

Race/Ethnicity and the Factor Structure of the Center for Epidemiologic Studies Depression Scale: A Meta-Analysis

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The purpose of this meta-analysis was to examine racial/ethnic differences in the factor structure of the Center for Epidemiologic Studies Depression Scale (CES-D). The total number of participants (N) in the assessed studies (k) varied according to whether the original study had used either Exploratory Factor Analysis (EFA; $N = 19,206$, $k = 13$) or Confirmatory Factor Analysis (CFA; $N = 65,554$, $k = 16$). The factor structures of the CES-D were compared across five racial/ethnic groups: African Americans, American Indians, Asians, Whites, and Hispanics. Meta-analysis results suggest that the structure of the CES-D observed in EFAs varied substantially between racial/ethnic groups, whereas the CFA-assessed structure of the CES-D was mostly consistent between racial/ethnic groups. The meta-analysis of EFA studies did not consistently replicate the original four-factor structure reported by Radloff (1977), but the meta-analysis of CFA studies replicated the original four-factor structure in four of the five racial/ethnic groups. Overall, the present meta-analysis found strong evidence that the original four-factor structure may not be the best fit for all racial/ethnic groups. Thus, in clinical settings where the CES-D is used as a tool to screen for depression, clinicians and researchers should recognize the risk that symptoms of depression may be presented differently by members of different racial/ethnic groups.

Keywords: depression, CES-D, meta-analysis, factor analysis, race/ethnicity

This meta-analysis focuses on one of the most widely used screening tools for depression: the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). The CES-D is a 20-item instrument with a dimensional response format used to determine the frequency and severity of current depressive symptoms in community samples. A substantial number of cross-cultural and cross-national studies have used the CES-D to assess depressive symptoms. Respondents are asked to report how often they have experienced individual symptoms of depression during the past week on a four-point scale from "rarely or none of the time" to "most or all of the time." Each item is scored 0–3, and total scores range from 0 to 60, with higher scores indicating greater depressive symptomatology. A standard cutoff score of 16 has been used to identify those with a higher probability of clinical depression (Andresen, Carter et al., 1994). Scores of 16 to 26 are considered indicative of mild depression and scores of 27 or more indicative of major depression (Zich, Attkisson, & Greenfield, 1990).

A number of studies have compared responses to the CES-D across diverse racial/ethnic groups and found differences in mean scores and prevalence rates (e.g., Blazer et al., 1998; Foley, Reed, Mutran, & DeVellis, 2002; Kim, Chiriboga, & Jang, 2009; Krause & Liang, 1992; Mackinnon, McCallum, Andrews, & Anderson, 1998). For example, in a study comparing performance on the CES-D across four racial/ethnic groups (Japanese, Taiwanese, African Americans, and Whites in the United States), Krause and Liang (1992) found that Japanese elders showed the lowest mean scores on overall depressive symptoms, followed by Taiwanese, Whites, and African Americans. More recently, Inoba and colleagues (2005) also found that Japanese respondents tend to have lower mean scores on the CES-D than Whites. The rates of probable depression derived from the CES-D also varied dramatically across diverse racial/ethnic groups, ranging from 3.5% to more than 30% (e.g., Blazer et al., 1998; Cho, Nam, & Suh, 1998; Foley et al., 2002; Gonzalez, Haan, & Hinton, 2001; Jang, Kim, & Chiriboga, 2005; Kim et al., 2009; Papassotiropoulos & Heun, 1999; Swenson et al., 2000). For example, using the standard cut-off score of the CES-D, Kim and colleagues (2009) reported that 16.0% of Whites, 14.4% of Blacks, and 23.1% of Mexican Americans fell within the probable depression category.

It is important to determine whether these racial/ethnic group differences in the CES-D reflect true differences in depressive symptoms or are instead due to measurement variance. Establishing the degree of measurement invariance (i.e., conceptual, metric, or structural equivalence) of the CES-D across racial/ethnic groups is an important psychometric issue, because if depressive symptom

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measures have differential meanings or validity across diverse populations, group comparisons would be misleading and prevalence rates of depression in each racial/ethnic group would not be accurate (Kim, 2010; Kim et al., 2009). To better understand its measurement properties, several factor analyses of the CES-D have been conducted in different racial/ethnic groups since its initial development in 1977. Notably, these analyses have not been guided by theoretical frameworks but rather by the appropriateness of the original four-factor solution described by Radloff (1977). One study by Roberts, Vernon, and Rhoades (1989), for example, found that a four-factor structure was supported in Anglo American and Mexican American psychiatric patients using confirmatory factor analysis. On the basis of the data from Duke site of the Established Populations for Epidemiologic Studies of the Elderly (EPESE), Blazer and colleagues (1998) also confirmed the original four-factor solution of the CES-D in both African Americans and Whites. In a recent meta-analysis, Shafer (2006) found that the original four-factor structure identified by Radloff (1977) has generally been supported across studies.

One limitation of the Shafer (2006) meta-analysis is that it did not examine the factor structure separately by race/ethnicity. A number of empirical studies have been unable to replicate the original four-factor structure of the CES-D (which is our theoretical structure) in diverse racial/ethnic groups (e.g., Chapleski et al., 1997; Crockett et al., 2005; Miller, Markides, & Black, 1997). Exploratory factor analyses of the CES-D in different populations have yielded anywhere from two to seven factors (e.g., Crockett et al., 2005; Liang, van Tran, Krause, & Markides, 1989; Miller et al., 1997). For example, on the basis of the Hispanic EPESE data, Miller and his colleagues (1997) concluded that a two-factor model of the CES-D was most appropriate for elderly Mexican Americans. Chapleski and colleagues (1997) reported that the factor solution for American Indians was not consistent with the original four-factor solution, while Crockett and colleagues (2005) found differences in the CES-D factor structure among subgroups of Latino adolescents (Mexican Americans, Cuban Americans, and Puerto Rican Americans). This latter study showed that the original four-factor solution fit very well for Whites and Mexican American adolescents but not for Cuban and Puerto Rican Americans. The authors argued that Cuban and Puerto Rican Americans may have differing concepts of depression than Whites.

Several researchers have suggested that the CES-D should be modified when used with minority populations (e.g., Callahan & Wolinsky, 1994; Chapleski et al., 1997; Cole, Kawachi, Maller, & Berkman, 2000; Kim et al., 2009; Liang et al., 1989; Yang & Jones, 2007). For example, Liang and colleagues (1989) observed inconsistencies in the factor structure of the CES-D between Whites and Mexican Americans, motivating their development of a 12-item version of the CES-D specifically for Mexican Americans. Chapleski and colleagues (1997) also found that a 12-item version of the CES-D had a better fit for American Indians than the original 20-item scale. In a study of Black and White Americans, Callahan and Wolinsky (1994) found different factor structures for race/gender groups and recommended dropping five items of the CES-D to maximize comparability across race and gender. McCallum and colleagues (1995) suggested that the CES-D was robust in the face of minor changes, but cautioned that alterations to the original scale may reduce reliability and comparability in norms for screening.

