a localized Chinese Social-Emotional Climate Scale with three dimensions—"Relation to others," "Relation to ideals," and "Relation to groups"—demonstrating good reliability, validity, and measurement invariance. Moving beyond emotional content and valence classifications, the scale establishes a three-dimensional structure of Chinese social-emotional climate from a social-relational perspective, offering a new path for measuring emotional climate and enriching the cross-cultural explanatory power of this concept. It provides a useful tool for future research on social mentality.

1 Introduction

When individuals enter a gathering, venue or area, they experience feelings of joy, distress or fear; this emotional experience is known as emotional climate. The social-emotional climate reflects the dominant collective emotions that individuals perceive within a group or nation under specific social contexts and social processes [1]. It has important implications for individuals' mental health, well-being, and social behaviors [2]. A positive social-emotional climate can be peaceful and harmonious and can arouse beliefs in safety and trust. For example, within a secure social-emotional climate, people get along harmoniously and trust and cooperate with one another. A negative social-emotional climate may be threatening, stressful, or unfair. It can evoke feelings of insecurity, distrust, fear, anger, and hatred [3]. For example, an emotional climate of fear shaped by authoritarian rule can produce collective panic. An

emotional climate of anger triggered by social corruption can reduce public trust in government credibility.

de Rivera [4] first defined the concept of the social-emotional climate and developed its measurement. The structure and connotation of the social-emotional climate are complex because it is influenced by sociopolitical conditions, economic structures, and national institutions [1]. As a subjective experience perceived by individuals, emotional climate valence serves as a critical dimension, and many scholars advocate measuring the social-emotional climate along positive and negative valence. The vocabulary included in the two-dimensional framework of emotional climate proposed by de Rivera [4] also appears in paired sets. For example, the dimension of "Relation to others" includes word pairs such as "fear–security" and "hostility–solidarity". Páez et al. [5] developed the Perceived Emotional Climate Scale, which contains five items in its positive dimension and three items in its negative dimension. The Perceived Broad Group Emotional Climate Scale also establishes two dimensions of positivity and negativity, with 10 emotional words under each dimension [2].

Some scholars adopt different perspectives and argue that a more multifaceted structure of the social-emotional climate should be distinguished. de Rivera [4] categorized the social-emotional climate into eight types based on the typical atmosphere of different countries, namely security, insecurity, confidence, depression, anger, love, fear, and trust. de Rivera and Yurtsever [6] divided the social-emotional climate scale into five dimensions by examining people's feelings about the current situation of their country: anger toward the government, fear of speaking out, despair–unease, national security, and social trust. In addition, some researchers adopt a social relational perspective and divide the social-emotional climate into two dimensions, "Relation to others" and "Relation to ideals" [4]. However, as this framework is rooted in Western cultural contexts and emphasizes personal relationships and individual ideals, it does not regard the emotional connection between individuals and groups as an independent analytical unit, and its applicability is thus limited by cultural contexts [7].

Within the Chinese cultural context, collectivist orientations lead individuals to pay attention not only to their Relation to ideals and Relation to others but also to highly value their Relation to groups, which includes in-groups such as families, schools, and work units [8]. Meanwhile, under interdependent self-construal, people's perceptions of social emotion inherently include emotional bonds with their affiliated groups and communities, and group belonging and evaluation serve as its indispensable constituent elements [9]. Therefore, we should incorporate the dimension "Relation to groups" when developing the social-emotional climate scale for the Chinese cultural context so that we can more accurately capture the collectivist-oriented structure of the social-emotional climate.

To sum up, to advance psychological measurement in the field of social-emotional climate, this study intends to revise the two-dimensional framework of social-emotional climate proposed by de Rivera [4] and test its reliability and validity, so as to develop a social-emotional climate scale suitable for the Chinese cultural context. The development of this scale starts from the social-relational perspective and includes three dimensions: "Relation to ideals", "Relation to others", and "Relation to groups". To reflect

the valence of emotional climate, this study plans to construct the scale using the semantic differential method, and the measurement content of each dimension consists of multiple pairs of bipolar antonym adjectives. The semantic differential scale can simultaneously capture respondents' bipolar evaluations of a concept across multiple semantic dimensions and reflect participants' subjective perceptions of different facets of the social-emotional climate [10]. Meanwhile, it can also force respondents to make directional judgments, reduce acquiescence bias, and enable the scale to better reflect the valence of emotional climate.

