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A structural equation model of depression and the defense system factors: A survey among Chinese college students

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Abstract

Questionnaires were administered to a large sample of subjects (1363 Chinese college students), to evaluate the mediating risk factors in the defense system of depression, including personality, coping skills, interpersonal context and family environment. Structural equation modeling (SEM) was used to analyze a total of 12 variables in order to understand how they interact with each other. Eysenck's Neuroticism, Extraversion, and Psychoticism personality types act as the essential parts of the model, both directly and indirectly impacting depression. Coping styles are the mediators that regulate the effects of personality and family environment on depression. Family environment has only indirect effects through personality and positive coping style. Interpersonal context may not have had a significant correlation with depression, but was influenced by family environment and had a correlation with positive coping style. According to the results, therapies based on personality adjustment, family environment and coping styles of college students are greatly recommended among college students in order to lessen the chances of or to prevent depression. The present results may advance our understanding of depression etiology in young Chinese adults and provide suggestions of factors that should be taken into account in the evaluation, treatment and even the prevention of depression.

Keywords: Depression; Personality; Coping styles; Family environment; Interpersonal context; College students

1. Introduction

Depression in China has been widely reported (Eddleston and Gunnell, 2006; Miller, 2006). Epidemiological data show that the prevalence of depression among young Chinese adults ranges from 3.7% to 14.8% (Shi et al., 2005; Xu et al., 2006). There is an imperative need to find practical ways to screen out depressed young adults and evaluate the mediating risk factors in the depression defense system so that effective intervention may be implemented and mental health outcome among such subjects may be improved. As depression is a prototypic multifactorial disorder that is profoundly affected by many potential causes, it is unlikely that any single etiological framework (e.g. personality, cognitive, familial context, interpersonal relationship) will provide a necessary and sufficient

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causal explanation for the development of depression (Hankin, 2006). Instead, many processes, mechanisms, and risk factors need to be evaluated simultaneously to provide a more complete understanding of the susceptibility to depression among young adults. This study is the first attempt to survey four perspectives from the defense system factors of depression, including the personality traits, coping styles, interpersonal context, and familial environment, in order to provide a more holistic understanding of how these factors interact and impact depression among young adults, so thereby an intervention strategy may be built on these results.

A vulnerability–stress framework suggested that acute stressful life events and chronic stressful circumstances trigger an underlying predisposition, which may be one of the most promising explanations for how a depressive episode develops (Hankin and Abela, 2005). Nevertheless, because not all individuals who experience stressful life events will suffer from depression, a defense system serves the function to prevent the disease. Firstly, some individual characters (called diatheses) contribute to the foundational differences (Monroe and Simons, 1991) in the system. Of the personal diatheses, temperament (or personality traits) plays a significant role in this framework. Three higher order temperaments have been consistently linked with depression: positive emotionality, negative emotionality, and constraint–attentional control. Positive emotionality refers to the extent to which an individual is receptive to reward, sociable, sensation seeking, and actively involved with his or her environment; while negative emotionality involves a tendency toward discomfort, fear, anger, sadness, and low soothability (Derryberry and Rothbart, 1988; Compas et al., 2004). According to Clark and Watson's (1991) tripartite model, negative emotionality is a nonspecific factor, increasing the risk for both depression and anxiety. Positive emotionality is a specific character, which only negatively affects depression and protects against depressive symptoms such as anhedonia. The dimensions of these two personality traits are largely independent (Clark and Watson, 1991; Clark et al., 1994; Compas et al., 2004; Lonigan et al., 2004), which is strongly supported by the findings of Chorpita (2002) in adolescents. The concept of the third trait of constraint–attentional control remains broad, involving effortful control of emotions and behaviors, self-regulation, task persistence, and attentional focus, all of which can modulate the expression of positive and negative emotionality (Compas et al., 2004). Eysenck proposed a personality theory based on three biological temperament traits: extraversion, neuroticism and psychoticism. In his theory, extraversion (E) is characterized by being outgoing, talkative, high on positive affect, and in need of external stimulation, which reflects positive emotionality. Neuroticism (N) is characterized by high levels of negative affect with low activation thresholds and easy upsets, which conceptually reflects negative emotionality. Psychoticism (P) is characterized by tough-mindedness, nonconformity, hostility, and impulsivity, embracing the concept of the constraint–attentional control temperament. (Acton, 2003). We used the Eysenck Personality Questionnaire, which has been well established in China and has a reliable Chinese version, and hypothesized that all of the three personality traits have direct effects on depression. Both E and N are also mediated by P.