In addition to differences between factor structures, previous studies have reported that specific CES-D items are more or less sensitive in certain racial/ethnic groups (e.g., Cole et al., 2000; Kim et al., 2009; Yang & Jones, 2007). Blacks were more likely than Whites to endorse the only two interpersonal items in the CES-D ("people were unfriendly" and "people disliked me") (Cole et al., 2000; Kim et al., 2009; Yang & Jones, 2007). Hispanics tended to endorse positive items in the CES-D (e.g., "I felt that I was just as good as other people," "I was happy," "I enjoyed life") more than Whites and Blacks (Kim et al., 2009) whereas Whites and Blacks responded to positive items similarly (Cole et al., 2000; Kim et al., 2009; Yang & Jones, 2007). Potential reasons for the different responses to the CES-D items could include cultural or racial/ethnic differences in conceptualization, meaning, and symptom expression of depression (Kim, 2010; Kim et al., 2009). Kim et al. (2009) also identified a number of so-called culture-free items that appeared to be consistent across cultures. Specifically, they found that four items in the CES-D ("I was bothered by things that usually don't bother me," "I did not feel like eating; my appetite was poor," "my sleep was restless," and "I felt lonely") functioned equivalently across three different racial/ethnic groups (i.e., Whites, Blacks, and Mexican Americans). The authors suggested that the three groups may share values, attitudes, and beliefs regarding the expression of these four items. Overall, these findings suggest that the CES-D may include some depressive symptoms whose expression is shared in all cultures or racial/ethnic groups as well as some culture-specific symptoms whose expression is unique to certain racial/ethnic groups.

Considering the variability of factor solutions across studies, as well as the substantial evidence for unique measurement properties of the CES-D in certain racial/ethnic groups, the factor structure of the CES-D continues to be an open question over 30 years after the introduction of this instrument. Of particular concern is whether or not the instrument can be expected to provide equivalent information across highly disparate groups. For this reason the purpose of the present study was to systematically examine the effect of race/ethnicity on the factor structure of the CES-D using a meta-analytic approach. We were specifically interested in examining the factor structure originally proposed by Radloff (1977) by testing whether the original four factors are found in each racial/ethnic group. This meta-analysis will provide a much more systematic and rigorously defined approach to capturing similarities and differences than exist in the many previous reviews on the factor structure of the CES-D scale.

Method

Initial Literature Search

Multiple search techniques were used to identify studies that had investigated the factor structures of CES-D in diverse racial/ethnic groups. The initial search phase examined several online databases, including PSYCINFO (1977-September 2009), PubMed (May, 1980-September 2009), and Digital Dissertations (1970-September 2009). The search phrase paired terms related to the CES-D, such as "CES-D," "CESD," and "Center for Epidemiologic Studies—Depression" with terms related to factor analysis, such as "factor," "component," and "structure." The reference sections of previous reviews of the CES-D literature (narrative and

meta-analytic) were also examined to identify any studies that may not have appeared in the search of the computerized indices. Finally, the first authors of articles identified by the above methods were contacted to obtain additional studies that included factor analyses of the CES-D. After excluding duplicated articles and studies reported in languages other than English, a total of 885 potential articles were found.

Inclusion Criteria

The abstracts of the 885 articles identified in the initial search were reviewed to determine whether or not they included a factor analysis (either exploratory or confirmatory) of the CES-D. A total of 106 articles met this criterion. The full texts of the 106 articles were then reviewed to further identify studies where (a) the factor analysis was performed on the original 20-item version of the CES-D; (b) the factor analytic results were reported separately by race/ethnicity; (c) the results contained enough information to determine which items loaded on each factor for each racial/ethnic group; and (d) the sample in the study did not overlap with those from other articles that had already been included. We did not limit studies to those based on specific analytic choices such as extraction method, choice of rotation, or fit index used to test the model because our goal was to identify the robust structural characteristics that appeared across a broad range of methods. A total of 28 studies met these criteria. Studies that examined the same sample were excluded because their inclusion would falsely inflate the study population. When two studies examined the same sample, the one that had the larger sample size was included.

For the purpose of the present study, studies meeting the inclusion criteria were broken down by race/ethnicity (i.e., African American, American Indian, Asian, White, and Hispanic) and analytic type (i.e., exploratory factor analysis and confirmatory factor analysis). Analytic type was of particular interest. Shafer's (2006) previous meta-analysis of the CES-D factor structure focused solely on exploratory factor analyses. We decided to examine both exploratory and confirmatory factor analyses because they each provide unique information about the structure of the CES-D. However, EFA and CFA studies were examined separately because we expected that they would be subject to different influences and would therefore produce different results. Exploratory factor analyses use a data-driven approach, providing the most information about the relations among the items when not subjected to theoretical constraints. Confirmatory factor analyses, on the other hand, use a model-driven approach, providing the most information about researchers' conceptualizations of the factor structure. These conceptualizations usually are based on the original four factor model (Radloff, 1977).

Data Analysis

The current meta-analysis was based on the methods suggested by Loeber and Schmalong (1985) and Frick et al. (1993), which have recently been used by Shafer (2006). First, the factor loadings were recorded for each factor analysis performed on a separate racial/ethnic group. If a study reported factor analyses on multiple groups, each factor analysis was considered separately. Second, a co-occurrence matrix was created with 20 rows and 20 columns for each of these analyses, indicating whether each pair of items in the

CES-D did or did not load on the same factor. A pair of items was identified as loading on the same factor when they both had their highest loadings on the same factor and the magnitudes of both of those loadings were at least .30. When the loading magnitudes were both greater than .30 but one of the items had a higher loading on a different factor, the items were not identified as loading on the same factor. Secondary loadings were not considered when generating the co-occurrence matrices. Third, the co-occurrence matrices were averaged within each pairing of (a) racial/ethnic group (i.e., African American, American Indian, Asian, White, and Hispanic) with (b) analytic type (i.e., EFA and CFA) to create an aggregate correspondence matrix indicating the proportion of the factor analyses in which each pair of items loaded on the same factor. For example, if the first item and the second item loaded on the same factor three times out of a total of five analyses, the entry in the first row and second column (as well as the entry in the second row and first column) of the correspondence matrix would be equal to .6. These proportions can be thought of as measures of the similarity between each pair of items.

