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The Structure of the Chinese CES-D Scale: An Application of Confirmatory Factor Analysis to Higher-Order Factor Structure

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I . Introduction

Psychological distress, especially depression, is an important construct in research on stress, social support and coping process. There is compelling evidence in western as well as Chinese society that high level of psychological distress is significantly associated with stressful life events, chronic life strain, and lack of support (Chou, 1993; Cohen & Syme, 1985; Kessler, Price & Worthman, 1985). However, meaningful comparisons of research findings from different studies are based on the assumption that psychological distress in various social groups and across different cultures is in fact the same construct. And many researchers have argued that this assumption may not be warranted. For instance, there may be cultural differences in the manifestation of depressive

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symptoms or in the expression of psychological distress (Aneshensel, Clark, & Frerichs, 1983; Kleinman, 1986).

The major purpose of the study is to investigate whether a depressive-symptom scale developed in the United States is assessing the same underlying psychological distress in Taiwan. In particular, it aims to examine the factor structure of a Chinese version of the Center for Epidemiological Study Depression (CES-D) scale. The CES-D scale is widely used as a measure of mental health in research on stress and social support, as well as on social gerontology.

The 20-item CES-D(Radloff, 1977) scale was developed based on items tapping depressed mood, feeling of guilt and worthlessness, feeling of helplessness and hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance. Four items were worded in the positive direction to break tendencies toward response set as well as to assess positive affect. According to Radloff and Locke (1986), factor analysis of the scale usually revealed a four-factor structure. It included a positive affect factor, a depressed affect factor, a somatic-retarded activity factor and a fourth factor reflecting interpersonal difficulty. Although the scale was not designed to discriminate various subtypes of clinical depression, it was expected to identify the presence and the severity of depressive symptomatology (Radloff & Locke, 1986). This scale has been used in many community studies as an indicator of well-being. Several studies have attempted to investigate the factor structure of the CES-D scale.

Krause and Markides (1985) using maximum likelihood exploratory factor analysis found four factors that correspond to the factor structure found by Radloff (1977) and Roberts (1980) of the CES-D scale. Ensel (1986) also factor analyzed the CES-D scale and reproduced the four-factor model. Lin (1989) using principal components factor analysis with orthogonal rotated solution to identify a 16-item Chinese version of the CES-D scale (four positive affect items were excluded from factor analysis) and found three factors (i.e. affective mood, somatic-retarded activity, and interpersonal problem) that were consistent with findings from other studies.

However, these previous research on the structure CES-D scale has generally conducted using exploratory factor analysis (EFA) approach which could not specify a prior factorial patterns. And orthogonality of factors was often arbitrarily imposed in the analysis. Thus factor solutions from different studies showed substantial discrepancy for some items. Liang, Van Tran, Krause and Markides (1989) have provided a succinct comparisons among different factor solutions of the CES-D. The limitations of EFA approach in construct validation have been well documented. These include limitations on defining a testable model, yielding unique factorial solutions, assessing alternative models, and adequately test factorial invariance across multiple groups (Long, 1983). Unlike exploratory factor analysis, confirmatory factor analysis approach (CFA) does not have these limitations, therefore, is considered more powerful test of factorial validity.

Only recently, there were studies using CFA approach to investigate the factorial structure of the CES-D scale. In a study comparing generational differences in the structure of the 12-item CES-D scale among Mexican American, Liang et al. (1989) found that a three-factor model (i.e. depressed affect, somatic-retarded activities, and positive affect factor) to fit observed data adequately. The 12-item CES-D scale examined by Liang et al. did not include the two interpersonal problem items, thus their results gave partial support to the factor structure of the

CES-D proposed by Radloff. In a study of elderly women, Thompson and Heller (1990) briefly reported a three-factor (i.e. positive affect, negative affect, and behavior symptoms) structure of the 20-item CES-D to have adequate fit. Their findings were consistent with other studies with the exception that they combined the two interpersonal items with the negative affect items to form a negative affect factor. However, Thompson and Heller did not include detail information on the process of model-fitting in their article.