2 Participants and Methods

2.1 Participants

This study consists of two phases: the first phase focuses on scale development, including item generation and analysis, exploratory factor analysis, confirmatory factor analysis, and reliability and validity tests; the second phase mainly conducts equivalence tests for the newly developed scale.

Sample 1: These participants were mainly used for item analysis and exploratory factor analysis. This study adopted a convenience sampling method and collected questionnaires through a combination of online distribution via Sojump and offline paper-and-pencil surveys; the respondents covered citizens with diverse ages, genders, occupations, and educational levels, and 250 valid questionnaires were retrieved. Among them, there were 116 males and 134 females, and the mean age of participants was 26.3 ± 4.9 years.

Sample 2: These participants were mainly used for confirmatory factor analysis, criterion-related validity, convergent validity, and internal consistency reliability tests. The sampling method remained the same, and 250 valid questionnaires were obtained, including 122 males and 128 females with a mean age of 26.0 ± 4.3 years. Finally, participants from Sample 1 and Sample 2 were combined to form the research sample for scale equivalence testing. The demographic information of Sample 1 and Sample 2 is shown in Table 1.

Table1 Demographic information of sample 1 and sample 2 (*n* = 500)

	Item	Sample 1(%)	Sample 2(%)
Gender	Male	102(40.80%)	122(48.80%)
	Female	148(59.20%)	128(51.20%)
Age	18-25 years	94(37.60%)	120(48.00%)
	26-30 years	110(44.00%)	85(35.00%)
	31-50 years	46(18.40%)	45(18.00%)
Educational level	High school and below	14(5.60%)	28(11.20%)
	Junior college and bachelor's degree	217(86.80%)	211(84.40%)
	Postgraduate	19(7.60%)	11(4.40%)

2.2 Scale Development

This study searched Chinese and English literature in sociology and psychology published over the past decade on CNKI and Baidu Scholar using the keywords "social-emotional climate", "social emotion", and "emotional climate", retaining papers that explicitly proposed the structure of social-emotional climate. The literature search revealed relatively few measurement tools for social-emotional climate, and most researchers developed measurement instruments based on the dimension of positive–negative emotional climate. Therefore, in constructing the social-emotional climate construct, this study started from the two dimensions of social-emotional climate proposed by de Rivera [4] based on "Relation to others" and "Relation to ideals", and formulated emotional-climate terms for the three dimensions: "Relation to ideals", "Relation to others", and "Relation to groups". A research team consisting of 8 members, including masters students, summarized and sorted synonyms and near-synonyms and conducted word frequency analysis. The team selected frequently used semantic differential phrases of emotional climate, such as "disordered–coordinated", "depressed–energetic", "Dissatisfaction–Satisfaction", "Despair–Hope", and "powerless–strong". Team members developed and revised questionnaire items on the basis of these semantic differential word pairs, and the initial Social-Emotional Climate Scale was finalized after repeated refinement. This scale includes a total of 44 formal items, with an additional item included for validity checking. A 7-point Likert rating scale was employed for response scoring, in which 1 represents " completely inconsistent" and 7 represents " completely consistent" . Respondents were instructed to take an observer's perspective when filling out the questionnaire and report the emotions and feelings of people around them as they subjectively perceived.

Unified guidelines and standardized procedures were adopted for formal questionnaire distribution. The online survey platform was used to deliver electronic questionnaires, enabling participants to complete and submit their responses conveniently via mobile phones or computers. Meanwhile, offline paper-based questionnaires were distributed as a supplementary method, with professional guidance provided

to ensure participants completed the questionnaires in strict accordance with standardized requirements.