The final step was to perform an exploratory factor analysis on each of the aggregate correspondence matrices to determine the factor structure of the CES-D separately for each combination of racial/ethnic group and analytic type (i.e., EFA vs. CFA). Although factor analyses are typically performed on correlation matrices, the aggregate correspondence matrices also possess the qualities needed to act as the basis of a factor analysis (Tatsuoka, 1971). Principle components extraction was used, keeping any factors with eigenvalues greater than 1. The Scree plots of the eigenvalues were also examined, but did not provide any evidence that basing the factor selection on eigenvalues distorted the results. A varimax rotation was then performed on the extracted factors, providing the final loadings for interpretation. The extraction and rotation methods matched those used by Radloff (1977) in the original analysis of the CES-D. Among studies using exploratory factor analysis, 10 studies used varimax rotation (8 studies used varimax rotation only, 2 studies used oblique rotation, and 2 studies used both orthogonal [varimax] and oblique rotations). One article by Crockett et al. (2005) did not provide information on the rotation method.

Results

Characteristics of Studies Meeting the Meta-Analytic Inclusion Criteria

Table 1 summarizes the descriptive characteristics of studies meeting the meta-analytic inclusion criteria by analytic type (i.e., EFA vs. CFA). The studies meeting the inclusion criteria were published between 1977 and 2010. The number of CES-D factors found in studies ranged from 2 to 7 for EFA studies and from 2 to 4 for CFA studies. From a total of 28 studies meeting the inclusion criteria, 13 studies were included in the EFA meta-analysis while 16 studies were included in the CFA meta-analysis. The article by Crockett and colleagues (2005) used both factor approaches and therefore contributed to both the EFA and CFA meta-analyses. The inclusion of both EFA and CFA from Crockett et al. (2005) does not double count the samples, because EFAs were only conducted on the White and Mexican American samples, while CFAs were

Table 1
Characteristics of Studies Meeting Inclusion Criteria

Characteristic	Racial/ethnic groups				
	African American	American Indian	Asian	White	Hispanic
EFA studies (<i>n</i> = 13)					
Number of studies	2	1	6	3	3
Number of participants	1,687	188	2,469	5,772	9,090
Publication years (range)	1994–2000	1990	1984–2000	1977–2003	1989–2007
Number of CES-D factors (range)	4–7	3	2–5	2–6	2–5
CFA studies (<i>n</i> = 16)					
Number of studies	6	4	2	7	5
Number of participants	44,736	1,140	852	13,184	5,642
Publication years (range)	1998–2010	1991–1997	2001–2003	1989–2010	1989–2008
Number of CES-D factors (range)	4	3–4	3–4	4	2–4

Note. One article (Crockett et al., 2005) contributed to both the EFA and CFA meta-analyses.

only conducted on the Puerto Rican and Cuban American samples. The total number of participants was 19,206 for the EFA meta-analysis and 65,554 for the CFA meta-analysis. For EFA studies, sample sizes ranged from 151 to 5,191, with a mean of 1,200 and a median of 424. For CFA studies, sample sizes ranged from 45 to 40,403, with a mean of 2,731 and a median of 638. Hispanics ($N = 9,090$) were the largest group in EFA studies while African Americans ($N = 44,736$) were the largest in CFA studies. Basic characteristics (e.g., publication year, sample size, sample context, age range, mean (SD) and range of CES-D scores, and model fit indices) of the studies included in the meta-analysis are summarized in Table 2.

Factor Structures by Race/Ethnicity

A summary of our meta-analytic results is provided in Table 3, which describes the factor each item of the CES-D loads on for each racial/ethnic group. The rotated factor loadings from the meta-analyses of EFAs and CFAs for each racial/ethnic group are presented in Appendix 1 and 2, respectively. American Indians were not included in the EFA meta-analysis because there was only a single sample that reported an EFA on this group.

As shown in Table 3, all four factors (i.e., depressed affect, positive affect, somatic symptoms, and interpersonal problems) appeared in the results for EFA studies. Radloff's (1977) original four factors were identified among Hispanics, although there were deviations regarding which items loaded on each factor. While interpersonal problems and positive affect factors contained the original items, the depressed affect and somatic symptom swapped several items in the Hispanic sample. Two additional factors appeared in results for African Americans (demoralization, including items #5 "mind," #9 "failure," and #20 "get going" and "distress" including items #10 "fearful" and #17 "cry"), one additional factor for Asians (alienation, including items #10 "fearful," #14 "lonely," and #17 "cry"), and one additional factor for Whites (preoccupation, including items #1 "bothered," #5 "mind," and #13 "talk").

In contrast, the meta-analyses of CFA studies replicated the original four-factor structure in four of the five racial/ethnic groups: African Americans, American Indians, Whites, and Hispanics. Only Asians showed a different factor structure: in addition

to the original four factors, one unique factor (sorrow/grief, including items #3 "blues," #6 "depressed," and #17 "cry") was found in the Asian sample.

Global Comparisons of the CES-D Factor Structure Between Racial/Ethnic Groups

After obtaining the factor analytic results by race/ethnicity, the equivalence of factor structures across racial/ethnic groups was determined using a method proposed by Kaiser, Hunka, and Bianchini (1971) and implemented by Fleming (1992). The Kaiser method was selected in the present study because it is a well-established method that has a commonly accepted criterion for matching. It also has a software implementation, allowing the method to be easily replicated and expanded by others. The Kaiser method allows pairwise comparisons of the full factor structures between groups to determine whether the structures are equivalent. Bushman and colleagues (1991) describe three principal steps to the Kaiser method. First, the variable vectors from both groups must be normalized to ensure that the variables make equal contributions to the final results. Second, the factor loadings are used to position the variables from the two samples in a common vector space. This provides a representation of how the variables are related to the factors in each of the two samples. Finally, the factor axes are rotated to provide maximal overlap between the two samples. After the solution is obtained, the cosines between pairs of variable vectors (defined across the factors) can be taken as a measure of the equivalence of the factor structure between the two groups. The cosines range from -1 to 1, with values closer to 1 indicate greater congruency. Kaiser and colleagues (1971) suggest that a mean variable cosine of .85 or higher indicated that the fit between the samples was "reasonable," although Barrett (1986) recommends a more conservative cutoff of .90.