Another diathesis between stressful events and depression is the coping style, which also receives great attention in explorations of the risk factors of depression. The term "coping styles" is broadly defined as the individual's emotional, cognitive and behavioral efforts to moderate the impact of stressful events on his or her physical, social, and emotional functioning (Nakano, 1991; Beutler et al., 2003). Previous studies suggest that the coping styles predict depression (Nakano, 1991), independent of personality traits and regulating them (Tyssen and Vaglum, 2002). The coping styles are divided into several factors. Moreover, Jiang (1999) grouped the coping style factors into two categories, that have been used to measure Chinese people's coping skills. In terms of this method, negative coping styles, associated with increased psychological symptoms, mediate neuroticism; positive coping styles, including the concept of active coping, distraction, and support seeking, are generally associated with decreased symptoms and mediate extraversion and psychoticism (Rothbart et al., 1995; Beutler et al., 2003; Muris et al., 2003; Compas et al., 2004; Liu et al., 2004). Research has also indicated that the positive coping styles have a correlation with the interpersonal context (Schwartz et al., 2000; Tyssen and Vaglum, 2002) and mediate family environment (Tyssen and Vaglum, 2002).

Furthermore, aside from the diatheses mentioned above, interpersonal context, which is another mediating factor in the defense system of depression, should also be included. The interpersonal context mentioned here comprises both the interpersonal relationship status and the interpersonal skills, relating to social support and social functioning. From this framework, several studies illustrate that the relationship between interpersonal context and depression is ambiguous. On the one hand, interpersonal problems can precede depressive episodes, and are viewed as a kind of interpersonal stressor to depression (Schwartz et al., 2000; Sakai et al., 2005). On

the other hand, they can also co-occur with or even result from depressive mood states (Schwartz et al., 2000; Zlotnick et al., 2000). Additionally, there is evidence that suggests an individual's interpersonal relationship status and management skills are influenced by his temperament or personality characteristics (McDonald and Linden, 2003; Sakai et al., 2005), as well as the family environment (Schwartz et al., 2000; Zlotnick et al., 2000). A good interpersonal context consists of a mutual relationship with well-mastered coping skills (Schwartz et al., 2000), which means it has a correlation with the positive coping styles.

Finally, family environment, which an individual is developmentally tied to, cannot be neglected. Family systematic climate, referring to the internal psychological procedures, behaviors and communications among family members, as well as the interaction between the internal and external family environment (Macdonald, 1992), is predictive of depression among the young people (Nomura et al., 2002). However, the relationship between family environment and depression is not necessarily directly correlated. It may instead be mediated by other factors (Sander and McCarty, 2005), such as temperament (Lengua et al., 2000; Pergadia et al., 2006), coping styles (Compas et al., 2004; Sander and McCarty, 2005) and interpersonal relationship and management (Schwartz et al., 2000; Zlotnick et al., 2000).

When all contributing factors are taken into consideration together, the moderating vulnerabilities of depression among the young adults are so complicated that the relationship among these factors is of great intricacy. In this study, we hypothesized that three personality traits as well as both negative and positive coping styles have direct effects on depression. Other than that, Eysenck's N and E variables are mediated by the P variable. Negative and positive coping styles also play mediating roles between personality traits and depression. Negative coping styles mediate the N variable, and positive coping styles mediate both E and P. Interpersonal context is affected by three personality traits and family environment, correlated with positive coping styles and depression. Family environment has indirect effects on depression through three personality traits, positive coping styles and interpersonal context. In order to test this hypothesis, 1363 subjects were recruited and surveyed on depression and the defense system factors mentioned above, and structural equation models were used to gain insight into how these mediators interact with each other and contribute to depression among Chinese young adults.

2. Methods

2.1. Participants

A cross-sectional design was used in this study, in which 1437 students were randomly selected from five technology colleges in Dalian City to be administered our questionnaires. The experiment was approved by a local Institutional Review Board and an informed consent was obtained from each participant were administered. Out of the 1437 students in the study, complete responses were available from 1363 students, and these were included in the final statistical analysis. The effective response rate for these questionnaires was 94.85%. Among the student respondents, 931 were males, 68.3%, and 432 were females, 31.7%. The ages of the participants ranged from 18 to 29 (21.40 ± 1.522). The ethnic distribution within the group was as follows: 1238 (90.8%) students were Han Chu, 69 (5.1%) were Man Chu, 15 (1.1%) were Korean, 14 (1.0%) were Mongol, and 27 (2.0%) were identified as others.

