

2002s-37

**Static Versus Dynamic Structural  
Models of Depression:  
The Case of the CES-D**

*Andrea S. Riddle, Marc R. Blais, Ursula Hess*

---

**Série Scientifique**  
*Scientific Series*

---



**CIRANO**  
Centre interuniversitaire de recherche  
en analyse des organisations

Montréal  
Avril 2002

## CIRANO

Le CIRANO est un organisme sans but lucratif constitué en vertu de la Loi des compagnies du Québec. Le financement de son infrastructure et de ses activités de recherche provient des cotisations de ses organisations-membres, d'une subvention d'infrastructure du ministère de la Recherche, de la Science et de la Technologie, de même que des subventions et mandats obtenus par ses équipes de recherche.

*CIRANO is a private non-profit organization incorporated under the Québec Companies Act. Its infrastructure and research activities are funded through fees paid by member organizations, an infrastructure grant from the Ministère de la Recherche, de la Science et de la Technologie, and grants and research mandates obtained by its research teams.*

### Les organisations-partenaires / The Partner Organizations

- École des Hautes Études Commerciales
- École Polytechnique de Montréal
- Université Concordia
- Université de Montréal
- Université du Québec à Montréal
- Université Laval
- Université McGill
- Ministère des Finances du Québec
- MRST
- Alcan inc.
- AXA Canada
- Banque du Canada
- Banque Laurentienne du Canada
- Banque Nationale du Canada
- Banque Royale du Canada
- Bell Canada
- Bombardier
- Bourse de Montréal
- Développement des ressources humaines Canada (DRHC)
- Fédération des caisses Desjardins du Québec
- Hydro-Québec
- Industrie Canada
- Pratt & Whitney Canada Inc.
- Raymond Chabot Grant Thornton
- Ville de Montréal

© 2002 Andrea S. Riddle, Marc R. Blais et Ursula Hess. Tous droits réservés. *All rights reserved.* Reproduction partielle permise avec citation du document source, incluant la notice ©.

*Short sections may be quoted without explicit permission, if full credit, including © notice, is given to the source.*

Les cahiers de la série scientifique (CS) visent à rendre accessibles des résultats de recherche effectuée au CIRANO afin de susciter échanges et commentaires. Ces cahiers sont écrits dans le style des publications scientifiques. Les idées et les opinions émises sont sous l'unique responsabilité des auteurs et ne représentent pas nécessairement les positions du CIRANO ou de ses partenaires.

*This paper presents research carried out at CIRANO and aims at encouraging discussion and comment. The observations and viewpoints expressed are the sole responsibility of the authors. They do not necessarily represent positions of CIRANO or its partners.*

# Static Versus Dynamic Structural Models of Depression: The Case of the CES-D

Andrea S. Riddle\*, Marc R. Blais\*, and Ursula Hess\*

## Résumé / Abstract

La dépression comprend différentes facettes dont des symptômes interpersonnels, cognitifs, affectifs et somatiques. En effet, la majorité des mesures de la dépression sont de nature multidimensionnelle. Néanmoins, les utilisateurs de ces mesures utilisent typiquement le score total ou composé plutôt que le score individuel des dimensions. Nous proposons un examen plus en profondeur de la nature des relations entre ces dimensions sous-jacentes qui peut aider notre compréhension de la dépression. Des analyses par équations structurelles ont été utilisées auprès de 1,734 sujets afin de vérifier les relations de types statique (structures factorielles) et dynamique (modélisation causale) entre les dimensions de la version française du CES-D (Radloff, 1977). Les résultats des analyses transversales et prospectives soutiennent des liens de type causal entre les symptômes de la dépression. Ces résultats sont comparés à ceux des analyses factorielles hiérarchiques.

*Depression is composed of multiple subcomponents including social, cognitive, affective, and somatic symptomatology. Many widely used self-report scales are also multidimensional, suggesting that the subcomponents of depression are empirically differentiated, yet the use of a composite score is the common practice. The authors argue that a closer examination of the subscales of symptom inventories, and their interrelationships, can further our understanding of the development and persistence of depression. Structural equation modeling is used on the French version of CES-D responses (Radloff, 1977) from 1,734 participants, providing an explicit test of causal relations between several response classes commonly associated with depression. These structural models are consistent with a view of depression as a process that unfolds over time and are tested within both a cross-sectional and a prospective framework. They are compared to a higher-order factor model which speaks to the nature, but not the development, of depression.*

**Mots-clés :** Dépression, concept multidimensionnel, version française du CES-D, analyses factorielles confirmatoires, analyses par équations structurelles, relations statiques versus dynamiques

**Keywords:** Depression, multidimensionality, French version of CES-D, Confirmatory factor analysis, Structural equation modeling.

---

\* Université du Québec à Montréal and CIRANO

## Static Versus Dynamic Structural Models of Depression:

### The Case of the CES-D

Some of the most widely researched mental health constructs are multifaceted. 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 widely used self-report inventories designed to assess depression are also multidimensional (e.g., Beck's Depression Inventory, BDI, Beck, Ward, Mendelson, Mock, & Erlbaugh, 1961; Zung's Self-Rating Depression Scale, SDS, Zung, 1965; the Center for Epidemiologic Studies Depression Scale, CES-D, Radloff, 1977). Yet, it is interesting to note that elaborate theoretical models underlying the development of such measures and their respective subcomponents have often been lacking. In fact, many of these scales were originally conceived to reflect a (somewhat) broad and varied range of symptoms and came to reveal specific subcomponents only over time, usually through the application of exploratory factor analysis (EFA). Moreover, despite the conceptual and empirical differentiation of distinct depressive response classes, researchers have not placed much emphasis on the subcomponents of scales, opting instead for a single, summary measure of depression: a total score.

A total score approach is justified by several arguments. First, the subcomponents commonly extracted via EFA (e.g. somatic disturbances, affective

response, psychological or cognitive concomitants) can all be conceptualized as subdimensions of a higher-order depression syndrome. Support for this view has indeed been provided in studies that have applied hierarchical confirmatory factor analysis to the BDI (Byrne & Baron, 1993; Tanaka & Huba, 1984) and the CES-D (Hertzog, Van Alstine, Usala, Hultsch, & Dixon, 1990; Riddle, Blais, & Hess, 2000; Sheehan, Fifield, Reisine, & Tennen, 1995). Second, given well-known principles of reliability and validity assessment (Carmines & Zeller, 1979), a total score will produce a more reliable and valid assessment of depression (i.e., assuming that all of the items are in fact related to depression). This inherent characteristic of a total score certainly presents an advantage in primary care settings and epidemiological surveys where the accurate identification of individuals and groups high at risk for depression is critical.

The use of a total score approach for screening purposes has generally not been disputed; however, researchers have pointed out that the subscales of depression inventories could provide valuable information in a research setting. For example, Riddle et al. (2000) as well as Sheehan et al. (1995) argued that an emphasis on the subcomponents of depression could further our understanding of its development and persistence over time. Yet, a multidimensional approach would require the construction of theoretical models that can explain the development of all response classes measured by symptom inventories. Moreover, these models would need to articulate the interrelationships between the different subcomponents rather than simply considering them as a linear combination.

One possibility is that the subcomponents (e.g., cognitive distortions, affective symptomatology, somatic disturbances) develop simultaneously, but somewhat independently, thus creating different patterns of depression in the population. A small number of studies have explored this possibility and have indeed shown that certain population subgroups differ not only in the overall intensity of their depression, but also in the predominance of specific symptom clusters (Berry, Storandt, & Coyne, 1984; Gatz & Hurwicz, 1990; Hawkins, McDermott, Sheilds, Harvey, 1989; Hertzog et al., 1990; Zemore & Eames, 1979). Yet, few studies have adopted this approach and only a small range of correlates such as age and sex have been examined. Certainly, these variables may interact with a number of environmental, social and personal factors in determining differential symptom patterns. Thus, while this line of research seems promising, tests of more elaborate psychological models that can explain the etiology of differential symptom patterns are needed.

A second possibility is that a temporal sequence exists between the different subcomponents such that one aspect of depression arises first and, in turn, prompts the development of other subcomponents. Consider, for example, the BDI which has been shown to consist of three subscales: negative attitudes towards one's self, performance impairments and somatic disturbances (e.g., Byrne & Baron, 1993; Tanaka & Huba, 1984). As a description (symptom) of depression, the experience of a distorted self view is uncontroversial. However, Beck's (1967, 1979) theory of depression goes beyond description and attributes causal significance to depressive-

related cognitions. With regard to the BDI specifically, one might posit that for some individuals a negative sense of self precipitates the development of performance difficulties which, in turn, leads to somatic disturbances. Alternatively, it is reasonable to argue that for other individuals, decrements in performance lead to a negative self image as well as to somatic problems. Thus, a causal analysis of the depressive response classes underlying the BDI (and other self-report scales) can provide some information as to the onset and persistence of depression over time. This is in contrast to a higher-order conceptualization of depression inventories which speaks to the nature, but not the development, of depression.