Table 4 presents the mean variable cosines comparing the rotated factor structures between racial/ethnic groups by analytic type (i.e., EFA vs. CFA). In EFA studies, the mean variable cosines ranged from .752 to .875, suggesting that none of the racial/ethnic groups have congruent factor structures based on Barrett's (1986) guideline of .90. The factor structures for Asians and Hispanics were the most similar (the mean variable cosine = .875), whereas African Americans and Hispanics were the least

Table 2
Summary of Studies Included in the Meta-Analysis (28 Studies)

Citation	Racial/ethnic group	Number of participants (N)	Sample context	Age range (M, SD)	CES-D Range (M, SD)	Model fit indices/ % variance explained
EFA studies (<i>n</i> = 13)						
Callahan and Wolinsky (1994)	AA	1,294	Community	60–102 (69.71, N. A.)	N. A. (N. A., N. A.)	Eigenvalue = 10.20
Chiriboga, Jang, Banks, and Kim (2007)	White Hispanic	625 3,050	Community Community	60–102 (65.54, N. A.) 60+ (N. A., N. A.)	N. A. (N. A., N. A.) N. A. (N. A., N. A.)	Eigenvalue = 10.43 Eigenvalue = 32.06 (Factor 1, high acculturation)
Crockett et al. (2005)	Hispanic	444	School	12–18 (N.A., N.A.)	N. A. (N. A., N. A.)	Eigenvalue = 35.28 (Factor 1, low acculturation)
Edman et al. (1999)	Hispanic	405	School	12–18 (N.A., N.A.)	N. A. (N. A., N. A.)	Eigenvalue = 11.36 (Factor 2, high acculturation)
Guarnaccia, Angel, and Worobey (1989)	Asian Hispanic	243 5,191	School Community	14–19 (15.8, 1.21) 20+ (N. A., N. A.)	N. A. (N. A., N. A.) N. A. (N. A., N. A.)	Eigenvalue = 2.23 (Factor 2, low acculturation)
Kim, Han, and Phillips (2003)	Asian	154	Community	18–87 (44.5, 14.6)	N. A. (N. A., N. A.)	Eigenvalue = 5.79 (Korean, Factor 1)
White	151	Community	18–87 (44.5, 14.6)	N. A. (N. A., N. A.)	Eigenvalue = 1.37 (Korean, Factor 2)	
Kuo (1984)	Asian American Indian	499	Community School	N. A. (N. A., N. A.) 15–17 (N. A., N. A.)	N. A. (9.38, 8.07) 2–48 (19.5, 9.43)	Eigenvalue = 7.56 (Anglo, Factor 1) Eigenvalue = 1.27 (Anglo, Factor 2)
Manson, Ackerson, Dick, Baron, and Fleming (1990)	American Indian	188				Multiple r^2 = .173
McCallion and Kolomer (2000)	AA	393	Community	40–82 (N. A., N. A.)	N. A. (15.9, 9.5)	Explained variance (%) = 27.9 (Factor 1)
Noh, Avison, & Kaspar (1992)	Asian	860	Community	N. A. (45, N. A.)	N. A. (N. A., N. A.)	Explained variance (%) = 12.9 (Factor 2)
Radioff (1977)	White	4,996	Community	18+ (N. A., N. A.)	N. A. (9.25, 8.58) Q1 (8.17, 8.23) Q2 (7.94, 7.53)	Explained Variance (%) = 8.4 (Factor 3)
Ying (1988)	Asian	360	Community	19+ (N. A., N. A.)	N. A. (11.55, 8.23)	Total explained variance (%) = 43.2
Ying, Tsai, Yeh, and Huang (2000)	Asian Asian	353	School	N. A. (20.23, 1.77)	N. A. (N. A., N. A.)	Total explained variance (%) = 43.2
CFA Studies (<i>n</i> = 16)						
Beals, Manson, Keane, & Dick (1991)	American Indian	605	School	17–54 (23, 25.5)	N. A. (16.2, N.A.)	$\chi^2 = 372$, $df = 162$, GFI = .94, NFI = .93
Blazer et al. (1998)	AA	1,848	Community	N. A. (65+, N. A.)	N. A. (3.14, 2.55)	$\chi^2 = 265.8$, $df = 143$, GFI = .993,
White		1,553	Community	N. A. (65+, N. A.)	N. A. (2.57, 3.76)	AGFI = .990 $\chi^2 = 169.85$, $df = 143$, GFI = .994, AGFI = .992

(table continues)

Table 2 (continued)

Citation	Racial/ethnic group	Number of participants (<i>N</i>)	Sample context	Age range (<i>M</i> , <i>SD</i>)	CES-D Range (<i>M</i> , <i>SD</i>)	Model fit indices/ % variance explained
Carrillo (2008)	Hispanic	45	Community	N. A. (43.1, 8.2)	N. A. (20.4, 13.3)	$\chi^2 = 296.63$, <i>df</i> = 64, CFI = .74, RMSEA = .14
Chapleski et al. (1997)	American Indian	227	Community	N. A. (55+, N. A.)	N. A. (6.49, 5.98)	$\chi^2 = 248.85$, <i>df</i> = 153, CFI = .89, GFI = .83,
Crockett et al. (2005)	White	8,517	School	12–18 (N.A., N.A.)	N. A. (N. A., N. A.)	NFI = .77, RMSEA = .058
Dick, Beals, Keane, and Manson (1994)	Hispanic	1,279	School	12–18 (N.A., N.A.)	N. A. (N. A., N. A.)	$\chi^2 = 2852.10$, <i>df</i> = 164, CFI = .95, RMSEA = .04, SRMR = .03
Flynn Longmire and Knight (2010)	American Indian AA	188	School	13–20 (15.8, N.A.)	N. A. (18.82, 10.75)	$\chi^2 = 609.14$, <i>df</i> = 161, CFI = .92, RMSEA = .05, SRMR = .04
Golding and Anshensel (1989)	White	175	Community	N. A. (57.48, 14.44)	N. A. (16.06, 11.31)	$\chi^2 = 276.21$, <i>df</i> = 163, GFI = .866, NFI = .90
Gupta and Yick (2001)	Hispanic Asian AA	225	Community	N. A. (62.88, 13.57)	N. A. (17.74, 9.64)	$\chi^2 = 611.377$, <i>df</i> = 328, CFI = .941, PGFI = .671, RMSEA = .048
Hales (2006)	White	1,101	Community	Adults	N. A. (N. A., N. A.)	$\chi^2 = 611.377$, <i>df</i> = 328, CFI = .941, PGFI = .671, RMSEA = .048
Miller, Markides, and Black (1997)	Hispanic AA(HANLDS)	1,244	Community	Adults	N. A. (N. A., N. A.)	$\chi^2 = 403.97$, <i>df</i> = 377, GFI = .99
Nguyen et al. (2004)	White	76	Community	50–86	N. A. (N. A., N. A.)	$\chi^2 = 306.42$, <i>df</i> = 167, CFI = .70
AA(NHEFS)	Hispanic	610	School	N. A. (17.79, .6)	N. A. (14.95, 9.993)	$\chi^2 = 374.44$, <i>df</i> = 166, CFI = .976, NNFI = .972, RMSEA = .045
White(BLSA)		452	School	N. A. (17.59, .6)	N. A. (13.626, 9.190)	$\chi^2 = 261.57$, <i>df</i> = 166, CFI = .985, NNFI = .983, RMSEA = .036
Roth, Ackerman, Burgio, and Okonkwo (2008)	Hispanic	2,866	Community	N. A. (73, N. A.)	N. A. (N. A., N. A.)	$\chi^2 = 2437.21$, <i>df</i> = 212, CFI = .96, GFI = .94, AGFI = .92, TLC = .95, RMSEA = .05
Somervell et al. (1992)	White	426	Community	18–92 (50, N.A.)	N. A. (N. A., N. A.)	$\chi^2 = 336.88$, <i>df</i> = 164, CFI = .95, GFI = .97, RMSEA = .05
Tran, Ngo, and Conway (2003)	American Indian Asian	988	Community	33–86 (53, N.A.)	N. A. (N. A., N. A.)	$\chi^2 = 336.88$, <i>df</i> = 164, CFI = .95, GFI = .97, RMSEA = .05
Williams et al. (2007)	AA	666	Community	19–92 (53, N.A.)	N. A. (N. A., N. A.)	$\chi^2 = 414.34$, <i>df</i> = 102, CFI = .960, RMSEA = .051
		294	Community	N. A. (58.2, 12.9)	N. A. (12.87, 10.27)	
		208	Community	N. A. (58.9, 14.3)	N. A. (18.62, 11.55)	
		681	Community	N. A. (65.0, 13.1)	N. A. (15.24, 11.24)	
		120	Community	20+ (N. A., N. A.)	N. A. (N. A., N. A.)	$\chi^2 = 414.34$, <i>df</i> = 102, CFI = .960, RMSEA = .051
		776	Community	18–84 (52.72, 12.60)	N. A. (N. A., N. A.)	
		40,403	Community	21–69 (N. A., N. A.)	N. A. (N. A., N. A.)	
						Note. AA = African American; N.A. = not applicable.