2.2. Measurement instruments

2.2.1. Beck Depression Inventory (BDI)

We used a Chinese version of the Beck Depression Inventory to survey the status of depression among college students. The BDI is a 21-item inventory that was originally constructed by Beck and introduced into China in 1985. It assesses the severity of depressive symptomatology, each item of which is rated on a scale ranging from (0) Normal to (3) Most severe. The total score ranges between 0 and 63 (Wang et al., 1999).

2.2.2. Eysenck Personality Questionnaire (EPQ)

The 85-item revised Chinese version of the Eysenck Personality Questionnaire for Adults was employed. It contains four personality subscales: extroversion (E), neuroticism (N), psychoticism (P) and lie (L) (Chen, 1983). A higher E score reflects being outgoing, talkative, high on positive affect, and in need of external stimulation. A higher N score indicates low activation threshold, experiencing negative affect in the face of relatively minor stressors (Acton, 2003). The P score focuses on the traits of impulsiveness, rigidity, superego controls, social sensitivity and persistence (Howarth, 1986), which corresponds to constraint–attentional control temperament. This questionnaire covers the personality traits that our study is interested in, and it has been widely used in Chinese school settings since it was introduced into China in 1983 (Chen, 1983).

2.2.3. Simplified Coping Style Questionnaire

The Simplified Coping Style Questionnaire is a two-scale and 20-item questionnaire, which aims to measure the Chinese people's coping styles. The coping styles in this questionnaire were classified into two categories: positive coping styles and negative coping styles. Positive coping consists of 12 items, such as focusing on the positive aspects and trying to find different resolutions of the problem. Negative coping consists of eight items, such as the use of tobacco and alcohol to deal with situations. Scores range from (0) Never to (3) Always. The scale has satisfactory test-retest reliability with a correlation coefficient of 0.89 (Wang et al., 1999).

2.2.4. Interpersonal context

Three tests were administrated to evaluate the college students' interpersonal relationship status and management capabilities. These three tests are the Interpersonal Relationship Test (IR), the Interpersonal Conflict Soothability Test (ICS), and the Amity Relationship Capability Test (ARC). The IR has 36 yes or no items, emphasizing the test of individuals' interpersonal relationships and behaviors, such as whether one cares about one's interpersonal relationships and whether one eats by oneself at the cafeteria. The ICS is an eight-item test to measure a person's soothability in face of conflicts with others, such as fourfold choice on how one will respond when very busy and a friend is pouring out his or her complaints. The ARC is also an eight-item test, reflecting attitudes toward interpersonal relationships, such as a three-choice question about how to behave as a friend (Li, 2004).

2.2.5. Questionnaire of Systematic Family Dynamics (QSFD)

We used the three-subscale, 25-item Questionnaire of Systematic Family Dynamics to assess the students' family environment. This questionnaire is based on the theory of systematic family dynamics in agreement with Chinese families. The three subscales are Family Atmo-

