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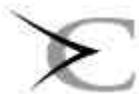
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Résumé / Abstract

Le but de cette recherche était d'évaluer, à l'aide d'analyses multi-groupes, la structure factorielle de notre version française du CES-D (Radloff, 1977) parmi trois groupes d'âge. Trois études transversales ont été réalisées auprès d'échantillons francophones du Québec provenant du système d'éducation : 599 élèves du secondaire, 291 étudiants à l'Université et 844 employés d'une commission scolaire. Cinq modèles a priori ont été évalués à l'aide d'analyses de modélisation par équations structurales : un modèle unidimensionnel, deux modèles à trois dimensions, un modèle à quatre facteurs et un modèle hiérarchique. Les deux derniers modèles se sont avérés les meilleurs. Les analyses multi-groupes révèlent que le modèle hiérarchique était le plus *invariant* parmi les différents groupes d'âges. D'autres caractéristiques psychométriques de cette version canadienne française du CES-D, au niveau de la fiabilité temporelle, de la consistance interne et de la validité convergente-discriminante, se sont avérées satisfaisantes. Les implications concernant l'utilisation des scores des dimensions plutôt que du score total de l'ensemble de la mesure sont discutées.

The aim of the present research was to investigate, via multi-group analyses, the dimensional structure of the CES-D (Radloff, 1977) across three age groups. For this, three studies were conducted on cross-sectional samples of French speaking respondents, varying in age and drawn from the Quebec educational system: 599 adolescent high school students, 291 young adults attending university, and 844 middle-aged adult employees of a school board. Five a priori hypothesized models were tested via structural equation modeling: a single-factor, two three-factors, a four-factor and a second-order factor model. The four-factor and the second-order factor model provided the best fit and the latter model remained largely invariant across the groups when tested via multi-group comparisons. Other psychometric characteristics of the French Canadian version of the scale (e.g., test-retest reliability, internal consistency, convergent-discriminant validity) were also shown to be satisfactory. Possible applications of subcomponent scores in research (based on the multidimensional structure of the scale), rather than the commonly used composite CES-D score, are discussed.

Mots-clés : Dépression, version française du CES-D, structure factorielle, multi-groupe

Keywords: Depression, French version of CES-D, factorial structure, multi-group

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Some of the most widely researched mental health constructs are composed of multiple subcomponents**n**. Nowhere does this seem more true than in the case of depression, generally viewed as a syndrome associated with several response domains, including cognitive, emotional, behavioral, somatic and social components (Rehm, 1988). Not surprisingly, many of the self-report symptom inventories designed to assess depression are also multidimensional. However, it is interesting to note that researchers have not placed much emphasis on the subcomponents of scales, opting instead for a single, summary measure of depression: a total score.

While there are clear advantages to a total score approach in some contexts (e.g., for screening purposes), a closer examination of the subcomponents of symptom inventories as well as their interrelationships may help to further our understanding of the nature of depression and the processes underlying its development. Consequently, the present research investigates the dimensional structure of the Center for Epidemiologic Studies Depression Scale (CES-D, Radloff, 1977) across three French Canadian samples varying in age group. The CES-D is a widely used self-report instrument that measures several response domains commonly associated with depression (e.g., affective and somatic symptomatology).

The CES-D was developed by researchers at the National Institute of Mental Health's Center for Epidemiologic Studies to explore relationships between depressive symptomatology and other characteristics of populations in survey samples (Radloff, 1977). It has seen widespread use in community surveys and is one of the most researched nonclinical instruments available for cross-cultural studies. It has been translated into several languages (Italian, Chinese, Japanese, Spanish) and has been shown to be suitable for administration to diverse ethnic groups (e.g., Noh, Avison, & Kaspar, 1992; Roberts, Vernon, & Rhoades, 1989). The scale's psychometric characteristics have also been substantiated for a wide range of age groups (Radloff, 1977, 1991; Radloff & Teri, 1986).

As regards the CES-D's underlying dimensionality, Radloff (1977) assessed the scale's structure in three community samples via principal component analysis with varimax rotation. For each of her samples, Radloff identified four factors: 1) depressed affect, 2) reduced positive affect, 3) somatic and retarded activity, and 4) interpersonal problems. This initial finding was replicated repeatedly in studies also using exploratory factor analysis (Golding & Aneshensel, 1989; Noh et al., 1992; Pretorius, 1991; Roberts et al., 1989; Ross & Mirowsky, 1984). However, a three-factor structure has also been found and, in most cases, the items representing Radloff's depressed affect and somatic activity dimensions combined to form a single factor (e.g., Guarnaccia, Angel, & Worobey, 1989; Manson, Ackerson, Dick, Baron, & Fleming, 1990; Ying, 1988).

In response to a growing number of criticisms of exploratory factor analysis in general and principal components analysis in particular (e.g., Borgatta, Kercher, & Stull, 1986; Kim & Mueller, 1978), confirmatory factor analysis was increasingly employed to examine the underlying structure of the CES-D. Many of these investigations confirmed a four-factor model of the scale similar to the structure found by Radloff (see Figure 1, Golding & Aneshensel, 1989; Hertzog, Van Alstine, Usala, Hultsch, & Dixon, 1990; Roberts, Andrews, Lewinsohn, & Hops, 1990; Sheehan, Fifield, Reisine, & Tennen, 1995).

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insert Figure 1 here

Yet, confirmatory factor analysis also allows one to stringently compare several alternative factor models. Thus, two investigations compared a four-factor, a three-factor and a single-factor model among American Indians (Beals, Manson, Keane, & Dick, 1991; Somervell et al., 1993b). The single-factor model, in which all items are proposed to load on one factor, represents the use of a composite CES-D (see Figure 2a). Results from both studies indicated that the four-factor and three-factor models provided good fit indices and were superior to the single-factor model. Yet, the three-factor model was preferred because the depressed affect and somatic activity factors of the four-factor model were highly related (see Figure 2b).

3

Hertzog et al. (1990) as well as Sheehan et al. (1995), based on the observation that although the four-factor model yielded good fit indices many of the factors were highly interrelated, extended the investigation by examining the possibility that the four subscales of the CES-D are subdimensions of a higher-order depression construct (see Figure 2c). The higher-order factor model, consisting of four first-order factors (depressed affect, reduced positive affect, somatic activity, and interpersonal problems) and a general depression second-order factor, was found to represent the data well. Sheehan et al. (1995) could further show that the higher-order factor model, like the four-factor model, was superior to both a single-factor model and a three-factor model combining the depressed and positive affect subscales (for a slight variant of this three-factor model, see Figure 2d).