Table 3

Factor Names of Highest Factor Loadings of the CES-D Items by Race/Ethnicity

CES-D items	EFA studies					CFA studies				
	African American	American Indian	Asian	White	Hispanic	African American	American Indian	Asian	White	Hispanic
1: Bothered (S)	S	—	D	Pr	S	S	S	S	S	S
2: Appetite (S)	S	—	S	S	S	S	S	S	S	S
3: Blues (D)	D	—	D	D	S	D	D	SG	D	D
4: Good (P)	P	—	P	P	P	P	P	I	P	P
5: Mind (S)	De	—	D	Pr	S	S	S	S	S	S
6: Depressed (D)	D	—	D	D	S	D	D	SG	D	D
7: Effort (S)	S	—	D	S	S	S	S	S	S	S
8: Hopeful (P)	P	—	P	P	P	P	P	P	P	P
9: Failure (D)	De	—	S	I	D	D	D	D	D	D
10: Fearful (D)	Di	—	Al	D	D	D	D	D	D	D
11: Sleep (S)	S	—	D	S	S	S	S	S	S	S
12: Happy (P)	P	—	P	P	P	P	P	P	P	P
13: Talk (S)	S	—	S	Pr	D	S	S	S	S	S
14: Lonely (D)	D	—	Al	D	D	D	D	D	D	D
15: Unfriendly (I)	I	—	I	I	I	I	I	I	I	I
16: Enjoy (P)	P	—	P	P	P	P	P	P	P	P
17: Cry (D)	Di	—	Al	D	D	D	D	SG	D	D
18: Sad (D)	D	—	D	D	D	D	D	D	D	D
19: Dislike (I)	I	—	I	I	I	I	I	I	I	I
20: Get going (S)	De	—	S	S	S	S	S	S	S	S
Number of factors	6	—	5	5	4	4	4	5	4	4

Note. Letters in parentheses indicate original four factors suggested by Radloff (1977). D = Depressed affect; p = Positive affect; S = Somatic symptoms; I = Interpersonal problems; De = Demoralization; Di = Distress; Al = Alienation; Pr = Preoccupation; SG = Sorrow/Grief.

similar (the mean variable cosine = .752). In the CFA comparisons, all mean variable cosines were .90 or above, suggesting that the structures were congruent across all of the racial/ethnic groups.

Comparing Individual Factors Between Race/Ethnic Groups

The four factors identified in the original conceptualization of the CES-D (depressed affect, positive affect, somatic symptoms, and interpersonal problems) appeared in the meta-analytic results of all of the racial/ethnic groups. Congruence coefficients were therefore calculated to determine whether the structures of these four factors were individually equivalent across racial/ethnic groups. Whereas the Kaiser method assessed the equivalence of the full factor structure between groups, the congruence coefficients assessed the equivalence of individual pairs of factors. The congruence coefficient takes values between -1 and 1, where values closer to 1 indicate a greater correspondence between the two factor definitions. Mulaik (1972) suggests a rule of thumb that congruence coefficients greater than .90 indicate that the factor structure is invariant between two groups. To simplify the presentation of these comparisons, tables of homogenous subsets are provided in Table 5 identifying racial/ethnic groups that have equivalent definitions of each of the four factors, where equivalence is indicated by having a congruence coefficient greater than .90.

The results from the EFA studies showed that the depressed affect and somatic symptom factors were uniquely defined for each racial/ethnic group. The positive affect factors for Asians, Whites, and Hispanics were equivalent, but the positive affect factor for African Americans differed from the positive affect factors for Asians and Whites. The interpersonal problem factors were equivalent between African Americans and Asians, but the

Table 4
Mean Variable Cosines Comparing Factor Structures by Race/Ethnicity

EFA/CFA	Racial/ethnic groups				
	African American	American Indian	Asian	White	Hispanic
EFA studies					
African American	1.000	—	.778	.803	.752
American Indian	—	—	—	—	—
Asian	.778	—	1.000	.802	.875
White	.803	—	.802	1.000	.844
Hispanic	.752	—	.875	.844	1.000
CFA studies					
African American	1.000	.968	.928	.999	.986
American Indian	.968	1.000	.908	.967	.985
Asian	.928	.908	1.000	.928	.928
White	.999	.967	.928	1.000	.986
Hispanic	.986	.985	.928	.986	1.000

Note. American Indians were excluded in the EFA meta-analysis because only a single study was available; Mean variable cosines greater than .90 indicate that the factor structure is invariant between two racial/ethnic groups.

Table 5
Factor Equivalences Across Racial/ethnic Groups

	CES-D factors			
	Depressed affect	Positive affect	Somatic symptoms	Interpersonal relations
EFA studies				
African American	A	A	A	A
American Indian	—	—	—	—
Asian	B	B	B	A
White	C	B	C	B
Hispanic	D	AB	D	C
CFA studies				
African American	α	α	α	α
American Indian	α	α	α	α
Asian	α	α	α	β
White	α	α	α	α
Hispanic	α	α	α	α

Note. Within a factor, racial/ethnic groups not sharing any Roman letters have distinct EFA factor loadings (i.e., congruence coefficient less than .90) and racial/ethnic groups not sharing any Greek letters have distinct CFA factor loadings.

interpersonal problem factors of Whites and Hispanics were not equivalent to those of any of the other racial/ethnic groups.