2.3 Criterion Measures

Criterion Scale 1: Delaware Social and Emotional Competence Scale. This scale requires participants to rate how closely the behaviors or opinions described in each item match their personal experiences. It contains 12 items across four dimensions: responsible decision-making, peer relationships, social awareness, and self-management. A 4-point scoring system was adopted. One item within the responsible decision-making subscale, "I blame others when I get into trouble", was reverse-scored. After recoding this reverse-scored item, the total score across all items can be computed; higher total scores reflect greater social and emotional competence. The Cronbach's α of the full scale was 0.78 [11].

Criterion Scale 2: Public Emotion Scale. This scale comprises two dimensions: positive emotion and negative emotion. The Cronbach's α was 0.81 for the positive public emotion dimension and 0.76 for the negative public emotion dimension, with relevant items reverse-scored [12].

2.4 Statistical Software

SPSS 26.0 software was adopted to conduct item analysis, descriptive statistics, and exploratory factor analysis. AMOS 24.0 was used to perform confirmatory factor analysis, and Mplus 8.3 was employed for the examination of measurement invariance of the scale.

3 Results

3.1 Item Analysis

First, the extreme groups method was applied for item screening. The total scale scores were sorted in descending order, and participants in the top 27% and bottom 27% were categorized into the high-score group and low-score group, respectively. Independent-samples t-test results showed that score differences for all 44 items reached statistical significance at $p < 0.001$. Second, item-total correlation analysis was adopted for further examination. Pearson correlation results indicated that, except for the item pair "polite–arrogant" ($r = 0.170$, $p = 0.007$), the correlation coefficients between the remaining item scores and the total scale score were all above 0.40 ($r = 0.436$ to 0.825, all $p < 0.001$). These findings demonstrated that most items exhibited satisfactory homogeneity with the overall scale.

Taken together, based on the above analytical results, the item pair "polite–arrogant" was eliminated from the item pool, and the remaining 43 items were retained for subsequent exploratory factor analysis.

3.2 Exploratory Factor Analysis

Following item analysis, exploratory factor analysis (EFA) was conducted on the remaining 43 screened scale items. The KMO value was 0.970, and Bartlett's test of sphericity yielded a chi-square value of 9584.893 ($p < 0.001$), indicating that the dataset was suitable for exploratory factor analysis. Principal component analysis was adopted to extract common factors with eigenvalues greater than 1, and the factor matrix was obtained via varimax rotation. Strict item screening criteria were applied during EFA: item communalities ≤ 0.5, absolute pattern loadings ≤ 0.5, cross-loadings > 0.4, an absolute difference between cross-loadings ≤ 0.05, and factors containing fewer than three items. Questionnaire items that violated these criteria were eliminated accordingly.

Item deletion was performed stepwise through repeated exploratory factor analysis, with EFA rerun after each round of item elimination. After multiple iterative analyses, the final Social-Emotional Climate Scale containing 9 items was obtained, and three common factors with eigenvalues greater than 1 were extracted. These three factors jointly accounted for 78.60% of the total variance. Item factor loadings ranged from 0.743 to 0.861, and item communalities fell between 0.761 and 0.816. The detailed associations between factors and their corresponding items are shown in Table 2 and Figure 1.

Table2 Exploratory factor analysis results of the Social-Emotional Climate Scale

Item	Relation to ideals	Relation to groups	Relation to others	Communality
Powerless–Strong	0.809			0.793
Depressed–Energetic	0.802			0.793
Frustrated–Confident	0.794			0.762
Disordered–Coordinated		0.861		0.815
Fake–Loyal		0.831		0.800
Biased–Fair		0.743		0.761
Fearful–Safe			0.822	0.816
Hostile–Friendly			0.779	0.773
Tense–Harmonious			0.763	0.761
Eigenvalue	5.24	1.06	0.78	
Variance Explained (%)	26.35	26.22	26.03	
Cumulative Variance Explained (%)	26.35	52.57	78.60	

The finalized Social-Emotional Climate Scale contains three dimensions and nine items. The three dimensions are specified as follows: Relation to ideals: powerless–strong, depressed–energetic,

frustrated–confident; Relation to others: fearful–safe, hostile–friendly, tense–harmonious; Relation to groups: disordered–coordinated, fake–loyal, biased–fair.