Thus, findings from both exploratory and confirmatory factor-analytic studies suggest that the CES-D is multidimensional. A four-factor structure has been replicated in general population surveys as well as in population subgroups that differ according to age and ethnicity. However, studies focusing on ethnic minority groups have revealed a preference for a three-factor structure (e.g., Guarnaccia et al., 1989; Iwata & Roberts, 1996; Manson et al., 1990; Ying, 1988), leading researchers to speculate that depressive symptom patterns may vary

4

across cultures. Specifically, it has been suggested that differences in communication style and socialization practices predispose non-Western populations to report depressed affect in somatic rather than psychological terms (Somervell et al., 1993b; Ying, 1988). Finally, there is evidence for a hierarchical conceptualization of the CES-D (Hertzog et al., 1990; Sheehan et al., 1995).

The goal of the present article is to examine and compare the different models discussed above in a single study, across different age groups (adolescent high school students, young adults attending university and middle-aged adult employees of a school board). In addition to examining the five alternative models, the equivalence of the best-fitting model was compared across the three age groups using multi-group comparisons. The latter analyses represent an important extension of the literature since even though conceptual equivalence is generally assumed for adolescents and adults, this assumption has not been explicitly tested using the appropriate multi-group analyses.

As mentioned above, five models have been described in the literature. First, the Single-Factor Model, which is based on the assumption that a global construct is responsible for the high internal consistency of the CES-D and for the moderate to high correlations typically found between item pairs (see Figure 2a).

Second, two three-factor models have been proposed. The Three-Factor Affectivity Model combined the depressed affect and positive affect dimensions (see Figure 2d). This combination of factors is usually justified by the hypothesis that the two dimensions are simply opposite poles on a single affect continuum.

However, this assumption is undermined by strong evidence regarding the distinctiveness of positive and negative affect (Diener & Emmons, 1984; Diener, Smith, & Fujita, 1995; Watson & Kendall, 1989; Watson & Tellegen, 1985). The Three-Factor Somatization Model posits a structure in which the items from the depressed affect and somatic activity factors are combined into a single factor (see Figure 2b). This three-factor model has been supported in several ethno-cultural groups (e.g., Guarnaccia et al., 1989; Manson et al., 1990; Ying, 1988), however, there is no evidence that French Canadians construe physical and psychological symptoms in this fashion. Given these considerations, both three-factor models are not expected to provide a good fit in the present context.

The original Four-Factor Model posits four distinct factors representing interpersonal problems, lack of positive affect, depressed affect and somatic complaints (see Figure 1). This model has been repeatedly shown to provide a reasonable fit (e.g., Hertzog et al., 1990; Pretorius, 1991; Radloff, 1977; Roberts et al., 1990), however, we predict that the Second-Order Factor Model, with a single second-order factor, will provide the best overall fit. The advantage of this model is that it accounts explicitly for the high degree of covariation observed between the four first-order factors (see Figure 2c). It takes into account the respective value of unidimensional and multidimensional conceptualizations of the CES-D by allowing for the coexistence of four conceptually distinct constructs, but also by positing that they are best explained by a single theoretical variable of depression (Hertzog et al., 1990; Sheehan et al., 1995).

OVERVIEW

The investigation of the measurement structure of the CES-D necessitated two preliminary steps. First, a French version of the scale (CES-D-FR) was developed by the authors through a parallel back-translation procedure (Brislin, 1986; Vallerand, 1989). Second, traditional psychometric characteristics (e.g., nonresponse rates, reliability, convergent-discriminant validity) of the CES-D-FR were substantiated in each sample. The scale's measurement structure was then evaluated via single-group confirmatory factor analysis, followed by multi-group comparisons.

STUDY 1

Method

Participants

The CES-D-FR was administered to 291 French speaking undergraduate students (70% women) attending a French university in the Montreal area. The mean age of participants was 28 years ($\underline{SD}$ = 6.8). The majority of students were attending Management or Social Sciences programs. Following an introduction to the study as an investigation of well-being and attitudes, participants completed the CES-D-FR along with other measures during the first 20 minutes of a class period. The questionnaires were completed anonymously and participation was voluntary. Following a one-month interval, the CES-D-FR was completed a second time by 239 participants (68% women). The mean age of participants at Time 2 was 27 ($\underline{SD}$ = 6.4). Individualized codes were used to pair

questionnaires across administrations while keeping responses anonymous. A total of 214 participants completed the scale twice.

<u>Measures</u>

The convergent-discriminant validity of the scale was established by examining its relationships with life satisfaction and socially desirable responding. It was anticipated that CES-D-FR scores would be moderately (negatively) related to life satisfaction and weakly related to social desirability. Life satisfaction was evaluated by the five items of the <u>Satisfaction With Life Scale</u> (Diener, Emmons, Larsen, & Griffin, 1985; French version, Blais, Vallerand, Pelletier, & Brière, 1989). In addition, students rated their agreement or disagreement with the 33 items of the <u>Marlowe-Crowne Social Desirability Scale</u> (Crowne & Marlowe, 1960; French version, Blais & Lachance, 1992) which measures an individual's need to obtain approval by responding in a culturally appropriate and acceptable manner.

<u>Statistical Procedures</u>

Confirmatory factor analysis was used to assess the dimensionality of the CES-D. Maximum-likelihood estimation was employed using the standard variance/covariance matrices provided by EQS (Bentler, 1993). Missing data were deleted listwise. Assessment of model fit was based on the Satorra-Bentler Scaled Statistic (S-Bχ^2; Satorra & Bentler, 1988) and the corrected Comparative Fit Index (CFI*; Bentler, 1990; Byrne, 1994). These goodness-of-fit criteria are

strongly recommended for the analysis of data that violate multivariate normal

distribution assumptions (Bentler, 1993).

Three criteria were used to compare competing models statistically. First,

the difference between chi-squares (ΔS-Bχ^2) associated with two alternative

models, which is also distributed as chi-square, was calculated (Hoyle & Panter,

1995; Kline, 1998). However, because more complex models will generally

provide a better fit than less complex models, Akaike's (1987) information

criterion (AIC) and Bozdogan's (1987) consistent version of Akaike's information

criterion (CAIC) were used to compare the models in terms of parsimony. As a

general rule, a more parsimonious model is preferable and is indicated by lower

AIC and CAIC values. Finally, the Target Coefficient was used to compare the fit

of the first-order four-factor model with that of the second-order factor model

(Marsh & Hocevar, 1985).