Based on findings from these studies on the CES-D, one can conclude that the stability of the four-factor structure was generally supported. However, no study has yet demonstrated the original 20 items of the CES-D can be accounted for fully by the four-factor model using confirmatory factor analysis strategy. One major study of the CES-D scale using covariance analysis approach focused on 12 items of the original 20 items because some items did not pass reliability test (Liang et al., 1989). Because many empirical studies were and are still using the summated score of the 20-item CES-D as an indicator of mental health (Ensel & Lin, 1991; Levy, Derby & Martinkowski, 1993; Roberts & Bengtson, 1993). More investigations using confirmatory factorial analysis are needed to establish the factorial validity of the full 20-item CES-D scale. Therefore, the present study will use confirmatory factor-analytic approach to examine the factor structure of the Chinese version of the 20-item CES-D scale.

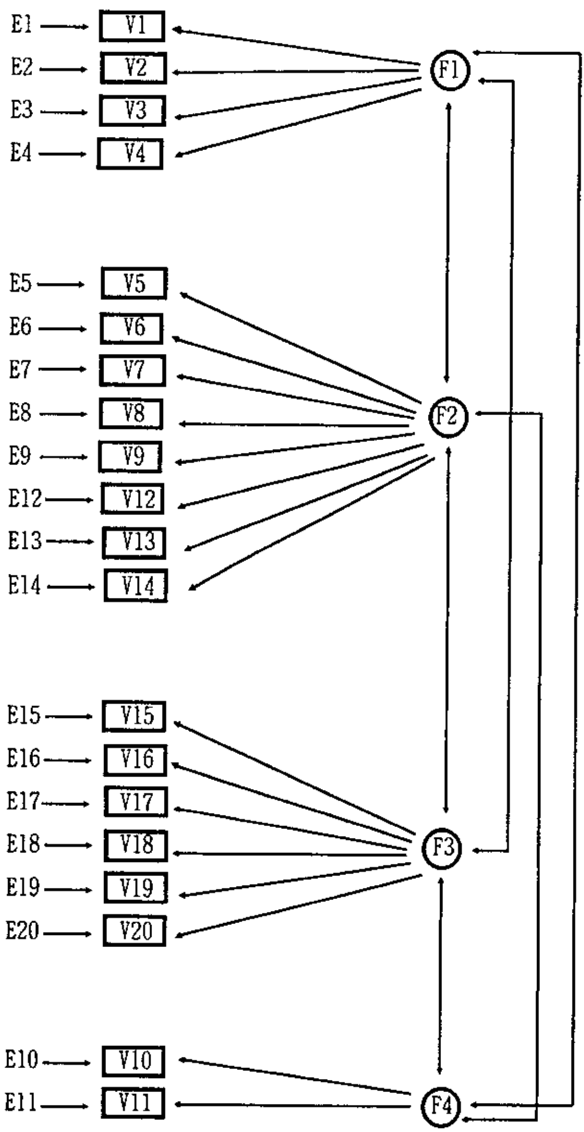
In addition, the present study proposes a single second-order factor to account for the correlations among four primary factors. Since previous dimensionality research on the CES-D has generally conducted using exploratory factor analysis approach, it focused on primary level components and often assumed independent (orthogonal) factors structure to explain the covariation of depressive symptoms. Tanaka and Huba (1984) have pointed out that incorrectly imposed orthogonality can produce results that the levels of simple structure after varimax rotation are poor. This may be part of reason that research findings did not reveal complete consensus concerning factorial structure of the full 20-item CES-D scale. With the hierarchical confirmatory factorial analysis one can test the appropriate of the factor independence assumptions. If these primary level factors of the depression scale are found to be highly intercorrelated, then this indicates the possible presence of higher order constructs. In practice, a single sum score from the CES-D is often used to represent the degree of depressive symptoms. Thus, it is critical to establish empirically a framework of the CES-D that has a single second-order construct accounting for interrelationships among primary level factors of depressive symptoms.