The CFA analyses showed that the depressed affect, positive affect, and somatic symptoms factors had congruence coefficients greater than .90 across all the racial/ethnic groups, suggesting that these three factors were relatively robust. African Americans, American Indians, Whites, and Hispanics all had equivalent interpersonal factors, but the interpersonal factor was different for Asians. The interpersonal factor for Asians included one additional item (#4 "good") whereas only two items (items #15 "unfriendly" and #19 "dislike") were seen in the interpersonal factor for other racial/ethnic groups.

Discussion

The present meta-analysis examined the effect of race/ethnicity on the factor structure of the CES-D using a total of 28 studies reported in the literature. Our meta-analytic approach clearly advanced our knowledge about the factor structure of the CES-D by comparing the factor structures by race/ethnicity and by separately examining the factor structures observed in CFA and EFA.

Meta-analytic results based on the more model-driven CFA studies were generally consistent with the previous CES-D meta-analysis (Shafer, 2006), suggesting that the original four-factor structure was present in all racial/ethnic groups except for the Asian sample. However, unlike Shafer's findings supporting the original four-factor structure of the CES-D, our EFA meta-analyses provided strong evidence for racial/ethnic differences. The differences between Shafer's (2006) and our meta-analyses may be because of the studies included in the samples. Our meta-analysis excluded several studies included in Shafer (2006) that did not provide information on the race/ethnicity of the respondents. More importantly, Shafer (2006) aggregated all of the racial/ethnic groups together into a single analysis, whereas our analyses were separated by race/ethnicity. What we have learned from the present meta-analysis is new to the field of psychological

assessment, and the present meta-analytic approach clearly builds upon our prior knowledge on the factor structure of the CES-D.

The EFA results suggest that the structure of the CES-D varies by racial/ethnic group. Although basic elements of the four factors identified in the original conceptualization of the CES-D (i.e., depressed affect, positive affect, somatic symptoms, and interpersonal problems) were indeed present in the current meta-analytic results of all five racial/ethnic groups, additional factors were found in three racial/ethnic groups. Two additional factors (demoralization and distress) appeared in the structure for African Americans; one additional factor (alienation) appeared in the structure for Asians; and one additional factor (preoccupation) appeared in the structure for Whites. EFA studies of Hispanics showed four factors, but the structure differed from the original Radloff (1977) structure in that loadings of depressed affect and somatic symptom items had sometimes switched between the two factors. Even in CFA studies, some evidence of different factor structures was found. Among Asians, one additional factor representing sorrow/grief appeared that was distinct from the original depression factor. Combining findings from the two current meta-analyses, results clearly show that the original four-factor structure does not fit for all racial/ethnic groups.

Comparisons of the individual CES-D factors between racial/ethnic groups were particularly intriguing. The results from CFA studies suggested that all of the factors were equivalent across the five racial/ethnic groups, with the single exception that the interpersonal problem factor differed for Asians. The results from EFA studies, on the other hand, suggested that almost all of the CES-D factors differed strongly across racial/ethnic groups. The commonalities in the EFA factor loadings were restricted to the positive affect and interpersonal problem factors: Asians and Whites had similar factor loadings for the positive affect factor, and African Americans and Asians had similar factor loadings for the interpersonal problem factor. These results indicate the existence of qualitative differences between groups in factor structures, suggesting that different conceptualization, meaning, and symptom expression of depression may exist across diverse cultural groups. More broadly this would also mean that certain cultures may not share their values, attitudes, and beliefs regarding the expression of depressive symptoms (Kim, 2010; Kim et al., 2009).

The differences in the meta-analytic results from CFA and EFA studies deserve special attention. Unlike Shafer's (2006) meta-analyses, which only included EFA studies, we included both CFA and EFA studies to compare the results from the two analytic approaches representing very different sources of information. Our suspicion that these two different approaches would lead to different results was confirmed in that there were strong racial/ethnic differences in the factors arising from the analysis of EFA studies but almost no racial/ethnic differences in the factors arising from the analysis of CFA studies. As mentioned earlier, EFA is a data-driven approach while CFA is a model-driven approach. The results from CFA studies suggest that researchers expected to find the original structure of the CES-D in all racial/ethnic groups, but the results from EFA studies suggest these expectations may not have been warranted. A wider variety of confirmatory models should be considered in future research of the CES-D when the structure of the CES-D is examined using CFA. While researchers' beliefs will guide some decisions that affect the results of EFAs, the models tested in CFAs are completely determined by the desire

of the analyst, and so will show much stronger influences of researcher expectations. This may explain why the results from the meta-analysis of CFAs were much more homogeneous than those of EFAs. Alternatively, the more uniform findings found in CFA studies may have been results of publication bias. CFA results are typically evaluated using hypothesis tests and fit indices, which are not available for EFAs. The EFA findings may be more diverse because they include results that would have not surpassed the fit thresholds typically applied to CFAs.

The fact that our CFA results supported Shafer's conclusion of a general four-factor solution while the EFA results differed from those of Shafer (2006) was intriguing. This demonstrates how strongly results can be influenced by the analytic approach taken. A key difference between the two approaches was that Shafer's analyses combined all 21 studies included into a single database whereas our approach examined the factor structure separately by the five discrete racial/ethnic groups. Our CFA results support Shafer's findings, suggesting that if researchers look for the presence of a general four factor solution they will likely find some evidence. On the other hand, the EFA results emphasize the great variability that does in fact seem to exist, and which should be taken into consideration by clinicians and researchers who are working with the CES-D.

The present meta-analysis has implications for both research and practice. When the original CES-D scale is used to measure depressive symptoms in diverse racial/ethnic groups, researchers and clinicians should be aware of the potential qualitative differences in the factor structures of the CES-D. In a proposed model of the relationship of culture to depression, Kim (2010) suggested that when the same measure is used to assess depression across cultures, the outcomes obtained from using those measures are often structurally different as a function of culture. Such results suggest that people from different cultures express their depressive symptoms in a different manner (Kim, 2010). This also demonstrates a potential reason why the unique factorial structures on depression are observed in certain racial/ethnic groups. Our results clearly show that the CES-D includes some common depressive symptom items shared across cultures as well as culture and/or ethnic-specific items that are unique to certain cultures. Findings from the EFA meta-analysis suggest that different cultures conceptualize the problem of depressive symptoms in different ways, and that there may be no equivalent concepts for depression in certain non-Western cultures. Researchers should recognize that depressive symptoms may be experienced, expressed, and responded to in different manners in some cultures. Thus, in clinical settings where the CES-D and similar instruments are used as a tool to screen for depression, clinicians should recognize that summary scores may not equally reflect the risk of depression across different racial/ethnic groups.