<div align="center">Results</div>

<div align="center">insert Table 1 here</div>

<u>Psychometric Characteristics of the Translation</u>

The CES-D-FR has satisfactory psychometric characteristics (see Table 1).

Specifically, the average nonresponse rate to individual items was negligible and

the reliability of the scale was satisfactory both in terms of internal consistency

and of test-retest correlation. Finally, the CES-D-FR's convergent-discriminant

<div align="right">9</div>

validity was confirmed by a moderate negative relationship with life satisfaction and a weak negative correlation with socially desirable responding (see Table 2). Yet, the composite CES-D-FR score is positively skewed, suggesting a moderate proportion of high scores in the data. Indeed, using the conventional cutoff score (16 and above) recommended by Radloff (1977), a large percentage of students showed elevated depression scores.

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insert Table 2 here

Factor Structure

Fit indices for each of the hypothesized measurement models are presented in Table 3. The single-factor model clearly provided a superior fit to the null model, which assumes that all observed variables are uncorrelated (Bentler & Bonett, 1980). Yet, this model provided an inadequate fit as the CFI* value was below the conventional cutoff value of .90 (Bentler & Bonett, 1980). While the two three-factor models presented an improvement over the single-factor model as indicated by significant chi-square difference tests and smaller parsimony indices, the CFI* coefficients were either marginally acceptable or unacceptable.

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insert Table 3 here

The fit of the four-factor model was adequate (CFI* = .91). Although this

model is more complex than those previously tested (i.e., more parameters are

estimated), the AIC and CAIC indices are smaller, indicating a slight superiority

in terms of parsimony. Furthermore, a chi-square difference test indicated that

the four-factor model provided a statistically better fit than the three-factor

somatization model, ΔS-Bχ^2 = 20$_{(3)}$, $\underline{p}$ < .001. Individual parameter estimates for

the four-factor model are shown in Table 4. All standardized factor loadings

were significant and above .30. As shown in Table 4, the correlations between

factors were moderate to large.

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insert Table 4 here

The second-order factor model provided a test of the hypothesis that the

covariation between the four first-order factors can be accounted for by a higher-

order general depression construct. Although this model yielded a slightly

larger Satorra-Bentler fit statistic than the four-factor model, the difference was

not significant. The CFI* value was acceptable and the large Target Coefficient

(.99) suggested that the upper portion of the second-order factor model explains

the relations between the four first-order factors well (Marsh & Hocevar, 1985).

With regard to parsimony, the second-order factor model showed slightly

smaller AIC and CAIC indices than the four-factor model. Thus, compared to

the four-factor model, the higher-order model yielded an equally well-fitting,

11

more parsimonious model. The first-order factor loadings for this model were virtually identical to those obtained for the four-factor model, suggesting stability of the parameter estimates. The higher-order factor loadings relating the first-order factors to the general depression construct were moderate to large (see Table 5).

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insert Table 5 here

In sum, Study 1 showed that the traditional psychometric characteristics of the CES-D-FR are satisfactory. The somewhat high percentage of participants with elevated depression scores is congruent with previous findings reported for university student populations (e.g., Radloff, 1991). With regard to the measurement structure of the scale, the results indicated that the four-factor and higher-order factor models provided good fits.

STUDY 2

Method

Participants

The CES-D-FR was administered to 599 French speaking high school students (55% girls) in Quebec. Their mean age was 16 years ($\underline{SD}$ = .69). All participants were following a regular school program and were taking part in a larger study concerning their academic life, health and well-being. Volunteers completed the CES-D-FR along with other questionnaires during an allotted time

period on a regular school day. Anonymity and confidentiality of responses were assured by instructing participants to not write their names on the battery of questionnaires. The rate of participation was 82.3%.

<u>Measures</u>

The convergent validity of the CES-D-FR was assessed by examining its relationships with measures tapping adolescents' quality of life in general and quality of school life in particular. Specifically, it was anticipated that the scale would be moderately related to daily hassles, school burnout and suicide ideation. In addition, higher CES-D-FR scores were expected to be associated with lower life and academic satisfaction.

Daily hassles were measured by the <u>Inventory of High School Students' Recent Life Experiences</u> (Kohn & Milrose, 1993). This instrument consists of 41 irritants often encountered by adolescents in their everyday life (e.g., academic challenges, relationship problems, excessive demands). <u>School burnout</u> was evaluated by a modified version of the Maslach Burnout Inventory's emotional exhaustion subscale (Maslach & Jackson, 1986). Items of this scale refer to fatigue and emotional depletion resulting from involvement in academic activities (α = .86). The 8 items were rated on a frequency scale with end- and mid-points of (0) *never*, (3) *a few times a month*, and (6) *everyday.* Two items were used to assess <u>suicidal thoughts and intentions</u>. Participants rated the frequency with which they had experienced these symptoms during the previous month on a 6-point scale, ranging from (0) *never* to (5) *always*. <u>Academic satisfaction</u> was assessed by

a modified version of the Satisfaction With Life Scale (Diener et al., 1985) which consists of five items related to students' general satisfaction with their academic life. Participants rated their degree of agreement with the items on a 7-point scale, ranging from (1) *strongly agree* to (7) *strongly disagree.*

Results

The basic psychometric characteristics of the CES-D-FR were substantiated (for a summary, see Table 1). Nine participants did not answer more than four items, rendering their responses invalid and their data was excluded (Radloff, 1977). The average nonresponse rate to individual items for the remaining scales was negligible. Internal consistency was high. Correlations of the CES-D-FR with related but different variables (i.e., daily hassles, school burnout, suicide ideation, and academic and life satisfaction) were moderate and in the expected direction, thus supporting the convergent validity of the scale (see Table 2). Again, a large proportion of participants showed elevated CES-D-FR scores, confirming previous reports documenting high rates of depression among adolescents (Radloff, 1991; Roberts et al., 1990).

Factor Structure

The single-factor and three-factor affectivity models yielded CFI* values below .90 and therefore provided inadequate fits. The three-factor somatization model and the four-factor model were marginally acceptable as suggested by CFI* values of .90. Although the two models were comparable in terms of parsimony, a significant chi-square difference test suggested that the four-factor

model was slightly superior to the three-factor somatization model, $\Delta S\text{-}B\chi^2 = 8(3)$, $\underline{p} < .05$. Individual parameter estimates for the four-factor model, which were all significant and above .45, are shown in Table 4.