In the present paper, the CES-D is used to examine structural models that reflect a sequential pattern in the development of several response components associated with depression. Given the fact that existing depression scales have typically been developed without regard to psychological theory or a priori conceptual definitions of subscales, they vary considerably with regard to symptom content coverage. For example, the BDI strongly emphasizes cognitive symptoms of depression but includes few items measuring mood disturbance. The SDS has about as many somatic items as it does cognitive ones (i.e., attitudes as well as cognitive impairments such as decision-making difficulties) but, compared to the BDI and the CES-D, few studies have investigated its measurement structure. As for the CES-D, it is heavily weighted with affective symptomatology. In fact, the CES-D has revealed two distinct subscales measuring mood disturbance: depressed affect and reduced positive affect/anhedonia. The lack or loss of positive affect has been

shown to be a distinctive feature of depression (Watson, Clark et al., 1995; Watson & Kendall, 1989; Watson & Tellegen, 1985; Watson, Weber, et al., 1995), yet, this aspect of depression has generated relatively little research in comparison to the distorted thinking patterns that accompany depression. The CES-D was therefore chosen rather than the BDI.

The CES-D is a multidimensional scale that was developed for use in studies of the epidemiology of depressive symptomatology in the general population. Four subscales were derived via EFA and were identified as: 1) depressed affect, 2) reduced positive affect, 3) somatic and psychomotor complaints and 4) interpersonal difficulties (Radloff, 1977). Generally, this structure has been replicated using both exploratory and confirmatory factor analytic approaches (see Figure 1, e.g., Golding & Aneshensel, 1989; Hertzog et al., 1991; Noh, Avison, Kaspar, 1992; Riddle et al., 2000; Roberts, Andrews, Lewinsohn, & Hops, 1990; Roberts, Vernon, & Rhoades, 1989; Ross & Mirowsky, 1984; Sheehan et al., 1995). However, for certain ethnic minorities (e.g., Asians), a three-factor structure has also been found in which Radloff's depressed affect and somatic complaints subscales combine to form a single factor (Beals, Manson, Keane, & Dick, 1991; Guarnaccia, Angel, & Worobey, 1989; Manson, Ackerson, Dick, Baron, & Fleming, 1990; Somervell et al., 1993; Ying, 1988). It has been suggested that the latter finding is due to cross-cultural differences in communication style and socialization practices that predispose non-Western populations to somatize depression (Guarnaccia et al., 1989; Ying, 1988). However, it should be noted that even in Anglo-Americans and French Canadians,



the depressed affect and somatic complaints subscales are moderately to highly related (see for example, Hertzog et al., 1991; Riddle et al., 2000; Sheehan et al., 1995). Further, there is good evidence suggesting that the somatization of depression is a universal phenomenon (Jenkins, Kleinman & Good, 1991).

---

insert Figure 1 here

---

Also, based on the observation that the four factors are highly intercorrelated, researchers have tested the hypothesis that the four subscales are subdimensions of a higher-order depression construct. The higher-order factor model was shown to fit well (Hertzog et al., 1990; Riddle et al., 2000; Sheehan et al., 1995). Sheehan et al. (1995) as well as Riddle et al. (2000) could further demonstrate that the higher-order factor model was superior to a unidimensional model in which all items were proposed to load on a single factor. Thus, there is evidence suggesting that the CES-D represents one underlying general syndrome of depression that can be decomposed into four distinct, yet highly related, symptom clusters. As a result, these findings justify the use of a total score as is the common practice, but they also suggest that the four subscales of the CES-D are important in their own right.

While a higher-order factor model has been proposed to account for the interrelationships observed between the symptom clusters measured by the CES-D,

interestingly, alternative models have not been tested. Yet, it is possible to formulate theoretically compelling models in which one subcomponent has causal priority over another. Further, these models might explain the mechanisms underlying the relationships between the CES-D's subcomponents as well as or better than a higher-order factor model. In the present paper, two structural models are proposed that articulate presumed causal relationships between the CES-D's subcomponents. The models are based on relevant etiological theories and findings in the general depression literature.

#### Reduced Opportunities for Reinforcement Model

The first model is based on the notion that the behavior of depressed persons produces situations in which they experience few pleasurable events with a consequent loss of pleasurable emotions (e.g., enjoying life, feeling happy and good about one's self). Behaviorists describe this phenomenon in terms of reinforcement. For example, Ferster (1973) suggested that depressives fail to engage in actions that lead to positive reinforcement because their behavior is misdirected towards the avoidance of unpleasant situations (punishment) rather than towards positive goals (reward). Lewinsohn (1974) argued that a variety of reinforcement-reducing contingencies may apply in depression: 1) a person may find few activities to be rewarding, 2) few activities may be available in the person's immediate environment, and 3) a person may lack social skills requisite to producing positive reinforcement from others. Support for Lewinsohn's (1974) hypothesis that depressed individuals lack response-contingent reinforcement comes from several

studies showing that depressed persons engage in a restricted number and range of pleasant activities when compared to nondepressed persons (Lewinsohn & Amenson, 1978; Lewinsohn & Graf, 1973; Lewinsohn & Libet, 1972). Further, Lewinsohn's (1974) hypothesis regarding deficits in social skills is consistent with Libet and Lewinsohn's (1973) results showing that depressed persons engage in fewer conversations and emit fewer positive responses when approached by others during group interactions. In other words, responses that might be reinforced by others are made infrequently.

Rehm's (1977) self-control model of depression suggests that multiple deficits are involved in depression. Among these deficits include: 1) selective attention to negative rather than positive events, 2) harsh self-judgment or self-evaluation and 3) the administration of insufficient contingent self-reward and excessive self-punishment to motivate behavior. Partial support for Rehm's model comes from self-reinforcement experiments in which participants are asked to evaluate their own performance. Depressed individuals have been shown to give themselves fewer merits (awards) and more demerits (punishment) than nondepressed individuals (Lobitz & Post, 1979; Nelson & Craighead, 1977). Further, depressed persons have been found to evaluate themselves more negatively than do nondepressed persons, even in the absence of differences in actual performance (e.g., Lobitz & Post, 1979; Smolen, 1978). Thus, evidence suggests that depressed people judge themselves too harshly and rarely engage in self-reinforcement, self-praise or positive self-evaluations.

Other theories have presumed that a loss or reduction in the effectiveness of available reinforcers underlies depression. For example, it has been suggested that depressed individuals are unable to experience pleasure in response to available reinforcement either for biological (e.g., Klein, 1974; Meehl, 1975) or psychological reasons (Costello, 1972; Lewinsohn, 1974). Supportive of this formulation are findings showing that the subjective enjoyment potential of pleasant events is rated much lower by depressed persons than by nondepressed persons (Lewinsohn & MacPhillamy, 1974; MacPhillamy & Lewinsohn, 1974). Furthermore, there is some evidence indicating that reinforcer effectiveness may be reduced in depression as a consequence of increased exposure to unpleasant events. For example, Grosscup and Lewinsohn (1980) found that the frequency of unpleasant events was inversely correlated with the subjective enjoyability of pleasant ones. Lewinsohn (1974) suggested that the inability to experience pleasure in response to available reinforcement is due to interfering anxiety. A parallel might be drawn between the latter hypothesis and Ellis' (1962) suggestion that the inability to derive satisfaction and enjoyment out of life is related to harsh, absolutistic beliefs about the way one "should" be in order to be acceptable as a person. Musterbation (i.e., the belief that one must or should be a certain way to be acceptable) is usually coercive, creating tension and pressure on a person to achieve unattainable standards, leading inevitably to disappointments and an inability to enjoy life (Safran & Greenberg, 1989).

All of the models above share a common final pathway to the onset of depression: a lack or loss of positive reinforcement and an associated reduction in pleasurable emotions. The Reduced Opportunities for Reinforcement (ROR) model postulates that individuals who experience such a low rate of positive experiences (i.e., reduced positive affect) are predisposed to developing more negative emotional states, that is, depressed mood. A depressed emotional state may then become part of a downward spiral wherein somatic and psychomotor symptoms are elicited. Watson and colleagues have provided strong support for a link between negative affective states and the appearance of somatic complaints (Clark & Watson, 1988; Watson, 1988; Watson & Pennebaker, 1989).

Finally, based on Lewinsohn (1974) and Coyne's (1976b) observations that ongoing depression erodes or alters the social support available to the person, it is hypothesized that individuals with heightened depressed mood will report increased disturbances in their social relationships. Several explanations have been provided to account for this phenomenon. For example, Lewinsohn and colleagues suggested that depressed individuals lack social competence or skills, thus disrupting ongoing social interactions (Lewinsohn, 1974; Lewinsohn & Shaffer, 1971; Libet & Lewinsohn, 1973). Coyne (1976b) argued that some aspects of depressive behavior may be aversive to other people, thereby leading to conflict or avoidance of contact with the depressed person. Indeed, studies have shown that the symptoms of depressed persons place a strain on relationships as reported by spouses and significant others (e.g., Coyne, 1985; Coyne et al., 1987). Furthermore, people who

engaged in brief conversations with a depressed person were more anxious, depressed, hostile and rejecting of the person following the interaction (Coyne, 1976a; Strack & Coyne, 1983). Importantly, Strack and Coyne (1983) could further show that the depressed persons accurately perceived the negative responses they received from others.