The present study will address three major research questions: (a) Is the Chinese version of the CES-D scale measuring the same underlying dimensionality of psychological distress among the elderly in Taiwan? that is, can the four-factor primary level model of the CES-D obtained in the United States be replicated in Taiwan? (b) can a single second-order factor model explain the interrelationships among four primary level factors, and (c) if so, can the second-order factorial model be validated successfully across another independent sample of the elderly?

Ⅱ. Analysis

This study uses confirmatory factor-analytic (CFA) approach to assess both primary and secondary factor structure of the Chinese version of the CES-D scale. The CFA model specifies the relations of the

Figure 1. The Hypothesized Four-Factor Structure of the CES-D Scale (F1: positive affect; F2: depressed affect; F3: somatic activities; F4: interpersonal difficulty).



observed measures to their posited underlying constructs, with the constructs allowed to intercorrelate freely. Figure 1 presents a diagram of the proposed four-factor model of the CES-D scale. The four factors are positive affect (F1), depressed affect (F2), somatic/retarded activities (F3), and interpersonal difficulty (F4). The specific items associated with these four factors can be found in Table 1. In the present study, the schematic presentation of structural equation model follows the Bentler-Weeks representation system (i.e. EQS notation, Bentler, 1992). Thus, in Figure 1 the Vs indicate the observed variables while residuals associated with the measurement of the observed variables are designated as Es. Fs refer to the latent constructs (i.e. factors).

In addition, one-way arrows represent structural regression coefficients and thus indicate the impacts of F latent constructs on the observed V variables. The sourceless one-way arrows pointing from the Es indicate the impact of random measurement error on the observed Vs. And finally, the curved two-way arrows linking all possible pairs of factors suggest that the factors are intercorrelated. Since in the CFA model one is more interested in testing the significance of each factor loading than the significance of the factor variances. Therefore, the factors, rather than one of the factor loadings, were given unit variances for the purpose of setting the scale metric of the latent variables (Bollen, 1989). Anderson and Gerbing (1988) have also recommended that in confirmatory measurement models it is more appropriate to fix the variances of the latent construct to unity than to fix the pattern coefficient for one indicator of each latent construct at 1.0.

Factorial validity of the CES-D was tested using analyses of covariance structure. The maximum likelihood estimates of the models were obtained from the EQS program (Bentler, 1992). It is important that the evaluation of model fit in the analyses of covariance structure should base on multiple criteria (Anderson & Gerbing, 1988; Cudeck & Browne, 1983; Mulaik et al., 1989; MacCallum, Roznowski, & Necowitz, 1992; Tanaka, 1993). That is, the model fitting strategies should reflect the meaningfulness of the substantive theory, the significance of statistical fit as well as parsimony of the model.

Therefore, the hypothesized four-factor model was proposed based on past research on the CES-D scale, several criteria were then used to evaluate the overall model fit in this study. These include the x^2 likelihood ratio statistic, the relative x^2 likelihood ratio (x^2/df ratio), the Bentler-Bonett's Normed Fit Index (NFI), the Bentler's Comparative Fit Index (CFI). The chi-square likelihood ratio statistic measures the fit between the sample covariance and the fitted covariance matrix. A nonsignificant chi-square indicates the hypothesized model fits the observed data adequately. However, the x^2 statistic is very sensitive to sample size and deviation of multinormality assumption. In practice, it is often found that a good fit based on a large sample size may result in a significant chi-square. Hence, alternative indices of goodness-of-fit should be used. One alternative is the x^2/df ratio which attempts to take sample size into consideration.

The goodness-of-fit indices of the NFI and CFI are based on comparisons to a null model. They range from 0 to 1. Usually, values of NFI and CFI greater than .90 are desirable. According to Bentler (1990), the CFI is not influenced by sample size and avoids the underestimation of fit found with the normed fit index. In addition to the overall goodness-of-fit indices, assessment of model adequacy should also be examined by evaluating parameter estimates. Convergent validity of the factorial model can be assessed by determining whether each indicator's estimated pattern coefficient on its posited underlying construct is significant (Anderson & Gerbing, 1988; Byrne, 1994).