The correlations between factors were moderate to large, thus suggesting that a higher-order factor structure might also fit the data well.[1] While the second-order factor model yielded a slightly larger Satorra-Bentler fit statistic than the four-factor model, the difference was not significant. The Target Coefficient was large (.99), suggesting that the second-order depression construct accounts for the covariations between the first-order factors well (Marsh & Hocevar, 1985). Of all the models tested, this model yielded the smallest AIC and CAIC indices. Thus, as was the case in Study 1, compared to the four-factor model, the higher-order factor structure yielded an equally well-fitting, more parsimonious model. The second-order factor loadings were moderate to large (see Table 5) and the first-order factor loadings were virtually identical to those obtained for the four-factor model.

The CES-D-FR was shown to be a valid and reliable measure for use with adolescents as suggested by low nonresponse rates, satisfactory internal consistency, good convergent validity and score distributions similar to those reported for English speaking high school students (Radloff, 1977; Roberts et al., 1990). With regard to the scale's measurement structure, the four-factor and second-order factor models were preferred to the three-factor somatization model based on significant chi-square difference tests and the parsimony indices.

Method

<u>Participants</u>

The CES-D-FR was administered to 844 French speaking employees (62% women) of a Catholic school board in Quebec with a mean age of 41 years (<u>SD</u> = 9.2). All employee groups participated including school principals and assistant principals, teachers (kindergarten, elementary school, high school, and adult education levels), professionals (e.g., psychologists and counselors) and support staff (technical, administrative and maintenance). Participants were volunteers in a larger study concerning the quality of their work life as well as their health and well-being. Data collection was carried out on a pedagogical day. Participants were not required to write their names on the test materials and anonymity was guaranteed. The participation rate was 77.4%.

<u>Measures</u>

Convergent-discriminant validity was assessed by examining the CES-D-FR's relationships with other indicators of distress and with measures of participants' quality of life in general and quality of work life in particular. Specifically, it was hypothesized that the CES-D-FR would be highly correlated with a different scale designed to measure depression but moderately correlated with other indicators of psychological distress, namely, hostility, cognitive disturbances and anxiety. Furthermore, it was anticipated that the CES-D-FR would be more strongly correlated with emotional exhaustion which reflects

emotional depletion and fatigue resulting from prolonged job stress, a symptom

relatively similar to depression, than with two additional indicators of job

burnout, namely, depersonalization and a reduced sense of personal

accomplishment at work (Maslach & Jackson, 1986). Finally, the CES-D-FR was

expected to be (moderately) positively related to physical health problems and

suicidal ideation but negatively related to life satisfaction.

The Psychiatric Symptoms Index was used to evaluate the frequency of

occurrence during the previous week of 29 symptoms related to depression,

anxiety, hostility, and cognitive disturbances (Ilfeld, 1978; French version,

Kovess, Murphy, Tousignant, & Fournier, 1985). The 22 items of the Maslach

Burnout Inventory were used to assess the frequency of occurrence of symptoms

related to emotional exhaustion, depersonalization and a reduced sense of

personal accomplishment at work (Maslach & Jackson, 1986; French version,

Blais, Richer, Lachance, & Dulude, 1991). Eight items were used to measure the

severity of physical health problems including digestive, respiratory,

cardiovascular, and back problems (Blais, Lachance, & Richer, 1989). Participants

rated each complaint on a 6-point scale, ranging from (0) *no problem at all* to (5)

extremely severe problem.

<div align="center">Results</div>

The CES-D-FR's basic psychometric characteristics were replicated for the

middle-aged adult respondents. The average nonresponse rate was again

negligible and the composite scale showed satisfactory internal consistency (see

Table 1). As was the case for the adolescents and university students, a moderate

proportion (35%) of the sample scored above the conventional cutoff.

The convergent-discriminant validity of the CES-D-FR was also largely

supported (see Table 2). As anticipated, the correlation between the CES-D-FR

and the depression subscale of the Psychiatric Symptoms Index (Ilfeld, 1978) was

higher than any other value obtained. The scale also showed moderate

correlations with other indicators of distress (i.e., hostility and cognitive

disturbances). Further, the CES-D-FR was found to be moderately correlated

with emotional exhaustion, but weakly correlated with depersonalization and a

reduced sense of personal accomplishment. Finally, higher depression scores

were (moderately) associated with more frequent suicide ideation, more severe

physical health problems and lower life satisfaction. However, the scale also

showed a relatively large correlation with anxiety.

Factor Structure

The single-factor and three-factor affectivity models provided inadequate

fits as suggested by marginal or unacceptable CFI* values (see Table 3). The

somatization model on the other hand, in which the depressed affect and somatic

activity items were collapsed onto one factor, adequately represented the data.

The four-factor model also provided a good fit, explaining 95% of complete

covariation in the data. A chi-square difference test indicated that the four-factor

model provided a statistically better fit than the three-factor somatization model,

$\Delta\text{S-B}\chi^2 = 32_{(3)}$, $\underline{p} < .001$. Furthermore, the smaller AIC and CAIC indices for the

four-factor model suggested that it is the more parsimonious of the two. All

standardized factor loadings for the four-factor model were significant and

above .50 (see Table 4).

Since the correlations between factors were moderate to large, a second-

order factor model was tested (see Footnote 1). This model also showed an

acceptable fit (CFI* = .95) and the reduction in fit when compared to the four-

factor model was not significant. The Target Coefficient of .99 suggested that the

higher-order depression construct accounts for the covariations between the four

first-order factors well (Marsh & Hocevar, 1985). Parsimony indices for the four-

factor and higher-order factor models were comparable. The first-order factor

loadings were virtually identical to those presented for the four-factor model and

the second-order factor loadings were moderate to large (see Table 5).

The basic psychometric characteristics of the CES-D-FR, and its

underlying factor structure, were again replicated. Internal consistency estimates

were satisfactory and percentages of participants with elevated scores were

similar to those reported for English speaking teachers (see for example,

Hammen and deMayo, 1982). In addition, the convergent-discriminant validity

of the scale was largely supported by positive correlations with other indicators

of distress and negative correlations with measures of quality of life. However, a

large correlation between depression and anxiety was observed, confirming

previous findings of high rates of overlap between negative affective states

(Clark, 1989; Dobson, 1985; Gotlib & Cane, 1989; Orme, Reis, & Herz, 1986;

Vernon & Roberts, 1981; Watson & Kendall, 1989; Weissman, Sholomskas, Pottenger, Prusoff, & Locke, 1977). With regard to the scale's measurement structure, the four-factor and second-order factor models provided comparable fits and were preferred to the three-factor somatization model based on statistical criteria and indices that take parsimony into account.