### Interpersonal Stress Model

The second model is based on several lines of research suggesting that interpersonal problems play a major role in the development of depression. For example, studies on life situations (e.g., Brown & Harris, 1978; Costello, 1982), recent life events of major magnitude (e.g., Lloyd, 1980; Paykel et al., 1969), and minor life events or hassles (Bolger, DeLongis, Kessler, & Schilling, 1989) all point to interpersonal stressors (e.g., social exit events, argument with spouse) as an important contributor to the onset of depression. Also relevant are studies showing that inadequate social support or unsupportive relationships predict depression and unhappiness (Coyne & DeLongis, 1986; DeLongis, Folkman, & Lazarus, 1988; Duer, Schwenk, & Coyne, 1988; Schaefer, Coyne, & Lazarus, 1981). Conversely, the availability of social support (Cohen & Wills, 1985) or confidants (Brown & Harris, 1978) and the development of close social bonds (Baumeister & Leary, 1995) have been shown to contribute to psychological well-being.

The Interpersonal Stress (ITS) model postulates that interpersonal disturbances are the first link in a chain leading to changes in affect and associated somatic complaints. Specifically, unsatisfactory social interactions are expected to

lead to reduced pleasure, presumably due to the loss of a major source of gratification or positive reinforcement. It is also anticipated that interpersonal problems will lead directly to heightened depressed mood. This relationship might be mediated by a reduction in self-esteem. Changes in affect, in turn, are hypothesized to lead to somatic complaints and reduced psychomotor activity. As already mentioned, available evidence strongly suggests that negative affective states are correlated with psychosomatic complaints and health problems (e.g., Beiser, 1974; Harding, 1982; Watson & Pennebaker, 1989); however, as regards the relationship between positive affect and somatic complaints, mixed findings have been reported (Clark & Watson, 1988; Watson, 1988; Watson & Pennebaker, 1989).

## OVERVIEW

The CES-D has been shown to consist of four distinct, yet intercorrelated, subscales reflecting important depressive symptom clusters. This study investigates three competing models that articulate specific hypotheses about how these correlations arise. First, based on previous findings, the Higher-Order Factor Model posits that the four symptom clusters can be subsumed under an umbrella construct of general depression (Hertzog et al., 1990; Riddle et al., 2000; Sheehan et al., 1995). We propose two additional models, the Interpersonal Stress and Reduced Opportunities for Reinforcement Models, that reflect a sequential pattern in the development of depressive symptoms. The latter models are consistent with a view of depression as a dynamic process and stand in contrast to the higher-order factor model which necessarily implies a static view of depression. Given the assumption

that interpersonal problems and the lack of pleasurable experiences are important “drivers” of depression, the ITS and ROR models are tested within both a cross-sectional and a prospective framework.

## Method

### Participants

Combined data from three samples drawn from the education domain yielded a relatively heterogeneous sample of 1,734 French Canadians, ranging in age from 14 to 61 years ( $M = 30$ ,  $SD = 13$ ). Participants were adolescents attending regular high school education programs (Grades 10 and 11), young adults enrolled in undergraduate university courses, and adult employees from a school board in the province of Quebec. The employee sample was composed primarily of teachers (71%), but included other groups of personnel as well (e.g., school principals, professionals and support staff). A more detailed description of each sample is provided by Riddle et al. (2000). All participants completed a French version of the CES-D (along with additional measures not analyzed in this article) anonymously and participation was voluntary.<sup>1</sup>

The samples were pooled in order to obtain a heterogeneous sample of participants. Their combination was justified by previous findings reported by Riddle and colleagues (2000). Specifically, the authors found an invariant factor structure across the three samples, suggesting that adolescents, young adults and middle-aged adults manifest depressive symptomatology in similar ways. Yet, given the advantages of cross-validation in structural equation modeling, the 1,734



participants were divided into two random subsamples. This procedure resulted in two samples that were virtually identical with regard to mean age and sex distribution: Sample 1 (M age = 30, SD = 14, 62% women) and Sample 2 (M age = 30, SD = 13; 61% women).

### Statistical Procedures

Structural equation modeling was used to examine the viability of the three hypothesized models. 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 ( $S-B\chi^2$ , Satorra & Bentler, 1988) and the Robust Comparative Fit Index (CFI\*, Bentler, 1990; Bryne, 1994) which are strongly recommended for data that violate normal distribution assumptions (Bentler, 1993). Values for the CFI\* range from 0 to 1 with a value greater than .90 indicating an acceptable fit to the data (Bentler & Bonett, 1980). Competing models were statistically compared using Akaike's (1987) information criterion (AIC) and Bozdogan's (1987) consistent version of the AIC which address concerns of parsimony related to model fit.

## Results

### Higher-Order Factor Model

---

insert Table 1 here

---

The higher-order factor model posits that the CES-D's four subcomponents are subdimensions of a higher-order depression syndrome. Goodness-of-fit indices are presented in Table 1. This model provided a good fit, explaining 92% and 94% of complete covariation in the data for Samples 1 and 2, respectively (CFI\* = .92 and .94). All first-order loadings were significant and above .50, suggesting that the items were all good indicators of their hypothesized constructs. Furthermore, the second-order factor loadings were similar across the two samples and were all significant and above .70 ( $p < .05$ , see Figure 2).

---

insert Figure 2 here

---

#### Reduced Opportunities for Reinforcement Model

In contrast to the higher-order factor model which provides a static view of depression, the Reduced Opportunities for Reinforcement Model attempts to explain the processes underlying the development of depression. This model postulates that a lack of positive emotional experiences plays a pivotal role, leading to heightened depressed mood which, in turn, leads to relationship difficulties and psychosomatic complaints. This model provided a good fit for both samples (Sample 1, CFI\* = .92; Sample 2, CFI\* = .94). As shown in Figure 3, all hypothesized paths were large, significant ( $p < .05$ ), and in the expected direction. Further, the ROR model was comparable to the higher-order factor model in terms of parsimony (see Table 1).

---

insert Figure 3 here

---

### Interpersonal Stress Model

In contrast to the ROR model, the Interpersonal Stress Model posits that interpersonal problems are a precipitant rather than a consequence of depression. Specifically, difficulties in social relationships are hypothesized to be the first link in a chain leading to changes in affect and associated somatic complaints. Again, this model provided a good fit (Sample 1, CFI\* = .92; Sample 2, CFI\* = .94). As shown in Figure 4, all path coefficients were large and significant ( $p < .05$ ), with the exception of two. The impact of reduced positive affect on somatic complaints for both samples was indirect, via depressed affect. Thus, a reduction in positive emotional experiences will eventually lead to psychosomatic health problems only if an individual also experiences depressed mood.

---

insert Figure 4 here

---

### Prospective Models

The ROR and ITS models postulate respectively that anhedonia and relationship difficulties precipitate the development of other symptoms commonly associated with depression. Given the primary role devoted to these two

subcomponents, the two causal models were tested within a prospective framework. For the university students only, the CES-D was administered on two separate occasions. A total of 214 participants completed the scale twice, separated by a one-month interval. This allowed for a test of the models in a prospective framework with the limitation that a full measurement model could not be specified. However, the first-order factor loadings remained stable across the three cross-sectional models, attesting to the robustness of the measurement structure. Moreover, measurement error was controlled for by fixing the error variance of each variable using external reliability measures (for a description of this procedure, see also Wang, Fisher, Siegal, Falck & Carlson, 1995).

Both models provided excellent fits as suggested by their CFI values of .99. All hypothesized paths were significant ( $p < .05$ ) and in the expected direction, with the exception of one. The path coefficient between reduced positive affect and somatic complaints in the ITS model was nonsignificant, replicating the results obtained from the cross-sectional analyses. Inspection of Figure 5 shows that the paths between all endogenous variables (i.e., those measured at time 2) remained large in both models. However, the relationships between the exogenous and endogenous variables were moderate. One would expect smaller values given that the exogenous variables (i.e., reduced positive affect in the ROR model and interpersonal problems in the ITS model) were measured one month prior to the endogenous variables. In spite of this, both models replicate well within a

prospective design, thereby providing further support for a view of depression as a developing process.

---

insert Figure 5 here

---

## Discussion

While there are clear advantages to a total score approach for screening purposes, the present paper argues that the subcomponents of depression inventories can be used in a research setting. A multidimensional approach was therefore adopted and three theoretically plausible models were proposed to explain the mechanisms underlying the coexistence of the multiple subcomponents of the CES-D (Radloff, 1977). The first of these proposes no causal relation between components, rather this model, the higher-order factor model, was based on previous findings suggesting that depressed affect, reduced positive affect, interpersonal problems and somatic disturbances can all be conceptualized as subdimensions of a general depression syndrome (e.g., Hertzog et al., 1990; Riddle et al., 2000; Sheehan et al., 1995). In contrast, the Reduced Opportunities for Reinforcement (ROR) and Interpersonal Stress (ITS) models reflect two theoretical approaches describing different sequential patterns in the onset and development of depressive symptoms.