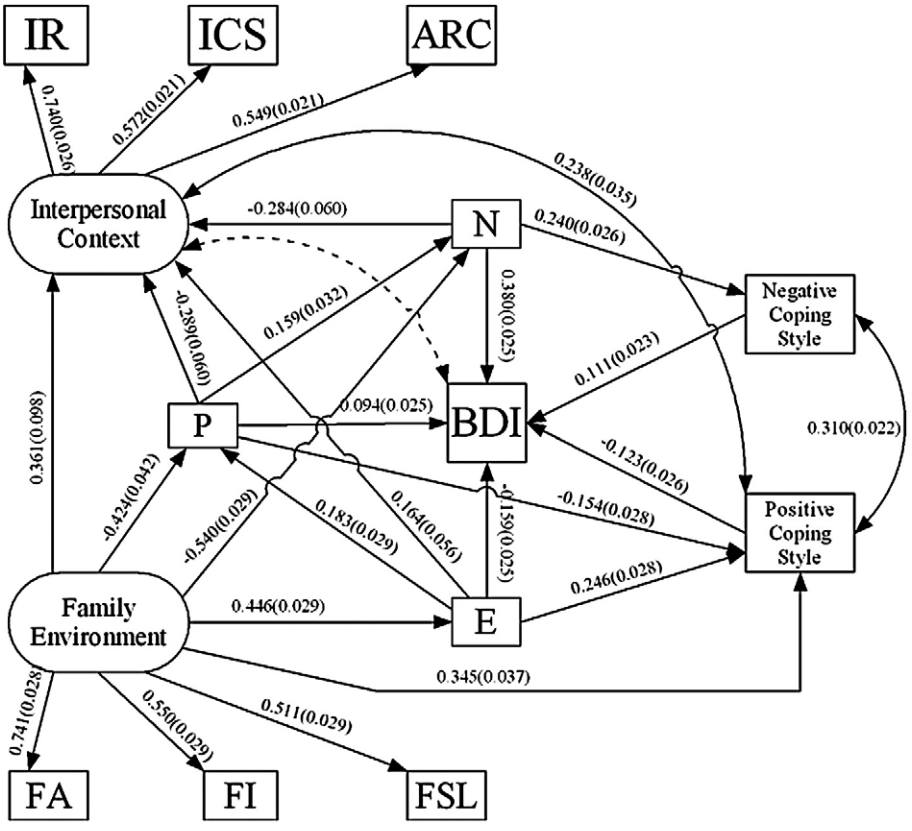

Fig. 1. The structural equation model of depression and the defense system factors among Chinese college students. Standardized path coefficients with standard errors are presented on each arrow. BDI=Beck Depression Inventory; N=Neuroticism; E=Extroversion; P=Psychoticism; IR=Interpersonal Relationship; ICS=Interpersonal Conflict Soothability; ARC=Amity Relationship Capability; FA=Family Atmosphere; FI=Family Individuation; FSL=Family Systematic Logic. The dotted line indicates the correlation between BDI and Interpersonal Context is not significant at $P=0.05$ and was finally deleted from the structural equation model.

sphere (FA), reflecting the emotional characters of intercommunication in the family; Family Individuation (FI), reflecting the emotional and behavioral differentiation among the family members; and Family Systematic Logic (FSL), reflecting the logic characters of family member's value judgments. The correlation coefficient for the test–rest reliability is 0.7112 (Kang et al., 2001).

2.3. Model construction and statistical method

According to our hypothesis, the BDI total score was set as the endogenous variable. Three personality trait variables obtained from the EPQ were set as exogenous variables, the central part of the structural equations that had direct effects on the BDI. Two coping style variables had also direct effects on the BDI, mediating the personality traits, and neither was independent of the other. The positive coping style variable mediated E and P variables; negative coping style variable mediated the N variable. Three interpersonal context variables were extracted into one variable of interpersonal context; the same procedure was performed for the three family environment variables, which were extracted into one family environment variable. The interpersonal context variable was influenced by three personality traits and the family environment variable, and correlated with positive coping style and the BDI. The family environment variable had an indirect impact on the BDI, regulated by three personality variables and positive coping style, affecting interpersonal context. Fig. 1 shows the construction of the structural equation model, in which all the connection and interaction of the variables were presented.

Data were analyzed by SPSS 13.0 for Windows (SPSS Inc., Chicago, IL). Descriptive analysis procedures were performed to demonstrate demographic information.

Structural equations were conducted by AMOS 5.0 for student version (SPSS Inc., Chicago, IL), using the Maximum Likelihood Method. Standardized path coefficients, direct and indirect effects, were presented. Chi-square (χ^2) coupled with the degrees of freedom (*df*) (Carmines and Mclver, 1981), the normed fit index (NFI) (Bentler and Bonett, 1980), the relative fit index (RFI) (Bollen, 1986), the incremental fit index (IFI) (Bollen, 1989), the Tucker–Lewis coefficient (TLI) (Bollen, 1989), the comparative fit index (CFI) (Bentler, 1990), as well as the root mean square error of approximation (RMSEA) (Browne and Cudeck, 1993) were shown to measure the model fit globally and incrementally.

3. Results

3.1. Structural equation model (SEM)

A structural equation model was established as shown in Fig. 1, using the Maximum Likelihood Method. Only the correlation between BDI and Interpersonal Context was not significant at $P=0.05$. This link was deleted and a more satisfactory model was attained. Standardized path coefficients are presented on each arrow in Fig. 1 with standard error (S.E.). All of the coefficients are significant at the level of $P<0.001$.