<div align="center">Multi-Group Comparisons</div>

In all three studies, the fits of the four-factor and second-order factor models were comparable, yet the second-order factor model was more parsimonious. To assess whether this factor structure does indeed replicate across the three age groups, multi-group comparisons were effectuated. These comparisons provide a stringent test of the degree to which depressive symptomatology is manifested in the three age groups in similar ways. For this, a three-group model was estimated that specified the same second-order factor structure in all groups, but did not impose any between-group equality constraints on the loadings. This model fit well and therefore re-confirmed the underlying second-order factor structure in all three samples, $\chi^2 = 1591_{(500)}$; CFI = .93.[2] Then a second model was tested in which all first- and second-order factor loadings were constrained to be equal across the three groups. The constrained model yielded a significantly larger chi-square value than the unconstrained model, $\Delta\chi^2 = 259_{(40)}$, $\underline{p} < .001$, indicating that the samples were not completely equivalent in terms of their factor loading pattern. Alternative

models in which equality constraints were imposed on the loadings of only one factor produced similar results. Furthermore, when the loadings were constrained in each of the three possible pairs of groups (e.g., the loadings for the two student groups were constrained to be equal and the loadings for the employees were free to vary), the null hypothesis of identical factor loadings was consistently rejected.

Thus, the assumption of invariant factor loadings across the three groups and across all pairs of groups was rejected. However, because the samples sizes are large, the substantive importance of the group differences in loadings is questionable. Examination of Tables 4 and 5 suggests that the absolute magnitudes of differences for most of the factor loadings are small. Therefore, two alternative methods were used to estimate the similarity of the loadings.

First, correlations of factor loadings between each pair of groups were calculated. Pearson's product-moment correlations reflect similarities in the pattern, but not the magnitude of the loadings across groups (Rummel, 1970). Correlations between the loadings for the four first-order factors and the second-order factor are displayed in the top half of Table 6. The majority of these correlations are large, suggesting similar patterns of loadings, with all but four reaching or exceeding .85. Of these four, two involve the first-order somatic activity factor for the high school students compared to the other two groups. The other two involve the second-order depression factor, again for the high school students compared to the two adult groups.

Second, coefficients of congruence, which reflect the similarity of both the pattern of loadings and their magnitude, were calculated for each pair of groups (Gorsuch, 1974; Rummel, 1970). Like correlations, values of the congruence coefficient range from -1.0 to +1.0, with greater values indicating greater negative and positive similarity, respectively. However, unlike correlations, the data is not standardized by equating group means (Rummel, 1970). The bottom half of Table 6 shows that these coefficients are all large, reaching or exceeding .96. These results suggest that the loadings are largely similar both in pattern and magnitude.

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insert Table 6 here

Discussion

To our knowledge, the present research is the first to examine the measurement structure of the CES-D across three French Canadian samples, varying in age from adolescence to adulthood, using stringent multi-group comparisons. Generally, the results suggest that the measurement structure of the CES-D-FR is largely similar across the different age groups.

Prior to testing the measurement structure of the scale, the psychometric characteristics of the newly developed French Canadian version of the CES-D were assessed. An examination of nonresponse rates, score distributions, test-retest reliability and internal consistency suggested that the CES-D-FR's

psychometrics are satisfactory. Furthermore, while the percentages of

individuals with depression scores above the conventional cutoff (i.e., 16 and

above) were somewhat high compared to the general population (see for

example, Radloff, 1977), they were nevertheless comparable to those reported for

samples of students and teachers (Hammen & deMayo, 1982; Roberts et al., 1990;

Radloff, 1991). Thus, it can be concluded that the high depression scores found

were not due to a lack of equivalence of the French version of the CES-D, but

rather due to the samples, which were drawn from populations generally

characterized by a high risk for mental health problems. Providing further

weight to this conclusion is the fact that the employees' score on a previously

translated and validated measure of psychopathology, the Psychiatric Symptoms

Index (Ilfeld, 1978), was also high. Further, the CES-D-FR showed convergent-

discriminant validity for all three age groups. Thus, the French version of the

CES-D used in the present research can be considered equivalent to the English

original and the investigation of the underlying factor structure can therefore be

confidently generalized to other versions of the CES-D.

With regard to the central aim of this article -- the measurement structure

of the CES-D-FR, confirmatory factor analyses showed that both three-factor

models were statistically inferior to the four-factor model. The rejection of the

three-factor affectivity model is consistent with findings reported by Sheehan et

al. (1995) who pointed out that the existence of distinct, yet correlated, factors is

consonant with theories of positive and negative affectivity (Diener & Emmons,

1984; Diener et al., 1995). Watson and Tellegen (1985), for example, have argued that positive and negative affect are not polar opposites and that the distinction between them is critical to distinguishing depression from anxiety. Specifically, they showed that whereas negative affect is related to both depression and anxiety, only depression is also characterized by reduced positive affect (see also Watson, Clark, et al., 1995; Watson & Kendall, 1989; Watson, Weber, et al., 1995).

The four-factor model statistically outperformed the three-factor somatization model. Yet, one might argue that the depressed affect and somatic activity factors are so highly correlated, especially among the employees and high school students, that practically speaking they are the same and should be combined into a composite variable (see for example, Beals et al., 1991). However, several reasons speak against this option. First, from a strictly statistical point of view, the four-factor model did not only show superiority over the three-factor model but tests of redundancy revealed that the two factors were not identical. Second, previous studies using the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erlbaugh, 1961) have shown a clear differentiation between depressed affect and somatic complaints in French Canadian adolescents, university students and the elderly (e.g., Baron & Laplante, 1984; Bourque & Beaudette, 1982; Vézina & Landreville, 1991).[3] Finally, affective and somatic symptomatology reflect two conceptually distinct constructs. A more definitive test of discriminant validity would be provided by examining differences and similarities in predictors and consequences of the two

dimensions. One might posit, for example, that depressed affect and somatic symptomatology respectively are differentially predicted by cognitive processes (e.g., faulty information processing, attributional style) and lifestyle habits (e.g., smoking, sleep habits). Anxiety, on the other hand, might exacerbate both types of symptoms. Thus, we believe that there is insufficient justification for combining the two scales into one.