The results show empirical support for all three hypothesized models. First, the good fit of the higher-order factor model underlying the CES-D suggests that the scale does indeed measure one underlying depression syndrome that can be decomposed into four distinct subcomponents. Hence this finding justifies the use of the total score that is the common practice. However, it also supports the notion that the subscales of the CES-D are each important in their own right (Riddle et al., 2000; Sheehan et al., 1995). A disadvantage of this model is that it views the different components as static in time, that is, it does not explain how depressive symptoms may develop over time.

In contrast, the two process models provide an understanding of the dynamic nature of depression over time. The ITS and ROR models respectively postulate that interpersonal problems and the lack of pleasurable experiences play important roles in the onset of depression. Support for the two models from within both a cross-sectional and a prospective framework indicated that these models may each have validity.

As mentioned above, the Reduced Opportunities for Reinforcement Model suggests that a lack or loss of positive affect can indeed precipitate the development of other depressive symptomatology, reflecting the commonsensical notion that a life void of pleasure is depressing. Yet, it is important to recognize that positive affect in this context refers not only to happiness and enjoyment in life. It also refers to confidence (I felt that I was as good as other people) and enthusiasm (I felt hopeful about the future). Watson, Wiese, Vaidya and Tellegen (1999) argued that

such positive feeling states serve to increase one's subjective perception that he or she is able to perform those behaviors that lead to reward (i.e., increased efficacy expectations) as well as one's expectations that those behaviors, once performed, will ultimately lead to reward (i.e., increased outcome expectations). Further, such positive feelings generally can be expected to increase the likelihood that individuals will engage in reward-seeking behaviors (Watson et al., 1999). Conversely, individuals who report low levels of positive affect are people who not only have less pleasure in their lives but also decreased expectations of future enjoyment, presumably leading to a decrease in pleasure seeking. One can see why such individuals might, over time, develop secondary demoralization or depressed mood.

A number of explanations for the hypothesized pleasure deficit have been outlined including environmental, biological and psychological factors. Given the adequate fit of the ROR model tested by us, these etiological factors can now be incorporated into future tests of the model. It should be noted that the environmental and person-centered explanations are not necessarily incompatible. As suggested by Watson and Kendall (1989), each may apply to different subtypes of depression: some depressives may lack sufficient reinforcement in their environment, whereas others may be incapable of deriving pleasure from normally rewarding activities. Further, both processes may be observed in the same individual (Watson & Kendall, 1989). For example, individuals with a decreased

ability to experience pleasure may actually reduce their rate of reward-seeking behavior, thereby leading to an objective lack of reinforcement in their lives as well.

The ROR model also supported the hypothesis that depressed mood leads to increased reporting of problems in social relationships. This finding is consistent with previous evidence suggesting that depressed persons are “depressing” to have around; they are evaluated negatively and often avoided (Coyne, 1976a; Klerman, 1989; Strack & Coyne, 1983). While expressions of distress sometimes do elicit attention and care from others, over time the communication of depression can be counterproductive. Yet, given that the present data were derived solely from using self-reports, it is unclear whether the link between depressed mood and relationship impairments reflects an objective deficiency in the depressed person’s environment. It may be that depressed mood biases the processing and recall of information relevant to social relationships. Yet, this hypothesis seems less likely in view of Strack and Coyne’s (1983) observation that depressed individuals accurately perceive the negative responses they receive from others.

In contrast to the ROR model, which suggests that relationship impairments are a consequence of depression, the ITS model supported the alternative hypothesis that unsatisfactory relationships precipitate the development of depressive symptoms. The two perspectives on the role of relationship difficulties in depression reflected by the two models are not necessarily incompatible with each other. In fact, it is likely that social problems and depression mutually feed into each other (Coyne, 1976b). Nevertheless, the ITS model indicates that interpersonal



disturbances can be the first link in a chain leading to changes in affect. This relationship was supported by both cross-sectional and prospective analyses.

Both the ROR and ITS models indicated that while depressed mood is related to increased somatic complaints, reduced positive affect is not. Salovey (1991) offered several explanations for the observation that negative emotions yield somatic complaints (cited in Hull, Tedlie, & Lehn, 1995). For example, negative emotions may 1) focus attention inward, leading to increased awareness of internal states including somatic disturbances (see also Watson & Pennebaker, 1989), 2) lead to behaviors that damage health (e.g., smoking, decreased exercise) and hence increased illness, and 3) motivate a desire for attention from others, thereby increasing the likelihood that individuals will express somatic complaints to elicit sympathy. Again, the good fit of the model in our investigation opens the door to future investigations that include additional variables to further elucidate the relationships established in the present investigation.

In sum, this study is the first to provide empirical support for two dynamic models of the CES-D that delineate different sequential patterns in the onset and development of depressive symptomatology. Yet, support for these two models does not rule out the possibility that other patterns of depression develop over time. For example, for some individuals, a decrease in the ability to enjoy pleasant activities may be a consequence of being depressed, rather than the reverse (Willner, p. 68). Reciprocal relationships between the different components of depression might also be examined. As already mentioned, depression may lead to

interpersonal problems or a loss of support which constitutes a stress that perpetuates the depression.

The sequential analysis of the CES-D in the present paper has implications for differential courses of recovery from depression. Under treatment or spontaneously, one might expect the first improvement to be manifested in the drivers of depression. Further, both models suggest that depressives may regain an increased ability to experience pleasure before their depressed mood lifts. A number of treatments derived from behavioral theories of depression have been developed based on the guiding principle that depressives need to increase perceived rewards. These treatments differ depending on the source of the pleasure deficit, but a combination of techniques are often used. They include the scheduling of activities that will afford mastery and pleasure, equipping individuals with the ability for self-reinforcement, and social skills training designed to modify behavior for more reinforcement, and secondarily, to shape interpretations of others' behaviors. Researchers might consider in the future using the subcomponents of symptoms inventories such as those of the CES-D to evaluate the impact of such treatment programs on the amelioration of depressive symptoms over time.

## References

- Akaike, H. (1987). Factor analysis and AIC. Psychometrika, 52, 317-332.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. Psychological Bulletin, 117, 497-529.
- Beals, J., Manson, S. M., Keane, E. M., & Dick, R. W. (1991). Factorial structure of the Center for Epidemiologic Studies-Depression Scale among American Indian college students. Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3, 623-627.
- Beck, A. T. (1967). Depression: Clinical, experimental and theoretical aspects. New York: Hoeber.
- Beck, A. T. (1979). Cognitive therapy of depression. New York: Guilford Press.
- Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erlbaugh, J. (1961). An inventory for measuring depression. Archives of General Psychiatry, 4, 53-61.
- Beiser, M. (1974). Components and correlates of mental well-being. Journal of Health and Social Behavior, 15, 320-327.
- Bentler, P. M. (1990). Comparative fit indexes in structural models. Psychological Bulletin, 107, 238-246.
- Bentler, P. M. (1993). EQS: Structural equations program manual. Los Angeles: BMDP Statistical Software.
- Bentler, P. M. & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. Psychological Bulletin, 88, 588-606.

Berry, J. M., Storandt, M., & Coyne, A. (1984). Age and sex differences in somatic complaints associated with depression. Journal of Gerontology, 39, 465-467.

Bolger, N., DeLongis, A., Kessler, R. C., & Schilling, E. A. (1989). Effects of daily stress on negative mood. Journal of Personality and Social Psychology, 57, 808-818.

Bozdogan, H. (1987). Model selection and Akaike's information criteria (AIC): The general theory and its analytical extensions. Psychometrika, 52, 345-370.

Brown, W., & Harris, T. (1978). Social origins of depression. London: Tavistock.

Byrne, B. M. (1994). Structural equation modeling with EQS and EQS/Windows: Basic concepts, applications, and programming. Thousand Oaks, CA: Sage.

Byrne, B. M., & Baron, P. (1993). The Beck Depression Inventory: Testing and cross-validating a hierarchical factor structure for nonclinical adolescents.

Measurement and Evaluation in Counseling and Development, 26, 164-178.

Carmines, E. G., & Zeller, R. A. (1979). Reliability and validity assessment. Beverly Hills, CA: Sage.

Clark, L. A., & Watson, D. (1988). Mood and the mundane: Relations between daily life events and self-reported mood. Journal of Personality and Social Psychology, 54, 296-308.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. Psychological Bulletin, 98, 310-357.

Costello, C. G. (1972). Depression: Loss of reinforcers or loss of reinforcer effectiveness? Behavior Therapy, 3, 240-247.

Costello, C. G. (1982). Social factors associated with depression: A retrospective community study. Psychological Medicine, 12, 329-339.