Limitations of the present study should be noted. First, the present meta-analysis only included studies published in English. Given that our study focused on racial/ethnic differences, it may be worth examining studies written in other languages in future research. Second, our meta-analysis only included studies using the original 20-item version of the CES-D. While conducting this meta-analysis study, a number of studies were not included because they used the short form or a modified version of the CES-D. Future meta-analyses should include studies using the short form or other modified versions to more fully address racial/ethnic

differences in the factor structure. Third, the present meta-analysis did not consider other confounding factors that might affect the factor structure of the CES-D. Previous studies reported differences in the factor structure of the CES-D caused by gender, socioeconomic status, and the level of acculturation (e.g., Chiriboga, Jang, Banks, & Kim, 2004; Cole et al., 2000; Yang & Jones, 2007). These factors should be considered in future meta-analytic research. Fourth, differences in the extraction and rotation methods that used in EFA studies might have potentially affected our meta-analysis results. However, given that our analyses were based on what pairs of items go together in previous findings, we expect that most of the differences would not be large enough to alter our findings. In addition, Guadagnoli and Velicer (1988) have demonstrated that the results of EFAs do not strongly vary by extraction method. Future meta-analysis studies should more thoroughly consider the effect of particular factor-analytic methods. Fifth, given the large range in sample sizes were included in the meta-analysis, weighting studies might have been useful to account for the group differences. Lastly, in the EFA studies, there were limited numbers of studies for aggregation within certain racial/ethnic groups.

Notwithstanding these limitations, the present meta-analysis provides strong evidence that the Radloff's (1977) original four-factor structure may not be the best fit for all racial/ethnic groups or all analysis types (i.e., CFA or EFA). Results from the meta-analysis of CFA studies replicated the original four-factor structure in all racial/ethnic groups except for Asians while results from the EFA meta-analysis did not consistently replicate the original four-factor structure across all racial/ethnic groups. Based on the current findings, we would suggest that it is important for researchers and clinicians to understand the structure of the CES-D before drawing conclusions based on the patterns of factor scores between racial/ethnic groups. Our recommendation to researchers would be to use exploratory factor analysis first and then apply confirmatory factor analysis when examining the factor structure of the CES-D in racially/ethnically diverse groups. In addition, researchers and clinicians may wish to consider modifying the CES-D scale when applying it to culturally diverse patients. Lastly, special effort is needed to develop culturally relevant measures that assess depression accurately within specific cultures.

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(Appendices follow)

Appendix 1**Rotated Factor Loadings From the Meta-Analysis of EFAs by Race/Ethnicity****A. African American**

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal	Demoralization	Distress
1: Bothered	0.222	-0.062	0.639	0.045	0.429	0.102
2: Appetite	0.235	-0.066	0.775	0.113	0.363	-0.111
3: Blues	0.926	0.112	0.072	0.056	0.239	0.176
4: Good	-0.206	0.827	-0.051	-0.023	0.4	0.074
5: Mind	0.137	0.026	0.026	0.042	0.855	-0.016
6: Depressed	0.926	0.112	0.072	0.056	0.239	0.176
7: Effort	-0.159	0.043	0.683	-0.131	-0.001	0.309
8: Hopeful	-0.151	0.825	-0.05	0.24	0.076	0.053
9: Failure	0.137	0.026	0.026	0.042	0.855	-0.016
10: Fearful	0.241	-0.019	0.022	0.012	-0.003	0.827
11: Sleep	0.348	0.619	0.544	-0.166	-0.11	-0.113
12: Happy	0.273	0.927	0.015	-0.054	-0.079	-0.07
13: Talk	-0.059	0.015	0.812	0.245	-0.107	-0.071
14: Lonely	0.595	-0.092	0.029	0.428	0.317	0.314
15: Unfriendly	-0.012	0.016	0.109	0.864	-0.14	0.005
16: Enjoy	0.273	0.927	0.015	-0.054	-0.079	-0.07
17: Cry	0.171	0.007	0.055	-0.012	-0.044	0.91
18: Sad	0.674	0.586	0.009	-0.074	-0.162	0.231
19: Dislike	0.188	0.037	0.05	0.655	0.407	-0.051
20: Get going	0.121	0.045	0.54	-0.004	0.769	-0.025
% variance explained	15.85	19.31	13.79	7.79	14.99	9.41

B. Asian

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal	Alienation
1: Bothered	0.895	-0.001	0.248	0.149	-0.006
2: Appetite	0.243	-0.014	0.863	0.057	0.201
3: Blues	0.821	-0.004	0.355	0.085	0.376
4: Good	0.289	0.862	-0.065	0.063	-0.023
5: Mind	0.304	-0.009	0.8	0.074	-0.208
6: Depressed	0.821	-0.004	0.355	0.085	0.376
7: Effort	0.69	0.246	-0.157	0.048	-0.007
8: Hopeful	-0.018	0.991	0.017	-0.013	0.006
9: Failure	0.009	0.009	0.71	0.027	0.523
10: Fearful	0.601	0.017	0.159	0.103	0.726
11: Sleep	0.606	0.007	0.546	0.127	0.183
12: Happy	-0.018	0.991	0.017	-0.013	0.006
13: Talk	-0.002	0.007	0.71	0.366	0.368
14: Lonely	0.213	-0.004	0.519	0.324	0.561
15: Unfriendly	0.004	-0.007	0.135	0.925	0.167
16: Enjoy	-0.018	0.991	0.017	-0.013	0.006
17: Cry	0.29	-0.015	0.193	0.132	0.834
18: Sad	0.821	-0.004	0.355	0.085	0.376
19: Dislike	0.315	0.025	0.101	0.896	0.058
20: Get going	0.229	-0.012	0.907	0.009	0.173
% variance explained	22.72	18.77	21.72	10.01	12.75

(Appendices continue)

C. White

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal	Preoccupation
1: Bothered	0.045	0	0.394	0.038	0.847
2: Appetite	-0.006	0	0.96	0.019	0.251
3: Blues	0.904	0	-0.013	0.019	0.037
4: Good	0	1	0	0	0
5: Mind	0.105	0	0.423	-0.009	0.802
6: Depressed	0.742	0	-0.032	0.287	0.074
7: Effort	-0.006	0	0.96	0.019	0.251
8: Hopeful	0	1	0	0	0
9: Failure	0.283	0	0.157	0.36	0.218
10: Fearful	0.7	0	-0.023	-0.014	0.065
11: Sleep	-0.009	0	0.803	0.019	0.349
12: Happy	0	1	0	0	0
13: Talk	0.005	0	0.397	0.009	0.846
14: Lonely	0.964	0	0.016	-0.028	-0.008
15: Unfriendly	-0.005	0	-0.012	0.98	-0.028
16: Enjoy	0	1	0	0	0
17: Cry	0.964	0	0.016	-0.028	-0.008
18: Sad	0.964	0	0.016	-0.028	-0.008
19: Dislike	-0.005	0	-0.012	0.98	-0.028
20: Get going	-0.006	0	0.96	0.019	0.251
% variance explained	23.69	20.00	19.63	10.69	12.24