N and P personalities have positive effects on depression among college students; E personality's effect is negative. N and E affect depression independently, both mediated by P. In addition, N has another mediator, negative coping style. For E and P, another mediator is positive coping style. Both coping style variables are significantly correlated with each other at the level of $P<0.001$. Also, positive coping style has a significant correlation with interpersonal context and regulates family environment at $P<0.001$. Family environment has indirect impacts on BDI through three personality variables and positive coping style, and affects interpersonal context. There is no significant correlation between BDI and interpersonal context.

3.2. Model assessment

The goodness-of-fit test yielded a chi-square of 186.167 ($df=41$, $P<0.001$). The NFI is 0.954. The RFI is 0.913. The IFI is 0.964. The TLI is 0.931. The CFI is 0.963. And the RMSEA is 0.051. These indexes and the acceptable measures of them are given in Table 1 (Bentler and Bonett, 1980; Carmines and Mclver, 1981; Bollen, 1986, 1989; Bentler, 1990; Browne and Cudeck,

Table 1
Measures of fit for the depression model of Chinese college students

	χ^2	*df*	χ^2/df	NFI	RFI	IFI	TLI	CFI	RMSEA
Thresholds for acceptable fit			<5	≥0.90	≥0.90	≥0.90	≥0.90	≥0.90	0.05~0.08
Our results	186.167	41	4.541	0.954	0.913	0.964	0.931	0.963	0.051

df=degrees of freedom; *P*=probability value; NFI=normed fit index; RFI=relative fit index; IFI=incremental fit index; TLI=Tucker–Lewis coefficient; CFI=comparative fit index; RMSEA=root mean square error of approximation.

Table 2
Standardized effects of defense system factors on depression among Chinese college students

Variables	Direct effects	Indirect effects	Total effects
N	0.380	0.045	0.424
E	−0.159	−0.010	−0.169
P	0.094	0.019	0.113
Positive coping style	−0.123	0	−0.123
Negative coping style	0.111	0	0.111
Interpersonal context	0	0	0
Family environment	0	−0.395	−0.395

N=Neuroticism; E=Extroversion; P=Psychoticism.

1993). These results indicate a good fit of the structural equation model of defense system factors of depression among Chinese college students.

3.3. Standardized effects analysis

Table 2 gives the estimates of standardized direct, indirect and total effects of defense system factors on BDI total score. All of the three personality variables have both direct and indirect effects on depression. Positive and negative coping styles have only direct impacts on BDI, while family environment has only indirect effects. Interpersonal context's effect on BDI is zero. Of all the standardized total effects, the absolute value of N personality is the greatest (0.424), followed by family environment (0.395), and then, positive and negative coping styles together (0.123+0.111=0.234).

4. Discussion

Our results indicate that three personality variables are most critical in the structural model, especially N personality, which has the greatest standardized total effect of all the variables. According to the tripartite model, neuroticism or negative emotionality reflects the extent to which an individual perceives and experiences the world as threatening or distressing (Clark et al., 1994; Hankin, 2006). Furthermore, neuroticism is nonspecifically and positively related to depression, while extraversion or positive emotionality is specifically and negatively associated with depression. The dimensions of neuroticism and extraverson represent both hedonic tone and engagement–disengagement, and are hypothetically to be largely independent when affecting depression (Clark and Watson, 1991, 1994; Chorpita, 2002; Lonigan et al., 2004). This idea has been strongly supported by our structural equation model, in which both N and E personality variables have independent direct effects on BDI. P personality acts as a mediator between the other two personality characters and BDI, representing the broad trait of constraint–attentional control. The constraint–attentional control mediates the expression of both positive and negative affect, which includes effortful control of emotions and behaviors, self-regulation, task persistence, and attentional focus (Rothbart et al., 1995; Compas et al., 2004). Research indicated that the concept of Eysenck's P score can be accepted as impulsiveness, low superego control, low persistence, and low sensitivity (Howarth, 1986). The P score can be used to measure the constraint–attentional control trait. In addition, three personality characters can be combined in only one questionnaire.