Coyne, J. C. (1976a). Depression and the response of others. Journal of Abnormal Psychology, 85, 186-193.

Coyne, J. C. (1976b). Toward an interactional description of depression. Psychiatry, 39, 28-40.

Coyne, J. C. (1985). Studying depressed persons' interactions with strangers and spouses. Journal of Abnormal Psychology, 94, 231-232.

Coyne, J. C., & DeLongis, A. (1986). Going beyond social support: The role of social relationships in adaptation. Journal of Consulting and Clinical Psychology, 54, 454-460.

Coyne, J. C., Kessler, R. C., Tal, M., Turnbull, J., Wortman, C. B., & Greden, J. F. (1987). Living with a depressed person. Journal of Consulting and Clinical Psychology, 55, 347-352.

DeLongis, A., Folkman, S., & Lazarus, R. S. (1988). The impact of daily stress on health and mood: Psychological and social resources as mediators. Journal of Personality and Social Psychology, 54, 486-495.

Duer, S., Schwenk, T. L., & Coyne, J. C. (1988). Medical and psychosocial correlates of self-reported depressive symptoms in family practice. Journal of Family Practice, 27, 609-614.

Ellis, A. (1962). Reason and emotion in psychotherapy. New York: Lyle Stuart.

Ferster, C. B. (1973). A functional analysis of depression. American Psychologist, 28, 857-870.

Gatz, M., & Hurwicz, M.-L. (1990). Are old people more depressed? Cross-sectional data on Center for Epidemiological Studies Depression Scale factors. Psychology and Aging, 5, 284-290.

Golding, J. M., & Aneshensel, C. S. (1989). Factor structure of the Center for Epidemiologic Studies Depression Scale among Mexican Americans and Non-Hispanic Whites. Psychological Assessment: A Journal of Consulting and Clinical Psychology, 1, 163-168.

Grosscup, S., & Lewinsohn, P. M. (1980). Unpleasant and pleasant events, and mood. Journal of Clinical Psychology, 36, 252-259.

Guarnaccia, P. J., Angel, R., & Worobey, J. L. (1989). The factor structure of the CES-D in the Hispanic Health and Nutrition Examination Survey: The influences of ethnicity, gender and language. Social Science and Medicine, 29, 85-94.

Harding, S. D. (1982). Psychological well-being in Britain: An evaluation of the Bradburn Affect Balance Scale. Personality and Individual Differences, 3, 167-175.

Hawkins, W. E., McDermott, R. J., Shields, L., & Harvey, S. M. (1989). Sex differences in the "depressed affect" factor among selected university students. Psychological Reports, 64, 1245-1246.

Hertzog, C., Van Alstine, J. V., Usala, P. D., Hultsch, D. F., & Dixon, R. (1990). Measurement properties of the Center for Epidemiological Studies Depression Scale

(CES-D) in older populations. Psychological Assessment: A Journal of Consulting and Clinical Psychology, 2, 64-72.

Hull, J. G., Tedlie, J. C., & Lehn, D. A. (1995). Modeling the relation of personality variables to symptom complaints: The unique role of negative affectivity. In R. H. Hoyle (Ed.), Structural equation modeling: Concepts, Issues, and Applications (pp. 217-235). Thousand Oaks: Sage.

Jenkins, J. H., Kleinman, A., & Good, B. J. (1991). Cross-cultural studies of depression. In J. Becker, A. Kleinman, et al. (Eds.), Psychosocial aspects of depression (pp. 67-99). Hillsdale, NJ: Lawrence Erlbaum Associates.

Klein, D. F. (1974). Endogenomorphic depression: A conceptual and terminological revision. Archives of General Psychiatry, 31, 447-454.

Klerman, G. L. (1989). The interpersonal model. In J. J. Mann (Ed.), Models of depressive disorders: Psychological, biological and genetic perspectives (pp. 45-77). New York: Plenum Press.

Lewinsohn, P. M. (1974). The behavioral study and treatment of depression. In K. S. Calhoun, H. E. Adams, & K. M. Mitchell (Eds.), Innovative treatment methods in psychopathology New York: Wiley.

Lewinsohn, P. M., & Amenson, C. S. (1978). Some relations between pleasant and unpleasant mood-related events. Journal of Abnormal Psychology, 87, 644-654.

Lewinsohn, P. M., & Graf, M. (1973). Pleasant activities and depression. Journal of Consulting and Clinical Psychology, 41, 261-268.

Lewinsohn, P. M., & Libet, J. (1972). Pleasant activities, activity schedules, and depression. Journal of Abnormal Psychology, 79, 291-295.

Lewinsohn, P. M., & MacPhillamy, D. J. (1974). The relationship between age and engagement in pleasant activities. Journal of Gerontology, 29, 290-294.

Lewinsohn, P. M., & Shaffer, M. (1971). Use of home observations as an integral part of the treatment of depression: Preliminary report and case studies. Journal of Consulting and Clinical Psychology, 37, 87-94.

Libet, J. M., & Lewinsohn, P. M. (1973). Concept of social skill with special reference to the behavior of depressed persons. Journal of Consulting and Clinical Psychology, 40, 304-312.

Lloyd, C. (1980). Life events and depressive disorder reviewed: II. Events as precipitating factors. Archives of General Psychiatry, 37, 541-548.

Lobitz, W. C., & Post, R. D. (1979). Parameters of self-reinforcement and depression. Journal-of-Abnormal-Psychology, 88, 33-41.

MacPhillamy, D. J., & Lewinsohn, P. M. (1974). Depression as a function of levels of desired and obtained pleasure. Journal of Abnormal Psychology, 83, 651-657.

Manson, S. M., Ackerson, L. M., Dick, R. W., Baron, A. E., & Fleming, C. M. (1990). Depressive symptoms among American Indian adolescents: Psychometric characteristics of the Center for Epidemiologic Studies Depression Scale (CES-D). Psychological Assessment: A Journal of Consulting and Clinical Psychology, 2, 231-237.



- Meehl, P. E. (1975). Hedonic capacity: Some conjectures. Bulletin of the Menninger Clinic, 39, 295-307.
- Nelson, R. E., & Craighead, W. E. (1977). Selective recall of positive and negative feedback, self-control behaviors, and depression. Journal-of-Abnormal-Psychology, 86, 379-388.
- Noh, S., Avison, W. R., & Kaspar, V. (1992). Depressive symptoms among Korean immigrants: Assessment of a translation of the Center for Epidemiologic Studies-Depression Scale. Psychological Assessment, 4, 84-91.
- Paykel, E. S., Myers, J. K., Dienelt, M. N., Klerman, G. L., Lindenthal, J. J., & Pepper, M. P. (1969). Life events and depression: A controlled study. Archives of General Psychiatry, 21, 753-760.
- Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. Applied Psychological Measurement, 1, 385-401.
- Rehm, L. P. (1977). A self-control model of depression. Behavior Therapy, 8, 787-804.
- Rehm, L. P. (1988). Assessment of depression. In M. H. & A. S. Bellack (Ed.), Behavioral assessment: A practical handbook (pp. 313-364). New York: Pergamon Press.
- Riddle, A. R., Blais, M. R., & Hess, U. (2000). A multi-group investigation of the CES-D's measurement structure across adolescents, young adults and middle-aged adults. Manuscript submitted for publication.

Roberts, R. E., Andrews, J. A., Lewinsohn, P. M., & Hops, H. (1990). Assessment of depression in adolescents using the Center for Epidemiologic Studies Depression Scale. Psychological Assessment: A Journal of Consulting and Clinical Psychology, 2, 122-128.

Roberts, R. E., Vernon, S. W., & Rhoades, H. M. (1989). Effects of language and ethnic status on reliability and validity of the Center for Epidemiologic Studies Depression Scale with psychiatric patients. Journal of Nervous and Mental Disease, 177, 581-592.

Ross, C. E., & Mirowsky, J. (1984). Components of depressed mood in married men and women. American Journal of Epidemiology, 119, 997-1004.

Safran, J. D., & Greenberg, L. S. (1989). The treatment of anxiety and depression: The process of affective change. In P. C. Kendall & D. Watson (Eds.), Anxiety and depression: Distinctive and overlapping features (pp. 455-489). San Diego, California: Academic Press.

Satorra, A. & Bentler, P.M. (1988). Scaling corrections for chi square statistics in covariance structure analysis. (UCLA Statistics Series 2). Los Angeles: University of California at Los Angeles, Department of Psychology.

Schaefer, C., Coyne, J. C., & Lazarus, R. S. (1981). The health-related functions of social support. Journal of Behavioral Medicine, 4, 381-406.

Sheehan, T. J., Fifiield, J., Reisine, S., & Tennen, H. (1995). The measurement structure of the Center for Epidemiologic Studies Depression Scale. Journal of Personality Assessment, 64, 507-521.

Smolen, R. C. Expectancies, mood, and performance of depressed and nondepressed psychiatric inpatients on chance and skill tasks. Journal-of-Abnormal-Psychology, 87, 91-101.