D. Hispanic

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal
1: Bothered	0.457	0.086	0.785	-0.094
2: Appetite	0.384	0.042	0.862	-0.038
3: Blues	0.531	0.038	0.768	-0.114
4: Good	-0.04	0.882	-0.045	0.019
5: Mind	0.364	0.05	0.708	-0.063
6: Depressed	0.531	0.038	0.768	-0.114
7: Effort	0.166	0.048	0.928	0.029
8: Hopeful	-0.008	0.8	-0.021	0.008
9: Failure	0.811	0.018	0.27	0.27
10: Fearful	0.595	0.02	0.404	0.24
11: Sleep	0.518	0.094	0.651	-0.116
12: Happy	0.149	0.717	0.193	-0.048
13: Talk	0.782	0.091	0.395	0.235
14: Lonely	0.904	0.055	0.168	0.015
15: Unfriendly	0.096	-0.002	-0.011	0.916
16: Enjoy	0.069	0.904	0.072	0.017
17: Cry	0.815	0.015	0.263	0.1
18: Sad	0.746	0.055	0.347	0.021
19: Dislike	0.262	-0.007	-0.079	0.917
20: Get going	-0.019	0.027	0.791	0.414
% variance explained	25.57	13.96	28.07	10.53

(Appendices continue)

Appendix 2**Rotated Factor Loadings From the Meta-Analysis of CFAs by Race/Ethnicity****A. African American**

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal
1: Bothered	0.007	0	1	0
2: Appetite	0.007	0	1	0
3: Blues	0.995	0	-0.008	0
4: Good	0	1	0	0
5: Mind	0.007	0	1	0
6: Depressed	0.995	0	-0.008	0
7: Effort	0.007	0	1	0
8: Hopeful	0	1	0	0
9: Failure	0.934	0	0.095	0
10: Fearful	0.934	0	-0.007	0
11: Sleep	0.007	0	1	0
12: Happy	0	1	0	0
13: Talk	0.007	0	1	0
14: Lonely	0.995	0	-0.008	0
15: Unfriendly	0	0	0	1
16: Enjoy	0	1	0	0
17: Cry	0.995	0	-0.008	0
18: Sad	0.995	0	-0.008	0
19: Dislike	0	0	0	1
20: Get going	0.007	0	1	0
% variance explained	33.45	20.00	35.04	10.00

B. American Indian

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal
1: Bothered	0.404	0	0.899	0
2: Appetite	0.404	0	0.899	0
3: Blues	0.958	0	0.253	0
4: Good	0	1	0	0
5: Mind	0.404	0	0.899	0
6: Depressed	0.958	0	0.253	0
7: Effort	0.022	0	0.541	0
8: Hopeful	0	1	0	0
9: Failure	0.777	0	0.328	0
10: Fearful	0.958	0	0.253	0
11: Sleep	-0.035	0	0.769	0
12: Happy	0	1	0	0
13: Talk	0.404	0	0.899	0
14: Lonely	0.958	0	0.253	0
15: Unfriendly	0	0	0	1
16: Enjoy	0	1	0	0
17: Cry	0.866	0	0.035	0
18: Sad	0.958	0	0.253	0
19: Dislike	0	0	0	1
20: Get going	0.404	0	0.899	0
% variance explained	33.81	20.00	26.76	10.00

(Appendices continue)

C. Asian

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal	Sorrow/grief
1: Bothered	-0.019	-0.003	0.982	0.003	0.173
2: Appetite	0.071	0.017	0.774	-0.062	-0.302
3: Blues	0.566	-0.001	0.216	-0.068	0.788
4: Good	-0.16	0.376	-0.021	0.622	0.216
5: Mind	-0.019	-0.003	0.982	0.003	0.173
6: Depressed	0.566	-0.001	0.216	-0.068	0.788
7: Effort	-0.019	-0.003	0.982	0.003	0.173
8: Hopeful	0.006	0.996	0.001	0.028	-0.007
9: Failure	0.975	-0.003	-0.01	0.125	0.166
10: Fearful	0.975	-0.003	-0.01	0.125	0.166
11: Sleep	-0.019	-0.003	0.982	0.003	0.173
12: Happy	0.006	0.996	0.001	0.028	-0.007
13: Talk	0.389	-0.004	0.756	0.196	-0.449
14: Lonely	0.975	-0.003	-0.01	0.125	0.166
15: Unfriendly	0.265	-0.049	0.022	0.922	-0.138
16: Enjoy	0.006	0.996	0.001	0.028	-0.007
17: Cry	0.566	-0.001	0.216	-0.068	0.788
18: Sad	0.975	-0.003	-0.01	0.125	0.166
19: Dislike	0.265	-0.049	0.022	0.922	-0.138
20: Get going	-0.019	-0.003	0.982	0.003	0.173
% variance explained	25.46	15.60	30.68	11.03	12.488

D. White

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal
1: Bothered	-0.001	0	0.998	0
2: Appetite	-0.001	0	0.998	0
3: Blues	0.993	0	-0.001	0
4: Good	0	1	0	0
5: Mind	-0.001	0	0.998	0
6: Depressed	0.993	0	-0.001	0
7: Effort	-0.001	0	0.998	0
8: Hopeful	0	1	0	0
9: Failure	0.902	0	0.15	0
10: Fearful	0.904	0	0.003	0
11: Sleep	0.154	0	0.888	0
12: Happy	0	1	0	0
13: Talk	-0.001	0	0.998	0
14: Lonely	0.993	0	-0.001	0
15: Unfriendly	0	0	0	1
16: Enjoy	0	1	0	0
17: Cry	0.993	0	-0.001	0
18: Sad	0.993	0	-0.001	0
19: Dislike	0	0	0	1
20: Get going	-0.001	0	0.998	0
% variance explained	32.91	20.00	33.92	10.00

(Appendices continue)

E. Hispanic

CES-D items	Depressed affect	Positive affect	Somatic symptoms	Interpersonal
1: Bothered	0.139	0	0.98	0.082
2: Appetite	0.153	0	0.885	0.103
3: Blues	0.985	0	0.145	0.076
4: Good	0	0.992	0	0
5: Mind	0.139	0	0.98	0.082
6: Depressed	0.985	0	0.145	0.076
7: Effort	0.139	0	0.98	0.082
8: Hopeful	0	0.915	0	0
9: Failure	0.985	0	0.145	0.076
10: Fearful	0.985	0	0.145	0.076
11: Sleep	0.153	0	0.885	0.103
12: Happy	0	0.992	0	0
13: Talk	0.139	0	0.98	0.082
14: Lonely	0.862	0	0.153	0.194
15: Unfriendly	0.18	0	0.188	0.922
16: Enjoy	0	0.992	0	0
17: Cry	0.985	0	0.145	0.076
18: Sad	0.985	0	0.145	0.076
19: Dislike	0.199	0	0.184	0.929
20: Get going	0.139	0	0.98	0.082
% variance explained	33.87	18.95	32.92	9.21

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