When the four-factor and second-order factor models were compared, their measures of fit were comparable, with a thin margin favoring the second-order factor model in terms of parsimony. It is interesting to note that both of these models were superior to the single-factor model, which indiscriminately collapses all items into a single-factor. The second-order factor model supports the multidimensional nature of the CES-D-FR but further implies that the scale's subdimensions can be subsumed under an umbrella of general depression. As a result, the present findings justify the use of both a single summary score and four separate factor scores.

There are at least three possible arguments in favor of partitioning the CES-D into multiple subscales for research purposes. First, it has been argued that the use of a composite CES-D score alone may obscure differential patterns of depressive symptomatology over time and across different groups in the population (Hertzog et al., 1990; Sheehan et al., 1995). As suggested by Sheehan and colleagues (1995), "people may not simply have more or less intensity in their distress, but rather, some may have both more and less of particular types

of symptoms" (p. 519). Second, it is reasonable to argue that the specific

dimensions measured by the CES-D might be related in a directional, or perhaps,

reciprocal fashion. For example, interpersonal stresses may lead to changes in

affect which, in turn, may lead to somatic symptomatology. Thus, it is possible

to conceptualize of alternative structural models (i.e., other than the higher-order

factor structure) that are capable of explaining the relations observed between

the scale's primary level factors. Finally, not only might the scale's

subdimensions be related in a directional manner but, as already mentioned

above, they may also be differentially predicted by relevant environmental and

person-related variables. Clearly, a closer look at the scale's subdimensions

would facilitate a better understanding of the underlying nature of depression.

On the other hand, while the use of factor scores may be relevant for

research purposes, Hertzog et al. (1990) argued against partitioning the CES-D

into multiple subscales of lower reliability for screening purposes. They

suggested that an accurate classification of individuals as cases versus noncases

would not be enhanced by the use of subscales with lower reliability. Indeed,

Somervell and colleagues (1993a) found that the use of factor scores did not

enhance the specificity or sensitivity of the CES-D for the detection of depressive

disorders among American Indians. Thus, in evaluating the need to partition the

CES-D into multiple dimensions, it seems important to consider the intended use

of the scores. It should be noted, however, that even if one were to argue that it

is more useful to employ a summary score for screening purposes, responses to

the CES-D are nevertheless multidimensional. It is clear that some information is masked when respondents' depressive symptomatology is summarized by a single score. Future research might therefore focus on how to use most appropriately the information that can be obtained from the CES-D rather than to ignore it.

This study also examined the assumption that the CES-D-FR measures the same underlying construct of depression among adolescents, young adults and middle-aged adults. It was necessary to reject on statistical grounds the hypothesis that the factor loadings are completely equivalent across the three groups. However, the sample sizes are large, which means that potentially trivial differences may be represented as substantive differences rather than sampling fluctuations (Kline, 1998). Indeed, inspection of the factor loadings in Tables 4 and 5 as well as the computation of congruence coefficients indicate that the first-order and second-order factor loadings are substantively similar. The calculation of correlations based on the factor loadings for all pairs of groups also suggested high congruence between the factors, with four exceptions. Of these four, two involve the first-order somatic activity factor and two involve the second-order depression factor. Furthermore, all four suggest that the pattern (or rank order) of loadings differ for the high school students compared to the two adult groups.

Examination of the loadings on the somatic activity factor in terms of their rank order suggests that for the adults, the items representing motivational or

cognitive types of deficits (mind, get going, effort) have higher loadings than the items reflecting physical or overt-motor symptoms of depression (appetite, sleep, talked less, bothered). This pattern is especially pronounced among the university students. In contrast, a similar pattern is not apparent for the high school students. Physical or motor symptoms may be less salient indicators of somatic concerns among undergraduate students who, perhaps, consider them to be part and parcel of a typical student lifestyle characterized by heavy course loads, impending deadlines, reduced social activities and multiple stresses such as financial difficulties and juggling part-time employment. Inspection of the factor loadings on the second-order factor suggests that interpersonal problems is a more salient indicator of the general depression construct than reduced positive affect among the high school students, whereas the reverse pattern is true for the adults. In hindsight, it is not surprising that interpersonal problems (i.e., "people dislike me", "people are unfriendly") would be a more important indicator of depression for adolescents given the key role of social relationships, especially those with peers, in teens' daily lives and self-concepts (Marsh & Hocevar, 1985).

Generally speaking, the data suggest that the higher-order factor structure is relatively robust across the three groups. Although the factor loadings can not be said to be identical across the three groups in a strict statistical sense, the differences observed were not striking, representing what could be more accurately described as subtle differences in the expression of depressive

symptomatology. Similar multi-group comparisons conducted in the future

might shed more light on this issue but, for the time being, it seems safe to

conclude that the phenomenology of depressive symptomatology does not differ

markedly across adolescents and adults. Future research efforts might therefore

focus on cross-sectional studies comparing depressive symptoms in adolescents

and adults as well as on longitudinal studies following adolescents into

adulthood.

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Footnotes

[1] Because the phi coefficient between the depressed affect and somatic activity factors was so large, a test for their redundancy was performed. For this, the correlation between the two dimensions was constrained to 1.0 and a chi-square difference test was performed on the values obtained for the constrained and unconstrained models. As noted by Bagozzi and Phillips (1982), a significantly lower chi-square value associated with the model in which the factor correlation is not constrained to unity would indicate that the factors are not perfectly correlated and that discriminant validity is achieved (see also Anderson & Gerbing, 1988; Kline, 1998). Results indicated that the unconstrained model provided a significantly better fit. Thus, the depressed affect and somatic activity factors were very highly related but not identical when compared with a phi value of unity. The two factors were therefore considered to be sufficiently distinct to test the adequacy of a higher-order model.

[2] It should be noted that in version 4.02 of the EQS program, the S-Bχ^2 is not available for multi-group analyses. Therefore, the usual χ^2 statistic and the uncorrected CFI are reported instead. However, given the fact that the χ^2 has not been scaled to correct for multivariate kurtosis, its values are expected to be larger than would be the case for the S-Bχ^2 statistic.

[3] The employees and high school students were drawn from the same school board and therefore can not be said to be strictly independent. Whether the high correlations were due to contextual factors (i.e., perhaps the members of the school board give more validity to physical complaints and therefore these symptoms were considered more relevant to report) is an interesting question that, unfortunately, can not be answered here.

Table 1

<u>Descriptive Statistics</u>

Characteristics	University students	High school students	School board employees
Sample size	291	599	844
Average nonresponses rates	.002	.003	.003
Skewness	.76	.68	.98
Percentage $\geq$ 16	45.90	50.80	34.60
Mean CES-D score (SD)	16.52 (9.80)	17.87 (11.19)	13.31 (10.86)
Test-retest reliability	.59	--	--
Coefficient alpha	.90	.92	.93

<u>Note</u>. SD = Standard deviation.