3.3 Confirmatory Factor Analysis

The three factors extracted via exploratory factor analysis (EFA) were treated as latent variables, and the nine corresponding items served as observed variables for confirmatory factor analysis (CFA). To test whether the scale's three-factor structure represented the optimal model, several plausible competing models were constructed and compared, including a one-factor model, a two-factor model, and the three-factor model. The results (Table 3) showed that factor loadings in the three-factor model ranged from 0.743 to 0.861. The model fit indices were as follows: χ^2/df = 1.418, *NFI* = 0.976, *RFI* = *0.964*, *IFI* = 0.993, *TLI* = 0.989, *CFI* = 0.993, *RMSEA* = 0.041.

Table3 Comparison of fit indices for alternative models

Model Fit Indices	χ^2	*df*	χ^2/df	NFI	RFI	IFI	TLI	CFI	RMSEA
One-factor model	194.324	27	7.197	0.862	0.816	0.879	0.838	0.878	0.158
Two-factor model	78.705	26	3.027	0.944	0.923	0.962	0.947	0.962	0.090
Three-factor model	34.021	24	1.418	0.976	0.964	0.993	0.989	0.993	0.041

According to the model fit cutoff criteria proposed by Wu [13], χ^2/df should be less than 2.00 (with a lenient cutoff of 5.00). *RFI*, *CFI*, *NFI* and *IFI* are generally expected to exceed 0.90, RMSEA should be below 0.08, and *PNFI* and *PCFI* should be greater than 0.50. As shown in the table above, all fit indices of the three-factor model outperformed those of the other competing models, indicating that the three-factor model was relatively ideal. On this basis, we may preliminarily conclude that Chinese social-emotional climate comprises three factors.

The overall structural model of social-emotional climate and its associated path coefficients are presented in Figure 1:

3.4 Criterion-Related Validity

Correlation coefficients between the Social-Emotional Climate Scale and the three criterion scales were 0.539, 0.549, and 0.228, respectively; all were significantly positive. These results indicated that the Social-Emotional Climate Scale exhibited satisfactory criterion-related validity (see Table 4).

Table 4 Correlations between criterion scores and scale dimension scores and total Score(*n*=250)

	Relation to ideals	Relation to others	Relation to group	Total score
Delaware Social and Emotional Competency Scale	0.414**	0.513**	0.495**	0.539**
Positive Affect	0.461**	0.511**	0.476**	0.549**
Positive Affect	0.188**	0.212**	0.202**	0.228**

Note**p<0.01(Two-tailed test)

3.5 Convergent validity

The average variance extracted (AVE) for the social-emotional climate construct was 0.642, and the composite reliability (CR) was 0.942. The CR exceeded 0.70, indicating that items within each measured dimension converged satisfactorily and demonstrating good internal consistency reliability. Convergent validity assesses whether items loading on the same dimension converge. An AVE value above 0.36 is considered acceptable, and values greater than 0.50 indicate good convergent validity. The AVE of the present scale met the acceptable standard. All validity analyses satisfied the recommended statistical criteria.

3.6 Reliability Analysis

The internal consistency reliability analysis showed that the Cronbach's α of the full scale was 0.916. The Cronbach's α values for Relation to ideals, Relation to others, and Relation to groups were 0.846, 0.855, and 0.874, respectively. The Cronbach's α coefficients across all dimensions ranged from 0.61 to 0.90, indicating that the scale exhibited good internal consistency reliability.

3.7 Measurement Invariance Test

The combined dataset from Sample 1 and Sample 2 (N = 500) was used to test measurement invariance of the scale. The grouping variables included gender, age, and educational level. Gender was split into two groups: male (n = 224) and female (n = 276). Age was divided into two groups: 18 to 25 years (n = 247) and 26 to 50 years (n = 253). Educational level was categorized into three groups: high school education or below (n = 42), college and undergraduate education (n = 428), and postgraduate education or above (n = 30). Sequential tests of configural, metric, and scalar invariance were conducted for these grouping variables. For the configural invariance tests across the three variables, all *CFI* values were greater than 0.90 and all *RMSEA* values were below 0.08, supporting configural invariance. Metric invariance tests were then performed. In these metric invariance tests, all *CFI* values exceeded 0.90 and all *RMSEA* values were below 0.08. Furthermore, the Δ*CFI* and Δ *RMSEA* between Model 0 and Model 1