Somervell, P. D., Beals, J., Kinzie, J. D., Boehnlein, J., Leung, P., & Manson, S. M. (1993b). Use of the CES-D in an American Indian village. Culture, Medicine and Psychiatry, 16, 503-517.

Strack, S., & Coyne, J. C. (1983). Social confirmation of dysphoria: Shared and private reactions to depression. Journal of Personality and Social Psychology, 44, 798-806.

Tanaka, J. S., & Huba, G. J. (1984). Confirmatory hierarchical factor analyses of psychological distress measures. Journal of Personality and Social Psychology, 46, 621-635.

Wang, J., Fisher, J. H., Siegal, H. A., Falck, R. S., & Carlson, R. G. (1995). Influence of measurement errors on HIV risk behavior analysis: A case study examining condom use among drug users. Structural Equation Modeling, 2, 319-334.

Watson, D. (1988). Intraindividual and interindividual analyses of positive and negative affect: Their relation to health complaints, perceived stress, and daily activities. Journal of Personality and Social Psychology, 54, 1020-1030.

Watson, D., Clark, L. A., Weber, K., Assenheimer, J. S., Strauss, M. E., & McCormick, R. A. (1995). Testing a tripartite model: II. Exploring the symptom structure of anxiety and depression in student, adult, and patient samples. Journal of Abnormal Psychology, 104, 15-25.

Watson, D., & Kendall, P. C. (1989). Understanding anxiety and depression: Their relation to negative and positive affective states. In P. C. Kendall & D. Watson (Eds.), Anxiety and depression: Distinctive and overlapping features (pp. 3-26). San Diego, California: Academic Press.

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. Psychological Review, 96, 234-254.

Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. Psychological Bulletin, 98, 219-235.

Watson, D., Weber, K., Assenheimer, J. S., Clark, L. A., Strauss, M. E., & McCormick, R. A. (1995). Testing a tripartite model: I. Evaluating the convergent and discriminant validity of anxiety and depression symptom scales. Journal of Abnormal Psychology, 104, 3-14.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. Journal of Personality and Social Psychology, 76, 820-838.

Willner, P. (1985). Depression: A psychobiological synthesis. New York: John Wiley & Sons.

Ying, Y. (1988). Depressive symptomatology among Chinese-Americans as measured by the CES-D. Journal of Clinical Psychology, 44, 739-746.

Zemore, R., & Eames, N. (1979). Psychic and somatic symptoms of depression among young adults, institutionalized and noninstitutionalized ages. Journal of Gerontology, 34, 716-722.

Zung, W. W. K. (1965). A self-rating depression scale. Archives of General Psychiatry, 13, 508-516.

## Footnotes

<sup>1</sup> The CES-D-FR was developed and validated by Riddle, Blais and Hess (2000).

The authors reported that the French version of the scale shows high internal consistency and satisfactory test-retest reliability over a one-month period.

Nonresponse rates are negligible and the influence of socially desirable responding is minimal. Furthermore, the CES-D-FR correlates strongly with other measures of depression and moderately with scales that assess related but different variables.

Finally, using confirmatory factor analysis, the authors reported that a four-factor structure underlies the CES-D-FR and that a second-order depression construct can explain the covariation between the four first-order factors.

Table 1.

Goodness-of-Fit Indices of Competing Models

Model	<i>df</i>	$\chi^2$	Based on $\chi^2$			Based on S-B $\chi^2$	
			CFI	AIC	CAIC	S-B $\chi^2$	CFI*
Sample 1							
Higher-order factor model	167	713	.93	379	-576	572	.92
ROR model	167	713	.93	379	-576	571	.92
ITS model	165	710	.93	380	-563	568	.92
Sample 2							
Higher-order factor model	167	668	.93	334	-621	533	.94
ROR model	167	666	.93	332	-623	531	.94
ITS model	165	660	.93	330	-613	526	.94
Prospective models: University students <sup>a</sup>							
ROR model	3	4	.99	-2	-15	--	--
ITS model	1	1	.99	-1	-5	--	--

Note. AIC = Akaike's (1987) information criterion; CAIC = Bozdogan's (1987) consistent version of the AIC; S-B $\chi^2$  = Satorra-Bentler Scaled Statistic; CFI\* = Robust Comparative Fit Index; ROR = Reduced Opportunities for Reinforcement Model; ITS = Interpersonal Stress Model.

<sup>a</sup>Results for the corrected versions of the  $\chi^2$  and the CFI are not reported given that these data were normally distributed.

## Figure Captions

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

Figure 2. Higher-order factor model of the CES-D.

Note. Parenthesized values represent estimates for Sample 2.

Figure 3. Reduced Opportunities for Reinforcement Model.

Note. Parenthesized values represent estimates for Sample 2.

Figure 4. Interpersonal Stress Model.

Note. Parenthesized values represent estimates for Sample 2.

Figure 5. Prospective models of depression for the university students only.