Recently, MacCallum et al. (1992) have call attention to the problem of capitalization on chance in model modifications in covariance structure analysis. They argue that stability and cross-validity are critical issues in model fitting process. Cudeck and Browne (1983) also argue for the importance of cross-validating the covariance structure models. Therefore, to provide more stringent test of the proposed structure of the CES-D, the final factorial model obtained from the analysis will be cross-validated using another independent sample.

Ⅲ. Method

1. Respondents

The data for the present investigation came from a study of social support and psychological well-being among older people conducted in 1992 in Taiwan. A stratified three-stage area probability design was used to draw a sample of noninstitutionalized adults 60 years of age and older that reflected the different geographic regions and degree of economic development in the island of Taiwan. Face to face interviews were conducted by trained interviewers in respondents' home. The CES-D scale was used as one of indicator of psychological well-eing in that study (Chou, 1993). A total of 1460 respondents were interviewed.[1]

Since more than 95% of respondents were either married or widowed, the present study will not include those respondents who were divorced or single. The final sample for this analysis consisted of 1379 elderly who were married or widowed at time of interview. Among 1379 elderly, seventy-two percent were married and 28% were widowed. Fifty-three percent were men and 47% were women. The ages of the respondents in this final sample ranged from 60 to 95, with a mean age of 69.4. Most respondents (43%) were illiterate, another 35.5% had no more than a grade school education. Thirty-two percent had monthly family income less than NT$ 5,000, twenty percent between NT$ 5,000 and 9,999, 17% between NT$ 10,000 and 15,000, and the remaining 31% had more than NT$ 15,000.

To establish the cross-validity of the CES-D factor structure, the sample was randomly split into two subsamples. After excluding cases with missing data, the effective sample size was 662 for the calibration sample and 661 for the validation sample.

2. Instrumentation

The Center for Epidemiological Studies Depression (CES-D, Radloff, 1977) scale is a 20-item scale which measures symptoms of depression over the past week on a four-point scale. The scale was intended to assess depression in general population. The CES-D was translated into Chinese using back-translation procedure. Because the most common spoken language in daily life in Taiwan is Taiwanese rather than mandarin Chinese, and majority of current cohort of older adults in Taiwan either can not understand or are not comfortable to communicate with mandarin Chinese. Therefore, two stages of translation were involved. First, the CES-D was translated into Chinese, then the Chinese version was translated into Taiwanese. Same procedure was followed in each of the two translation stages.

The CES-D was translated into Chinese by the author. The Chinese version was then back-translated by another bilingual professional into English, which was compared with the original version. This back-translation process continued until these two professionals both agreed that the accuracy of Chinese translation was achieved. Next, the Chinese version was translated into Taiwanese by members of research team (including the author) who were proficient in Taiwanese, and version was finalized after agreement was reached among the members. One remark is in order regarding back-translation process. Because some items were more difficult to translate into Chinese and Chinese into Taiwanese, the agreement on accuracy of translation was based on semantic equivalence rather than literal translations of the original items. Lin's (1989) study of depressive symptomatology in China using the CES-D scale also adopted semantic equivalence criterion.

Ⅳ. Results

1. Test of the hypothesized four-factor model

The hypothesized four-factor model with independent measurement errors (M1, Figure 1) was examined using data from the calibration sample. As indicated in Table 1, the x^2 likelihood ratio was highly significant with a value of 613.103 (df = 164). Since the x^2 likelihood ratio is highly sensitive to sample size, with a sample size of 662 it is expected that this ratio will be significant which indicates that the proposed model does not perfectly fit the observed data. However, other fit indices suggested that the proposed model had an adequate fit. The relative x^2/df ratio was 3.738. The NFI and CFI for this model were .913 and .935 which suggested more than 91% of variance in the observed data was explained by the proposed model.