Table 2

Correlations Between the CES-D-FR and Other Scales*

Variables	University students	High school students	School board employees
Satisfaction with Life Scale	-.48	-.64	-.64
Marlowe-Crowne Social Desirability Scale	-.23	--	--
Psychiatric Symptoms Index			
Depression	--	--	.89
Anxiety	--	--	.74
Cognitive disturbances	--	--	.65
Hostility	--	--	.64
Maslach Burnout Inventory			
Emotional exhaustion	--	--	.61
Depersonalization	--	--	.34
Personal accomplishment[a]	--	--	.29
Physical health problems	--	--	.51
Suicidal ideation	--	.54	.46
Inventory of High School Students' Life Experiences	--	.64	--
School burnout	--	.57	--
Academic satisfaction	--	-.45	--

[a]Items were reverse coded.   *All correlations are significant, $\underline{p}$ <.001

Table 3

Comparisons of Competing Models

Model	q	df	χ^2	CFI	AIC	CAIC	S-Bc^2	CFI*
					Based on χ^2		Based on S-Bc^2	
				University students				
Null	20	190	2157	-	1777	894	1653	-
Single-factor model	40	170	468	.85	128	-662	393	.85
Three-factor model-1	43	167	389	.89	55	-720	328	.89
Three-factor model-2	43	167	371	.90	37	-739	312	.90
Four-factor model	46	164	348	.91	20	-742	292	.91
Hierarchical model	44	166	349	.91	17	-754	293	.91
				High school students				
Null	20	190	5170	-	4790	3777	4022	-
Single-factor model	40	170	1074	.82	734	-173	878	.82
Three-factor model-1	43	167	995	.83	661	-230	819	.83
Three-factor model-2	43	167	664	.90	330	-561	547	.90
Four-factor model	46	164	653	.90	325	-550	539	.90
Hierarchical model[a]	43	167	657	.90	323	-568	543	.90
				School board employees				
Null	20	190	8134	-	7754	6673	5489	-
Single-factor model	40	170	1037	.89	697	-270	801	.88
Three-factor model-1	43	167	864	.91	530	-421	675	.90
Three-factor model-2	43	167	620	.94	286	-664	492	.94
Four-factor model	46	164	580	.95	252	-681	460	.95
Hierarchical model[a]	43	167	586	.95	252	-669	464	.95

Note. AIC = Akaike's (1987) information criterion; CAIC = Bozdogan's (1987) consistent version of the AIC; S-Bχ^2 = Satorra-Bentler Scaled Statistic; CFI* = corrected Comparative Fit Index.
[a]The residual term for the depressed affect factor was fixed to .005, thus accounting for the additional degree of freedom.

Table 4

Parameter Estimates Associated with the Four-Factor Model*

Item	University students	High school students	School board employees
	Depressed affect		
Blues	.70	.66	.75
Depressed	.81	.81	.83
Failure	.57	.71	.63
Fearful	.63	.63	.63
Lonely	.66	.69	.73
Cry	.52	.66	.64
Sad	.83	.80	.84
	Positive affect		
Good	.56	.55	.52
Hopeful	.65	.63	.67
Happy	.71	.76	.85
Enjoy	.71	.77	.79
	Somatic activity		
Bothered	.41	.56	.62
Appetite	.33	.49	.55
Mind	.59	.56	.67
Effort	.72	.59	.75
Sleep	.32	.57	.64
Talk	.34	.62	.63
Get going	.74	.74	.77
	Interpersonal problems		
Unfriendly	.57	.73	.69
Dislike	.91	.86	.80
	Phi coefficients		
Dep/Pos	.83	.60	.80
Dep/Som	.88	.96	.95
Dep/Int	.55	.85	.73
Pos/Som	.79	.56	.77
Pos/Int	.45	.46	.53
Som/Int	.51	.80	.68

Note. Dep = Depressed affect, Pos = Positive affect, Som = Somatic activity, Int = Interpersonal problems. *All estimates are significant, p < .05.

Table 5

<u>Factor Loadings Associated with the Second-Order Factor Model*</u>

First-order factor	University students	High school students	School board employees
	Second-order depression construct		
Depressed affect	.96	.99	.99
Positive affect	.86	.59	.80
Somatic activity	.91	.96	.95
Interpersonal problems	.56	.84	.72

*All estimates are significant, $\underline{p}$ < .05.

Table 6

Comparisons of Factor Loadings

Factor	University and high school students	University students and school board employees	School board employees and high school students
	Correlations[a]		
Depressed affect	.85	.95	.90
Positive affect	.99	.95	.92
Somatic activity	.59	.90	.78
Second-order factor	.22	.88	.65
	Congruence coefficients		
Depressed affect	1.0	1.0	1.0
Positive affect	1.0	1.0	1.0
Somatic activity	.96	.97	1.0
Interpersonal problems	.99	.99	1.0
Second-order factor	.97	1.0	.99

[a]Loadings that were fixed to 1 were omitted from this analysis. The interpersonal problems factor was not analyzed because only one item remained.

Figure Captions

Figure 1. Four-factor model of the CES-D.

Figure 2. Competing models of the CES-D.

     (a) Single-factor model (upper left corner)

     (b) Three-factor somatization model (upper right corner)

     (c) Second-order factor model (lower left corner)

     (d) Three-factor affectivity model (lower right corner)