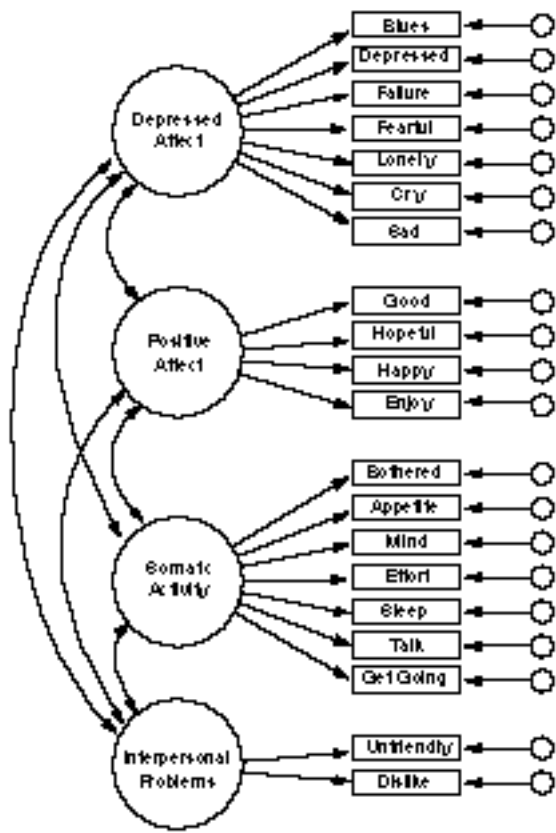
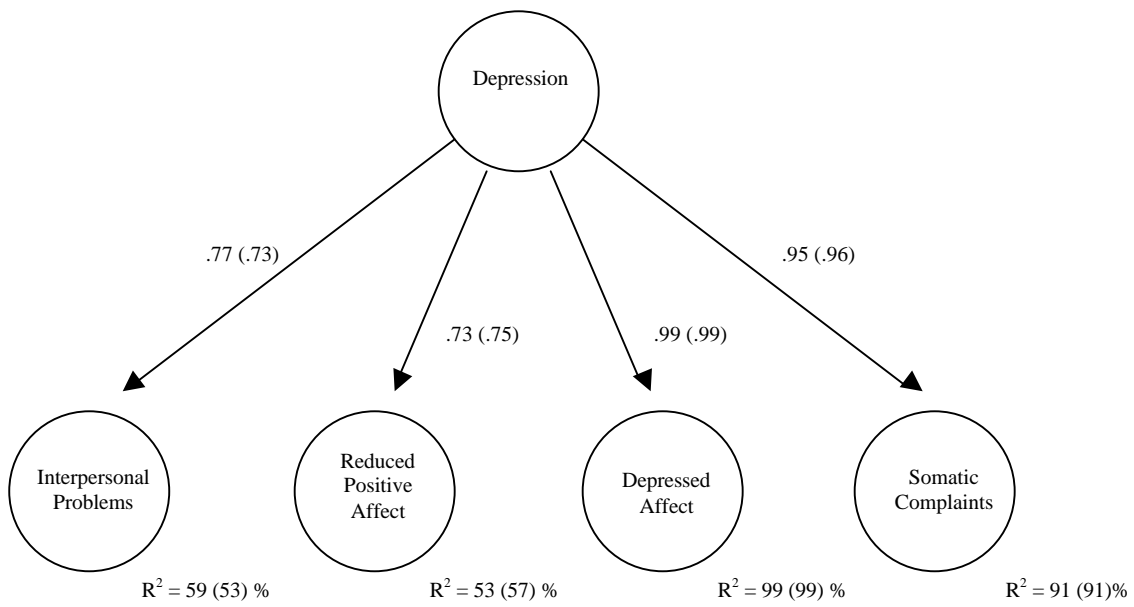
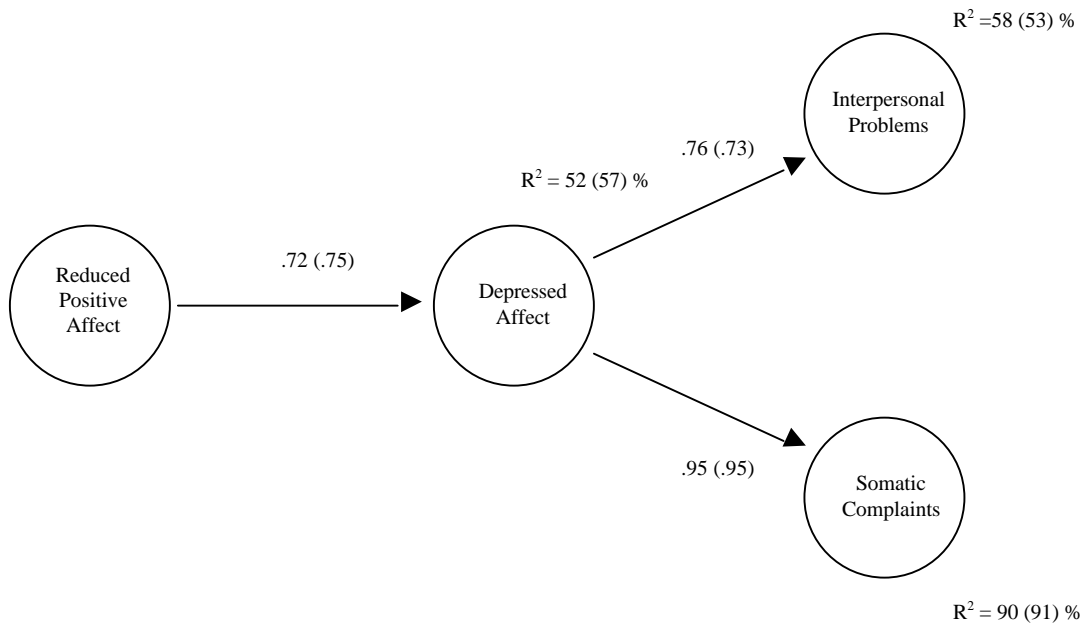
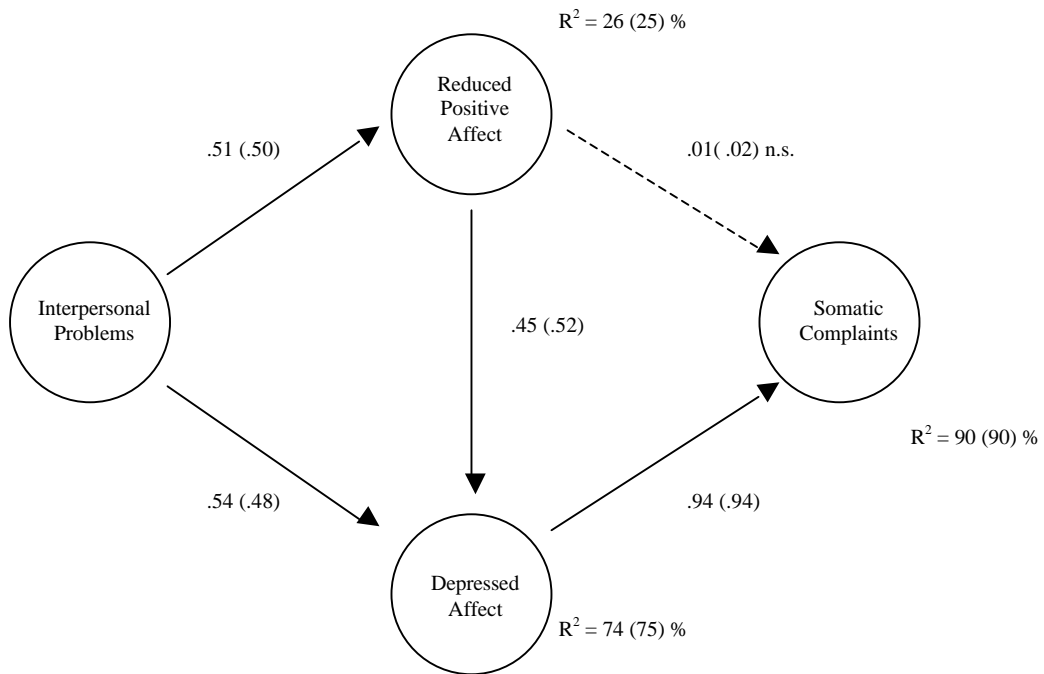
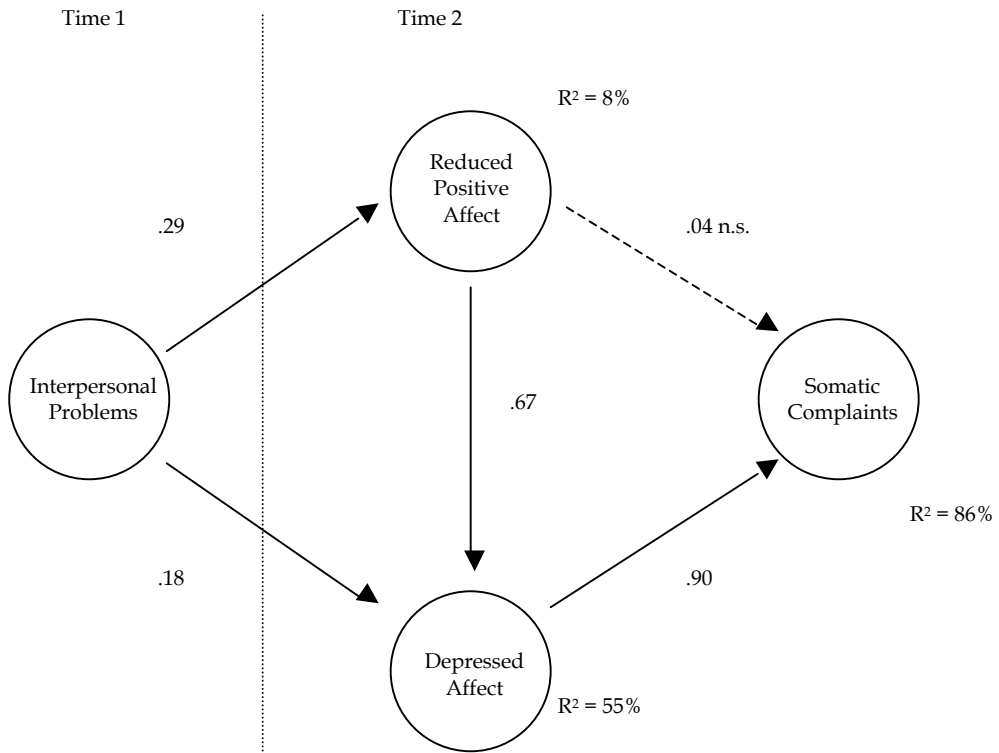
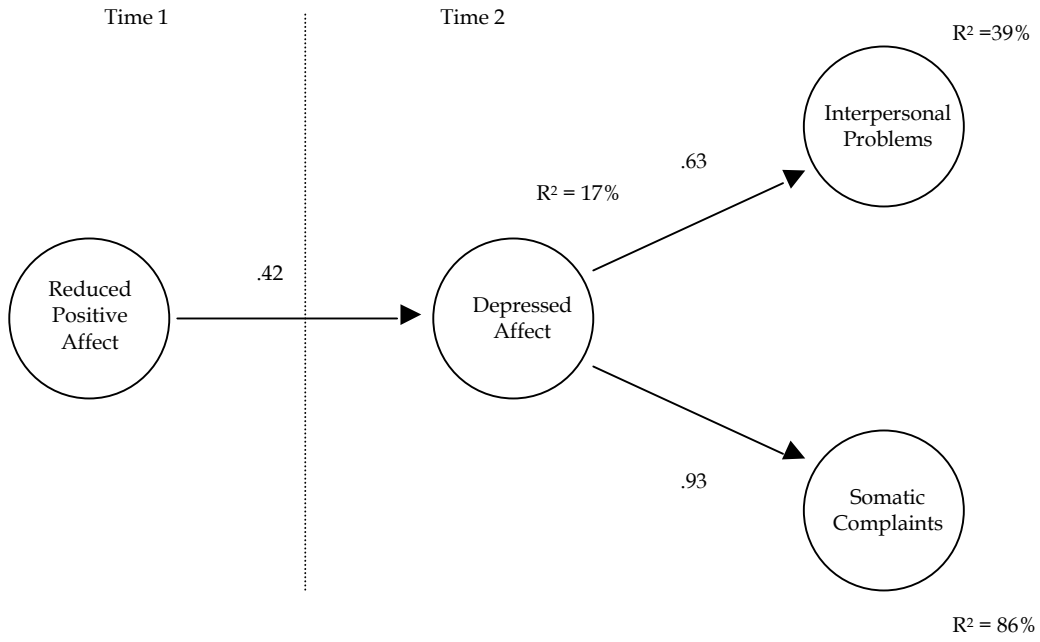


Figure 1. Four-factor measurement model of the CES-D.