Table 1. Standardized Maximum Likelihood Estimates for CES-D Scale Items and Goodness-of-Fit indexes (The Four-Factor Model, M1)

parameters	Calibration sample(n=662)
Variances and covariance of first-order factors	
[F1,F1]	1.000*
[F2,F2]	1.000*
[F3,F3]	1.000*
[F4,F4]	1.000*
[F1,F2]	-.277
[F1,F3]	-.243
[F1,F4]	-.221
[F2,F3]	.873
[F2,F4]	.743
[F3,F4]	.752
First-order factor loadings	
F1 Positive Affect	
v1 Felt as good as others	.485
v2 Happy	.837
v3 Enjoyed life	.868
v4 Hopeful	.693
F2 Depressed Affect	
v5 Bothered	.646
v6 Blues	.756
v7 Sad	.882
v8 Fearful	.808
v9 Lonely	.719
v12 Failure	.587
v13 Depressed	.819
v14 Crying spells	.768
F3 Somatic Activity	
v15 Poor appetite	.578
v16 Hard to concentrate	.726
v17 Talked less	.575
v18 Restless sleep	.599
v19 Couldn't get going	.816
v20 Everything an effort	.740
F4 Interpersonal Difficulty	
v10 People disliked me	.812
v11 People unfriendly	.611
Goodness-of-fit indexes	
χ^2 likelihood ratio	613.103(df=164)
χ^2/df likelihood ratio	3.738
Bentler-Bonett NFI	.913
Bentler's CFI	.935

* denotes a parameter fixed to 1.0 in the analysis.
note: all parameter estimates are significant at .05 level.

In addition to the overall goodness-of-fit indices, assessment of model adequacy should also include the examination of parameter estimates. Ideally, the specified parameters should be statistically significant. Table 1 showed that standardized factor-loadings were all significant and were all greater than .48, indicating each indicator did in fact have substantial nonzero coefficient on its posited latent construct.

As expected, Positive Affect (F1) had significant negative correlations with the other three factors while Depressed Affect (F2), Somatic Activity (F3), and Interpersonal Difficulty (F4) factors were positively correlated. Correlations among factors ranged from -.221 to .873. To establish discriminant validity among factors with high correlations (i.e. among F2,F3,F4), each of the estimated correlation parameters among these factors was constrained to 1.00, then three constrained models were reestimated separately. According to Anderson and Gerbing (1988), a chi-square difference test on the values obtained for the unconstrained and constrained model can be evaluated. If the unconstrained model has a significantly lower chi-square, then the factors are not perfectly correlated and discriminant validity is achieved. The results showed that, compared to the unconstrained model, all three constrained model had a significantly higher chi-square values. For example, the model with correlations between Depressed Affect and Somatic Activity factors constrained to 1.00 had a x^2 value of 755.079 which yielded a large x^2 difference score of 141.976 (df = 1) with the unconstrained model. The values of NFI and CFI for this constrained model were .893 and .914 as compared to the .913 and .935 of the unconstrained model.

Therefore, although there were high correlations among three of the four proposed factors, above analysis demonstrated the discriminant validity among these factors. However, moderate to high covariations among these four factors indicates that there is possibility of the presence of a general second-order factor to account for these covariation. The higher-order factorial model will be examined in the next section.

Although researchers generally agree that model-fitting process should be justified on substantive as well as statistical criterion, in practice there is no one agreed upon guideline. For instance, some researchers suggest that confirmatory factor analysis models involving psychological constructs often require the researcher to specify correlated error variances in order to obtain a well-fitting model. Correlated error variances can be substantively meaningful in reflecting minor, possibly sample-specific data covariation not explained by the target factors in the model (Byrne, Shavelson & Muthen, 1989; Tanaka & Huba, 1984).

On the other hand, Anderson and Gerbing (1988) consider that the use of correlated measurement errors can be justified only when they are specified as a prior. MacCallum et al. (1992) also raised the issues of generalizability of models resulting from data-driven modification of an initial model. They strongly recommended that the final model obtained from modification process should be cross-validated to independent samples.