49
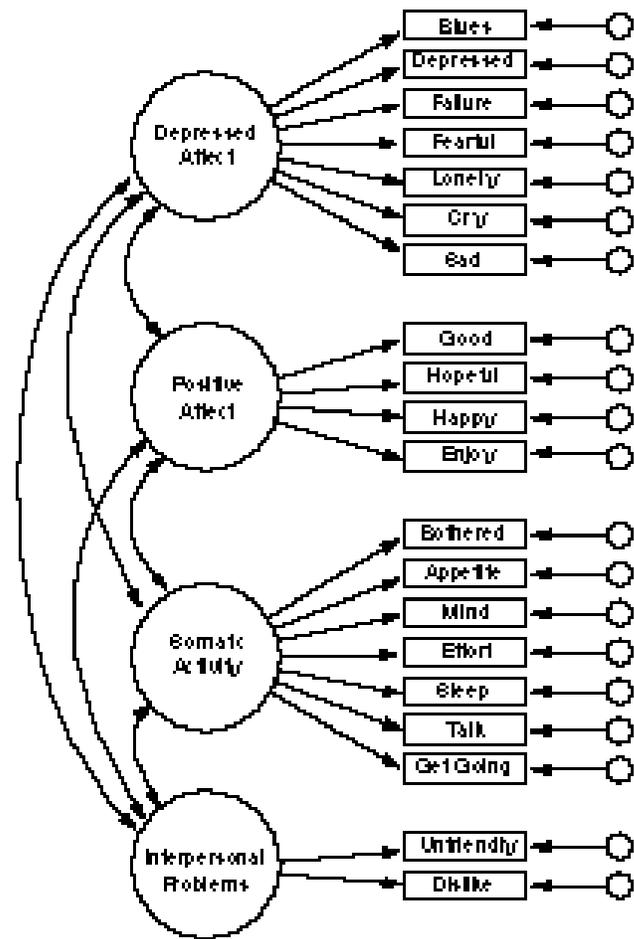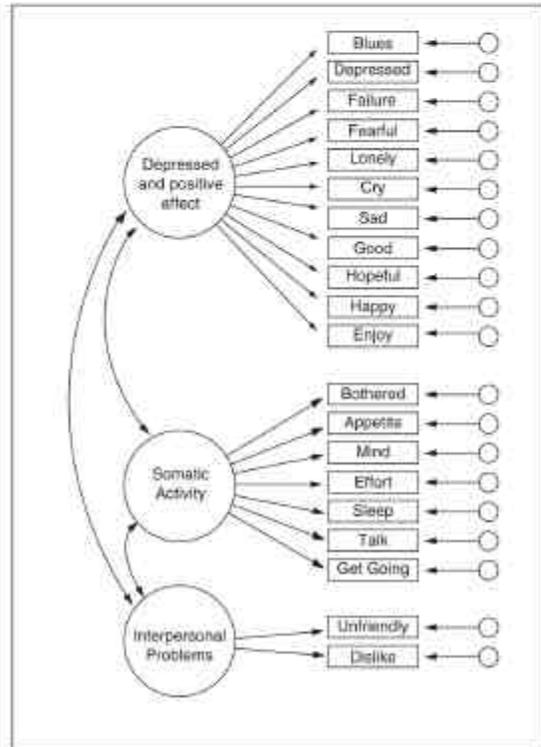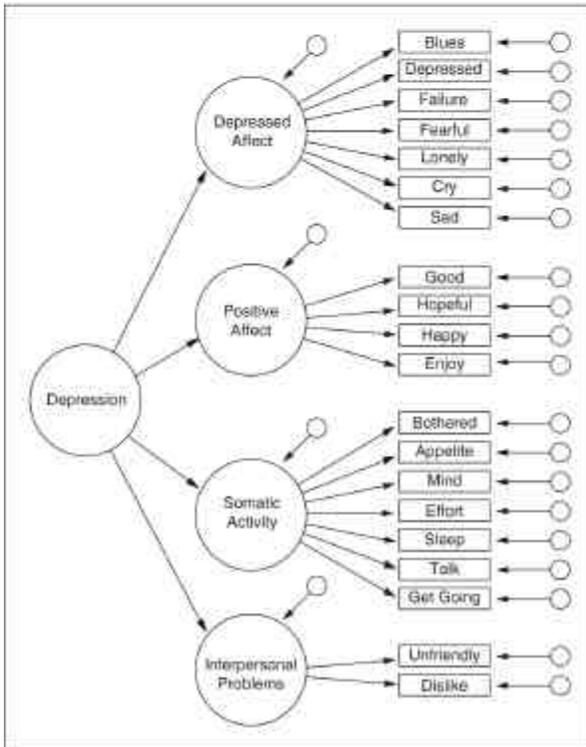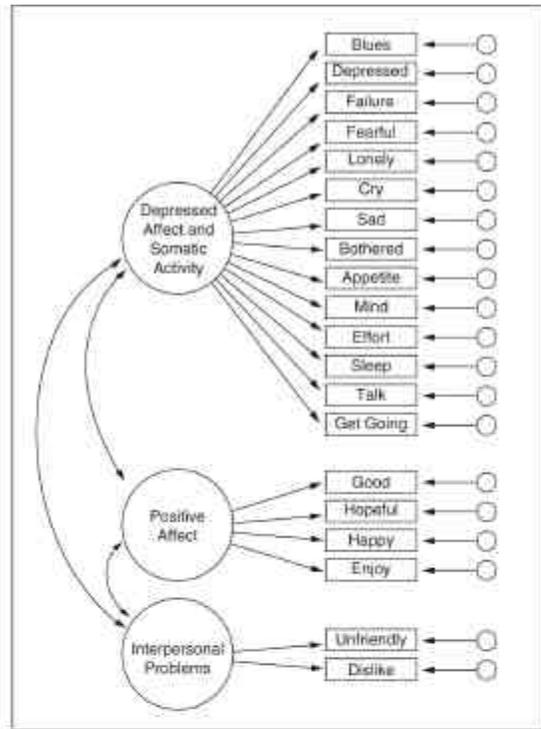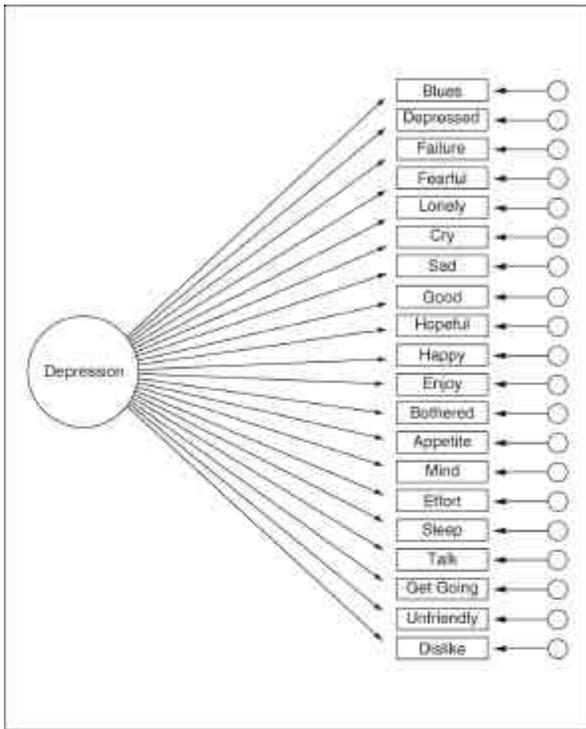
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