## Liste des publications au CIRANO\*

### Série Scientifique / *Scientific Series* (ISSN 1198-8177)

- 2002s-37 Static Versus Dynamic Structural Models of Depression: The Case of the CES-D / Andrea S. Riddle, Marc R. Blais et Ursula Hess
- 2002s-36 A Multi-Group Investigation of the CES-D's Measurement Structure Across Adolescents, Young Adults and Middle-Aged Adults / Andrea S. Riddle, Marc R. Blais et Ursula Hess
- 2002s-35 Comparative Advantage, Learning, and Sectoral Wage Determination / Robert Gibbons, Lawrence F. Katz, Thomas Lemieux et Daniel Parent
- 2002s-34 European Economic Integration and the Labour Compact, 1850-1913 / Michael Huberman et Wayne Lewchuk
- 2002s-33 Which Volatility Model for Option Valuation? / Peter Christoffersen et Kris Jacobs
- 2002s-32 Production Technology, Information Technology, and Vertical Integration under Asymmetric Information / Gamal Atallah
- 2002s-31 Dynamique Motivationnelle de l'Épuisement et du Bien-être chez des Enseignants Africains / Manon Levesque, Marc R. Blais, Ursula Hess
- 2002s-30 Motivation, Comportements Organisationnels Discrétionnaires et Bien-être en Milieu Africain : Quand le Devoir Oblige / Manon Levesque, Marc R. Blais et Ursula Hess
- 2002s-29 Tax Incentives and Fertility in Canada: Permanent vs. Transitory Effects / Daniel Parent et Ling Wang
- 2002s-28 The Causal Effect of High School Employment on Educational Attainment in Canada / Daniel Parent
- 2002s-27 Employer-Supported Training in Canada and Its Impact on Mobility and Wages / Daniel Parent
- 2002s-26 Restructuring and Economic Performance: The Experience of the Tunisian Economy / Sofiane Ghali and Pierre Mohnen
- 2002s-25 What Type of Enterprise Forges Close Links With Universities and Government Labs? Evidence From CIS 2 / Pierre Mohnen et Cathy Hoareau
- 2002s-24 Environmental Performance of Canadian Pulp and Paper Plants : Why Some Do Well and Others Do Not ? / Julie Doonan, Paul Lanoie et Benoit Laplante
- 2002s-23 A Rule-driven Approach for Defining the Behavior of Negotiating Software Agents / Morad Benyoucef, Hakim Alj, Kim Levy et Rudolf K. Keller
- 2002s-22 Occupational Gender Segregation and Women's Wages in Canada: An Historical Perspective / Nicole M. Fortin et Michael Huberman
- 2002s-21 Information Content of Volatility Forecasts at Medium-term Horizons / John W. Galbraith et Turgut Kisinbay
- 2002s-20 Earnings Dispersion, Risk Aversion and Education / Christian Belzil et Jörgen Hansen

---

\* Consultez la liste complète des publications du CIRANO et les publications elles-mêmes sur notre site Internet :

- 2002s-19 Unobserved Ability and the Return to Schooling / Christian Belzil et Jörgen Hansen
- 2002s-18 Auditing Policies and Information Systems in Principal-Agent Analysis / Marie-Cécile Fagart et Bernard Sinclair-Desgagné
- 2002s-17 The Choice of Instruments for Environmental Policy: Liability or Regulation? / Marcel Boyer, Donatella Porrini
- 2002s-16 Asymmetric Information and Product Differentiation / Marcel Boyer, Philippe Mahenc et Michel Moreaux
- 2002s-15 Entry Preventing Locations Under Incomplete Information / Marcel Boyer, Philippe Mahenc et Michel Moreaux
- 2002s-14 On the Relationship Between Financial Status and Investment in Technological Flexibility / Marcel Boyer, Armel Jacques et Michel Moreaux
- 2002s-13 Modeling the Choice Between Regulation and Liability in Terms of Social Welfare / Marcel Boyer et Donatella Porrini
- 2002s-12 Observation, Flexibilité et Structures Technologiques des Industries / Marcel Boyer, Armel Jacques et Michel Moreaux
- 2002s-11 Idiosyncratic Consumption Risk and the Cross-Section of Asset Returns / Kris Jacobs et Kevin Q. Wang
- 2002s-10 The Demand for the Arts / Louis Lévy-Garboua et Claude Montmarquette
- 2002s-09 Relative Wealth, Status Seeking, and Catching Up / Ngo Van Long, Koji Shimomura
- 2002s-08 The Rate of Risk Aversion May Be Lower Than You Think / Kris Jacobs
- 2002s-07 A Structural Analysis of the Correlated Random Coefficient Wage Regression Model / Christian Belzil et Jörgen Hansen
- 2002s-06 Information Asymmetry, Insurance, and the Decision to Hospitalize / Åke Blomqvist et Pierre Thomas Léger
- 2002s-05 Coping with Stressful Decisions: Individual Differences, Appraisals and Choice / Ann-Renée Blais
- 2002s-04 A New Proof Of The Maximum Principle / Ngo Van Long et Koji Shimomura
- 2002s-03 Macro Surprises And Short-Term Behaviour In Bond Futures / Eugene Durenard et David Veredas
- 2002s-02 Financial Asset Returns, Market Timing, and Volatility Dynamics / Peter F. Christoffersen et Francis X. Diebold
- 2002s-01 An Empirical Analysis of Water Supply Contracts / Serge Garcia et Alban Thomas
- 2001s-71 A Theoretical Comparison Between Integrated and Realized Volatilities Modeling / Nour Meddahi
- 2001s-70 An Eigenfunction Approach for Volatility Modeling / Nour Meddahi
- 2001s-69 Dynamic Prevention in Short Term Insurance Contracts / M. Martin Boyer et Karine Gobert
- 2001s-68 Serial Cost Sharing in Multidimensional Contexts / Cyril Tétédo et Michel Truchon
- 2001s-67 Learning from Strike / Fabienne Tournadre et Marie-Claire Villeval
- 2001s-66 Incentives in Common Agency / Bernard Sinclair-Desgagné

- 2001s-65 Detecting Mutiple Breaks in Financial Market Volatility Dynamics / Elena Andreou et Eric Ghysels
- 2001s-64 Real Options, Preemption, and the Dynamics of Industry Investments / Marcel Boyer, Pierre Lasserre, Thomas Mariotti et Michel Moreaux
- 2001s-63 Dropout, School Performance and Working while in School: An Econometric Model with Heterogeneous Groups / Marcel Dagenais, Claude Montmarquette et Nathalie Viennot-Briot
- 2001s-62 Derivatives Do Affect Mutual Funds Returns : How and When? / Charles Cao, Eric Ghysels et Frank Hatheway
- 2001s-61 Conditional Quantiles of Volatility in Equity Index and Foreign Exchange Data / John W. Galbraith, Serguei Zernov and Victoria Zinde-Walsh
- 2001s-60 The Public-Private Sector Risk-Sharing in the French Insurance "Cat. Nat. System" / Nathalie de Marcellis-Warin et Erwann Michel-Kerjan
- 2001s-59 Compensation and Auditing with Correlated Information / M. Martin Boyer et Patrick González
- 2001s-58 Resistance is Futile: An Essay in Crime and Commitment / M. Martin Boyer
- 2001s-57 The Unreliability of Output Gap Estimates in Real Time / Athanasios Orphanides et Simon van Norden
- 2001s-56 Exact Nonparametric Two-Sample Homogeneity Tests for Possibly Discrete Distributions / Jean-Marie Dufour et Abdeljelil Farhat
- 2001s-55 Les coûts de la réglementation : une revue de la littérature / Robert Gagné, Paul Lanoie, Pierre-Carl Micheud et Michel Patry
- 2001s-54 Testing for structural Change in the Presence of Auxiliary Models / Eric Ghysels et Alain Guay
- 2001s-53 Environmental Regulation and Productivity: New Findings on the Porter Hypothesis / Paul Lanoie, Michel Patry et Richard Lajeunesse
- 2001s-52 The Aftermarket Performance of Initial Public Offerings in Canada / Maher Kooli et Jean-Marc Suret
- 2001s-51 Capital Structure and Risk Management / Karine Gobert
- 2001s-50 The Underpricing of Initial Public Offerings: Futher Canadian Evidence / Maher Kooli et Jean-Marc Suret
- 2001s-49 How Innovative Are Canadian Firms Compared to Some European Firms? A Comparative Look at Innovation Surveys / Pierre Mohnen et Pierre Therrien
- 2001s-48 A Tale of Two Ports / Ngo Van Long et Kar-yiu Wong
- 2001s-47 Wage Policy of Firms: An Empirical Investigation / Stéphanie Lluit
- 2001s-46 Forecasting Some Low-Predictability Time Series Using Diffusion Indices / Marc Brisson, Bryan Campbell et John W. Galbraith
- 2001s-45 The Importance of the Loss Function in Option Pricing / Peter Christoffersen et Kris Jacobs
- 2001s-44 Let's Get "Real" about Using Economic Data / Peter Christoffersen, Eric Ghysels et Norman R. Swanson
- 2001s-43 Fragmentation, Outsourcing and the Service Sector / Ngo Van Long, Ray Riezman et Antoine Soubeyran