Since the assessments of the initially hypothesized four-factor model (M1) already showed an adequate fit, and the examination of the modification indices based on the Lagrange Multivariate (LM) test revealed that no substantial gain could be obtained from respecification of M1 model by including correlated measurement errors. To avoid the problem of capitalization on chance, no further modification was proceeded. Therefore, the hypothesized four-factor model is accepted as the CES-D structure model.

2. Validating second-order factor model of the CES-D

In this section, a single second-order factor, called Depression, is further proposed to explain the covariation among the four first-order factors obtained in the previous section (M2, Figure 2). This implies that the structure of the CES-D scale is multidimensional at the first-order but unidimensional at the second-order level. And the variance of each first-order factor was decomposed into the variance accounted for by the second-order factor and a residual variance (Ds in Figure 2) not accounted for by the higher-order factor. To establish the unit of measurement for the higher order factor, the variance of the second-order factor (i.e. F5) was fixed to unity. With this model specification, we expect to find empirically the model to have a satisfactory overall goodness-of-fit with all first-order as well as second-order factor loadings to be statistically significant.

The second-order factorial model was rejected for this sample, with a chi-square value of 614.637 (df = 166, $p < .001$), as fully adequate. However, NFI and CFI were .913 and .935 which indicated that the model was compatible with the observed data. The relative x^2/df ratio was 3.703. Table 2 presents the standardized maximum likelihood estimates of parameters. All of first- and second-order factor loadings are significant at the .05 level. Loadings from the second-order factor, Depression, to the four first-order factors vary between -.280 to .936, with the Depressed affect and Somatic Activity having highest loading. The Interpersonal Difficulty factor also had high loading(.800) on the Depression factor. The residual variances of first-order factors ranged from .032 to .323.

Figure 2. The Second-order Factorial Model (F1: positive affect; F2: depressed affect; F3: somatic activities; F4: interpersonal difficulty; F5: second-order general depression).

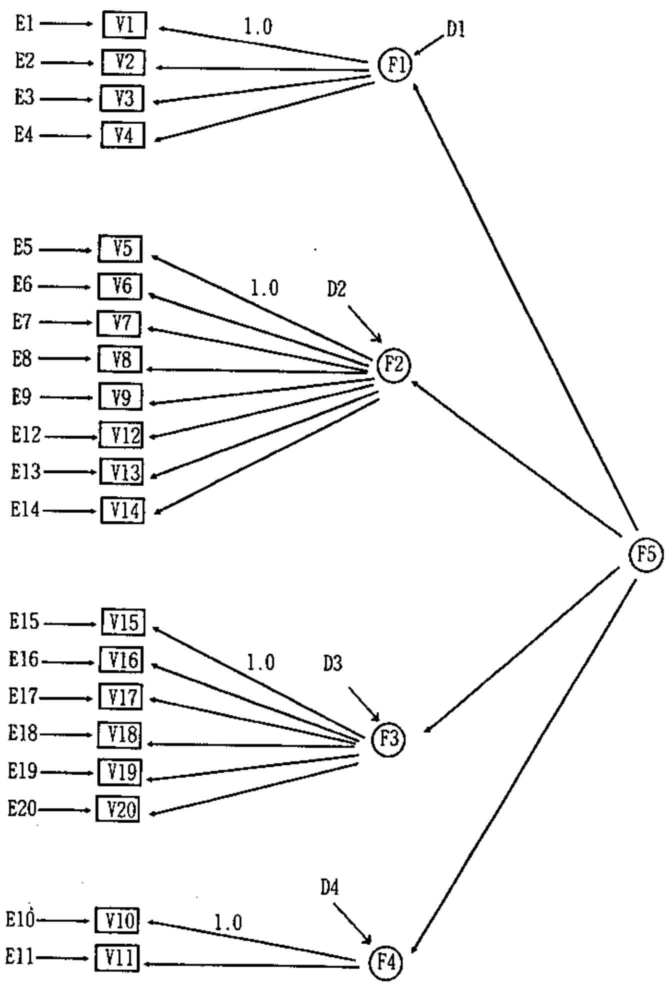


Table 2. Standardized Maximum Likelihood Estimates in the Second-Order Factor Model (M2)