did not exceed the psychometric cutoff criteria recommended by Cheung & Rensvold [14], namely Δ*CFI* ≤ 0.01 and Δ *RMSEA* ≤ 0.015, indicating that metric invariance was established. With metric invariance established, scalar invariance was further examined. All *CFI* values were greater than 0.90 and all *RMSEA* values were below 0.08. In addition, the Δ*CFI* and Δ*RMSEA* between Model 2 and Model 1 satisfied the psychometric cutoff criteria, supporting scalar invariance. Detailed results are shown in Table 5.

Table 5 Measurement invariance test of Chinese Social-Emotional Climate(*N*=500)

Model	c^2	*df*	CFI	RMSEA[90%CI]	ΔCFI	ΔRMSEA
Gender						
M0(configural)	68.668	48	0.992	0.042[0.015,0.062]		
M1(metric)	77.587	54	0.991	0.042[0.017,0.062]	0.001	0.001
M2(scalar)	89.877	60	0.989	0.045[0.024,0.063]	0.002	-0.003
Age						
M0(configural)	92.552	48	0.983	0.061[0.042,0.079]		
M1(metric)	97.703	54	0.984	0.057[0.038,0.075]	-0.001	0.004
M2(scalar)	108.041	60	0.982	0.057[0.039,0.074]	0.002	0.001
Education						
M0(configural)	103.708	72	0.988	0.051[0.027,0.072]		
M1(metric)	127.634	84	0.984	0.056[0.035,0.075]	0.004	-0.005
M2(scalar)	139.624	96	0.984	0.052[0.032,0.070]	0.001	0.004

4 Discussion

Using exploratory factor analysis and confirmatory factor analysis, this study developed the Chinese Social-Emotional Climate Scale, which comprises three dimensions: Relation to ideals, Relation to others, and Relation to groups. Each dimension contains three items, resulting in a total of nine items. The scale exhibited satisfactory internal consistency reliability and criterion-related validity. Furthermore, measurement invariance across gender, educational level, and age was verified, supporting its applicability across diverse groups.

This study found that the social-emotional climate scale developed within the Chinese cultural context retained the two relationship-oriented emotional climate dimensions proposed by de Rivera: Relation to ideals and Relation to others, although the emotional climate descriptors for these two dimensions differed.

On the one hand, the dimension Relation to ideals echoes the self-discrepancy theory proposed by Higgins [15]. When the discrepancy between the actual self and the ideal self is substantial, individuals tend to experience negative emotions such as depression, frustrated, and despair. Notably, the Chinese Social-Emotional Climate Scale emphasizes the cognitive emotions elicited by this discrepancy at the individual level (e.g., powerless, frustrated, energetic), whereas de Rivera's social-emotional climate theory places greater emphasis on the cognitive evaluative emotions elicited by such discrepancy at the macro-social level (e.g., dissatisfied, despairing), as well as on perceptions of environmental stability (e.g., turbulent).

On the other hand, the dimension Relation to others refers to interpersonal security and moral judgments within social interactions, mainly reflecting content related to the warmth dimension in the stereotype content model [16]. For example, the descriptors "fearful–safe"and "hostile–friendly"correspond to the warmth dimension concerning whether others hold hostile intentions or exhibit benevolence [17]. The difference is that the Chinese Social-Emotional Climate Scale includes an additional descriptor pair "tense–harmonious". Harmonious relationships are distinctive to Chinese culture and represent a core requirement in collectivist cultures [18].