The Eysenck Personality Questionnaire (EPQ) has been well studied in China and widely used in Chinese schools. Personality or temperament traits are acknowledged to have biological substrates (Gray, 1991; Compas et al., 2004). As Eysenck proposed, E reflected the cortical arousal system, N reflected the sympathetic nervous system or visceral brain, and P reflected the level of testosterone (Kumari et al., 2004). According to recent research, personalities are partially heritable, genetic in origin but may be modified by experience (Lengua et al., 2000; Hankin, 2006; Pergadia et al., 2006). Some special experiences, such as hypnosis and meditation, are related to self-regulation. The procedure of hypnosis involves such brain areas as dorsolateral prefrontal cortex (DLPFC) and anterior cingulate cortex (ACC), whose responses in the brain are reflective of different personalities, with different genetic bases (Raz, 2005; Raz et al., 2006). Our findings show that personality traits are the essential parts of the structural equation model and have the greatest effects on depression. These findings suggest that they are located at the base of the depression defense system. Furthermore, since personality remains comparatively stable across the life span, to ameliorate young adults' depression requires long-term effort, so that a better developed and more adaptive personality can be established through experience, for example, the experience of maturing and accepting treatment.

Of the risk factors we surveyed, family environment had the second greatest standardized total effect on BDI, next to N personality. It has no direct effect on BDI, but has an indirect impact instead, which is consistent with Sander and McCarty's theory (Sander and McCarty, 2005). Previous research found that family climate shaped personality characters (Lengua et al., 2000; Pergadia et al., 2006), was regulated by active coping styles (Tyssen and Vaglum, 2002; Sander and McCarty, 2005), and generated interpersonal problems (Lengua et al., 2000; Tyssen and Vaglum, 2002). Our findings show

that the family environment variable has direct pathways to N, E, and P scores, positive coping style and interpersonal context. Some investigators have proposed family- based therapy as a treatment for depression (Haley, 1990; Becvar and Becvar, 1996; Sander and McCarty, 2005). Our results strongly support the validity of family-based therapy and suggest that a harmonious family environment will facilitate the improvement of personality traits and, ultimately, the resolution of depressive episodes among Chinese young people.

Coping styles play a role in the relationship between personality and depression (Compas et al., 2004), regulate family environment and are linked with interpersonal problems (Nakano, 1991; Tyssen and Vaglum, 2002). Our results are consistent with these ideas. Of two coping style methods, positive coping skills are more important when moderating family or interpersonal stressors. In our results, coping skills also mediate personality traits. Recent brain imaging evidence showed that certain cognitive tasks, memory tasks, for example, show different brain responses in different personality types, especially in the DLPFC and the ACC. In accord with our results, Cognitive Behavior Therapy, which has as one of its purposes the effectuation of change in coping styles, is frequently found to be effective (Nakano, 1991; Schwartz et al., 2000; Beutler et al., 2003; Rupke et al., 2006). Adoption of positive coping styles may lead to changes in the activity of brain areas that are related to personality, and thus help to modify illness-related personality styles, resulting in an improved mental state.

We did not find a significant correlation between interpersonal context and total BDI score. Nevertheless, interpersonal context is directly affected by N, E, and P scores and by family environment, and it has been negatively associated with positive coping style in line with previous evidence (Schwartz et al., 2000; Tyssen and Vaglum, 2002; McDonald and Linden, 2003). It can be concluded that the relationship between interpersonal context and depression is not statistically significant. Additionally, depression may not have any direct effects on interpersonal problems or vice versa. It would be necessary to pursue further research to achieve a more definitive interpretation.

Statistical equation modeling facilitates multivariate statistical analysis. It conveys two important notions: (a) that structural relations can be modeled pictorially to enable a clearer conceptualization of the theory under study and (b) that the interacting effects among the variables under study are represented by a series of structural equations (Byrne, 2005). However, there is not yet a best assessment approach to evaluate the efficiency of structural equation modeling. Most investigators have advocated a few combined indexes to make the evaluation (Carmines et al., 1981). In our model, all of the fit indexes are acceptable, suggesting a good fit between the proposed theory and our data.

The results of this study contribute to our understanding of the relationship between the influencing framework of depression and defense system factors among Chinese college students. Furthermore, we demonstrate how these factors affect depression and interact with each other on a multidimensional level. The estimated standardized effects on depression were contrasted to predict that negative personality, family environment and coping styles influence the severity of depression. These findings also have clinical implications regarding how to strengthen the defense system in therapeutic programs among depressed young adults. Therapies based on personality adjustment, family environment and coping styles should be strongly considered.

In this study, we only surveyed technology colleges in Dalian City because these schools were cooperative, which led to some difference in the samples between the sexes. However, we were primarily interested in interactions among defense system factors in depression, not in sex differences in this system, so the difference in the numbers between the two sexes may not affect the results. Further study is needed in which subjects are selected from different kinds of colleges and several cities. At the same time, more investigations based on biological substrates, brain function and genetics could be also needed in the future.

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