parameters	Calibration sample(n=662)
Second-order Factor Loadings	
F5 General Depression Factor	
F1 Positive Affect	-.280
F2 Depressed Affect	.934
F3 Somatic Activity	.936
F4 Interpersonal Difficulty	.800
First-order Factor Loadings	
F1 Positive Affect	
v1 Felt as good as others	.485*
v2 Happy	.835
v3 Enjoyed life	.869
v4 Hopeful	.693
F2 Depressed Affect	
v5 Bothered	.646*
v6 Blues	.757
v7 Sad	.882
v8 Fearful	.807
v9 Lonely	.719
v12 Failure	.588
v13 Depressed	.819
v14 Crying spells	.769
F3 Somatic Activity	
v15 Poor appetite	.579*
v16 Hard to concentrate	.726
v17 Talked less	.575
v18 Restless sleep	.600
v19 Couldn't get going	.815
v20 Everything an effort	.740
F4 Interpersonal Difficulty	
v10 People disliked me	.810*
v11 People unfriendly	.612
Goodness-of-fit indexes	
χ^2 likelihood ratio	614.637(df=166)
χ^2/df likelihood ratio	3.703
Bentler-Bonett NFI	.913
Bentler's CFI	.935

* denotes a parameter fixed to 1.0 in the original solution.
note: all parameter estimates are significant at .05 level.

Overall, based on various fit assessment indices, the second-order factorial model can be concluded to well represent the observed data on the CES-D scale. Thus, the results of the second-order factorial model are consistent with the conceptualization of depression as a general construct with multiple interrelated yet distinct dimensions.

3. Cross-validation of the CES-D Factor Structure

To address the issue of cross-validation of the findings from the calibration sample in the previous analysis, the four first-order factors model was first tested for its invariance across a second independent sample (i.e. validation sample) then followed by the cross-validation of the second-order model. In the first-order structure, all factor-loadings, measurement error variance, and factor correlations were constrained equal across calibration and validation samples. For the higher-order structure cross-validation, all factor loadings (including first- and second-order), measurement error variance (variance of E), and the residual variances of first-order factors (Ds), were constrained equal across these two independent samples, and then tested statistically in a simultaneous analysis of the data using multigroups procedures of the EQS program.

The results of the first-order factorial model showed the constrained model to be well-fitting with values of .903 and .928 of NFI and CFI. The chi-square likelihood ratio was 1329.591 with 374 degree of freedom. The relative x^2/df ratio was 3.555. The LM test statistics in the EQS program provides information on whether the hypothesized equality of the specified constraint can be held statistically. Although the multivariate LM x^2 statistics indicated the five specified equality constraints did not hold (i.e. [F1, F3]; [V7, F2]; [E5, E5]; [E13, E13]; [E11, E11]), their chi-square values were all rather small (less than

5.815). Based on the above evaluation, the four-factor first-order factorial model is concluded to cross-validate successfully.

The findings of cross-validation of the second-order factorial model revealed a relative x^2/df ratio of 3.574; the values of NFI and CFI were .902 and .927. This indicates the model fit is adequate. The multivariate LM x^2 statistics indicated several equality constraints involving measurement errors and residuals of the first-order factor were significant (i.e. [E5, E5]; [E11, E11]; [E13, E13]; [D2, D2]; [D3, D3]). However, their x^2 values were again all relatively small (less than 5.894). No substantial improvement on model fit can be gained by releasing these equality constraints. Therefore, the second-order factorial model is also considered to cross-validate satisfactorily across validation sample.