Unlike the relational orientation proposed by de Rivera, the Chinese Social-Emotional Climate Scale additionally incorporates the dimension Relation to groups. Its three-factor structure captures individuals' complete subjective representations of society within the Chinese cultural context: perceived dyadic interpersonal relationships, perceived relations with groups, and evaluations based on social ideals and value standards [19]. In summary, the three dimensions of the Chinese Social-Emotional Climate Scale encompass the three categories of social psychological content outlined above and can relatively fully depict social-emotional climate in Chinese cultural contexts. Furthermore, the newly added dimension Relation to groups captures individuals' relational perceptions of groups during social identification, covering two core aspects: loyalty (fake–loyal) and fairness (biased–fair). Within Chinese culture, the bond between individuals and groups constitutes a group-self relationship, in which the "small self"is integrated into the "big self"(Yang, 2008). Loyalty reflects whether individuals internalize group norms and safeguard group interests, representing responsibility-based identification within the in-group boundary [20]. Moreover, Chinese perceptions of fairness differ from Western procedural justice rooted in individual rights. Chinese fairness places greater emphasis on impartiality and freedom from bias when groups treat members and allocate resources, and values equality and morality within the group [21]. In addition, this dimension also contains the descriptor pair "tense–harmonious". Whether the relation between individuals and groups is harmonious may be a combined outcome of perceptions of loyalty and fairness. When groups are perceived as loyal and fair, the relation between individuals and groups tends to be more harmonious [22, 23].

Social-emotional climate describes perceptible forms of social emotion [24]. It reflects individuals' perceptions of the emotions of surrounding others and represents an emotional environmental phenomenon associated with macro-social structures [25, 26]. The results of the present study suggest that, on the one hand, the emotional environment within Chinese society shows a generally relatively

positive trend. A cross-national nine-country comparison study also indicated that Finland, China, and African nations scored significantly lower on negative emotions, whereas positive emotions were more homogeneous across countries [27]. On the other hand, the means of the three dimensions of the Chinese Social-Emotional Climate Scale were ranked from high to low as follows: Relation to others (M_2 = 5.51), Relation to groups (M_3 = 5.38), and Relation to ideals (M_1 = 5.00). This suggests that the emotional environment perceived by Chinese residents is favorable in interpersonal and group interactions, yet the emotional environment related to the pursuit of personal ideals remains to be improved. It also indicates that the quality of social relationships plays a critical role in emotional experience. Research conducted within Chinese team contexts has found that dyadic relationship quality among team members positively predicts interpersonal admiration, sympathy, and envy, and negatively predicts interpersonal contempt [28].

In summary, beyond simple classifications of emotional content and emotional valence, this study established the three-factor structure of Chinese social-emotional climate from the social-relational perspective. It addresses the core proposition of how emotional climate functions as "the emotional relations within collectives" [4] and offers a new measurement approach. Meanwhile, addressing the limitation that most existing emotional climate scales are rooted in Western cultural contexts [5], the present study advances the indigenous measurement of the social-emotional climate construct and further enhances its cross-cultural explanatory power. Finally, the newly developed Chinese Social-Emotional Climate Scale provides a valid instrument for subsequent social mentality research.

Nevertheless, several limitations of this study should be noted. First, data were collected via self-report method in this study, which is inevitably affected by social desirability bias and common method bias. Second, whether the discrepancies between the scale developed in this study and de Rivera's two-factor structure[4] reflect genuine culturally specific structural differences remains to be distinguished through cross-cultural measurement invariance tests.

5 Conclusion

From the social-relational perspective, this study developed the Chinese Social-Emotional Climate Scale, which is suitable for the Chinese cultural context and constructed via the semantic differential scale method. The scale consists of three dimensions: Relation to ideals, Relation to others, and Relation to groups. Measurement invariance results indicate that this three-factor structure has cross-group stability across gender, age, and educational level. This study measured social-emotional climate through participants' perceptions of the emotions of surrounding others, effectively addressing the lack of localized measurement instruments in China. The reliability, validity, and model fit indices of the scale meet psychometric standards, and the scale can serve as a reliable measurement tool for subsequent research.

Declarations

Authors' contributions: Delang Xu (first author) , Ruotong Wang (second author) and Wenjing Ma (second author) made important contributions to this work. Delang Xu is mainly responsible for the conceptualization, methodology design, data collection, and initial draft preparation of this research. Ruotong Wang and Wenjing Ma is mainly responsible for the data validation, formal analysis, visualization of key results, and critical revision of the manuscript. Hongjie Dong had primary responsibility for supervising the full research project and approving the final versions of the manuscript. He is accountable for every part of this work to ensure that the content is both accurate and complete. All authors have read through the manuscript and given their approval for its final published form.

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Consent for publication: All authors have read and approved the submission and declare no conflicts of interest.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

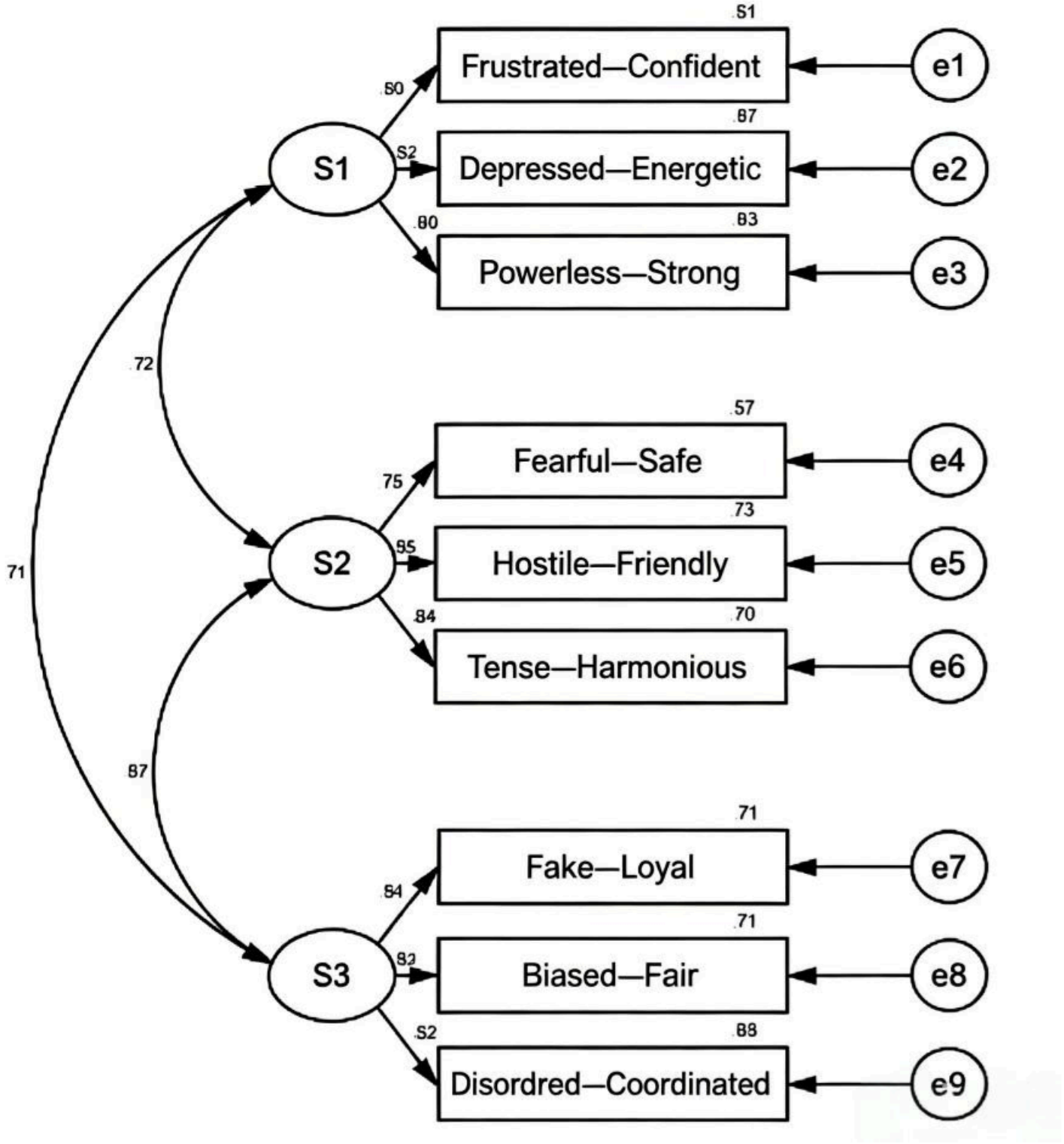


Figure 1

Structural model and standardized path coefficients of Social-Emotional Climate