V. Summary and Conclusions

Radloff (1977) had proposed that the CES-D consisted four dimensions: positive affect, depressed affect, somatic-retarded activity, and interpersonal difficulty. Although these four factors were generally obtained in several major investigations of the properties of the scale, no study attempts to directly fit all of the 20 items into the hypothesized four-factor model. The purpose of this study was to assess whether the hypothesized four-factor model well represented the structure of the Chinese version of the 20 item CES-D scale. Furthermore, this study proposed a single second-order factor to account for the covariations among primary factors. In addition to use confirmatory factor analysis approach, this study also provided the evidence of the cross-validity of the proposed models.

The results indicated that the four-factor model proposed by Radloff was consistent with the observed data. Not only global fit indices showed adequate model fit, all factor loadings were also significant and greater than .45. Thus, convergent validity of this factorial model for the 20-item CES-D was demonstrated. The moderate relationships between positive affect and other three factors were consistent with the argument in studying mental health that positive and negative affect should not be viewed as an opposite end of a single dimension. Instead, they should be treated as different yet related concepts.

Correlations among depressed affect, somatic activity, and interpersonal difficulty factors were quite substantial. However, further discriminat validity analysis indicated that these three highly correlated factors were indeed different constructs. These moderate to substantial covariatons among four primary factors suggested the existence of higher factorial structure. A single second-order factor, called general depression, was proposed to account for the covariation among four primary factors. The second-order factorial model also showed an adequate fit to the data. With exception of moderate loading from the second-order factor to positive affect factor, all the first-and second-order loadings were again substantial.

Several researchers (Aneshensel et al., 1983; Krause & Markides, 1985; Liang et al., 1989) have argued that two interpersonal items in the CES-D should be excluded because conceptually they seemed to confound the lack of social support resources with depressive affect, and empirically they were found to correlate weakly with other factors. Contrary to previous research findings in Western culture showing interpersonal factor having the weakest relationship with other three primary factors and with a second-order factor of depression, the results of this study indicated that interpersonal factor had strong relationships with depressed affect and somatic factors when the primary level of the factor structure was examined, And when the second-order structure was posited, the interpersonal factor again had strong loading on the second-order general depression factor. This findings suggest that for this sample of elderly in Taiwan these two items of interpersonal difficulty did reflect some degree of respondents' psychological distress. Is it possible that in this culture psychological distress is commonly manifested in the perception of interpersonal relations? This issue merits further study. It is also worth in the future research to examine the differential relationships among these four primary factors and other major concepts in stress and support research.

The presence of a second-order factor implies that the CES-D scale can be conceptualized as a generalized measure of psychological distress with four unique yet related subdimensions. In practice, it implies that the use of total score of the scale as an indicator of general psychological adjustment is justified. Further examination of the second-order loadings found that four primary factors did not contribute equally in defining the second-order factor, with positive affect factor contributing much less than the other three factors. In other words, the second-order factor mainly reflected the respondents' psycho-social distress, though it also assessed the absence of positive affect. Since the CES-D scale was originally developed to include not only the more general measures of distress but also the assessment of positive affect, these results gave the strong empirical support to the validity of the CES-D scale as a general measure of psychological well-being.

The four primary factorial model as well as the single second-order factorial model were all successfully cross-validated in another independent sample. Therefore, it can be concluded that the Chinese version of the CES-D scale has demonstrated sound psychometric properties as a general measure of psychological well-being. It has a factorial structure with four factor at primary level as originally proposed by the Radloff and a single factor at the second-order level. However, cautions should be taken when making generalizations from findings of this study. Although this study provided a much more stringent test of the CES-D structure than previous research, it is always possible that alternative models other than the one specified in this study will be equally consistent with the observed data. In addition, the model was derived from the elderly sample. More research is needed to substantiate the results of the present study and to investigate factorial invariance of the CES-D among various social groups in Taiwan.

Notes

1 Due to some clerical complications, exact response rate could not be computed. However, the demographic comparisons between the present sample and the 1990 census data showed comparable results with one exception that the present sample contained less proportion of older adults aged between 60 and 64, and more proportion of the elderly aged between 70 and 79.

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